A CASE STUDY | International Journal of Agricultural Engineering | Volume 7 | Issue 1 | April, 2014 | 271–274

Appraisal study of soil and water conservation measures in Raichur district, Karnataka

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Received : 04.12.2013; **Accepted :** 21.03.2014

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ABSTRACT : The present study was carried out in five villages in Raichur district of the Karnataka to determine the level of soil erosion on agriculture lands as well as the soil and water conservation measures adopted by farmers in their fields. The results indicated that the agriculture lands were moderately sloppy 3.5% with an estimated soil loss of 2.1 t/ha/year. Average bulk density was found to be 1.8 g/cc, indicating slightly compact soil leading to low infiltration rate. Conservation measures put in place by farmers to reduce erosion, increased soil nutrients and conservation moisture included use of chemical fertilizers and manure applications. The study revealed that soil erosion is moderately high in the area but the farmers put measures in place to reduce its effects and conservation soil moisture.

KEY WORDS : Bulk density, Conservation, Erosion, Infiltration rate, Soil moisture

HOW TO CITE THIS PAPER : Mallikarjuna, Khaleel, Ibrahim and Ayyanna (2014). Appraisal study of soil and water conservation measures in Raichur district, Karnataka. *Internat. J. Agric. Engg.*, **7**(1) : 271-274.

The uppermost weathered and designated layer of the earth's crust is referred to as soil. The soil layer is composed of mineral and organic matter is capable of sustaining plant life. The soil is less in some places and high depth in some other places; this may vary from practically no soil layer to several meters. The soil layer is continuously exposed to the actions of atmosphere. Water and wind are two main agencies which act on the soil layer and dislodge the soil particles and transport them. In other way water supply, especially rainfall contributes enormously to the productivity of any farming venture. However, erratic rainfall coupled with its associated setback of soil erosion leads to soil nutrient, and moisture losses has been a problem to farming over the years. Nutrient loss through erosion has a severe effect on soil fertility. Most nutrients are found in the topsoil which is mostly removed by erosion. Also, less water infiltrates into the soil since there is increase in run off rate as a result of erosion. Therefore, less moisture is absorbed and more soil is carried away. A sequel to the deforestation is typically large-scale erosion, loss of soil nutrients and sometimes total desertification. The physical structure of soil suffers when organic matter from biomass is depleted. A common result is soil surface crusting, which impedes germination and increases runoff. As a result, soils become more vulnerable to erosion. Also, organic matter, when decomposed, produces natural 'glue' that binds soil particles together thereby reduces its erodibility. So, when levels of organic matter drop as a result of deforestation, the particle binding ability of the soil is reduced making it susptability to erosion.

To achieve this, a number of conservation-oriented farming methods may be used. It includes that conservation tillage, contour farming, strip cropping, grassed waterways and gully control, shelter belts and wind breaks crop rotation as reported by Shahu (2003). Other methods are stone bunding, terracing, mounding, organic matter application and bed configuration. Raichur district of Karnataka has a good potential for the production of food grain crops but there are some constraints that prevent the realization of this. Prominent of these are periodic drought, low levels of soil nutrients and medium to high level of runoff and rainfall variability. The farmers in Kurubadoddi, Kadgamdoddi, Wadavatti, Singanodi and Baidoddi depend on rainfall for farming. This means that farmers in these communities are best with erratic rainfall, prolonged drought, degraded soil, as a result of erosion. This may lead to low productivity. Low crop yield threatens food security in the communities and ultimately aggravate the low-income levels of the people with its attendant problems such as inability to maintain wards in school, poor nutrition and migration of productive labour use. The research was, therefore, carried out to ascertain the soil conservation

measures adopted by farmers to mitigate soil and moisture loss for effective crop production in the area.

METHODOLOGY

Site location of study area description:

The study was carried out in the five villages namely Kurubadoddi, Kadgamdoddi, Wadavatti, Singanodi and Baidoddi of Raichur district in Karnataka. The area is located on 16°13' N latitude and 77°25' E longitude and at an elevation of 401m above mean sea level. The average annual rainfall is 610 mm, normally starts from July. Ninety farmers were enquired, eighteen from each of the five villages. Simple random sampling was used to select farmers for interview on the common soil conservation practices employed in the study area. Field observation of farmer practices was also used in the collection of data. To select field for the measurement of the soil physical parameters, simple random sampling was also used.

