



RESEARCH PAPER

Earthwork and cost estimation of SWC structures using ICT application

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Abstract : Today's world is of information technology (IT), so it has become extremely necessary to keep everything in touch with computers *i.e.*, everything is computerized to save time and efforts. Thus, it's become very necessary to stay in-tuned with computers. The impact of the information communication technology (ICT) on each sector of the life across the past two-three decades has been enormous. Now-a-day's online system has much more importance and widely used in every sector. It additionally saves our work. In the Agriculture field, it is important to provide ICT tools in various fields to make easy and very fast calculations of Earthwork and Cost Estimation of SWC Structures. The farms are being developed and digitalization is taking place. This paper highlights how to calculate the earthwork and cost estimation of Soil and Water Conservation Structure easily with the help of ICT tool and save time.

Key Words : Earthwork, Cost estimation of SWC structures, ICT tool, Java script, HTML, CSS

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INTRODUCTION

Application of new and contemporary information and communication technologies (ICTs) for rural and agricultural development in the Asia-Pacific region has been advancing quite rapidly over the last decade (FAO). Agriculture plays a significant role for economic and social development in most undeveloped countries. Information of adequate quality is a necessary condition for improvement of all areas of agriculture. With the rapid development of Information and Communication Technologies (ICTs), data and information can be effectively generated, stored, analyzed, disseminated and

used to support farmers and farming communities to improve agricultural productivity and sustainability.

With the introduction of agricultural informatization, the traditional agriculture has been reformed by advanced ICTs, eventually contributing to the significant improvements in agricultural productivity and sustainability. Agricultural informatization is a long-term stimulus for agricultural development and also an important indicator of agricultural modernization. Information services for farmers at the national and regional level are a promising new field of research and application in the emerging field of e-agriculture. United

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Nations reported that (1999) ICTs cover Internet service provision, telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries, documentation network-based information services, and other related information and activities. The field of education also has been affected by ICTs, with teaching, learning, and research (Yusuf, 2005). The Agriculture and the education departments are two elements where the ICT can play the very important role in the development of the country (Jadhav, 2018).

Existing system:

The existing system is completely manual. The Earthwork Calculation and Cost Estimation contains different formulas for calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures. These formulas are very complex to calculate with the use of calculators. It is purely paper based to store the records of the one-time calculated values of those formulas. The calculations are done with calculator by entering each value of formula manually in the calculator.

Limitations in present system :

There are certain limitations in system, which areas follow :

- There are various steps or formulae involved in Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures, so it is difficult to handle manually.
- Manually calculations are difficult to estimating various factors of methods and also more time required.
- For recording purpose, it should be note down in some paper, thus chances of losing the data is increases.
- It is difficult to search the old record of data.
- Manually calculations include more errors with less accuracy.

Proposed system:

The proposed system is deals with the Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures using ICT tool. To remove the complexities, errors and difficulties the proposed system is developed. Today the digitalization is directly comes with computerization, so the students, researchers are coming under the one roof to learn about digitalization and computerization. Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures

formulas manually on the paper are very complex method to find the accurate value of each factor. Since these works does manually thus it takes more time and there are chances of errors such as wrong details, wrong value at wrong place etc.

So, to reduce these faults “ICT Application for Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures” has been developed. The proposed system “ICT Application for Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures” deals with all the activities which are done by the agriculturist for Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures. This paper is all about how can information communication technology reduce the manual work load and give the accurate results of the proper formulas. The data will store sequentially in the SQL and we can access it whenever we need it.

Advantages of proposed system :

- Calculations are done very fast and it saves the time.
- It stores the old data, so data recovery is possible easily.
- No need to note down data on the paper because it stores digitally in computer.
- Modified the data as per requirement.
- System includes the various security features.
- System should be window based, user-friendly and efficient.
- Accuracy can be maintained.

Material :

This paper deals with the estimation of earthwork and cost of construction of SWCS. It includes different formulae and sub-formulae those were used while developing the software. It also encapsulates the configuration of the system and information about the used to develop software utility.

