International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 2, 2020, pp.-9461-9463.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

IMPACT OF MANAGEMENT PRACTICES ON SOIL EROSION IN HIGHLY DISORDERED RAVINES LANDS

SINGH A.*[1], SHARMA A.[2], BHADAURIA S.S.[1], KHAMBALKAR P.A.[3], YADAV S.S.[3] AND SINGH S.K.[4]

[1]Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002, Madhya Pradesh, India
[2]Department of Environment Science, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002, Madhya Pradesh, India
[3]Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002, India
[4]ICAR-Krishi Vigyan Kendra, Gwalior, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002, Madhya Pradesh, India
*Corresponding Author: Email - akhileshsingh01@gmail.com

Received: January 14, 2020; Revised: January 24, 2020; Accepted: January 27, 2020; Published: January 30, 2020

Abstract: The ravines of Chambal have been originated from tectonic movement and have till date shown no apparent relation to climate, but persistent deforestation exposes the nutrient deficient soil, which inflames ravine expansion. The study was conducted to identify effect of various management practices on soil erosion and was computed by using Modified Universal Soil Loss Equation (MUSLE). Study carried out at village Aisah of Morena district of Madhya Pradesh having six modules with various systems *viz.* M1- Diversified cropping system, M2- Agri- Horticulture, M3- Horti-Medicinal/pastoral, M4-Silvi-Medicinal, M5- Silvi- pastoral and M0- control for management of Chambal Ravine. The results indicate that maximum soil loss was recorded in the M0- controlled (28.7), whereas minimum soil loss was recorded in the M5- Silvi- Pastoral module (8.4), followed by M4- Silvi Medicinal (14.8), M1- Diversified cropping system (16.2), M3- Horti-medicinal (18.6) and M2- Agri-horti (24 ton/ha/year). Soil loss occurred mostly as sand (55-60%), followed by silt (35-40%) and minimum as clay (05-10%) which was almost in same ratio as texture of plough layer soil.

Keywords: *Soil Conservation, ravine erosion, Ravine management*

Citation: Singh A., *et al*., (2020) Impact of Management Practices on Soil Erosion in Highly Disordered Ravines lands. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 2, pp.- 9461-9463.

Academic Editor / Reviewer: Kalaivanan D., Arlindo Almeida

Introduction

Soil is a non-renewable resource present on the surface of the earth. It is dynamic and prone to continuous degradation due to adverse land use practices. Soil erosion is a serious problem arising from agricultural intensification and other anthropogenic activities. Its assessment is essential for planning and conservation works in a highly eroded soil [1]. Out of 328.0 million ha geographical area of the country, nearly 147.75 million ha is subjected to various types of degrees of degradation. Of this about 93.68 million ha is severely eroded [2]. Extreme climatic events in such a scenario can speed up erosion and prompt a disaster. A slow natural disaster- ravine erosion is an obvious threat to the inhabitants of the region. The estimated area of ravines in the country is 43.86 lakh ha, whereas Madhya Pradesh accounts about 6.83 lakh ha; and out of that, nearly 5.7 lakh ha is in Chambal and Gwalior divisions of the state. The ravines are not static, but are increasing in their spread every year. The average rate of encroachment into the table lands is estimated at 0.008 million ha. The available data shows that the average soil loss is about 16.35 Mg/ha/yr, which is a total soil loss of 5.3 billion Mg/yr [3]. A rough estimate suggests that about 8,000 ha is added to these ravines annually [4]. In the districts of Chambal region of Madhya Pradesh namely Morena, Sheopur and Bhind out of geographical area of about 16.5 lakh ha, out of which about 3.50 lakh ha is ravenous, which is about 20 % of their total geographical area and is increasing year after year [5]. Remaining 11.5 lakh ha (55%) area are under rainfed farming. Severe erosion and gully encroachments are more prominent. Long term sustainability of agriculture is dependent upon prudent land management to protect the finite soil resource in the short term. Agricultural sustainability implies achieving desired levels of agronomic productivity and profitability while maintaining or enhancing soil and environmental qualities. Identification of different agricultural-horticultural module for soil conservation in highly degraded ravine lands was the objective of research work.

