Journal of Advances and Scholarly Researches in Allied Education
Vol. 16, Issue No. 9, June-2019, ISSN 2230-7540

Appraisal of Watershed Management with Reference Agricultural Land Use Pattern: In Bairath Region (A Case Study of Thanagazi Tehsil)

Pranjal Saiwal*

Assistant Professor, Department of Geography, Dev International College, Alwar, Rajasthan

Abstract – The world as a whole, experienced remarkable economic growth, technological development and scientific progress, but development has harmed the environment and now the environmental harm has been adversely affecting the development. This paper is an attempt to have an appraisal of watershed management for exploring its impact agricultural land use pattern in Thanagazi tehsil. Furthermore, the study aims to investigate rationally and objectively the dynamic nature of land use and agricultural land use pattern and its findings and queries to make useful suggestions for better crop pattern because the change in cropping pattern is the best indicator of socio-economic and cultural development of an area.

----------X----------

INTRODUCTION

The present paper investigate watershed management impact on agricultural land use of the Bairath region is an attempt to elaborate the conceptual framework for congenial, temporal and spatial pattern of land to sustainable of development so that the future society can have a better place to live in the region also. The agricultural land resources development is important strategy for sustainable development of the area particularly with reference to watershed development on land and people.

A watershed is the most scientific agro climatic and hydrological unit bounded by natural ridges and allows the run-off due to rainfall to drain in well defined drainage pattern of streams formed within the watershed boundary. The watershed approach creates sustainable development aimed at eradicating poverty, increasing the standard of living, and improving the overall welfare of the rural population that is dependent on the geographical land area. The trapping of surface runoff water, watersheds have emerged as the growth engines in entire the fragile Bairath region.

The rapid depletion of underground water, growing mining and industrial activities and increasing population are severely affecting environment of Thanagazi tehsil and agrarian and rural society consequently.

Ever-increasing pressure of population coupled with poor, management of land and water resources in Thanagazi tehsil also is putting immense stress on the fragile environment of Bairath region which is the part of Aravalli mountain ranges. Land use data hold great potential for deriving timely and reliable information on the nature, extent and magnitude of agricultural land with reference to impact of watershed development at the micro level.

The watershed development helps in rehabilitation/revival of degraded land, forest water resources through various technological inputs (*both Indigenous and technology*) along with development of agriculture, horticulture, pisci-culture et cetera, to make people self-sufficient and self-reliant in food, fuel, fodder, forage, fiber and fertilizer.

OBJECTIVES:

The main objective of the paper is to have overall appraisal of watershed management on agricultural land management in Thanagazi tehsil. The others objective are following:

- To study and analyze critically land use and cropping pattern with reference to impact of micro-watershed.

- To trace the evolution and growth of the agricultural land use pattern during last decade as Villages-wise.

RESEARCH QUESTIONS:

In view of the objectives of the problem discussed above, the following research questions are also proposed to be answered and suggestion, if any, to be point out:

- The watershed management has influenced the agricultural pattern and practice.
- The impact of watershed development on land is uniform in the study region.

METHODOLOGY:

The present paper is based on data and information collected from various secondary and primary sources alongwith the two selected watershed. Tehsil level data have been collected from Land Records Office, Alwar and Thanagazi tehsil and villages level from tehsil and Headquarters of the district. For collecting primary data of impact of watersheds a set of questionnaire were prepared in which crop-wise detail obtained for year of 2018-19.

The physiography and relief aspect of slope, drainage, transport, settlement etc. information extracted from the topographical sheet no. 54 A, 54A/3, 54A/4, 54A/6, 54A/7, 54A/854A/10, 54A/11, 54A/12 (Survey of India). The details population is collected from District Census Hand Book, (census 2001) Rajasthan District Gazetteers, Alwar. The village level agricultural land use data obtained from the tehsil and district Headquarters for the selected sample villages. The study area covered 2 sample watersheds purposively through discussions, review of evaluation reports and field visits of different geographical locations of Thanagazi tehsil.

TABLE-1 SAMPLE SIZE OF WATERSHED: THANAGAZI TEHSIL

Micro Watershed Name	Sanwatsar	Rajpura	Total
Sample Size	50	50	100

REVIEW OF LITERATURE:

The study of appraisal of watershed management on agriculture land use involves measurement, distribution and classification of land utilization and crop characteristics of the concerned area and also aims at a more rational planning and development of its overall geographic environment.

