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RESEARCH ARTICLE :

Digitizing soil conservation and water harvesting measures in Patapur Micro Watershed using Quantum geographical information system (QGIS)

IBRAHIM KALEEL, U. SATISHKUMAR, MALLIKARJUNA AND MOHAMMED WASEEM

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SUMMARY : Soil conservation and water harvesting measuresare the most important components for watershed management. In soil conservation and water harvesting planning, efforts were concentrated on suggesting suitable type of soil conservation and water harvesting measures across the slope for both arable and non arable lands which helps in controlling erosion and reducing soil loss directly and in increasing crop yields through additional moisture conservation indirectly. The GIS software sector has developed rapidly over the last ten years. Open Source GIS applications are gaining relevant market shares in academia, business and public administration. The Quantum Geographical Information System (QGIS) is an open source GIS application which is widely used. The conservation measures for the study area are digitized using QGIS software assigning special picturesque icons for individual conservation measures. The conservation measures are suggested based on average annual rainfall (mm) and slope (%). In this paper we illustrate the use of QGIS software in digitizing soil conservation and water harvesting measures.

KEY WORDS :
Soil conservation measures, Water harvesting measures, QGIS

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Author for correspondence :

IBRAHIM KALEEL
Department of Soil and Water Engineering, College of Agricultural Engineering, University of Agricultural Sciences, RAICHUR (KARNATAKA) INDIA
Email : ibrahimkhaleel1075@gmail.com

See end of the article for authors' affiliations

BACKGROUND AND OBJECTIVES

Soil degradation is a global environmental problem that requires urgent intervention measures. It is responsible for 84% of degraded acreage (Aberha, 2008). The primary causes of soil degradation are rainfall and wind which causes soil erosion leading to low agricultural production, hence food insecurity, malnutrition and poverty (IARI, 1999). It is a matter of great concern that out of the total geographical area of 329 Mha of India, about 167 Mha is affected by serious water and wind erosion problem and out of this 127 Mha is affected by soil erosion and 40 Mha is suffering from gully erosion, water logging and soil salinity in varying degrees. The soil conservation and water harvesting are activities that maintain or enhance the productive capacity of land in areas affected by or prone to soil erosion (Dhruvanarayana, 2013). Soil erosion, on the other hand, is the movement of soil from one part of the land to another through the action of wind or water. Thus, soil erosion by water is caused by raindrop impact surface sealing, and crust formation leading to high runoff rate and amount, high runoff velocity on long and undulating slopes, and low soil strength of structurally weak soils with high moisture content due to frequent rains. Soil erosion by wind is caused by lack of vegetation cover, dry pulverized soils, strong wind speeds, and poor land management practices such as continuous tillage and over-grazing.

A QGIS is used to develop and store the feature of watershed like topology, soil type, texture, existing land use land cover, water resources and drainage pattern as obtained from field measurement thus QGIS has wide range of application (Juan *et al.*, 2011). Apart from that the Scalable Vector Graphic (SVG) files are drawn for individual soil conservation and water harvesting measures and stored in QGIS. The SVG file is an XML-based vector image format for two-dimensional graphics with support for interactivity and animation. SVG images and their behaviours are defined in XML text files. This means that they can be searched, indexed, scripted, and compressed. SVG allows three types of graphic objects: vector graphic shapes such as paths and outlines consisting of straight lines and curves, bitmap images, and text. Graphical objects can be grouped, styled, transformed and composited into previously rendered objects (Dries *et al.*, 2015). The QGIS modelling is a computer based and computationally efficient tool; it uses available inputs *viz.*, vector or/and raster and allows users to study the present and long-term impacts.

RESOURCES AND METHODS

The Patapur micro-watershed is a typical micro-watershed system under semi-arid agro climatic system having an area of 454.62 ha being located at Patapur village in Manvi taluk of Raichur district in Karnataka (Fig. A).The Patapur study area lies between the 16^0 07' 35.9” Latitude and 760 512 33.3”Longitudes and 16^0 082 22.3’’ Latitude and 76^0 532 27.7” Longitudes with an average elevation of 447 m above the mean sea level (MSL). This watershed is located about 63 km from the Raichur city on Raichur-Lingasugur road. It finds its place toposheet No. 56 D/16 (1:50,000) of the Survey of India data base.

