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Soil loss under different harvest managements of some vegetables in lower Gangetic plains of Nadia district in West Bengal.

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ABSTRACT

In order to investigate the loss of soil from up and medium land situations through harvest managements of some vegetables, both field experiments on farmers' plots and survey works were conducted in winter, summer and rainy seasons of the year 2003 – 04. Field observations on soil loss, number of plants, plant height, root length, root weight, and soil moisture at harvest were recorded. Farmers, retailers and wholesalers from adjacent daily and wholesale markets were interviewed towards having information regarding faulty harvesting managements of vegetables. The respondents available were in the ratio of 1:2:1. It was found from the survey report that red and green *Amaranthus* species, spinach and radish were commonly grown vegetables subjected to have faulty harvesting practices either "uprooting" only or "uprooting and washing". Red *Amaranthus* species was the most frequently grown vegetable of which almost 100% was found harvested with faulty practice by retailers and wholesalers. Average loss of soil on uprooting the plants was found to be correlated with respective means of number of plants, root weight, plant height, root length and soil moisture at harvest in varying level of association varied in different seasons of both the land situations. The highest loss of soil (i.e.115.11gm m^{-2}) by the faulty practice was found in medium land. The biomass yield of *Amaranthus* species varied within a range of 40.9 - 56.4 tonnes ha^{-1}. Thus the average loss of soil along with fresh organic substances due to faulty harvest management in *Amaranthus* species was estimated as 1.75 tonnes ha^{-1} $cultivation^{-1}$ $year^{-1}$.

Key words: Soil loss, harvest managements, vegetables.

The loss of soil is possible when it travels from place to place, from a few centimeters to hundreds of kilometers. It has been observed that soil loss by erosion on unprotected land may go up to 64.5 tons per hectare (Narayana and Babu, 1983). Although purposive carriage and transport of fertile excavated /disturbed soil from field by human being can also be regarded as loss of soil, the soil loss equations used so far did not consider such facts as factor which might be magnifying the loss. Amongst many events of soil displacement by human being faulty harvest managements of vegetables is noteworthy.

A few vegetables *e.g. Amaranthus* sp., spinach, coriander, radish (pot-herb) etc. have shallow root system and known as surface feeder. Normally harvesting of these vegetables are done by uprooting. Nowadays farmers practise cultivation of these short duration vegetables (pot-herb) three to four times on the same plot during a year. On uprooting these vegetables, surface soils alongwith organic matters get displaced. Although the loss of soil and organic matters vary with the variation in harvesting management of these vegetables, the magnitude of loss remain uninvestigated. Keeping the above mentioned fact in mind the present research work is a little attempt towards investigating the status of vegetables (pot herbs) in a particular area, the grower and sellers of these vegetables and amount of lost soil due to faulty harvesting management.

MATERIALS AND METHODS

Field experiment on six different plots were conducted two in each season like winter (October-November), summer (March-April) and rainy (May-June) during the year 2003-04 at actual farming situation of Ganguria village (23^0N latitude and 29^0E longitude) of Nadia district under new alluvial agro-climatic zone in West Bengal. The topography of the site is undulating at an attitude of 9.5 meter above mean sea-level. Details of land, soil and crop management (*Amaranthus* sp.) in the site is furnished in Table-1.

During each season at each land situation, three sites, each measuring one square meter area were chosen at random and observations on yield, yield attributes, soil moisture, soil and organic matter loss at harvesting were recorded. Data on plant height and root lengths were taken from ten plants chosen at random in each replication. Uprooted whole plants were weighed twice in the field i.e. just after harvest and then after cleaning roots manually. The difference in weight were taken to be recorded for soil loss. Similarly root weights were taken for loss of fresh organic matter from fields. Soil moisture was measured through gravimetric method.

For survey work a questionnaire was framed and testing of the same was carried out with enlistment of categorywise representative respondents, chosen at random from three adjacent markets, associated with cultivation or selling of vegetables (pot-herbs).

