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Developed contour map by using ArcGIS in Chhattisgarh agricultural engineering college farm for suitable site selection of farm pond

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Abstract
Chhattisgarh one of the thirty-five constituents of the country occupies 135194 km^2 which is 4.14% of the geographical area of India. The state has 59384 rural pond areas covering 0.751 lakh has and 17.70 irrigation reservoirs covering 0.826 lakh hectare water areas totaling 1.577 lakh hectare water area available for fisheries development at the end of 2013-14. The topographic survey of the study area has done by using the square grid method of differential height and taken an arbitrary benchmark. The elevation of the different points was measured by Auto-level, with the help of a topographic survey contour map of the study area is drawn. The average slope of the land was determined by 3%. The lowest and highest reduced levels were 289 m and 297 m respectively. Contours were prepared with a 1m contour interval from 289 m to 297 m. The site for the construction of the farm pond is selected by using the contour map of the study area. In this map according to respected land slope suitable site for a farm pond is selected in the lowest point of the study area in the south-west direction.

Keywords: farm pond, supplement irrigation, contour survey, topographic survey

Introduction
Rainfall is a basic resource for all the form of water Rainfall varies in both space and time, affecting the availability of water. With the occurrence of the high intense rainfall event, followed by long dry spells, and short duration most of the rain falling on the surface tends to flow away rapidly, harvesting surplus runoff can ensure supplemental irrigation during dry spells for critical irrigation. The erratic and uneven distribution of rainfall both spatially and temporally necessitates rainwater harvesting to increase and sustain agricultural productivity (Kumar *et al.*, 2011) [2]. Reddy *et al.* (2012) [3] stated that Farm ponds have a significant role in rainfed regions where annual rainfall has value more than or equal to 500 mm. Chhattisgarh agricultural engineering farm located at Durg, Chhattisgarh. Paddy is the main crop grown during the *Kharif* season. Irrigation is generally accomplished by rainfall. In *rabi*, fields are kept fallow. If pond therefore food and hence irrigation facility and improved cropping system. Keep in view all the above points a dugout pond has been proposed.

Material and Method
Profile of the study area
The state of Chhattisgarh is situated at $21^0$09'56" North Latitude and $81^0$14'10.23" East Longitude, with an altitude of 287 m above MSL. The study area is situated at 21°11'00" North latitude and 81°30'00"East longitude with an altitude of 288 m above mean sea level MSL at a distance of 55 km from Raipur. The Durg district comprises of 3 blocks viz. Durg, Dhamdha, and Patan. Durg block is bounded by Dhamdha in the north and Rajnandgaon in the west, Gunderdehi in the south, and Patan in the east which is shown in fig

Soil Investigation
Soil Texture
Soil texture influences runoff behavior in any catchment. It is one of the most important physical characteristics of the soil. A soil sample is investigated using sieve analysis and hydrometer test. The result of the test is plotted to get a particle-size distribution curve with the percentage finer as the ordinate and the particle diameter as the abscissa. For determination of soil of the study area collected soil sample is investigated by sieve analysis then hydrometer test is done.

Density
The density of the soil is determined by using the density bottle method. Take the dry sample of the soil of 10 g passing through 425 microns. Put the sample in a density bottle and weigh.

Take the weight of the empty density bottle. Take the weight of the density bottle with water. Mix the soil with water into the density bottle and dip the bottle in boiling water for 4-5 minutes.
Now calculate the specific gravity of soil by using eqn (3.1).

$$G_s = \frac{W_2 - W_1}{(W_4 - W_1) - (W_3 - W_2)} \ldots \text{eqn} \quad (3.1)$$

Where,
W_1 = wt. of an empty bottle
W_2 = wt. of a bottle with soil
W_3 = wt. of water + bottle + soil
W_4 = wt. of water + bottle

Topography
The topographic survey is carried out to determine the slope of a farm. This is done by using Auto level with staff rod, measuring tape.
A contour map of the study area was prepared by taking elevations of the field with the help of Auto level by taking a grid of 15×15 m. ArcGis10 software was also used to preparing the contour and slope map. The reduced levels of grid points were determined and contour lines are drawn taking 1 contour interval.

Site Selection
Site selection of dugout farm pond is done by observes the average slope direction in the farm area in which farm pond is to be planned for construction. Determination of the average slope following formula can be used.