System requirements :

Hardware requirements		
	Client side	Admin side
RAM	512 MB	1 GB
Hard disk	10 GB	20 GB
Processor	1.0 GHz	2.0 GHz

Software requirements		
	Client side	Admin side
Web server	Internet explorer 6 or any compatible browser	IIS 7.5
Framework		JAVA Script, HTML, CSS
Web browser		Internet explorer 6 or any compatible browser
Operating system	Windows or any equivalent OS	Windows server 2007

About the platform:

Development platform :

The system is developed in the computer language that is, JAVA Script, HTML, CSS. To develop and edit the software we have used the Visual Studio Code and Notepad.

Platforms to run on :

To run or use this software your system must have to fulfil the above software as well as hardware specifications, respectively.

Earthwork and Cost of SWCS can be calculated by following equations :

Contour bund :

- (a) For high rainfall, $a = 0.1$ and $b = 60$
- (b) For medium rainfall, $a = 0.1$ and $b = 60$
- (c) For low rainfall, $a = 1/15$ and $b = 60$
- Vertical Interval = Land slope(%) / $a + b$
- Length of Contour Bund per ha = $130 * \text{Land slope}(\%) / \text{Vertical Interval}$
- Earthwork per ha = $(\text{Top width} + \text{Bottom width}) * \text{Depth} / 2$
- Cost of Earthwork and Excavation = 125
- Cost of construction per ha = Earthwork per ha * Cost of Earthwork and Excavation
- Cost of survey per ha = 200
- Cost of site clearance = 500
- Total cost of construction = $(\text{Cost of construction per ha} * \text{No. of ha}) + \text{Cost of survey per ha} + \text{Cost of site clearance}$.

Continuous contour trenches (CCT) :

- Earthwork per ha = $\text{Total length of CCT in 1ha} * \text{Breadth} * \text{Depth}$
- Cost of survey = 200
- Cost of site clearance = 500

- Cost of construction per ha = $(\text{Earthwork per ha} * 22) + \text{Cost of survey} + \text{Cost of site clearance}$
- Total cost of construction = $\text{Cost of construction per ha} * \text{No. of ha}$.

Staggered contour trenches (SCT):

- Total No. of Trenches = $\text{No. of trenches in one row} * \text{No. of rows}$
- Earthwork of single trench = $\text{Length of trench} * \text{Width of trench} * \text{Depth of trench}$
- Cost of construction = $\text{Total No. of Trenches} * \text{No. of ha} * \text{Earthwork of Single Trench} * 22$
- Cost of survey = $200 * \text{No. of ha}$
- Cost of site clearance = $500 * \text{No. of ha}$
- Total cost of construction = $\text{Cost of construction} + \text{Cost of survey} + \text{Cost of site clearance}$.

Dugout pond :

- Surface Area = $(\text{Bottom length} * \text{bottom breadth}) + (\text{Top length} + \text{top breadth} + \text{Bottom length} + \text{Bottom breadth}) * \text{Depth}$
- Volume of Dugout Pond = $\text{Depth} / 2 * ((\text{Top length} * \text{Top breadth}) + (\text{Bottom length} * \text{Bottom Breadth}))$

Also, by prismoidal formula:

$$\text{Volume of dugout pond} = (A + 4B + C) \times D / 6$$

where, A = Area of excavation at top, in sq.m, B = Area of excavation at mid, in sq.m C = Area of excavation at bottom, in sq.m, D = Depth, in m.

- Cost of Excavation = $\text{Volume of Dugout Pond} * 100$
- Cost of plastic sheet = $30 * \text{Surface Area}$
- Cost of survey = 200
- Cost of site clearance = 500
- Total cost of construction = $\text{Cost of plastic sheet} + \text{Cost of excavation} + \text{Cost of survey} + \text{Cost of site clearance}$.

Bench terrace :

- (a) When cut is vertical, $n = 0$
- (b) When batter slope is 1:1, $n = 1$
- (c) When batter slope is 1/2:1, $n = 1/2$
- (d) When batter slope is 1/3:1, $n = 1/3$
- Earthwork = $\text{Width of Terrace} * \text{Length of Terrace} * \text{Depth of Terrace} / 8$
- When soil is of hard rock, Rate = 360
- When soil is of soft/ disintegrated/ weathered rock, Rate = 175

