Decision Support System

For

Runoff Estimation, Farm Pond Designing and Water Availability for Ground Water Recharge

User's Manual

Prepared by

PankajPanwar
O.P.S Khola
Sharmistha Pal
S.S. Shrimali
S.K. Sharma

ICAR- Indian Institute of Soil and Water Conservation
Research Centre, Sector 27A, Chandigarh – 160 019 –I NDIA

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Background

Shivalik Himalayas are one of the eight most degraded agroecosystem of India. The whole region has undulating topography, region is rainfed, rainfall is erratic, soils are gravelly, ground water is deep and difficult to use and canal irrigation is not possible thus rainfed agriculture is practiced and sustenance is a challenge. Water harvesting is an economic and viable option for these regions. In plain areas, lying below Shivaliks, of Punjab and Haryana problem of depleting ground water is increasing with every increasing year and most parts of the states have been put under red zone.

To address both the problems of water for irrigation (for shivaliks) and recharging ground water through excess runoff from pond, a dual purpose farm pond structure was developed. The conceptual framework is given in fig. 1.

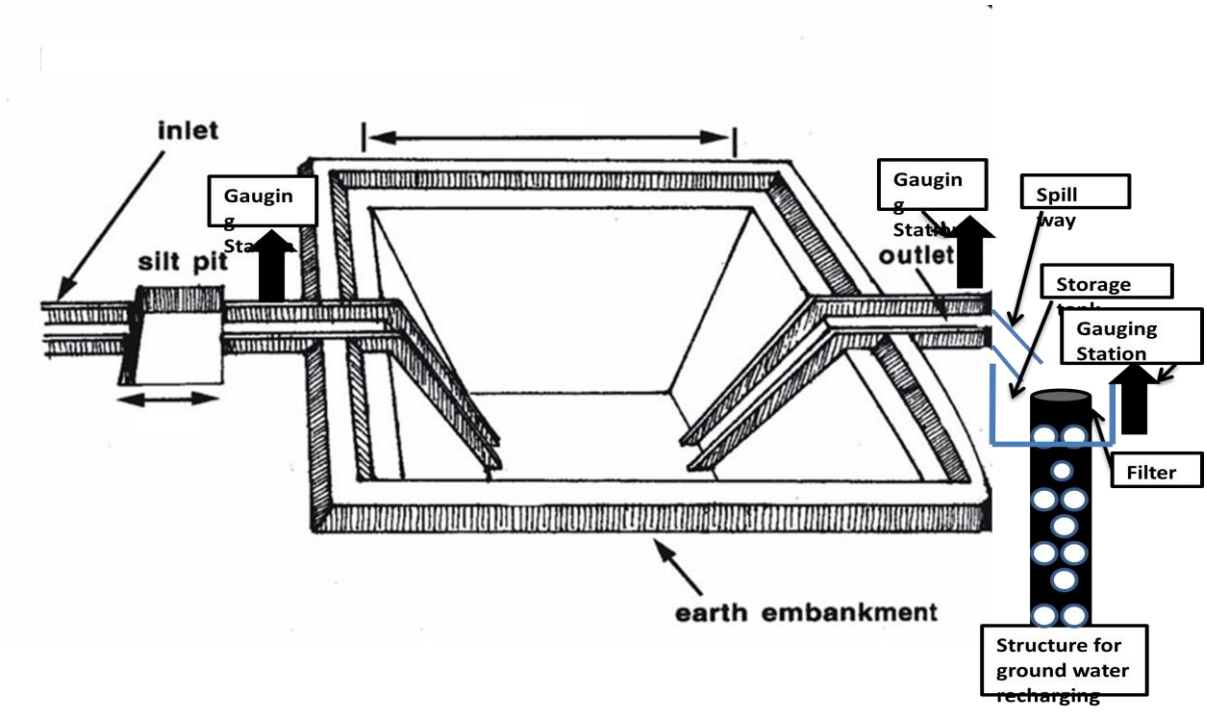


Fig. 1. Conceptual frame work of dual purpose farm pond

To facilitate the farmers and field functionaries in designing such structures, for achieving both the objectives of water harvesting for irrigation and ground water recharge, a software was developed which is available at ICAR-IISWC and NABARD website. The software is free and

a report can be generated, printed and saved on design and dimension of farm pond and recharge structure with minimum input requirements'.