A slope in the vertical direction

$$S_y = \frac{N_c \times C.I.}{\sum Y}$$

A slope in the horizontal direction

$$S_x = \frac{N_c \times C.I.}{\sum X}$$

The average slope of the basin

$$S = \frac{S_x + S_y}{2}$$

Where,
S_y = Vertical slope
S_x = Horizontal slope
S = Average slope
N_c = Number of the intersection point between contour line and Horizontal, Vertical line
C.I.= Contour Interval, m
$\sum X$ = Total length of Horizontal line, m
$\sum Y$ = Total length of Vertical line, m

Result and Discussion
Soil Investigation
Density
The density of the collected sample was computed using equation (3.1) and found to be specific gravity is 2.5.

Table 1: The observed value in the density bottle method

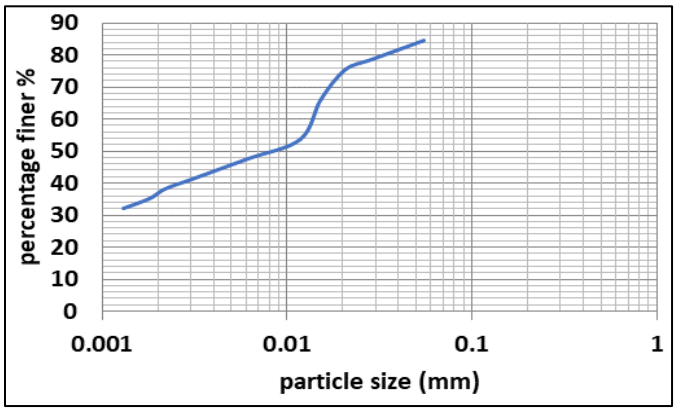
W_1 (wt. of an empty bottle)	18.57 gm
W_2 (wt. of a bottle with soil)	28.57 gm
W_3 (wt. of water + bottle + soil)	90.88 gm
W_4 (wt. of water + bottle)	84.88 m

Texture classification
Sieve analysis
For the determination of soil texture sieve analysis and hydrometer method is used. Soil retains in 75 µ sieve, so below 75 µ, soil particle analysis hydrometer method was used. The observed value sieve analysis is shown below.

Sieve Size	Wt. Retained (gm)	%wt. Retained	Cumulative% wt. Retained	% Passing
4.75 mm	7	1.04	1.04	98.96
2.0 mm	10	1.49	2.53	97.47
600 µ	19	2.84	5.37	94.63
425 µ	3	0.44	5.81	94.19
75 µ	13	1.94	7.75	92.25

Table 2: Particle percentage weight passed by sieve analysis

Gravel (4.75 mm)	1.04%
Coarse Sand (22mm)	1.49%
Medium Sand (>425 µ)	2.84+0.44=3.28%
Fine Sand (>75 µ)	1.94%
Silt + Clay	92.25%
Grand total	100%
Gravel (4.75 mm)	1.04%



Triangular textural classification diagram Textural classification of soil in which white line represents respective sand, silt, and clay percentage. After measurement of soil texture data find that sand was 28 %, Silt was 35%, and Clay was 37%. According to triangular textural classification, the soil type is clay loam.

Topographic survey of Study area
The field was surveyed with the help of ArGIS10 software. The reduced levels of grid points were determined and the map was prepared. The lowest and highest reduced levels were 289 m and 297 m respectively. Contours were prepared with a 1 m contour interval from 297 m to 289 m. It also helps in deciding the existing slope and outlet for the discharge of runoff through drains e.