Results and screen layouts

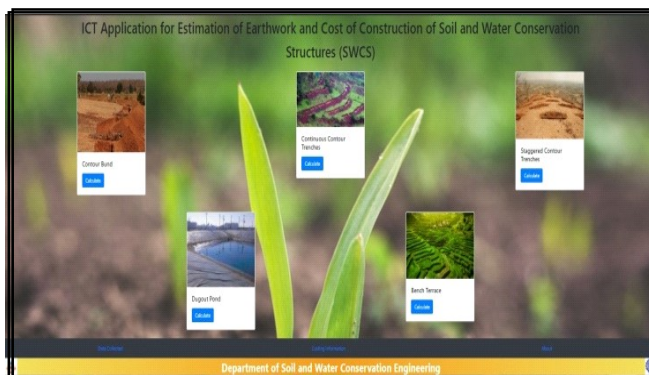


Fig. 1: Home page

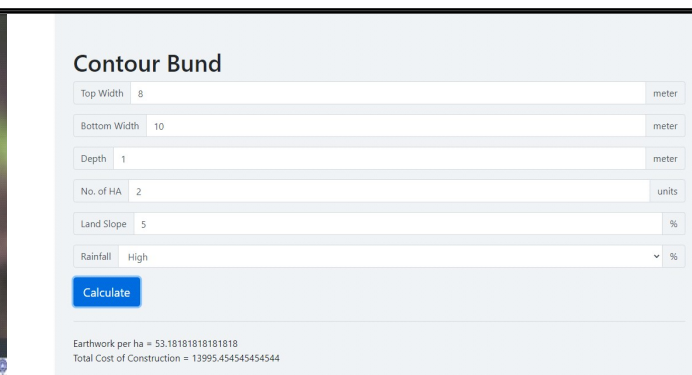


Fig. 4 : Contour bund



Fig. 2: Dugout pond

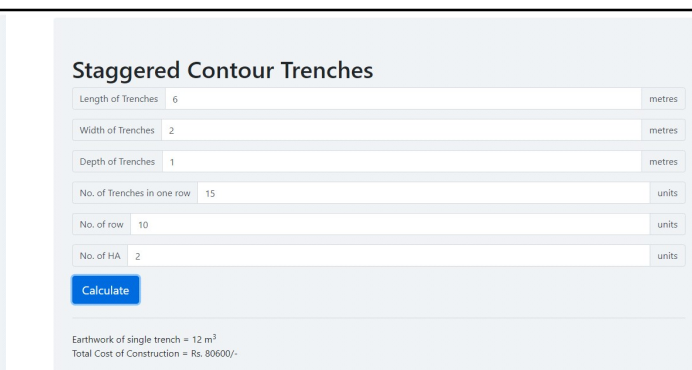


Fig. 5: Staggered contour trenches

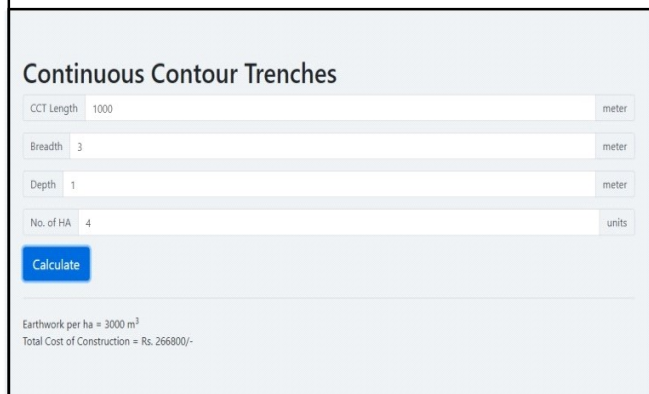


Fig. 3: Continuous contour trenches

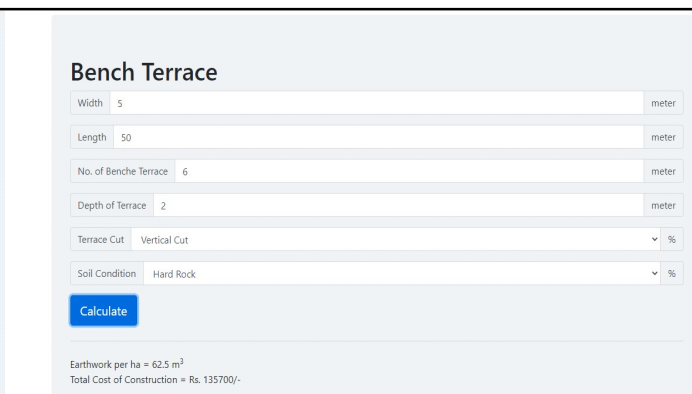


Fig. 6 : Bench terrace

- Cost of construction = Earthwork * Rate
- Cost of survey = 200
- Cost of site clearance = 500
- Total cost = (Cost of construction * No. of Bench Terrace) + Cost of survey + Cost of site clearance.