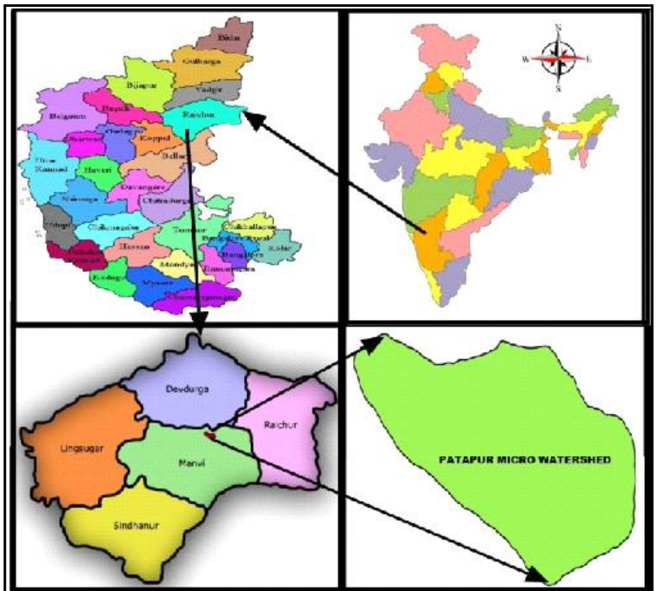


Fig. A : Identified Patapur micro-watershed in Raichur district

The study area is a part of the North-Eastern Dry Zone (Zone-2 of Region-1) with subtropical climate. The mean maximum temperature varies from 30.3^0 C in December to 40.6^0C in May. The April and May months are the hottest months, while the minimum temperature ranges from 15.7^0 C in December to 25.3^0 C in May. December and January are the coldest possible months. The mean relative of humidity fluctuates from 37.5 per cent in March to 69.1 per cent during August. Wind speed exceeds 15 km/h during the months of June and July. The recorded maximum annual potential evaporation would be of 1950 mm per year, and (220 mm) in May month and the lowest in December (120 mm). The average annual rainfall of the study area is 621 mm. The number of rainy days annually ranges between 35 and 60 days per year. Nearly 67 per cent of the rain being received during the South-West monsoon period (June - September) and the remaining about 24 per cent gets contributed during North- East monsoon.

Study area was surveyed to carry out soil profile study. Various soil profiles at identified location were sampled for each horizon and textural soil classification was performed. The number of soil mapping units delineated is 49 (Fig. B).

In Patapur micro watershed soil and water conservation is one of the most important components to conserve runoff water. In soil and water conservation planning, efforts were concentrated on suggesting suitable types of soil conservation and water harvesting measures across the slope which helps in controlling erosion and reducing soil loss directly and in increasing crop yields through additional moisture conservation indirectly. The current emphasis is more on improving moisture through various field and community-based moisture conservation practices.

Field based soil and water conservation measures are essential to reduce or prevent either water erosion or wind erosion, while achieving the desired moisture level for sustainable production. The suitability of soil conservation and water harvesting practices depend greatly upon soil, topography and climatic factors. The study area is classified into five slope classes (Fig. C)

