Advanced tool for analytical and efficient designing of different soil and water conservation structures

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ABSTRACT

Engineering measures of soil and water conservation are an integral part of watershed management or development, and thus they must be designed accurately and economically, after evaluating a number of design alternatives based on local site conditions. SCS_Designer was developed in Agricultural and Food Engineering Department at IIT Kharagpur for the design of soil and water conservation structures in 2001. But as this was the first effort of its kind all the soil and water conservation structures were not included in it. Also all the design considerations of structures were not incorporated in the model. In 2004, study was undertaken to develop comprehensive software by modifying the model for designing different soil and water conservation structures (bunds, terrace system, grassed waterways, permanent gully control structures, retaining wall, farm pond and earthen embankment) and also to estimate soil loss. SCS_Designer has the provision to check, display and print the step by step procedure undertaken by the model for the designing. These help the users to analyze the difference in design parameters by changing the input data. Also these step-wise procedure files make SCS_Designer an effective teaching tool. The modified version of SCS_Designer is equipped with help file for user's reference. The help file contains the detailed information about the theoretical consideration of the structures as well as the step-by-step procedure of the working of the model.

Key words : Soil conservation, Structures, Design, Model, Validation

Soil and water are the most vital resources of the country and must be conserved as carefully as possible. The happening of soil removal creates a very serious problem to perform agricultural activities and thereby causes reduction in crop yield. According to Dhruva Narayana and Ram Babu (1983), it was estimated that about 5334 m ton (16.35 ton/ha) of soil is detached annually due to agricultural and associated activities alone. Das (1985) estimated that out of a total reported geographical area of 329 m ha, about 167 m ha (51% of the total) is affected by serious water and wild erosion. Every watershed development programme employs agronomic as well as mechanical measures to achieve its objectives of increased infiltration into the soil, controlled damaging excess runoff, manage and utilize runoff and reduction in soil erosion. However, many people involved in watershed development programme do not posses sufficient design skills. Therefore, Decision support system was developed in Agricultural and Food Engineering Department at IIT, Kharagpur (More, 2001) for the designing of soil and water conservation structures. But at this was the first effort of its kind, all the conservation structures and the design considerations of structures were not incorporated in the software. Present study was undertake to develop user friendly comprehensive software, SCS_Designer for the design

of different soil and water conservation structures which can be used both as a professional as well as an educational tool.

METHODOLOGY

Methodology of SCS_designer model:

This section provides detailed theoretical aspects related to the design of the different soil and water conservation structures.

Soil loss estimation:

In SCS_Designer, soil loss is determined by both Universal Soil Loss Equation and Modified Universal Soil Loss Equation. For estimating the soil loss, the model also calculates runoff erosivity, soil erodibility, length-steepness factor separately and provides detailed option for different crop management factor and conservation practices factor.

Bund design:

They are divided into two types on the basis of their functional requirement as contour bunds and graded bunds. Design involves the selection of vertical and horizontal intervals and determination of bund cross-section. The maximum runoff volume which is to be stored behind the bund is estimated from the maximum amount