Source code :

Home page :

Html:

```

<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<title>Garud Seeds</title>
<link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bootstrap@4.6.0/dist/css/bootstrap.min.css"
    
```

```

integrity="sha384-B0vP5xmATw1+K9KR QjQERJ
vTumQW0nPEzvF6L/Z6nronJ3oUOFUFpCj
EUQouq2+I" crossorigin="anonymous">
  <link rel="stylesheet" href="index.css">
</head>
<body style="overflow-x: hidden;">
  <div class="container d-flex flex-row main-
heading">
  <span>ICT Application for Estimation of Earthwork
and Cost of Construction of Soil and Water Conservation
Structures (SWCS)</span>
  </div>
  <div class="row justify-content-center">
  <div class="my-4 col col-12 col-sm-6 col-md-4 ">
  <div class="card mx-auto" style="width: 18rem;">
  <imgsrc="/images/contour bund.jpg" class="card-
img-top" alt="...">
  <div class="card-body">
  <h5 class="card-title">Contour Bund</h5>
  <p class="card-text"></p>
  <a href="/contour_bud/index.html" class="btnbtn-
primary">Calculate</a>
  </div>
  </div>
  </div>
  </div>
  <div class="my-4 col col-12 col-sm-6 col-md-4">
  <div class="card mx-auto" style="width: 18rem;">
  <imgsrc="/images/continuous contour
trenches.jpg" class="card-img-top" alt="...">
  <div class="card-body">
  <h5 class="card-title">Continuous Contour
Trenches</h5>
  <p class="card-text"></p>
  <a href="/continuous_contour_trenches/
index.html" class="btnbtn-primary">Calculate</a>
  </div>
  </div>
  </div>
  </div>
  <div class="my-4 col col-12 col-sm-6 col-md-4">
  <div class="card mx-auto" style="width: 18rem;">
  <imgsrc="/images/staggered contour trenches.jpg"
class="card-img-top" alt="...">
  <div class="card-body">
  <h5 class="card-title">Staggered Contour
Trenches</h5>
  <p class="card-text"></p>
  <a href="/staggered_contour_trenches/
index.html" class="btnbtn-primary">Calculate</a>
  </div>
  </div>
  </div>
  </div>
  <div class="my-4 col col-12 col-sm-6 col-md-4">
  <div class="card mx-auto" style="width: 18rem;">
  <imgsrc="/images/dugout-pond.jpg" class="card-
img-top" alt="...">
  <div class="card-body">
  <h5 class="card-title">Dugout Pond</h5>
  <p class="card-text"></p>
  <a href="/dugout_pond/index.html" class="btnbtn-
primary">Calculate</a>
  </div>
  </div>
  </div>
  </div>
  <div class="my-4 col col-12 col-sm-6 col-md-4">
  <div class="card mx-auto" style="width: 18rem;">
  <imgsrc="/images/bench terrace.jpg" class="card-
img-top" alt="...">
  <div class="card-body">
  <h5 class="card-title">Bench Terrace</h5>
  <p class="card-text"></p>
  <a href="/bench_terrace/index.html"
class="btnbtn-primary">Calculate</a>
  </div>
  </div>
  </div>
  </div>
  <div class="row justify-content-center py-3 bg-
dark" style="margin-right: 0px !important; overflow:
hidden;">
  <div class="col col-12 col-md-4 text-center">
  <a href="/data/Data_collected.pdf">Data
Collected</a>
  </div>
  <div class="col col-12 col-md-4 text-center">
  <a href="/data/Costing Information.pdf">Costing
Information</a>
  </div>
  <div class="col col-12 col-md-4 text-center">
  <a href="/data/About.pdf">About</a>
  </div>
  </div>
  <div class="d-flex flex-row footer-line">
  <div class="">
  <imgsrc="/images/CAET logo.png" alt="">
  </div>