Material and Methods

The experimental site at village Aisah (district: Morena) was selected on the bank of river Chambal, which is about 80 Km from Vishwa Vidyalaya head quarter. The project area is situated at Latitude 26°40'40.84" N and Longitude 78°06'29.21 E with altitude ranges 150 to 240 m above mean sea level. Plantation of different species was done in 60 x 70 meters plot and installed the Coshocton wheel and water stage level recorder in each main plot in order to record the actual soil loss from different management modules, whereas, modified universal soil loss equation was used to estimate the soil erosion from different management modules.

Soil depth varied from 30 cm to > 120 cm with sandy clay loam in texture. Physiographic position of the Morena District is central high land pathar. The slope gradient of the fields was mostly in between 0.1 to 8.0 percent (very gently sloping to gently sloping). The problem of severe to very severe erosion is prominent because the area is unbounded and mostly uncultivated during rainy season. Soil have almost medium to low water holding capacity.

Geologically the study area (Northern M. P.) comes under Indo Gangetic and alluvial plain. Alluvium deposited is an old one as the soil profiles do show horizon differentiation. These alluvial soils have been classified in the US soil taxonomy [6] in the following orders and great groups

Order	Great groups
1. Entisols	Usti, Udi-or Torrifluvents, Haplaquents
2. Inceptisols	Ustochrepts, Haplaquepts
3. Alfisols	Haplustalfs, Natrustalfs

The five modules was tested for sustainable management of Chambal ravines. These modules are follows: M1= Diversified cropping system, M2 = Agri-horti module, M3= Horti Pastoral module, M4= Silvi-Medicinal Module, M5 = Silvi-Pastoral Module, Mo = Control.

Table-1 *List of plants planted in the study area their height and diameter*

Module	Plant	Height in meter			Stem diameter in cm		
		2012	2013	2014	2012	2013	2014
M_2- Agri-Horti and M_3-Horti-Pastoral	*Drumstick (Moringa oleifera)*	2.54	5.1	5.63	16.1	16.16	37
	Anola (Emblica orficinalis)	0.64	1.69	2.63	4.85	5.3	11.12
	Guava (Psidium guajava)	0.59	1.47	2	4.75	2.7	7.5
	Custard apple (Annona reticulata)	0.78	1.25	1.65	6.5	2.06	7
	Ber (Ziziphus mauritiana)	1.57	2.32	3.1	2	6.57	16.66
M_4 - Silvi- Medicinal	*Arjuna (Terminalia arjuna)*	0.65	2.37	2.91	3	5.57	13.5
	Mahua (Madhuca longifolia)	0.47	1.03	1.4	2.2	2.43	6.33
	Gugul (Commiphora wightii)	0.3	0.55	1.25		3.34	10
	Karanj (Millettia pinnata)	1.04	2.6	3.06	3.96	5.72	12.06
	Neem (Azadirachta indica)	1.25	2.4	3.7	4.7	5.62	18
M_5- Silvi-Pastoral	*Babool (Acacia Nilotica)*	0.53	1.47	2.47	4.1	6.23	9.58
	Siras (Albizia chinesis)	1.77	3.16	3.62	6	7.85	18.33
	Sheesham (Dalbergie Sissoo)	1.07	2.6	3.7	3	7.32	17
	Khamer (Gmelina Arbore)	0.47	2.39	3.59	0.22	7.64	20
	Teak (Tectona grandis)	--	2.45	2.87	--	7.16	11.5

After partially land terracing (where ever it was necessary) and cleaning a layout of the experimental plot was laid down in 15 blocks of 60 x 70 meter each to accommodate five modules in three replications. Six species (Drumstick, Aonla, Ber, Guava and Custard apple & pomegranate) of fruit tree and ten species of silvi-medicinal (Neem, Arjuna, Mahua, Gugul, Karanj, Babool, Teak, Siras, Khamer, Seasham) saplings were transplanted in pits of 30 x 30 x 45 cm. The excavated pit was filled with soil mixed with vermi compost (1.5 kg/plant), DAP (100 g/ plant) MOP (80 g/plant) Neem cake (500 g/plant). Chlorpyriphos (6-7 ml/plant) was applied to protect the plant from termite's attack. The soil loss from different module was estimated through Modified Soil Loss Equation [6] and actual soil loss was observed by using water stage level recorder and Coshocton wheel [7-13].