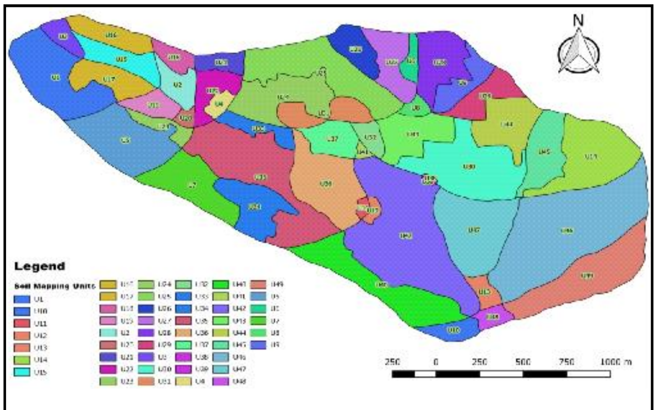


Fig. B : Delineated soil mapping units of Patapur micro-watershed

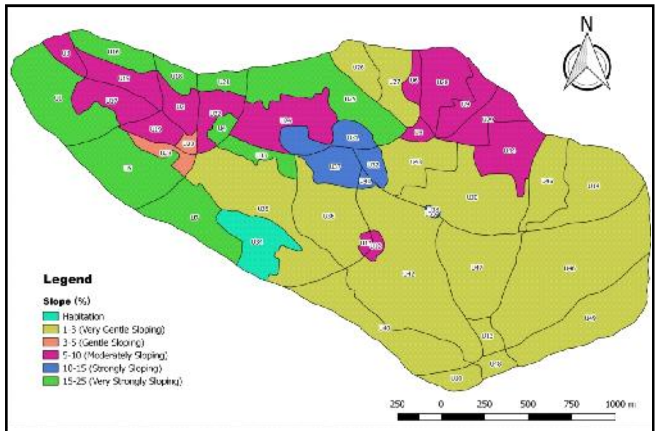


Fig. C : Variability of slope across Patapur micro watershed

Table A : Conservation measures for arable land

Sr. No.	Conservation measures for arable land	Rainfall, mm	Land slope, per cent
1.	Contour bunds	1 – 800 (Permeable Soils)	0 – 6
2.	Graded bunds	1 – 800 (Impermeable Soils)	0 – 6
		800 – 1500 (Permeable Soils)	0 – 6
3.	Level bench terracing	800 – 1500	0 – 6
4.	Inward sloping bench terracing	2500 - 3000	6 - 30
5.	Outward sloping bench terracing	800 – 1500	6 - 30
6.	Continuous contour trenches	800 – 1500	0 – 6
7.	Staggered contour trenches	1 – 800	0 – 6
8.	Graded trenches	1500 - 2500	6 - 30
9.	Conservation bench terracing	1500 - 2500	6 - 10
10.	Zingg terracing	1500 - 2500	6 - 10
11.	Contour stone wall	800 – 1500	6 - 30
12.	Graded stone wall	1500 - 2500	6 - 30
13.	Contour terrace wall	1500 - 2500	16 - 30

Table B : Conservation measures for non-arable land

Sr. No.	Conservation measures for non arable land	Land slope, per cent
1.	Diversion drains	0 - 30
2.	Contour trenching	0 - 6
3.	Contour wattling	6 - 60
4.	Retaining walls	6 - 30
5.	Geotextiles	0 - 30
6.	Bench terracing	6 - 10

Table C : Direct runoff water harvesting structures

Sr. No.	Direct runoff water harvesting structures	Land slope, per cent	Area, ha	Size (As per WDD, GOK)
1.	Dug out pond	0 - 3	1	10*10*3
		0 - 3	2	12*12*3
		0 - 3	3	15*15*3
		0 - 3	5	18*18*3
		0 - 3	>5	21*21*3
2.	Earthen Embankment pond	0 - 10	-	-

viz., very gently sloping (0-3%), gently sloping (3-5%), moderately sloping (5-10%), strongly sloping (10-15%), very strongly sloping (15-25%). The engineering measures applicable for arable land and non arable land under different rainfall pattern are shown in Table A and B (CSWCRTI, 2007). The direct runoff water harvesting structures are suggested with spacing based on slope and area as shown in Table C (WDD, GOK).

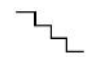
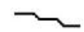
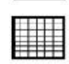
OBSERVATIONS AND ANALYSIS

The separate SVG picturesque icons for soil conservation and water harvesting measures were drawn using InkScape v 3 software as shown in Table 1. The separate directory was made naming soil conservation and water harvesting measures icons and the directory was uploaded into QGIS software. The soil mapping unit map of patapur micro watershed is analyzed in QGIS software. The separate point map was created for soil conservation and water harvesting measures by digitizing points in every soil mapping unit map. The soil conservation and water harvesting measures are adopted for patapur micro watershed on the basis of rainfall and soil slope as shown in Table A, B and C. In the QGIS software the point map of soil conservation and water harvesting measures were analyzed and separate picturesque icons are assigned by replacing points as shown in Table 1. The Fig. 1 depicts the main QGIS window frame showing vector shape file of soil conservation and water harvesting measures map of patapur micro watershed. The Fig. 2 shows the soil conservation and water harvesting measure map of patapur micro watershed with picturesque icons of soil conservation and water harvesting measures.

Conclusion :

The soil conservation measures suggested for arable lands with very gently sloping (0-3%) and gentle sloping

Table 1 : Picturesque icons of conservation measures for arable land, non-arable land and direct runoff water harvesting structures

Sr. No.	Conservation Measures for Arable Land	Displayed icon on QSCOT
1.	Contour bunds	
2.	Graded bunds	
3.	Level bench terracing	
4.	Inward sloping bench terracing	
5.	Outward sloping bench terracing	
6.	Continuous contour trenches	
7.	Staggered contour trenches	
8.	Graded trenches	
9.	Conservation bench terracing	
10.	Zingg terracing	
11.	Contour stone wall	
12.	Graded stone wall	
13.	Contour terrace wall	
14.	Hillside ditches	
Conservation measures for non arable land		
15.	Diversion drains	
16.	Contour trenching	
17.	Contour wattling	
18.	Retaining walls	
19.	Geotextiles	
20.	Bench terracing	
Direct runoff water harvesting structures		
21.	Dug out pond	
22.	Earthen embankment pond	