The first exploratory work on land utilization had its roots in **Sauer's** Michigan Economic survey and T.V.A. land classification attempt in U.S.A., **Stamp's** work known as "Land utilization survey of Britain". As a separate sub-field, agricultural geography emerged as a consequence of seeds sown by **Krzymowski (1911)** and **Wailed (1933)** through their pioneering articles titled, 'Scientific position of agricultural geography, and problem of agricultural geography, respectively. **Weaver's** (1954-least deviation model) researches inspired world geographers towards crop combination studies, **Sauer's (1952)**, Agricultural origins and dispersal proved a landmark in giving an entirely new perspective to agricultural science as a whole. In respect of spatial arrangement and distribution of agricultural phenomena, the works of **Chatterjee, S.P. (1942-52)** and **Prakash Rao, V.L.S. (1942-46),** have been significant contributions in encouraging land use studies in India.

Earlier deterministic interpretation gave way to probabilities approach (**Welpert 1964 and Mohammad 1978**) paving way to stress on spatial synthesis **(Brookfield 1964, Mohammad 1978)** and statistical analysis (**King 1969, Mohammad and Amani 1970 and Shafi 1972**). **Patel**, **Jashbai** (*1987*) narrates the story of the rebirth of a small river Arvari in Alwar through traditional water harvesting structure called Johads.

The works of **Singh, J.S. entitled, 'An Agricultural Atlas of India' (1978)** and **"An Agricultural Geography of Haryana" (1976)** also highlight the broader aspects of agricultural geography in particular and land use in general. In Rajasthan, the first pioneering work on agricultural land use was done by **Gupta, N.L. (1966)** and **Mrs. Laxshmi Shukla (1977),** as **"Agricultural land use in Udaipur plateau region"** and **"Agricultural land use in Chittorgarh district"** respectively. The above said studies of **Gupta and Mrs. Laxshmi Shukla** pertaining particularly to agricultural land utilization in the hilly region of Aravalli ranges go to contribute in their specific way. The other similar work on agricultural land use in Aravalli region was done by **Kalwar, S.C. (1981), Gamawat, S. (1988), Lodha, K. Khatri, L.C. (1989), Mohammad (1988) Saiwal,S (1991), Rajbala (2002)** etc. The similar work include **Roy, 1969, Dube 1969, Garg 1969, Saxena 1970, Bhatia 1970, Bhardwaj 1971, Pathak 1971, Joshi 1972, Sen 1974, Singh 1974, Dhillion 1977, Prasad 1978, Datta and Gupta 1979 etc**.

Apart from land use studies the various literatures on watershed development is also reviewed. **R.S. Deshpanda, M.J. Bhende and S. Erappa** has conducted a study on output and Impact Monitoring study of Kawad project in Karnataka state. Kawad project is a **'Resource Region'** centered watershed development programme. **Dr. Anuradha Mishra** contributed in **"Watershed Management"** and has analyzed the process of guiding and coordinating use of land and water resources in a watershed. She also examined socio-economic aspect of watershed management. "Watershed Management

Principles, Parameters and Programmes", **Mani N.D**, emphasis on an approach to area development programmes and analyzed the common guidelines of the Government; was issued in 1996 for the implementation programmes viz. **NWDPRA, DPAP, DDP and IWAP** and suggested to revise these programmes. **Ahluwalia**, **M (*1997*)**, focuses on a community-based watershed project in Rajasthan implemented by Seva Mandir. **Seva Mandir** has successfully facilitated 'community' identity and action, across caste, class and gender differences, in the context of local political struggles.

