

Application of LCC software for karwadi watershed

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■ **ABSTRACT** : The basic principle of soil and water conservation is to use the land according to its capability. Therefore, the knowledge of land capability classification is a prerequisite and important for planning of watershed development programme. The capability of land depends upon the characteristics of the land like slope, erosion status, soil depth and soil type. Considering these input parameters land capability classification (LCC) software is developed in 'C' programming language. This software can be executed on different platforms like windows, linux etc. mostly without any modification. The developed LCC software is executed successfully with the different conditions. Further the software is tested for Karwadi watershed (survey number 133 and 154) near Nandapur, Tq. Kalamnuri, Dist. Hingoli (M.S.) with different conditions. Field results shown by this LCC software are compared with the results obtained theoretically by considering ranges given in the standard table and were found similar. After successful testing it is concluded that the software is useful for suggesting the soil and water conservation practices for watershed development plan.

■ **KEY WORDS** : Land capability classification, Software, Watershed, Land

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Land capability is the basis of watershed management programmes. The basic principle of soil and water conservation is to use the land according its needs. Land capability classification refers to a systematic arrangement of different kinds of land according to those properties that determine the ability of the land to reproduce on a virtually permanent basis. Land use policy has to specify the use of land in the catchment is to avoid undue erosion of soil cover and the protection of forests. The protection of the fringe area of a reservoir to prevent loss of soil is also important. In the command area, the policy has to consider the type of crops to be cultivated so as to increase productivity. In the flood areas, it must be ensured that such areas are not used for habitation, industries or other economic activities. In the drought-prone areas, advance planning for drought management would involve the planning of

water use, which also would require land use planning. Ultimately the classification of soils into capability grouping enables one to get the picture of the hazards of soil to various factors which cause soil damage, deterioration and lowering of soil fertility and it enables the grouping of land based on limitations for crop production. Therefore, the knowledge of land capability classification is a prerequisite and important for precise planning of watershed development. The present study was undertaken with the objective to develop land capability classification (LCC) software and testing of developed land capability classification (LCC) software for karwadi watershed.

■ METHODOLOGY

Land capability classification software was developed by using 'C' language to accept the basic

information, to do the necessary computations and to present a detailed report. Attempt was made to make the programme menu driven but it is quite interactive while running. It can be used on any PC with linux or windows operation system. The software is organized into small modules. While running the software the user is firstly promoted for the basic information like, slope of the land, soil depth and soil texture. After this primary interactive data feeding the programme starts computation which leads to the final classification of land, selection of crops to be grown and conservation measures to be adopted in that land. The software automatically selects the class from the data base available with the software. By using the above methodology developed the software in 'C' language (Steven Holzner with Peter Norton Computing Group, 1992). The software tested for various characteristics of land *i.e.* depth of soil, slope of land, and soil texture.

Procedure to run the software :

On execution of software the user is firstly promoted to enter the slope of land in percentage, then it will asks for the depth in cm. When depth is entered it will ask for the final input *i.e.* soil texture. Enter the respective soil texture number given in the Table A. As soon as the inputs are entered, it will display the result on the screen.

Table A : Numerical notations for soil type	
Soil texture	Numerical notation
Loam	1
Sandy loam	2
Silty loam	3
Clay loam	4
Sandy clay loam	5
Silty clay loam	6
Sandy clay	7
Silty clay	8
Loamy sand	9
Clay	10
Sandy	11
Rocky	12
Stony	13
Very stony	14
Boulder strewn	15
Extremely stony	16
Swampy	17
Marshy	18

The procedure is same for each loop. But if the entered input do not match with the condition given in the software it will display result as "The system could not return proper classification".

Testing of LCC software for Karwadi watershed :

LCC software was tested for Karwadi watershed near Nandapur, Tq. Kalamnuri, dist. Hingoli. Total area of Karwadi watershed is 25 ha. We have selected five Plots from different locations in the vicinity of Karwadi village having different conditions.

- Plot I [area(75×30m), survey number 133]
- Plot II [area(85×30m), survey number 133]
- Plot III [area(165×35m), survey number 154]
- Plot IV [area(140×30m), survey number 133]
- Plot V [area(200×35m), survey number 154]

The location of the five plots from which soil samples were taken are shown in the Fig. A of Karwadi watershed.