```

```

<div class="flex-grow-1 d-flex flex-column">
  <p>Department of Soil and Water Conservation
  Engineering</p></div>
  <div class="">
    <imgsrc="/images/University_logo.png" alt="">
  </div>
  </div>
  <!-- scripts -->
  <script src="/index.js"></script>
  <script src="https://code.jquery.com/jquery-
  3.5.1.slim.min.js" integrity="sha384-DfXdz2htPH0lsSSs
  5nCTpuj/zy4C+OGpamoFVy38M VBnE+IbbVYU
  ew+OrCXaRkfj" crossorigin="anonymous"></script>
  <script src="https://cdn.jsdelivr.net/npm/bootstrap
  @4.6.0/dist/js/bootstrap.bundle.min.js" integrity="sha
  384-Piv4xVNRyMGpqs2 by6br4g NJ7DXjqk09
  RmUpJ8jgGtD7zP9yug 3goQfGII0yAns" crossorigin="
  anonymous"></script>
  </body>
</html>

```

RESULTS AND DISCUSSION

The existing system is completely manual. The earthwork and cost estimation contain different formulae for calculation of Soil and Water Conservation Structures. These formulae are very complex to calculate manually for farmers and field level staff. It is purely paper based to store the records of the one-time calculated values of those formulae. The calculations are done with calculator by entering each value manually in the calculator. If the operating person changes, the new person need to learn

all the formulae learned by the first person which is very much time consuming and tricky. So, we need a system which can deal with this problem easily with better accuracy.

The proposed system deals with the calculation of earthwork and cost estimation of Soil and Water Conservation Structures using ICT tool. To remove the complexities, errors and difficulties the proposed system is developed. Calculation of earthwork and cost estimation of Soil and Water Conservation Structures manually on the paper is very complex method. Since these works are done manually thus, it takes more time and there are chances of errors such as wrong details, wrong value at wrong place etc.

So, to reduce these errors “ICT Application for Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures” has been developed. For developing this software utility, Java Script, HTML and CSS languages was used. Java Script is easy to use and can be run immediately within the client-side browser unless outside resources are required. HTML is supported by all browsers and it is friendly search engine. CSS is easier to maintain and update and has greater consistency in design. The proposed system “ICT Application for Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures” deals with all the activities which are done by field level operator for Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures. Table 1 shows the comparison between manually and software calculated earthwork.

Table 1: Comparison between manually calculated and software calculated earthwork

Sr. No.	Structure	Manual calculation	Software calculation
1.	Contour bund	530.20 m ³	530.32 m ³
2.	CCT	3000 m ³	3000 m ³
3.	SCT	12 m ³	12 m ³
4.	Dugout pond	492 m ³	492 m ³
5.	Bench terrace	630 m ³	629.8 m ³

Table 2 : Comparison between manually estimated cost and the cost estimated by the software

Sr. No.	Structure	Manual calculation	Software calculation
1.	Contour bund	Rs. 66975	Rs. 66990
2.	CCT	Rs. 66700	Rs. 66700
3.	SCT	Rs. 32380	Rs. 32380
4.	Dugout pond	Rs. 52900	Rs. 52900
5.	Bench terrace	Rs. 110950	Rs. 110915

Table 2 shows the comparison between manually estimated cost and the cost estimated by the software. The above tables show that, the results obtained by the manual calculation and by the software are nearly same. So, this software can be used to save time and efforts. The software is easy to operate and it is user friendly.

Conclusion:

This study deals with the Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures using ICT application. Therefore, development the software for Calculation of Earthwork and Cost Estimation of Soil and Water Conservation Structures includes the calculations of the various formulae. It also encapsulates the configuration of the system and information about the used to develop software. The system is developed in the computer languages *i.e.* JAVA Script, HTML, CSS. The use of information communication technology is now growing in the various industries. So, it is necessary to increase the use of ICT in the agriculture field to facilitate the design and other calculations easily. It is necessary to research in agriculture field and develops the agricultural at the rural areas too. The software was developed for different structures using JAVA Script, HTML, CSS as programming languages. It will be very useful software for the agricultural engineering work. It can use at the farmers and field level to estimate the related cost of structures at field level.

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