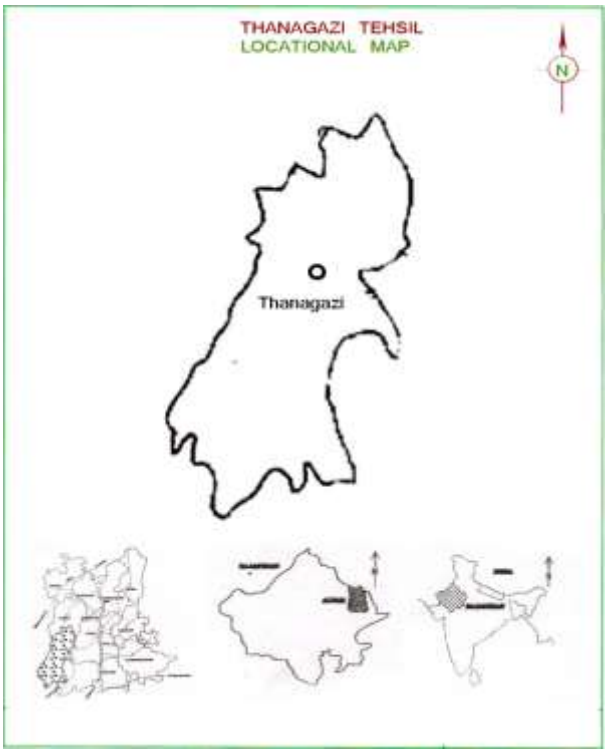
A booklet on **"Common Principles for watershed development Prepared"** by working group, Government of India, A Draft on **"Alternative water policy 1998** of India prepared by **'Jal Biraddory of India' (TBS Alwar)** has highlighted important recommendations, objective of water policy and discussed their implementations and impacts."

Ghosh G.K. (-) has written **"Water of India"** included watershed management for sustainable benefits for micro watershed as a unit for planning. **Amita shah** (*2000*) reviewed the experiences of different watershed development in different agro-ecological regions of Gujarat. **Hanumantha Rao** (***2000***) in his review study found overall impact of the watershed development positive and significant comparison to the previous programmers.

Further Krishna, **Anirudh**, (*2004*) study on watershed implementation in Rajasthan, suggests that instead of focusing their energies exclusively on developing newer and better programs and implanting these from the top down, development agencies ought to consider as well the capacities that emerge from the bottom-up that enable villagers to succeed in multiple development enterprises. This paper takes a critical look at the phenomenon of water harvesting technology experimented by **Tarun Bharat Singh's** projects in the Alwar district of Rajasthan. **Jeroen Dijkman** (2010) has revealed that livestock-environment interaction has created greater awareness among policy makers, planer, implementers for sustainable land and water management. **R.S. Bhalla, K.V. Devi Prasad, and Neil W. Pelkey** (2013) Watershed development (WSD) is an important and expensive rural development initiative in India. **Thomas Pikkety** (2014) has written a book entitled capital in Twenty First Century, which elaborates the investment in watershed development project and its role in promoting economic benefit to society.

Ibobel W. Health Cote (2014) in "Integrated Watershed Management: Principles and Practice" has elaborated that water is the next oil. A strong global consensus has began to develop that effective WSM must start at the watershed level and that water management actions must be taken in the context of watersheds and the human communities in them. **Beheim, E., Rajwar, G.S., Haigh, M., Krecek, J.** (2014) in "Integrated Watershed Management: Perspective and Problems have been discussed and suggest had waters are fragile environment threatened by anthropogenic actions Shashank Shekhar (2018) **in** Regeneration of Catchments-Watershed Management: New & Traditional Practices Watershed management involves land, water and other natural resources management leading to sustainable development of water resources. Regeneration of degraded catchment needs scientific planning with traditional wisdom.

It is clear from the above review that most of the studies to a large extent focus on aspects of watershed development. Very rarely one finds studies that look into watershed development in an integrated or a holistic manner. Moreover, the bulk of them remained project specific and covered very small area. Against this, the present paper includes all the major aspects of integrated watershed development and management and their subsequent impacts on agricultural land use of the Bairath region.



GEOGRAPHICAL PERSPECTIVE OF THANAGAZI TEHSIL:

The north-eastern belt of Rajasthan basically belong Bairath region of Alwar Hills of Aravalli ranges. Thanagazi tehsil is located between 27°7' to 27°37' North latitude and 76°7' to 76°25' East longitude at South-West of Alwar Tehsil and 42 kms far away from district Headquarters. It is surrounded by Aravalli ranges; Jaipur in West, Dausa in South, and Bansur in North, Alwar city in East and in South-East Rajgarh is situated. Alwar

–Jaipur state highway no. -13 is connecting Thanagazi to state capital Jaipur and Alwar HQ. It embraces an area of 1060.33 sq. km. and 35 Graham-Panchayats, 175 total villages are according to census 2011, which has 2.33395 Lakh populations and population density was 220 persons /$Km^{2.}$ Sex ratio in Thanagazi tehsil is 899 per 1000 male. Literacy rate in Thanagazi tehsil is 60.29%.