Measurement of slope :

The slope of agriculture land was measured using the water level as a tool. The slope was then calculated using by formula :

$$\text{Slope} = \frac{\text{Different in water level at two points}}{\text{Total distance}} \text{ x } 100 \quad (1)$$

Measurement of rills :

Rill erosion is the major form of erosion that was observed under cultivated fields in the study. Therefore, measurement was taken to determine the volume of soil that was eroded from plots of land under cultivation. The volume of soil loss from a field was calculated by measuring the depth, width and length of rills. The average width and depth of the rills were calculated, using the appropriate cross section area.

$$\text{Area of a triangle} = 0.5 \text{ x Horizontal width x depth} \quad (2)$$

$$\text{Volume of soil loss} = \text{Cross sectional area x Length of the rills} \quad (3)$$

$$\text{Soil loss} = \frac{\text{Volume of soil loss}}{\text{Catchments area}} \quad (4)$$

$$\text{Soil loss (t/ha)} = \text{Soil loss } (m^3/m^2) \text{ x Bulk density x } 10{,}000 \quad (5)$$

Measurement of infiltration rate:

The infiltration rate of the soil was determined for upstream, midstream and downstream of cropped field plots. A double ring infiltrometer was used for the collection of the infiltration data, depth of water that infiltrates into the soil was taken at a time interval of five minutes.

Measurements of moisture content and bulk density of soils:

Soil samples were collected 48 hours after the first rain of the year, for the determination of moisture content and bulk density. Soil samples were taken using a soil augur at different depths of 0 to 15, 15 to 30 and 30 to 45 cm along the upstream, midstream and downstream of crop field plots for soil moisture content determination. The soil samples were collected into transparent poly bags, airtight and labeled. These were then sent to the laboratory and put in empty containers for oven drying for 24 hours at 105^0C. For bulk density determination, soil samples of known volumes of core samples were collected at these same different depths, as mentioned already for soil moisture content. This was done for the upstream, midstream and downstream, after which average bulk density values were then determined. The core samples were driven into the soil vertically until its ends flushed with the soil surface inside the core at each layer thickness, and they were then covered with tight fitting lid. A sharp iron prod was used to dig around the core samplers to remove them from the soil. Soil was trimmed with the iron prod at the ends of the core samplers and covered, which were also sent to the laboratory for oven drying.

Laboratory analysis:

The wet soil samples collected for both the moisture content and bulk density were weighed and their initial weights recorded. These were then oven-dried at a temperature of 105^0C for 24 hours in the laboratory. The dried samples were weighed of water in the samples was obtained by finding the weight the difference in weight between the wet samples and the oven dried samples. The soil moisture content and bulk density of the soil for the upstream, midstream and downstream were calculated using the formula:

$$\text{Moisture content (\%)} = \frac{\text{Weigted of wet soil (Ww) - Weigted of dry soil (Wd)}}{\text{Weigted of dry soil (Wd)}} \text{ x } 100 \quad (4)$$

$$\text{Bulk density (g/cm}^3\text{)} = \frac{\text{Weigted of dry soil (Wd)}}{\text{Total volume of soil}} \quad (5)$$

RESULTS AND DISCUSSION

The average slope of the cropping field plots was found to be 3.5% and ranged from 2 to 6% with the soil loss associated with this area estimated to be 2.1 t/ha/year. Farmers in the study area undertake soil conservation practices in order to increase crop yields. The present conservation methods by the farmers are shown in Table 1. Farmers who practiced contour ploughing with tractors and FYM application forms the majority of 35%, while farmers who practiced bunding and composting form the minority of 6%.