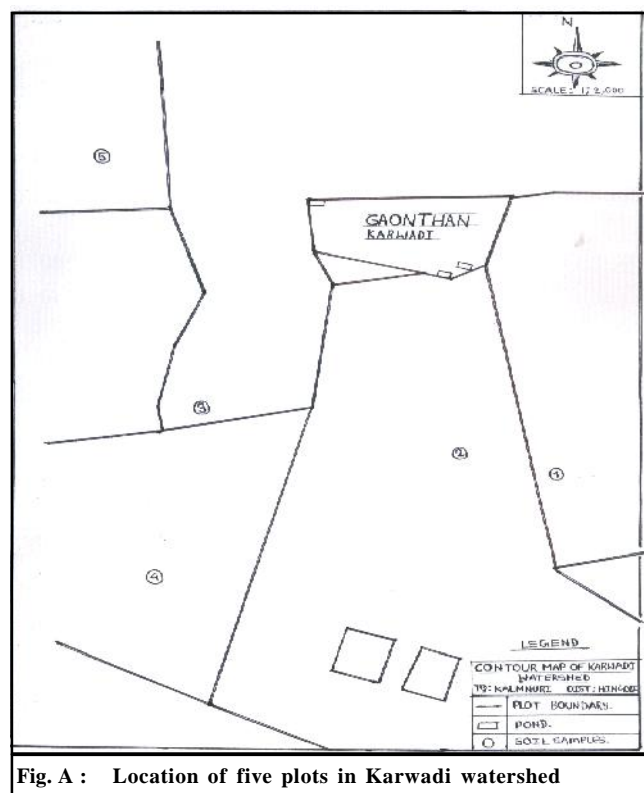


Fig. A : Location of five plots in Karwadi watershed

Determination of the parameters :

Slope :

Land slope is expressed in percentage or in degree with the horizontal (Bhave, 1970 and Dhake, 1971). By

using automatic level for the measurement of field slope. Readings of the slope in the plot I (75×30m) and plot II (85×30m) were taken at the interval of 5m because of the higher slope. Readings of plot III (165×35m) were taken at the interval of 15m. Readings of plot IV (140×30m) and plot V (200×35m) were taken at the interval of 20m. At every intermediate station fore sight and back sight readings were taken and slopes were calculated with the help of following formula :

$$(dBS - dFS) \div \text{total distance}$$

From the above procedure slopes of the plots I, II, III, IV, V were found out 22 per cent, 15 per cent, 2.8 per cent, 6.5 per cent and 2 per cent, respectively.

Depth :

Soil depth affects the soil capability in reference to availability of plant nutrients, moisture and root development (Pandey *et al.*, 2006). The depth was found out by digging four pits within each plot and then took the average of these depths. In this way, depths of plots I, II, III, IV and V found to be 7 cm, 65 cm, 46 cm, 22 cm and 49 cm, respectively.

Texture :

Identified the texture of the soil by feel method. In this method soil is molded in the hand, rubbed both wet and dry between the fingers while studying the feel and nature of the ribbon formed.

For determination of the texture by feel method we referred textural triangle. The triangle is made up of three major textural classes of following type

- Clays which include sandy clay, clay, and silty clay. These soils will form good ribbons.
- Clay loams which include sandy clay loam, clay loam, and silt clay loam. These soils will form medium quality ribbons.
- Loams which include sandy loam, loam and silt loam. These soils will form poor ribbons.

Colour notation :

The land capability classes are shown in the maps by standard colours.

■ RESULTS AND DISCUSSION

The software is tested for Karwadi watershed with respect to the conditions given in the database and are discussed as below.

Sample I [area (75×30m), survey number 133]

Entered the slope = 22 per cent, depth = 7 cm and soil type number = 16, then the result obtained from this input are shown in the Fig. 1. From this figure, the soil is coming under land capability class VII, Suggested soil and water conservation practices are terracing, strip cropping, Bunding not used for crop cultivation. The map coding colour of soil is brown.

Sample II [area (85×30m), survey number 133]

Table 1 : Ranges of slopes for land capability classes

Notation	Slope class	Land capability class	Slope ranges (%)
(A)	Nearly level	Class I	0-1%
(B)	Gentle sloping	Class II	1-3%
(C)	Moderate sloping	Class III	3-5%
(D)	Strongly sloping	Class IV	5-10%
(A)	Nearly level	Class V	0-1%
(E)	Moderate steep	Class VI	10-15%
(F)	Steep	Class VII	15-25%
(G)	Very steep	Class VIII	>25