Thanagazi was settled in medieval period. In 16th centaury Gazi was one of Subedar (administrator) in eastern Rajputana. Mughal emperor Akbar was crossing from this area when he went for Ajmer. Akbar pleased to Gazi for his kind service and he gave this area to Gazi. Then it called **Gazi ka Thana** after period of time its name change as **Thanagazi.**

The problems of the constituent part of the Bairath region area almost similar and it has a contiguous set up. The large portion of land in the tehsil suffers from barren and cultivable waste land due to hilly and rugged nature of topography, infertile soils, paucity and variability of rain fall and social backwardness. It will therefore, be interesting to trace out relationship between agricultural land use and watershed development of the Bairath region over a period of decade.

APPRAISAL OF SANWATSAR WATERSHED (THANGAZI, ALWAR DISTRICT)

Sanwatsar watershed at latitude $27^0$18' N and longitude $76^0$44' E covering an area of 911.70 ha is in Thanagazi tehsil of Alwar district of Rajasthan. It is situated 6 km from Thanagazi and 70 km from the district Headquarters. The average annual rainfall at Sanwatsar is 660 mm. Soils in the watershed are shallow to medium deep brown soils. Physiographically, watershed is having terrace like sloping pattern where gentle to moderate sloping pattern is observed specially in the middle and lower reaches. Geologically, the area is mainly occupied by Aravalli hills. Groundwater occurs under unconfined conditions in the weathered and fractured rocks and under semi-confined to confined conditions in the undulating terrain. Demographically the watershed area is having a total population of 750 with 150 household with an average family size of 5 members.

This watershed is comprised of Sanwatsar part of Thanagazi and Rundh-Jhiri the having communities of different socio economic background therefore; separate efforts were adopted to mobilize the villagers and to convinced them for Sharamdan and other guiding principles like Ban on tree cutting and open grazing. For example village Kabligarh and Rundh-Jhiri which located in the upper reaches of the watershed is predominantly Gurjar community where as is in Sanwatsar lower part of the watershed is having mixed community mainly comprised of Meena, Gurjar, Brahmin and SC. For example village Sanwatsar and Kabligarh which located in the upper reaches of the watershed is predominantly tribal villages have taken a lot of convincing to adopt social fencing as most of the households were having cattle and the villagers was excessively dependent on forest for the livelihood. The farmers were reluctant to adopt the watershed principles as per the guideline therefore in this part of the watershed different strategy was adapted to convince the villagers and to implement the project.

IMPACT ON LAND USE AND CROPPING PATTERN:

An attempt was made to analyze the land utilization pattern through the survey of the sample households. These households are equally distributed in upper, middle and lower reaches. The analysis of household data clearly reflects that the major impact of soil and water conservation treatment was on wasteland, which has been brought under cultivation and has been reduced to 4% of total area at present.

TABLE: 2 IMPACT ON AGRICULTURAL LAND USE AREA (IN HA): SANWATSAR WATERSHED

Sr. No.	Crops	Watershed Impact on Area (Ha)		
		Before Value	After Value	Change in %
1	Wheat	84	113	25.66
2	Barley	27	35	22.86
3	Gram	42	53.5	21.50
4	Mustard	57	73	21.92
5	Spices	0	0	0.00
6	Bajra	99	129	23.26
7	Jawar	19	28	0.00
8	Maize	78	99	21.21
9	Fodder	1	1	0.00
10	Vegetable	0	0	0.00
G. Total		**407**	**531.5**	**23.42**

In Rabi season where no crop was grown in the pre watershed intervention, now few farmers have started to take wheat and gram similarly in summer season due to watershed intervention now farmers have started to take vegetables. At present vegetable is also being grown by almost 6 farmers in the watershed area and this is purely post watershed phenomena For the land utilization pattern of different crop the analysis of household data clearly reveals that an increase of 25.66% is observed under wheat cultivation. The pattern of land utilization clearly reflects that still there is large scope to increase the area under Rabi and summer cultivation.