Using the DSS

Visit the website www.cswcrtiweb.org and NABARD

Locate and select "Online software" link on the left hand side of the Home page. Select the DSS on "Runoff Estimation, Farm Pond Designing and Water Availability for Ground Water Recharge" (Fig. 1). The home page provides the information on funding agency, developers and the institute. Click "ENTER" to move to another page (Fig. 2).

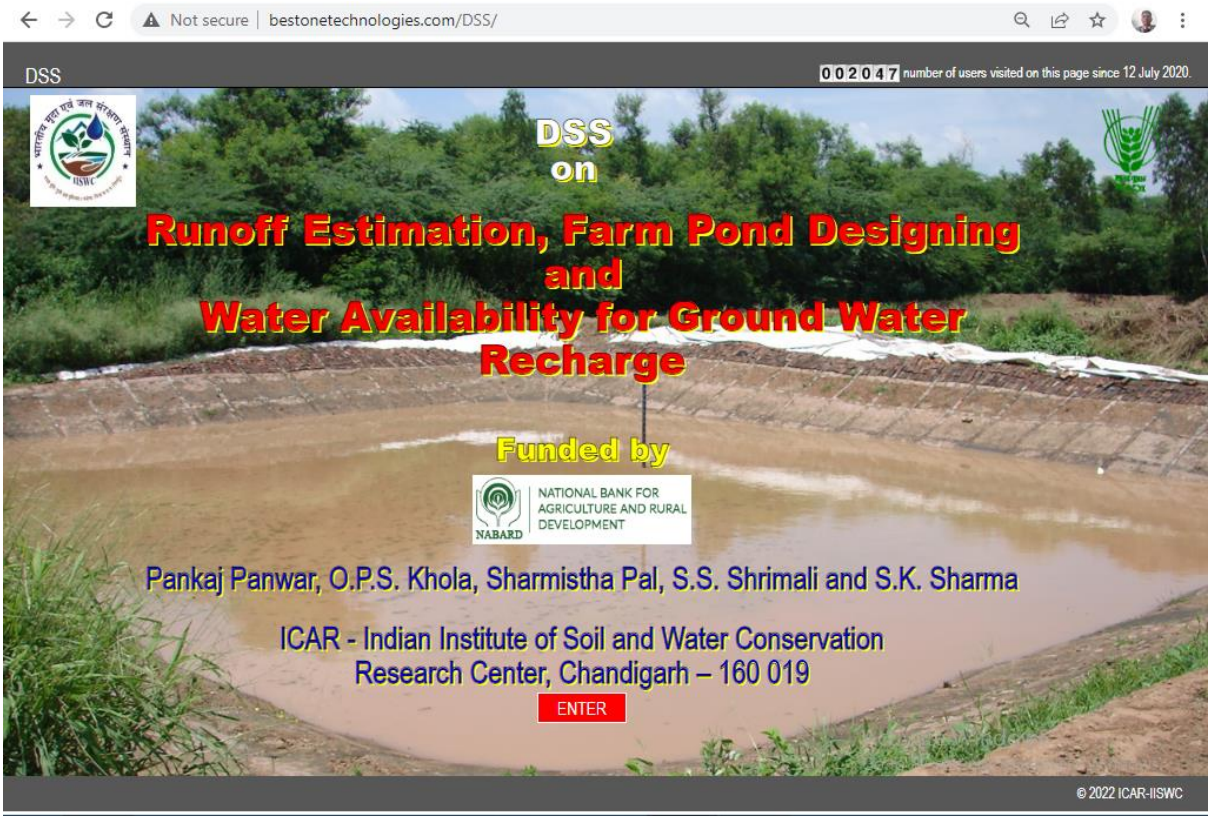


Fig 1. Home page

A) Runoff Calculation

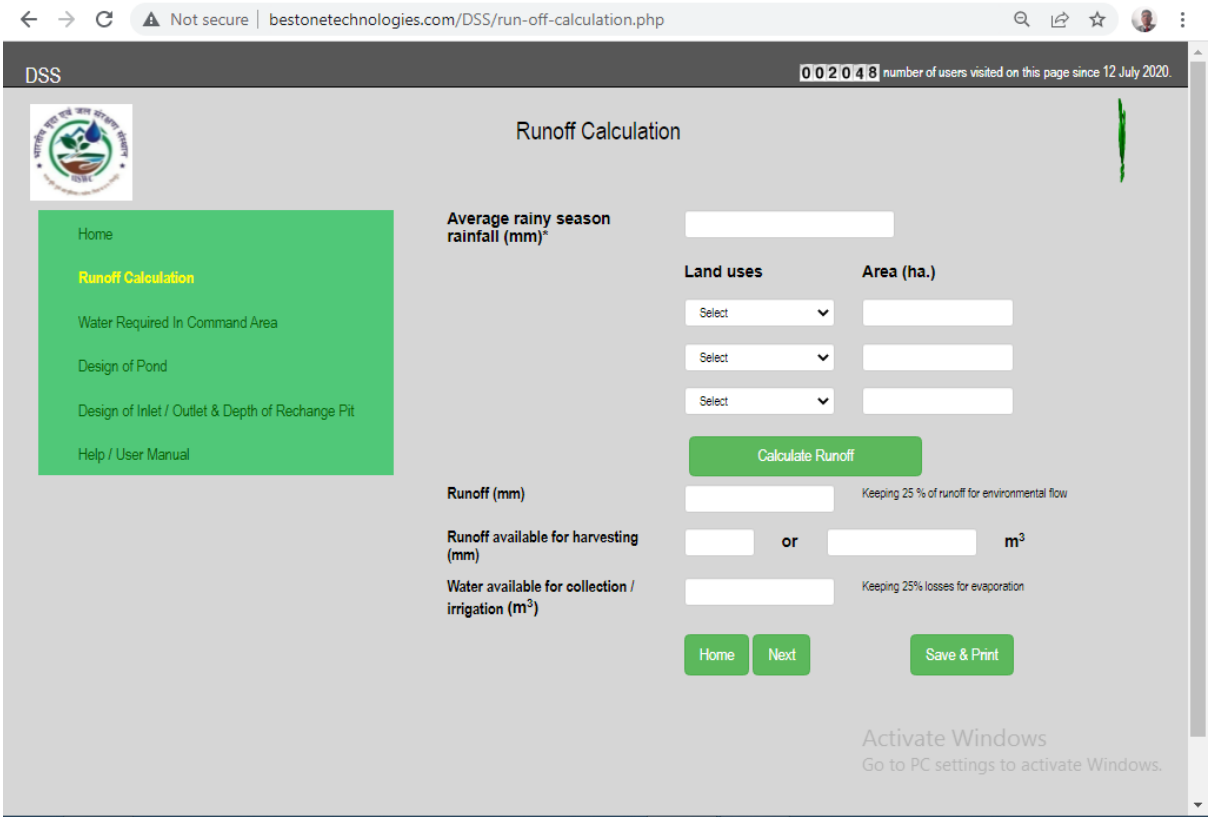


Fig 2. Runoff calculation

Estimation of Runoff calculation is a prerequisite for designing dimension of the pond. In case user is having estimated or measured runoff volume with him, he can move to next page either through “Next” button or from link provided on the left side of the screen.

The Runoff amount generated from the catchment area can be estimate by entering runoff and landuse of the catchment area.

Average seasonal rainfall means rainfall received during the study period. It is generally taken as rainfall during rainy season.

Example: 1

Shivalik region of Punjab and Haryana the rainfall during July – Oct. is 900 mm. Thus rainy season rainfall is taken as 900. Let the catchment area comprises of Forest – 3 ha, Horticulture – 3 ha and agriculture 2 ha. From drop down menu select

the relevant landuse and add the area in the corresponding box. Click the button "Calculate Runoff". The software will calculate the total expected runoff from the catchment. In the present case the runoff is 225 mm. Out of the total expected runoff about 25 % runoff is left as environmental flow and rest 75 % is available for harvesting. Environmental flow is kept to keep the downstream functions alive. Thus Runoff water available for harvesting is 168.8 mm or 13504 m^3 (Fig. 3). The water harvested/stored is in open pond and hence there are evaporation losses. The evaporation and other losses are also deducted from the stored water which is generally kept as 25 per cent. Thus the total water available for irrigation is 10128 m^3 (Fig. 3).