Results & Discussion

Growth (height and stem diameter) of plants under different module were recorded from year of plantation 2012 to 2014. The data revealed that Drumstick (*Moringa oleifera*) found to be the fastest growing plant followed by Siras (*Albizia chinesis*), Khamer (*Gmelina arbore*), Karanj (*Millettia pinnata*) and Ber (*Ziziphus mauritiana*) in the ravines area [Table-1]. Soil loss was computed by Revised Universal Soil Loss Equation (RUSLE) and actually estimated soil loss showed very wide gap [Table-2] it indicates that this model is unable to estimate the soil losses under such type of topography and soil. The maximum soil loss was observed in the M0- controlled (28.7 ton/ha/year), whereas minimum soil loss was recorded in the M5- Silvi- Pastoral module (8.4 ton/ha/year), followed by M4-Silvi Medicinal (14.8 ton/ha/year,), M1- Diversified cropping system (16.2 ton/ha/yea), M3- Horti-medicinal (18.6 ton/ha/year) and M2- Agri-horti (24 ton/ha/year). Soil loss was mostly as sand (55-60%), followed by silt (35-40%) and minimum as clay (05-10%) and it was occurred almost in same ratio as texture of plough layer soil.

The runoff losses computed by RUSLE and actually computed values do not show much variation with respected to different modules. The maximum runoff was recorded in M0 –controlled whereas the lowest runoff was recorded in M5- Silvi-Pastoral module.

Table-2 *Erosion losses computed and actually recorded under different system*

Module	Computed		Actually Recorded	
	Soil loss (t/ha/yr)	Runoff (cm)	Soil loss (t/ha/yr)	Runoff (cm)
M_0	18.24	32.42	28.70	30.80
M_1	7.54	26.94	16.20	25.60
M_2	2.87	25.60	24.00	25.80
M_3	14.37	25.21	18.60	25.90
M_4	11.50	25.90	14.80	24.60
M_5	11.50	26.37	8.40	24.20

Conclusion

Five modules were tested for soil erosion control in Chambal Ravines of Madhya Pradesh and soil loss in each module were calculated and recorded. The results clearly concluded that RUSLE model is unable to estimate the silt losses under such type of topography and soil. Whereas silvi-pastoral module was found most efficient to minimize the soil loss from ravines land.

Application of research: Study of soil erosion in highly disordered ravines lands

Research Category: Soil Science

Acknowledgement / Funding: Authors are thankful to Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002, Madhya Pradesh, India

****Principal Investigator or Chairperson of research: Dr Akhilesh Singh**
University: Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002
Research project name or number: Research station trials

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Aisah, District Morena

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Chaudhary B.S. and Kumar S. (2018) *Ind J. soil Cons.*,46 (3),305-311.
[2] NAAS (2010) *Degraded and Wastelands of India-Status of Spatial Distribution. National Academy of Agricultural Sciences, New Delhi*.
[3] Dhruvanarayana V.V. and Rambabu (1983) *J. Irri. Drain. Eng*., 109(4), 419-433
[4] Sharma A.K., Pradhan I.P., Nema J.P. and Tejwani K.G. (1980) *CS&WCR&TI, Research centre, Vasad.*
[5] Anonymous (1997) *Chambal Command Area Development Agency, Ninth Five Year Plan (1997-2002), Chairman, CADA, Gwalior, M.P*
[6] Soil Survey Staff (1998) *Key to soil taxonomy. Published by United state department agriculture, Natural Resources Conservation Services. 8th edition.*
[7] Wischmeier W.H., Smith D.D. (1978) *Agriculture Handbook, No. 537, U.S. Department of Agriculture, Washington DC.*
[8] Action Aid India (1996) *Workshop on Chambal Ravines, Gwalior on Feb.* 6-7, 1996
[9] Das D.C. (1985) *Proceedings of the National Seminar on the Soil Conservation and Watershed Management held on 17-18 September New Delhi.*

[10] Lal R. (1988) *In: Soil Erosion Research Methods. R. Lal (Ed.) Soil Water Conserv. Soc. Amer., Ankeny, IA, USA, 1-6.*
[11] Singh R.S., Maji A.K., Sehgal J. and Velayutham M. (1999) *NBSS Publ. 52b. NBSS&LUP, Nagpur, India.*
[12] Singh S.P., Jagat Ram, Walia C.S., Sachdeva C.B., Dhankar R.P., Rana K.P.C., Sehgal J., Velayutham M. and Gajbhiye K.S. (2003) *NBSS Publ. 68. NBSS&LUP, Nagpur, India.*
[13] Velayutham M., Mondal D.K., Mondal C. and Sehgal J. (1999) *NBSS&LUP Publ. 35. Nagpur, India.*