The major impact of watershed is the change in cropping pattern and preference of farmers for vegetable crops. Now village is one of the main suppliers of vegetables to close by Alwar and Thanagazi. The assured market in Alwar city, and Thanagazi and Narayanpur other neighboring tehsils have promoted all the farmers to go for vegetable and fodder cultivation. This reflects that

people of the watershed village have responded positively to the market need.

The significant change in cropping pattern is seen in the Sanwatsar. The Wheat, Bajra, Barley, Gram and Mustard and Maize has shown the maximum increase raining from 25.66% to 21.50% to whereas no change is observed in fodder crop whereas spices are not grown. Surprisingly vegetables area has not shown any change and cropping in the watershed area which is required after development of watershed programme. The spices and Jowar are also not grown in the Sanwatsar watershed.

APPRAISAL OF RAJPURA WATERSHED (THANAGAZI, ALWAR DISTRICT)

Rajpura is situated at $37^0$28' E. latitude and $76^0$18' N. longitude. Rajpura micro-watershed development project is sanctioned under IWDP [Haryali Batch III] and there watersheds are spread over in the entire Rajpura village along ridgeline. Rajpura is a large macro-watershed area of Thanagazi Panchayat Samiti having 18 micro-watersheds. Rajpura watershed is located in Thanagazi Panchayat Samiti of Alwar district of Rajasthan and lies nearly 90 km away from the district headquarters. The area is connected by metallic road as watershed. The watershed area consists of three villages namely Rajpura, Basai Abhayram and Gudha-Chotti Chind. The village has a total population of 1623 and the watershed covers treatable area of 1216.34 hectors. The literacy rate in the village is 66%. The watershed area belongs to mixed villagers with majority of Gurjar and Meena. The different communities in the area have maintained their own identity with their peculiar culture and traditions. There are total 17 landless households in all the watershed villages.

The people have to depend on rainfed agriculture and crops like Bajara, Moong, Moth and Guar are grown during Kharif. Agro-Forestry and Pasture development activities have not yet been carried out and horticulture has not been also picked up in a right way in the watershed. The watershed activity has made marginal impact on crop productivity and underground water table and ensuring the safe drinking water. The treatment has also helped to withstand the adverse effects of erratic rainfall. Further, it has also ensured the livelihood for entire year. Seasonal migration has become restricted. The indirect impact, is visible in the overall improvement of standard of living like improvement in the dwellings, household level assets have increased. The first glance of result reflects their overall marginal positive interaction productions for crops but forestation and pasture development progress is very poor but subcutaneously there is marginal increase in water level in the watershed area. Additional area also has been brought under cultivation. The overall impact of the measures undertaken fill date have been resulted into raising of ground water table, increase in productivity of crops as well as wage employment generation.

The watershed intervention has brought an overall improvement - in productivity, cropping pattern, sustainable drinking water supply socio economic conditions and reduction in the seasonal migration. Now, this area is known for Tomato, Onion and Potato cultivation, which has helped the farming villagers to attain self-sufficiency in term of assured livelihood.

IMPACT ON LAND USE AND CROPPING PATTERN:

In pre watershed period, area under cultivation was 1030 ha and about 50% of the land was fallow. The area under Kharif & Rabi season was 797 ha & 119 ha respectively whereas the fallow land in the same season was 233 ha & 910 ha respectively. This has changed after the watershed implementation. After watershed, area in Kharif season is 812.5 ha, Area in Rabi Season is 233.0 ha and area in summer is 25 ha with fallow land 217.5 ha, 797 ha & 1005 ha respectively.

Where it is observed that after watershed intervention a substantial increase in seasonal irrigation is there which has ultimately resulted in the increase of area for Rabi crop. The wasteland has decreased for almost 2/3 times, rain fed area has also registered a decrease of almost 25 percent where as seasonal irrigation has seen rise of more than 70% in the surveyed household. The land utilization pattern clearly reflects that watershed intervention has a positive impact in the area, which has resulted in the improved productivity. The change in cropping pattern is mainly attributed to the increased availability of water, preference of farmers towards cash crop and readily available market linkages.