Table 2 : Ranges of soil depth

Symbol	Name	Depth range (cm)
D ₁	Very shallow	0-7.5
D ₂	Shallow	7.5-22.5
D ₃	Moderately deep	22.5-45.0
D ₄	Deep	45.0-90.0
D ₅	Very deep	>90.0

Entered the slope = 15 per cent, depth = 6.5 cm and soil type number = 14, then the result obtained from this input are shown in the Fig. 2. From this figure, the

soil is coming under land capability class VI. Suggested soil and water conservation practices are contour furrows, ridges and water spreaders not used for crop

```

Applications  Actions
Terminal
File Edit View Terminal Go Help
bash-2.05b$ ./LCC
*****
This is the programme on land capability classification, which helps to find land
capability class, suggest special soil and water conservation practices and li
mitation for cultivation. It requires the following input data.
*****
Input Section :-
Pleae enter following data :
Slope (in percentage) : 22
Depth (in centimeter) : 7
Soiltype : Enter the no. of respective soil type

|-----|
| 1. Loam          | 2. Sandy Loam      | 3.Silt Loam      |
| 4. Clay Loam    | 5. Sandy Clay Loam | 6.Silty Clay Loam |
| 7. Sandy Clay   | 8. Silty Clay      | 9.Loamy Sand     |
| 10. Clay         | 11. Sandy          | 12.Rocky         |
| 13. Stony       | 14.Very Stony     | 15.Boulder Strewn |
| 16. Extremely Stony | 17. Swampy        | 18. Marshy       |
|-----|

16
*****
Result Section :-
*****
soil is in land capability class VII
suggested soil and water conservation practices are terracing, strip cropping, bunding
not used for crop cultivation, used cable or hallon timber cultivation
map coding colour of soil is brown
*****
bash-2.05b$ 

```

Fig. 1 : Result of soil sample I

```

Applications  Actions
Terminal
File Edit View Terminal Go Help
bash-2.05b$ ./LCC
*****
This is the programme on land capability classification, which helps to find land
capability class, suggest special soil and water conservation practices and limitation for cultivation. It requi
res the following input data.
*****
Input Section :-
Pleae enter following data :
Slope (in percentage) : 15
Depth (in centimeter) : 6.5
Soiltype : Enter the no. of respective soil type

|-----|
| 1. Loam          | 2. Sandy Loam      | 3.Silt Loam      |
| 4. Clay Loam    | 5. Sandy Clay Loam | 6.Silty Clay Loam |
| 7. Sandy Clay   | 8. Silty Clay      | 9.Loamy Sand     |
| 10. Clay         | 11. Sandy          | 12.Rocky         |
| 13. Stony       | 14.Very Stony     | 15.Boulder Strewn |
| 16. Extremely Stony | 17. Swampy        | 18. Marshy       |
|-----|

14
*****
Result Section :-
*****
soil is in land capability class VI
suggested soil and water conservation practices are contour furrows, ridges and water spreaders
not used for crop cultivation,used for pastures, woodland, fruit trees, ornamental trees
map coding colour of soil is orange
*****
bash 2.05b$ 

```

Fig. 2 : Result of soil sample II

cultivation, used for pastures, woodland, fruit trees, and ornamental trees. The map coding colour of soil is orange.

Sample III [area (165×35m), survey number 154]
Entered the slope = 2.8 per cent, depth = 46 cm

and soil type number = 6, then the result obtained from this input are shown in the Fig. 3. From this figure, the soil is coming under land capability class II. Suggested soil and water conservation practices are contour tillage, strip cropping, simple terrace, grassed waterways,

```

Applications  Actions
Terminal
File Edit View Terminal Go Help
bash-2.05b$ ./LCC
*****
This is the programme on land capability classification, which helps to find land capability clas
s, suggest special soil and water conservation practices and limitation for cultivation. It requi
res the following input data.
*****
Input Section :-
Pleae enter following data :
Slope (in percentage) : 2.8
Depth (in centimeter) : 46
Soiltype : Enter the no. of respective soil type

| 1. Loam | 2. Sandy Loam | 3.Silt Loam |
| 4. Clay Loam | 5. Sandy Clay Loam | 6.Silty Clay Loam |
| 7. Sandy Clay | 8. Silty Clay | 9.Loamy Sand |
| 10. Clay | 11. Sandy | 12.Rocky |
| 13. Stony | 14.Very Stony | 15.Boulder Strewn |
| 16. Extremely Stony | 17. Swampy | 18. Marshy |
|-----|-----|-----|
6
*****
Result Section :-
*****
soil is in land capability classII
suggested soil and water conservation practices are contour tillage, strip cropping, simple terra
ce, grassed waterways, suitable mulching, crop rotation
crop cultivation are row crops, soil cover crops such as legumes, grains and grasses
map coding colour of soil is yellow
*****
bash 2.05b$ █