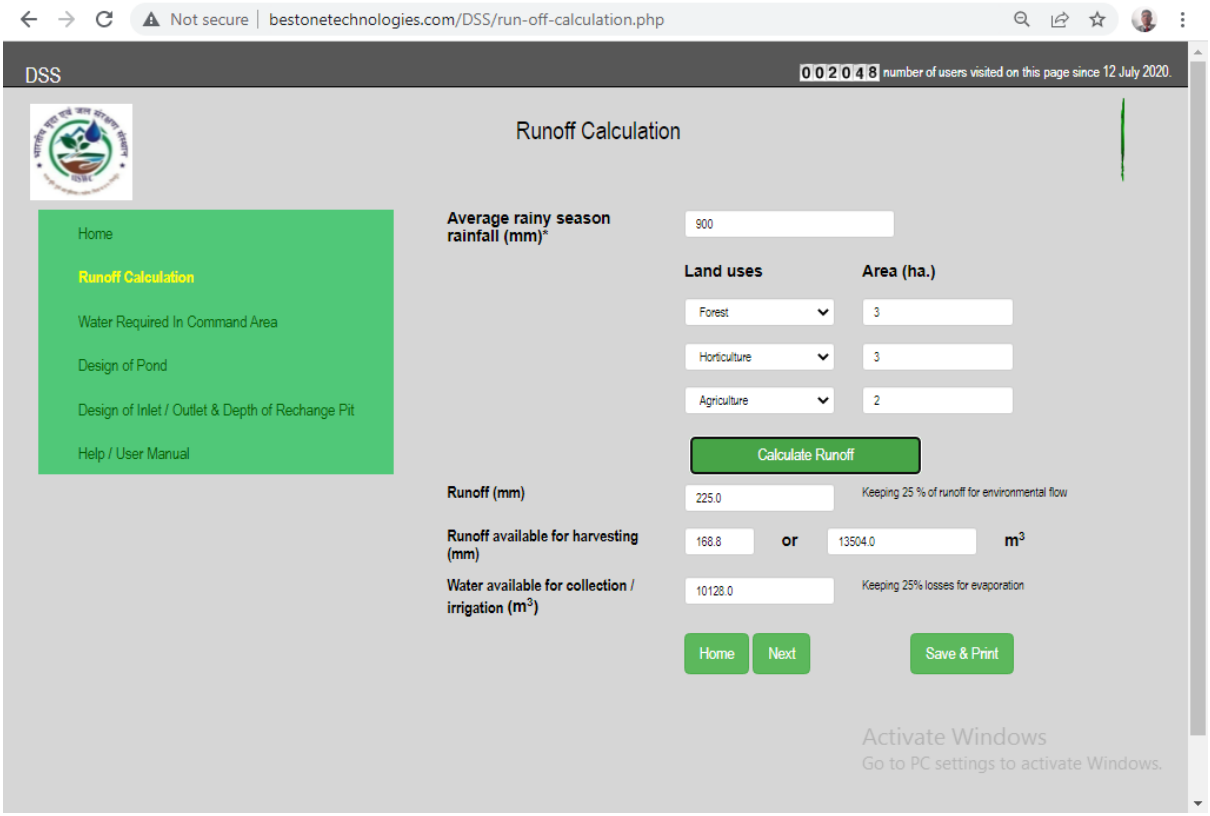
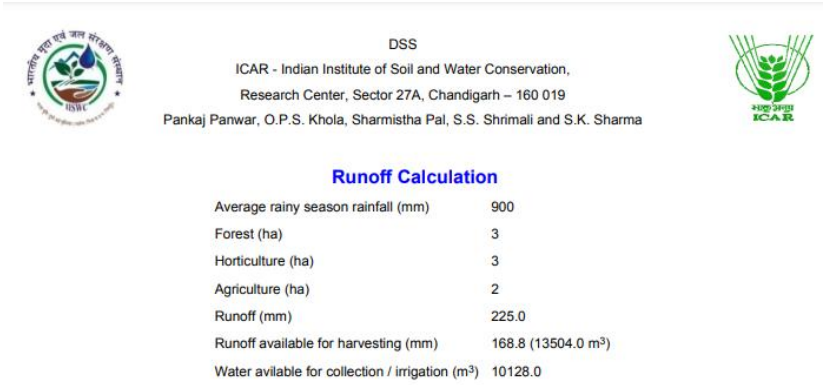


Fig. 3. Processed Runoff calculation

The results obtained can be printed by clicking button "Save & Print". The page will convert the matter into a pdf format and the button "Save & Print" will be converted to "Print page". Again click the "Print page" button and the result would be printed in pdf format (Fig. 4). The result can also be saved as pdf file.



DSS

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Research Center, Sector 27A, Chandigarh – 160 019

Pankaj Panwar, O.P.S. Khola, Sharmistha Pal, S.S. Shrimali and S.K. Sharma

Runoff Calculation

Average rainy season rainfall (mm)	900
Forest (ha)	3
Horticulture (ha)	3
Agriculture (ha)	2
Runoff (mm)	225.0
Runoff available for harvesting (mm)	168.8 (13504.0 m^3)
Water avilable for collection / irrigation (m^3)	10128.0

Fig. 4. Printable format of results of Runoff calculation submodule

B) Water required in command area

To move forward and calculate the “water required in command area” “next” button is selected. The next screen which will appear is given in figure 5. The water requirement in command area is highly complex and variable depending upon the type of crop, soil type, season and type of irrigation system. To have a fair representation of requirement, this software takes into account only two irrigation of 6 cm each to calculate the total water requirement. This has been done taking into understanding that in rainfed areas one or two irrigation are generally given.