TABLE: 3 IMPACT ON AGRICULTURAL LAND USE AREA (in ha): RAJPURA WATERSHED

S. No.	Crops	Watershed Impact on Area (Ha)		
		Before Value	After Value	Change in %
1	Wheat	65.5	71	7.75
2	Barley	6.5	7.5	13.33
3	Gram	5	7	28.57
4	Mustard	64	84	23.81
5	Spices	0	0	0.00
6	Bajra	125	144	13.19
7	Jawar	0	0	0.00
8	Maize	7	7	0.00
9	Fodder	3	4	25.00
10	Vegetable	0	0	0.00
G. Total		276	324.5	14.95

New cash crops like vegetable Tomato, Onion, Potato, Chilly and Green Pea are introduced. There overall change in area is reflected in the table given below. The increase in vegetable

cultivation has improved the economic conditions of the farmers in watershed area

The major impact of watershed is the change in cropping pattern and preference of farmers for vegetable crops. Now village is one of the main suppliers of vegetables to close by Alwar. The assured market in Alwar city, and Thanagazi and Narayanpur other neighboring tehsils have promoted all the farmers to go for vegetable and fodder cultivation. The significant change in cropping pattern is seen in the Rajpura. The Gram, Fodder, Mustard, Barley and Bajra have shown the maximum increase raining from 28.57% to 13.19% to whereas marginal change is observed in Wheat (7.75%). Surprisingly vegetables area has not shown any change and cropping in the watershed area which is required after development of watershed programme. The spices and Jowar are also not grown in the Rajpura watershed. Almost all major crops like heat, grain mustard, bajara, fodder etc. have shown positive impact on area but percentage of the Urad and Bajara has shown decreased trend of total cropped area whereas wheat, gram and odder percentage of the total cropped area has increased.

CONCLUSION

However, it is observed that the area has already been declared as dark zone and as a result, farmers are not getting loan for the construction of dug wells. Now farmers have resorted to bore well drilling and after watershed intervention around 27 new bore wells are drilled and they are causing serious overexploitation to the ground water regime.

The overexploitation of groundwater and erratic rain fall in the last few years have adversely affected the groundwater availability in the watershed area and it is reported that out of 110 bore wells drilled at present only 25-30 are functional and rest of them are either defunct or have little water. At the time of field visit, a vast tract of fallow land was observed and the reason cited was non-availability of groundwater and very less rainfall over last couple of years. This clearly indicates that at present the watershed interventions are not able to contribute towards drought proofing during long dry spells

The programme has brought prosperity in terms of improved income, which has increased many folds mainly due to agricultural activities. Since this watershed is situated nearly the Alwar-Narayanpur district high way and having close proximity to the market of Thanagazi, Narayanpur and Alwar which has resulted in the improved income for the farming villagers of the area. Moreover, village has also taken few steps forward by initiating other development work specially to improve the drinking water facility. Now the new water supply scheme at Vijaypura is nearing the completion. At present village is also getting input from agriculture department, which has resulted in improved irrigation practices and adoption of horticulture activities in a big way. At present almost 30%, tomato growers have adopted to drip irrigation. Though Rajpura watershed have achieved many landmarks but still issues like over exploitation of ground water, migration of land less in summer season, non functional institutions and non utilization of maintenance fund are causing serious concerns to the sustainability of watershed intervention and needs to be tackled on priority basis

BIBLIOGRAPHY

Agrawal, B.D. (1972) Rajasthan Distt. Gazetteers, Alwar, Directorate of District Gazetteers Govt. of Rajasthan Jaipur.

Amita Shah (1998). Watershed Development Programmes: Emerging Environment Perspectives. Economic and Political Weekly, Vol XXXIII, No. 26: pp. A66-80

Deshpande R. S. and N. Rajasekaran (1997). Impact of Watershed Development Programme: Experiences and Issues. Artha Vijnana, Vol.XXXIX, No.3: pp. 374-390.

Dhyani, B. L., J. S. Samra, G. P. Juyal, Ram Babu and V. S. Katiyar (1997). Socio-Economic Analysis of a Participatory Integrated Watershed Management in Garhwal Himalaya (Fakot Watershed). Central Soil and Water Conservation Research and Training Institute, ICAR, Deharadun

Government of India (GOI). (1994). Guidelines for Watershed Development. Department of Wastelands Development. Ministry of Rural Areas and Employment, New Delhi

Grewal, S. S., J. S. Samra, S. P. Mittal and Y. Agnihotri (1997). Sukhomajri Concept of Integrated Watershed Management. Central Soil and Water Conservation Research and Training Institute.