RESULTS AND DISCUSSION

From the systematic analysis of the survey data it is found that *Amaranthus sp*. (red and green), spinach and radish were most common with regard to cultivation and their availability in local markets as per the opinion of a group of farmers, retailers and wholesalers available in 1: 2: 1.

While 43% of the respondents in general reported three or four times cultivation of three pot-herbs during the year, maximum respondents (27%) opined for four time cultivation of *Amaranthus* sp. in the same plot at the same time(Table-2). The respondents also reported total amount of *Amaranthus* sp. harvested from different places during the same time as 3325.6 tonnes, out of which almost 100% acquired by retailers and wholesalers .

Whereas, 74% opinion was for faulty practice of harvesting i.e. ‘uprooting’ and ‘uprooting + washing’ of the vegetables (Table-3) in general, 90% opinion was from wholesalers, 78% from retailers and only 50% from farmers. The faulty practice was found pronounced (92%) in harvesting of radish, and in this respect other crops in priority order was red *Amaranthus* sp. (81%), green *Amaranthus* sp. (62%) & spinach (62%). Although ‘cutting’ is the best practice of harvesting (Thapa & Maity, 2002), the approved soil conservation practices (i.e. ‘cutting’ and ‘uprooting + rinsing’) had a poor support (maximum 26%for cutting) in practical farming (Table-3).

Table 1 Details of land soil and crop management in the experimental site (Ganguria)

A. Physico-chemical properties of soil		Land Situation	
		Up	Medium
Particle size distribution of soil	Sand (0%)	48.4	30.5
	Silt (%)	21.0	30.6
	Clay (%)	30.6	38.9
Bulk density	Kg/m^3	1.55	1.38
Particle density,	Kg/m^3	2.60	2.60
Waterholding capacity	%	40.4	46.9
Volume expansion	%	14.3	23.0
pH	-	7.2	7.2
Organic carbon	%	0.42	0.99
B. Area & size of experimental plots (m x m) = m^2	Winter	(35 x12) = 420	(20 X 22) = 440
	Summer	(26 X 14) = 364	(15 X 25) = 375
	Rainy	(28.5 X 2.48)=707	(25 X 12) = 300
C. Organic matter & fertilizer application			
(i) Cowdung manure, tones/ha	Winter	0.0	0.0
	Summer	6.5	11.0
	Rainy	6.5	11.0
(ii) N: P (kg/ha) through diammonium phosphate and urea	Winter	90 : 115	90 : 115
	Summer	90 : 115	90 : 115
	Rainy	90 : 115	90 : 115
D. Sowing dates of *Amaranthus* sp.	Winter	12/10/2003	10/10/2003
	Summer	3/03/2004	25/03/2004
	Rainy	20/05/2004	20/05/2004
E. Harvesting dates alongwith duration of growing (days)	Winter	28/11/2003 (46)	05/12/2003 (57)
	Summer	29/04/2004 (30)	2/05/2004 (39)
	Rainy	24/06/2004 (35)	21/06/2004 (32)

Table 2 Frequency of cultivation of pot-herb vegetables in same plot during a year as reported by respondents

Name of vegetables	Frequency of cultivation	Frequency as reported by different class of respondents			Total with percentages in parenthesis to respective row total (i.e. $F_1 \ldots F_4$)
		Farmers $N_1 = 9$	Retailers $N_2 = 18$	Wholesaler $N_3=10$	
Amaranthus sp. (green or red) ($F_1 = 37$)	A_1	2	6	0	8 (22)
	B_1	2	6	0	8 (22)
	C_1	3	3	5	11 (30)
	D_1	2	3	5	10 (27)
Spinach ($F_2 = 34$)	A_2	3	8	0	11 (32)
	B_2	5	6	8	19 (56)
	C_2	0	4	0	4 (12)
	D_2	0	0	0	0
Radish ($F_3 = 35$)	A_3	0	0	0	0
	B_3	4	10	-	14 (40)
	C_3	4	6	5	15 (43)
	D_3	0	2	4	6 (17)
($F_4 = 106$)	$\sum A$	5	14	0	19 (18)
	$\sum B$	11	22	8	41 (39)
	$\sum C$	7	13	10	30 (28)
	$\sum D$	2	5	9	16 (15)
Total		25	54	27	106

N.B.: Values of A, B, C & D are respectively 1, 2, 3 & 4 to indicate frequency of cultivation of vegetables in same plot.