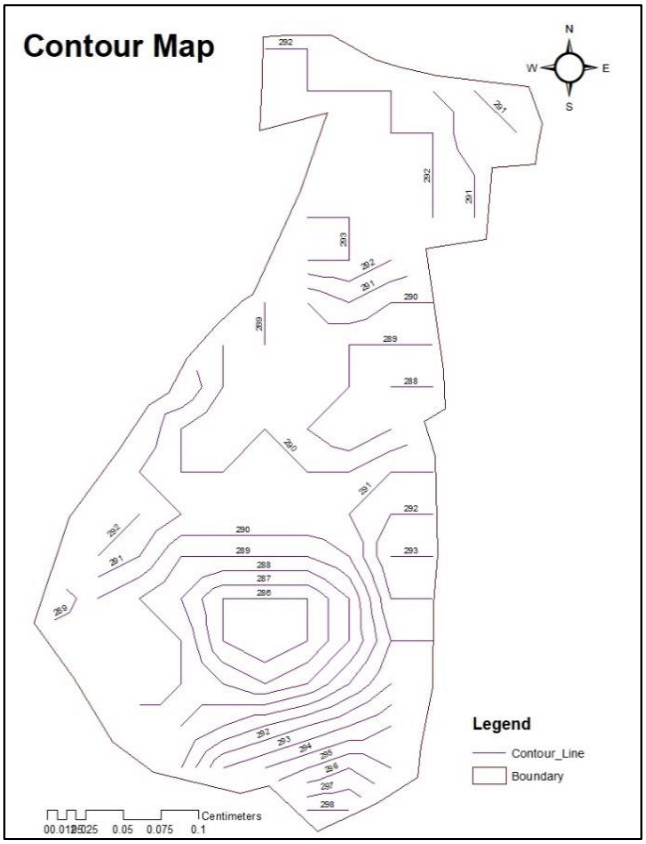


Fig 1: Contour map of the study area

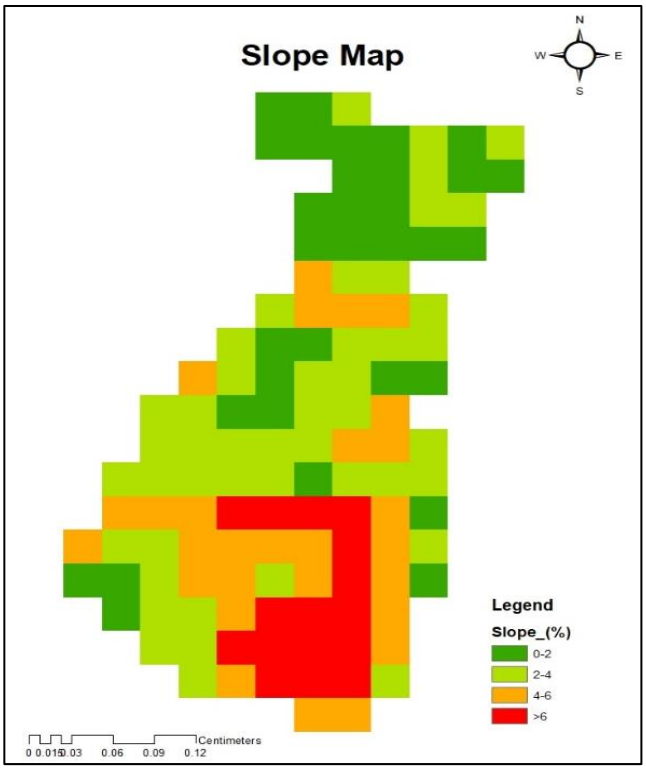


Fig 2: Slope map of the study area

The general slope was from north-east to south-west direction which is shown in fig, The average slope of the study area is found to be 3 % and calculation of the average slope is given below

Contour interval (C.I.) = 1 m

A slope in a vertical direction,

Where, Nc= 33 and ∑Y = 6540 m

Then, $Sy = \frac{33 \times .5}{6540}$ and Sy = 0.0025

A slope in a horizontal direction

Where, Nc= 87and ∑X = 6120 m

Then. $Sx = \frac{87 \times 0.5}{6120}$ and Sx = 0.007

The average slope of the basin,

$S = \frac{S_x + S_y}{2} = \frac{0.007 + 0.0025}{2}$ S = 0.004

Conclusion

To conduct the soil testing, soil samples were collected from different points of the study area. The specific gravity of the soil was determined by the density bottle method and specific gravity is found to be 2.5. The type of soil was determined by the hydrometer test and the result is found to be “clay loam”. The topographic survey of the study area has done by using the square grid method of differential height and taken arbitrary benchmarks. The elevation of a different point was measured by Auto-level, with the help of the topographic survey, a contour map of the study area is drawn. The average slope of the land was determined by 3%. The site for the construction of the farm pond is selected by using the contour map of the study area. In this map according to respected land slope suitable site for a farm pond is selected in the lowest point of the study area in the south-west direction.

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