J. S. Samra, V. N. Sharda and A. K. Sikka (1996). Water Harvesting and Recycling: Indian Experiences. Central Soil and Water Conservation Research and Training Institute

Joshi, P. K. and M. C. S. Bantilan (1997). Vertisol Watershed Research in the Semi-Arid Tropics: Directions for Impact Assessment. Artha Vijnana

Kanchan Chopra (1998). Watershed Management Programmes: An Evaluation of Alternative Institutional and Technological Options. IEG Working Paper No.E/197/98

Kerr, J., Pangare, G., and Lokur-Pangare, P.J.George and Shashi Kollavalli (1998). The Role of Watershed Projects in Developing Rainfed Agriculture in India. A Report submitted to the ICAR and the World Bank

Kolavalli, Shashi (1998). A Review of Approaches to Watershed Development in India. A Report submitted to the National Centre for Agricultural Economics and Policy Research, ICAR, New Delhi

Kurothe, R.S., B.B.Singh, K.T.N. Nambiar, V.C.Pande, R.M.Samarth and Virendra Kumar (1997). Watershed Management for Sustained Production in Aravalli Hills of North Gujrat (Navamota Watershed). Central Soil and Water Conservation Research and Training Institute, Vasad Centre, ICAR, Deharadun

Prasad, H (1992). "Research Methods and Techniques Geography" Rawat Publication Jaipur.

Prasad, S. N., Ratan Singh, C. Prakash, V. S. Katiyar, J. S. Samra and K. D. Singh (1996). Watershed Management for Sustained Production in South-Eastern Rajasthan (Chhajawa Watershed). Central Soil and Water Conservation Research and Training Institute, ICAR, Dehradun

Riebsame, W.E., Meyer, W.B. and Turner, B.L. II. (1994). Modeling Land-use and over as Part of Global Environmental Change. Climate Change. Vol. 28. p. 45.

Rosegrant, M.W., C. Ringler and R. V. Gerpacio (1997). Water and land resources and global food supply. Paper presented for the 23rd International Conference of Agricultural Economists on "Food Security, Diversification and Resource Management: Refocusing the Role of Agriculture", Sacramento, California, August 10-16, 1997. International Food Policy Research Institute, Washington, D.C

Saiwal, S (1990). "The Dynamics of Agricultural Land use in Aravalli Region" Unpublished, Ph.D. Thesis, University of Rajasthan – Jaipur.

Saiwal, S. (1986). "Dynamics of Crop Diversification and Aravalli Region" Annals the Asso. Of Rajasthan, Geographer, Vol. VI, Dec. 1986, pp. 23-27.

Saleth R.M. (1991). Water Resources as private property: I&II, The Economic Times, June 13-14

Sampath, R.K. (1990). Measures of Inequity for Distribution Analysis of Large Public Surface Irrigation Systems: A Welfare Theoretic Approach. In R.K.Sampath and R.A.Young (Eds) Social, economic and institutional issues in Third world irrigation management, West view Press, U.K

Verma, L. R. (1998). A Glimpse of Indigenous Technology Knowledge for watershed Management in Upper North-West Himalayas of India. PWMTA-FAO, Nepal

Wilkie, D.S., and Finn, J.T. (1996). Remote Sensing Imagery for Natural Resources Monitoring. Columbia University Press, New York. p. 295.

World Bank (1997). India: Sustaining Rapid Economic Growth, A World Bank Country Study, and The World Bank, Washington, D.C.

Xiaomei Y and Ronqing L.Q. Y, (1999). Change Detection Based on Remote Sensing Information Model and its Application to Coastal Line of Yellow River Delta - Earth Observation Center, NASDA, China.

Yadav S.M.T. Kamal (1998). "Daishi Riyasato Mai Rajnaitik Chaitn" Ritu Publication Jaipur.

Corresponding Author

Pranjal Saiwal*

Assistant Professor, Department of Geography, Dev International College, Alwar, Rajasthan