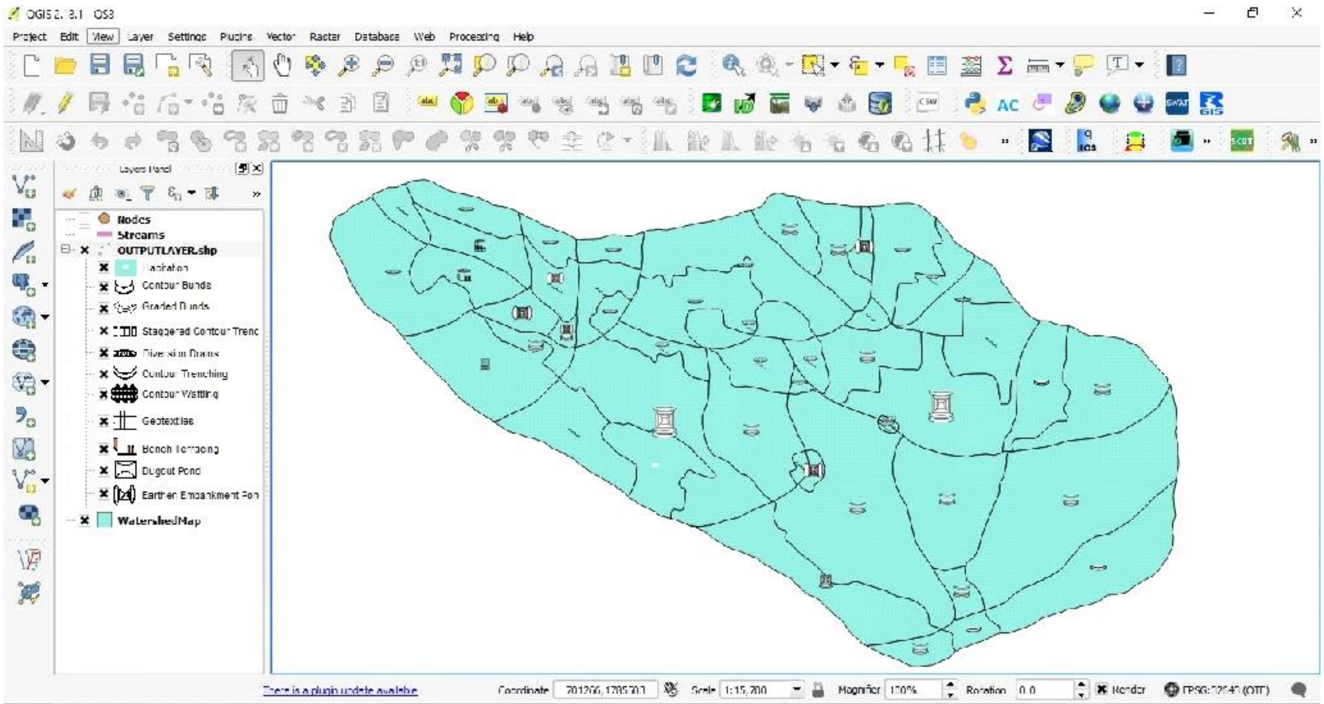


Fig. 1 : The QGIS window showing soil conservation and water harvesting measures map of patapur micro watershed