```

Fig. 3 : Result of soil sample III

```

Applications  Actions
Terminal
File Edit View Terminal Go Help
bash-2.05b$ ./LCC
*****
This is the programme on land capability classification, which helps to find land capability clas
s, suggest special soil and water conservation practices and limitation for cultivation. It requi
res the following input data.
*****
Input Section :-
Pleae enter following data :
Slope (in percentage) : 6.5
Depth (in centimeter) : 22
Soiltype : Enter the no. of respective soil type

| 1. Loam | 2. Sandy Loam | 3.Silt Loam |
| 4. Clay Loam | 5. Sandy Clay Loam | 6.Silty Clay Loam |
| 7. Sandy Clay | 8. Silty Clay | 9.Loamy Sand |
| 10. Clay | 11. Sandy | 12.Rocky |
| 13. Stony | 14.Very Stony | 15.Boulder Strewn |
| 16. Extremely Stony | 17. Swampy | 18. Marshy |
|-----|-----|-----|
10
*****
Result Section :-
*****
soil is in land capability class IV
suggested soil and water conservation practices are terracing, contour strips, cover crops
crop cultivation are cereals such as wheat or barley, grasses
map coding colour of soil is blue
*****
bash-2.05b$ █

```

Fig. 4 : Result of soil sample IV

suitable mulching, crop rotation. Crops to be grown are row crops, soil cover crops such as legumes, grains and grasses. The map coding colour of soil is yellow.

Sample IV [area (140×30m), survey number 133]

Entered the slope = 6.5 per cent, depth = 22 cm and soil type number = 10, then the result obtained from

this input are shown in the Fig. 4. From this figure, the soil is coming under land capability class IV. Suggested soil and water conservation practices are terracing, contour strips, cover crops. Crops suitable for cultivation are cereals such as wheat or barley, grasses. The map coding colour of soil is blue.