The magnitude of loss of soil due to faulty harvest management throughout the year at up and medium land situation varied significantly (Table-6). The variation might be attributed to the variation in soil moisture, root weight, root length, plant height and plant population per square meter area. Although there were significant simple correlation in between soil loss and former attributes (Table-7) in 10 out of 25 combinations of season and land situation, the non-uniformity in correlation might be due to variation in soil texture, organic carbon in soil (Table-1); plant protection and other environmental factors not taken into account in this experiment. However, it is evident from pooled data (Table-5) that loss of soil on faulty harvesting had significant positive relationship with plant population, plant height and root length.

The highest loss of soil was found in medium land situation in summer season (i.e. 123 gm. m^{-2}).This might be attributed to increased root length, number of plants per squire metre area and plant height. Although all these factors showed positive correlation (Table-5) with soil loss, the increased root length and more number of plants held more soil and organic substances per unit area on uprooting in comparison to those in uplands, might be the reason behind more soil loss in medium land. Average loss was 103.5 gm. m^{-2}. As the roots were not separated practically the average root weight i.e. 75.1 gm. m^{-2} found in the experiment might be considered as loss of fresh organic matter from the field. Thus the average loss of soil alongwith fresh organic matter could be estimated as 1.786 tonnes per hectare per cultivation.

Table3: Frequency of respondents practicing four types of harvesting of pot-herb vegetables

Class of respondents	Vegetables																*Total*			
	***Amaranthus* sp. (green)**				***Amaranthus* sp. (red)**				**Spinach**				**Radish**							
	W	**X**	**Y**	**Z**	**W**	**X**	**Y**	**Z**	**W**	**X**	**Y**	**Z**	**W**	**X**	**Y**	**Z**	**W**	**X**	**Y**	**Z**
Farmers N_1 = 9 F_1 = 36	5	2	1	1	1	3	0	5	5	1	1	2	0	1	1	7	11 (31)	7 (19)	3 (8)	15 (42)
Retailer N_2 = 18 F_2 = 72	5	0	8	5	2	1	6	9	4	2	5	7	0	2	2	14	11 (15)	5 (7)	21 (29)	35 (49)
Wholesaler N_3 = 10 F_3 = 40	2	0	3	5	0	0	3	7	2	0	3	5	0	0	10	0	4 (10)	0 (0)	19 (48)	17 (42)
Total, ∑N = 37 ∑F = 148	12 [32]	2 [6]	12 [32]	11 [30]	3 [8]	4 [11]	9 [24]	21 [57]	11 [30]	3 [8]	9 [24]	14 [38]	0 [0]	3 [8]	13 [35]	21 [57]	26 {18}	12 {8}	43 {29}	67 {45}

Figures in ( ) indicate percents to corresponding frequency total in rows (i.e. F_1, F_2 & F_3), those in { } indicate percents to total frequency (i.e. ∑F= 148) and those in [ ] indicate percents to total number of respondents (i.e. N = 37). W, X, Y, Z, F & N stand respectively for cutting, uprooting + rinsing, uprooting only, uprooting + washing, frequency number and number of respondents.

Table 4 Soil moisture and plant attributes* associated with loss of soil on uprooting of *Amaranthus* sp. (red) in up and medium land situation during three seasons at Ganguria.

Land situation	Season	Soil loss, gm. m^2	No. of plants, m^{-2}	Plant height, cm.	Root length, cm.	Root weight, gm. m^{-2}	Soil moisture at harvest (%)	Bio-mass yield, ton ha^{-1}
Up	Winter	90	78	16	9	58	16.8	49.0
	Summer	98	86	11	8	65	14.7	40.9
	Rainy	88	86	17	12	95	16.4	52.4
Medium	Winter	112	87	16	10	67	18.0	46.8
	Summer	123	83	17	12	80	16.1	48.3
	Rainy	111	87	17	11	85	18.5	48.0
Mean	-	103.5	84.5	15.5	10.4	75.1	16.8	47.6
S. Em ±	-	4.0	1.8	0.7	0.7	4.0	0.3	-
C.V. (%)	-	16.4	8.8	19.8	21.4	22.0	8.0	-

* Data on soil and plant parameters are averages of three observations.