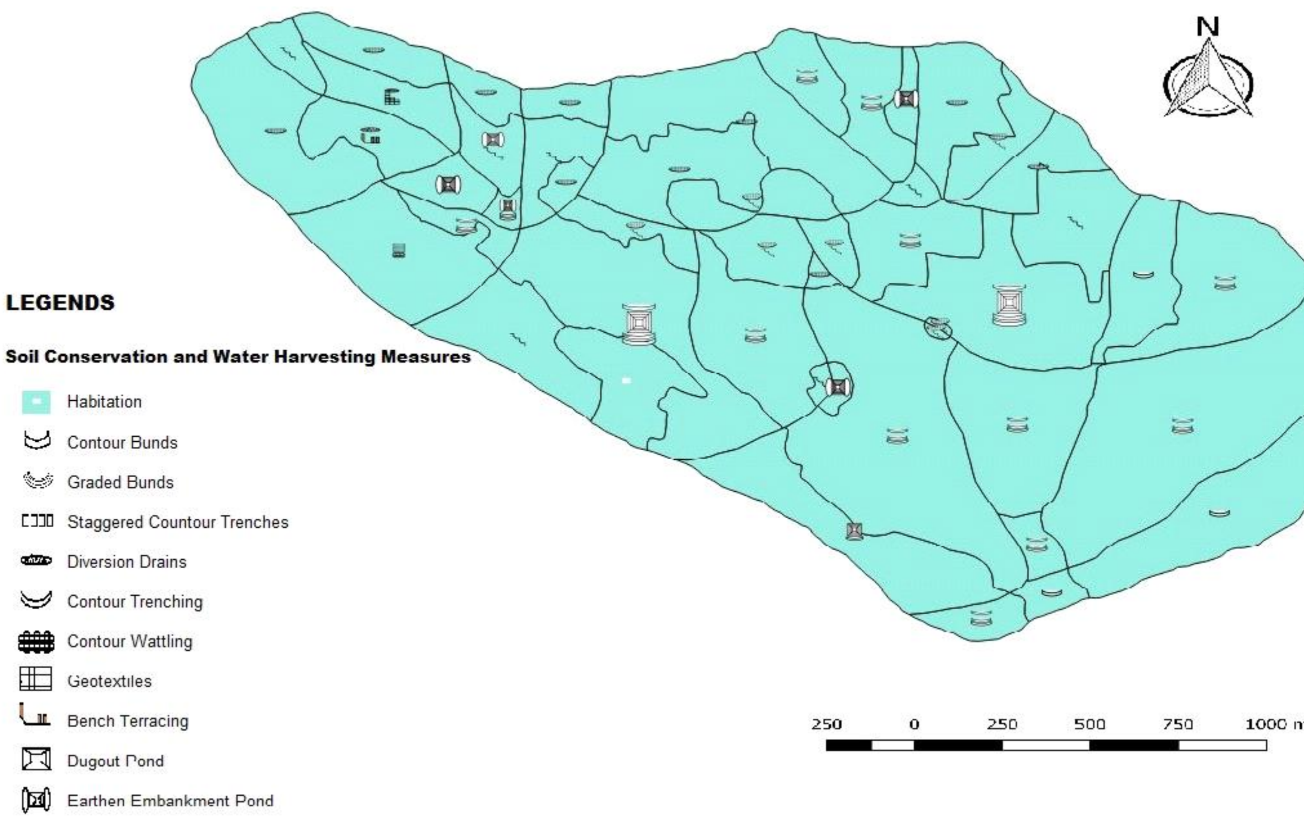


Fig. 2 : The soil conservation and water harvesting measures map of patapur micro watershed

(3-5%) are contour bunding, graded bunding, contour trenches and level bench terracing. Similarly for moderately sloping (5-10%), strongly sloping (10-15%) and very strongly sloping (15-25%) lands the conservation measures adopted are terracing, trenches and stone walls. The conservation measures suggested for non arable lands are diversion drains, contour trenching, contour wattling, retaining walls, geotextiles and bench terracing. The water harvesting structures suggested for the study area for land slope 0-3 % are dugout ponds and for land slopes >3 % are earthen embankment ponds. The sizes of dugout ponds are suggested as per the watershed development department, government of Karnataka as shown in Table C. The QGIS software depicts soil conservation and water harvesting measures more effectively so that users like watershed engineers, planners can make optimal planning to reduce soil loss and to harvest runoff water.

Authors' affiliations :

U. SATISHKUMAR, MALLIKARJUNA AND MOHAMMED WASEEM, Department of Soil and Water Engineering, College of Agricultural Engineering, University of Agricultural Sciences, RAICHUR (KARNATAKA) INDIA

REFERENCES

Aberha, E.T. (2008). Erosion and soil and water conservation group and environmental Policy group. Continue use of soil and water conservation practices. A Case Study in Tulla District, Ethiopia. Dissertaion for Award of MSc Degree at Wagenigen University, Nertherlands, pp.57.

CSWCRTI (2007). *Soil Conservation Manual*. Central Soil & water Conservation Research and Training Institute, Dehradun, Uttarakhand.

Dhruvanarayana, V.V. (2013). Soil and water conservation research in India. *Indian J. Soil Cons*., **14** (3) : 22-31.

Dries, L., Katrien, V.B., Steven, B., Jan, S., Patrick, M. and Peter, L.M.G. (2015). A GIS plug-in for Bayesian belief networks: Towards a transparent software framework to assess and visualise uncertainties in ecosystem service mapping. *Environ. Model. Soft.*, **71** : 30-38.

IARI (1999). Soil Survey Manual All India Soil and Land Use Survey," Indian Agricultural Research Institute, New Delhi.

Juan, F.M.M., Manuel, L.V., Jean, P. and Ruiz-Sinoga, J.D. (2011). Modelling the effects of land use changes on runoff and soil erosion in two Mediterranean catchments with active gullies (South of Spain). *Landform Analysis,* **17** : 99–104.QGIS

WDD GOK, *Annual report on Watershed Development*, Watershed Development Department, Government of Karnataka.

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