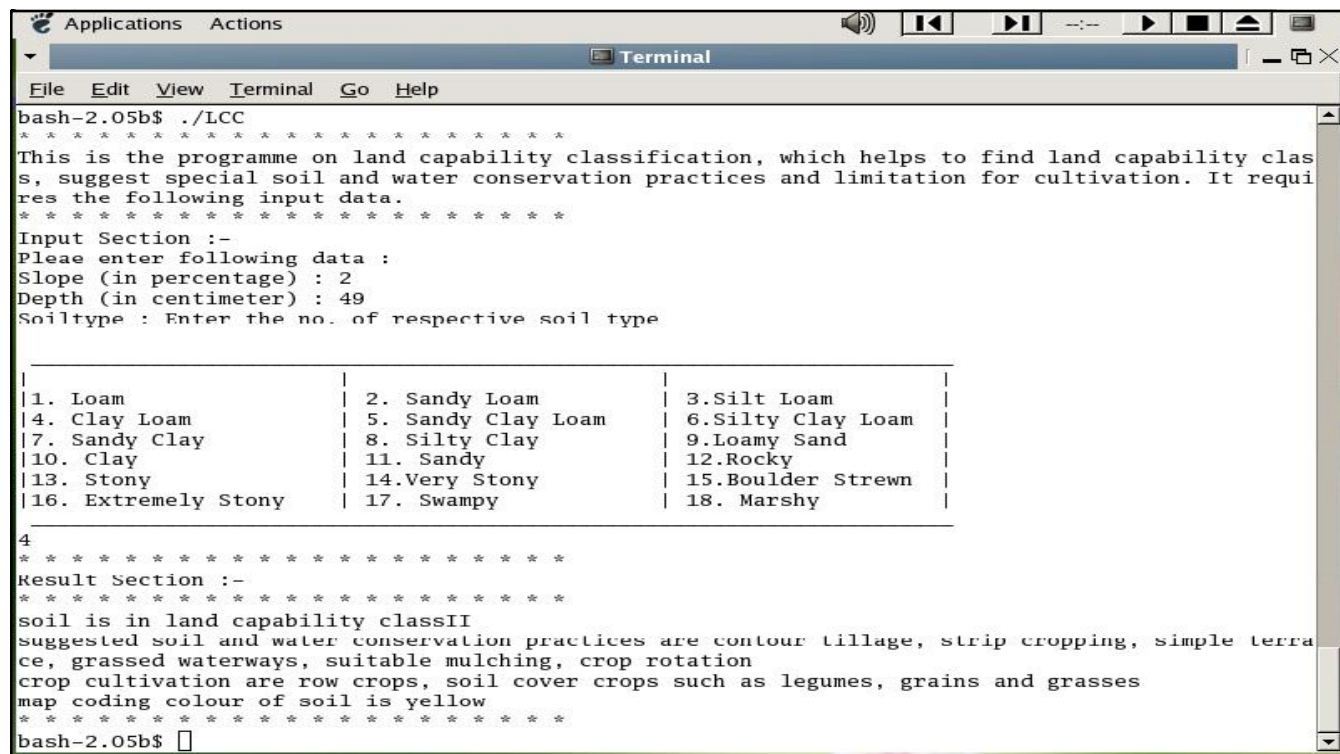


Fig. 5 : Result of soil sample V

Table 3 : Soil type recommended for different classes	
Capability class	Soil type
I	Silty clay loam, Clay loam, Loam, Sandy loam, Silty loam, Sandy clay loam.
II	Silty clay loam, Clay loam, Sandy loam, Silty loam, Sandy clay loam.
III	Sandy clay, Silty clay, Clay, Loamy sand.
IV	Clay, Sandy.
V	Rocky, Stony.
VI	Stony, Boulder strewn.
VII	Exteremely Stony, Rocky, Boulder strewn.
VIII	Rocky, Swampy, Marshy.

Table 4 : Observations of selected five samples					
Samples Parameters	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)
Slope	22%	15%	2.8%	6.5%	2%
Depth	7cm	6.5 cm	46 cm	22 cm	49 cm
Texture	Extremely stony	Very stony	Silty clay loam	Clay	Clay loam

Sample V [area (200×35m), survey number 154]

Entered the slope = 2 per cent, depth = 49 cm and soil type number = 4, then the result obtained from this input are shown in the Fig. 5. From this figure, the soil is coming under land capability class II. Suggested soil and water conservation practices are contour tillage, strip cropping, simple terrace, grassed waterways, suitable mulching, crop rotation. Crops to be grown are row crops, soil cover crops such as legumes, grains and grasses. The map coding colour of soil is yellow.

But when we entered the invalid input like slope =

20 per cent depth=90 cm and soil type number =11 *i.e.* soil type is sandy as shown in Fig. 6, then the result obtained is, “The system could not return proper classification”. Because the inputs which are entered does not match with the conditions provided in the database.

Classes shown by this software are correct and similar to the results obtained theoretically by considering ranges of the parameter.

Conclusion :

The developed software is tested for Karwadi watershed (survey number 133 and 154) with different conditions and the results are noted. Thus, the following conclusion are obtained from this study.

- Results shown by this LCC software are correct and similar to the results obtained theoretically by considering ranges given in the standard tables.
- After successful testing it is concluded that this software could be useful for classifying the land capability class for watershed management plan.
- After successful testing it is concluded that this software is useful for suggesting the soil and water conservation practices.

Capability class	Colour notation
I	Light green
II	Yellow
III	Red
IV	Blue
V	Dark green
VI	Orange
VII	Brown
VIII	Purple

```

Applications  Actions
Terminal
File Edit View Terminal Go Help
bash-2.05b$ gcc -oLCC LCC.c
bash-2.05b$ ./LCC
*****
This is the programme on land capability classification, which helps to find land capability clas
s, suggest special soil and water conservation practices and limitation for cultivation. it requi
res the following input data.
*****
Input Section :-
Pleae enter following data :
Slope (in percentage) : 20
Depth (in centimeter) : 90
Soiltype : Enter the no. of respective soil type

|-----|
| 1. Loam          | 2. Sandy Loam      | 3.Silt Loam      |
| 4. Clay Loam    | 5. Sandy Clay Loam | 6.Silty Clay Loam |
| 7. Sandy Clay   | 8. Silty Clay      | 9.Loamy Sand     |
| 10. Clay        | 11. Sandy          | 12.Rocky         |
| 13. Stony       | 14.Very Stony     | 15.Boulder Strewn |
| 16. Extremely Stony | 17. Swampy        | 18. Marshy       |
|-----|

11
*****
Result Section :-
Sorry ! system could not return proper classification
bash-2.05b$

```

Fig. 6 : Output result of invalid input data

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