Infiltration rate on agricultural lands:

The infiltration rate and their corresponding permeability at the different lands levels shown in Table 3, the initial infiltration rate for the upstream, midstream and downstream

Table 1 : Current conservation practices by farmers

Sr. No.	Conservation practice	No. of farmers	Percentage (%)
1.	Ploughing with tractor	32	35
2.	Ploughing with bullock drawn	41	46
3.	Ridging across the slope	05	6
4.	Green manuring	10	11
5.	Others (bunding)	02	2
	Total	90	100

Table 2 : Permeability inductions ration (Mc Quen, 1998)

Ratio (fo/fc)	Permeability capacity
>5	High permeability
3-5	Moderate permeability
<3	Low permeability

Table 3 : Infiltration rates and the permeability of soil

Location	Initial infiltration capacity of (cm/h)	Final infiltration capacity fc (cm/h)	Permeability index (fo/fc)
Upstream	282.25	107.55	2.62
Midstream	298.45	95.82	3.11
Downstream	306.76	137.95	2.22

were 282.25, 298.45 and 306.76 cm/h, and final infiltration rate, which is the terminal infiltration capacity, were 107.55, 95.82 and 137.95 cm/h, respectively. These soil to be suitable for enhance infiltration it must, in particular be permeable and unsaturated (Singer and Munns, 2006). The midstream had the highest permeability index of 3.11 whilst the downstream recorded the least of 2.22. The indication of low and high permeability is based on fo/fc ratio as shown in Table 2. Permeability is the property of soils that allows water to pass through them at some rate.

Soil moisture content and bulk density of Agricultural lands:

The soil moisture content of upstream, midstream and downstream and bulk density of the agricultural lands shown in the Table 4, it shows that soil moisture content in the upstream and midstream was fairly high between 0 to 15 cm and 15 to 30 cm. Thus, it indicated that soil moisture content is low between 15 to 30 cm and decreases with depth between 30 cm and 45 cm. With this regards to bulk density, the upstream recorded the highest soil bulk density of 1.8 g/cc while the downstream side recorded the least of 1.61 g/cc.

From the results, it was analyzed that crop residues after harvesting were used for other purpose such as domestic fuel and feed for livestock, in lieu of leaving them on the field to serve as reduce the soil erosion. By this action the soil to heavy rain causing erosion and compaction of the soil. The low fertility of the soil accordion g to the farmers could be as a result of erosion, which washed most of the soil nutrients away. Also, the farmers cultivate the soil usually with a MB plough at the same depth year after year. This increases root restricting layers such as hardpan and traffic pan to develop. Plants with restricted roots would not reach their entire potential hence, less crop yield. Because of the erratic rainfall in this area, soil conserve action practices such as cover-cropping, crop rotation and mulch crops are practiced. In the some cases the soil conservation practices are adopted by the farmers included contour ploughing with tractors, normally with a MB plough, disc plough and cultivator. Surface runoff is reduced as water moves across the ridges to the furrows and then down the furrows. This reduces soil erosion, since there is reduction of volume of soil loss by erosion as surface runoff moves across the ridge. The weeds incorporated into the mounds improved the fertility of the soil against the impact of direct rainfall and impedes runoff (Lal, 1988). This helps control the erosion rate in the area.

The farmers plough across the slope twice before planting their crops. Ploughing across the slope increased capture of runoff water, thereby reducing soil erosion and maintaining infiltration rate as well as increasing soil macro pores after ploughing as reported by Singh *et al*. (1995). The ploughing is done to mix the manure with the soil thoroughly. This helps to improve the cohesiveness of the soil and increases its water retention capacity. Some farmers also prefer making ridges to ploughing the land before cropping.

Conclusion:

The results indicated that the agriculture lands were moderately sloppy 3.5% with an estimated soil loss of 2.1 t/ha/year. Average bulk density was found to be 1.8 g/cc, indicating slightly compact soil leading to low infiltration rate. The permeability of the soil is, therefore, low infiltration rate and surface water flows highly causes moderate erosion on land. This leads to low fertility of the soil, which affect crop

Table 4 : Soil moisture content and bulk density of soil in the study area

Different levels of land	Depth (cm)	Average soil moisture content (%)	Average bulk density (g/cc)
Upstream	0 to 15	29	1.80
Midstream	15 to 30	33	1.55
Downstream	30 to 45	26	1.61

yield. However, farmers are able to conserve the soil and control erosion to some extent through some conservational methods such ridging across the slope, tillage practice and ploughing with tractors and some time animals traction with organic manure or fertilizer application with mulching which enhance crop growth thus increasing crop yields.

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