Table 5 Simple correlation co-efficient (r) indicating relationship in between soil loss and other parameters

Soil loss Vs.	Seasons			Land situation		Polled
	Winter	Summer	Rainy	Up	Medium	
Soil moisture at harvest	0.786	0.885*	0.840*	– 0.392	– 0.104	0.318
Root weight	0.907*	0.765	– 0.029	– 0.006	0.654	0.355
Root length	0.774	0.938**	0.188	– 0.268	0.717*	0.513*
Plant height	0.821*	0.945**	0.393	– 0.109	0.748*	0.515*
No. of plant per m^2 area	0.945**	– 0.293	0.716	0.725*	0.664	0.576*
Table Value						
'r' significant at 5%*	0.811	0.811	0.811	0.666	0.666	0.448
'r' significant at 1%**	0.917	0.917	0.917	0.874	0.874	0.590

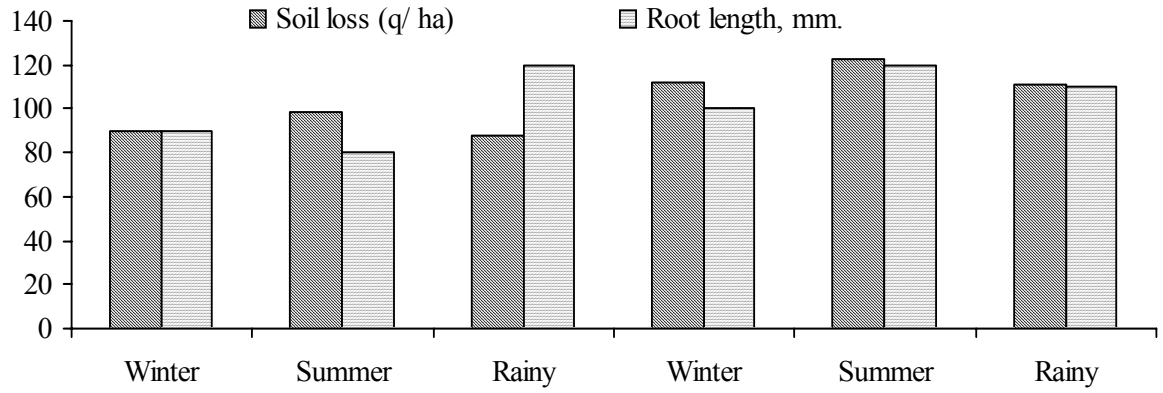

Fig 1. Soil loss on uprooting of Amaranthus sp. influenced by average root length.

With the increase in intensity of cropping to four times, the loss would be 7 tons ha^{-1} yr^{-1} .The loss of soil to this extent has never been included in the much-publicized permissible rate of soil erosion *i.e.* 16.35 tons ha^{-1} yr^{-1} (Narayana and Babu, 1983).

The present study had clearly brought out the marked effect of faulty harvest of pot-herbs specially in case of *Amaranthus* sp. (red). Within approximately 50 days period loss of soil with fresh organics was to the tune of 1.78 tonnes ha^{-1}.

Organizing mass awareness campaign towards adoption of suitable harvesting methods i.e. 'cutting' could minimize the soil loss.

REFERENCES

Narayana, D V.U. and Ram Babu, 1983. Estimation of soil erosion in India. *J. Irrig. Drain. Engg,*. **109** (4): 419-434.

Thapa, U. and Maity T.K. 2002. Response of Amaranthus (*Amaranthus* sp.) to nitrogen, phosphorus fertilization and cutting management. *Haryana J. Horti. Sci.,* **31** (3 & 4): 267-269.