In the software “water available for collection/irrigation” automatically comes from previous link of “Runoff Calculation” (Fig. 5). In case the user has his own value of water availability the same can also be used as input for “water available for collection/ irrigation”.

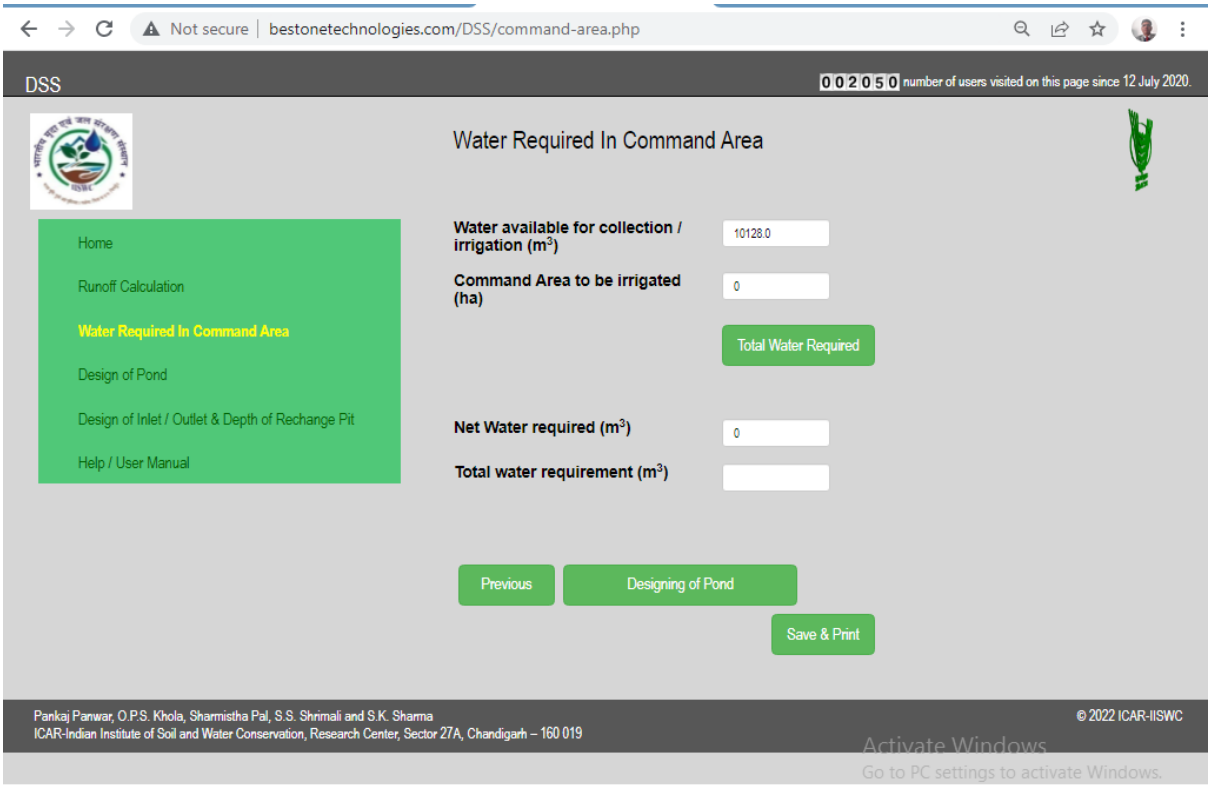


Fig. 5. Water required in command area

The command area which is required to be irrigated is added. The "Total water required" button is pressed to obtain the values of "Total water required" and "net water required". The total water required obtained by adding evaporation losses and conveyance losses. The lumpsum evaporation and conveyance losses is kept as 25 %. This amount is added to the net water required.

Example 2

Water available for irrigation : 10128 m^3 (obtained as output of "runoff calculation" sub-module)

Command area to be irrigated : 5 ha

Net water required : 3000

Total water required : 4000

The result can be printed and saved as pdf file (Fig. 6) in similar manner as done for "Runoff Calculation"

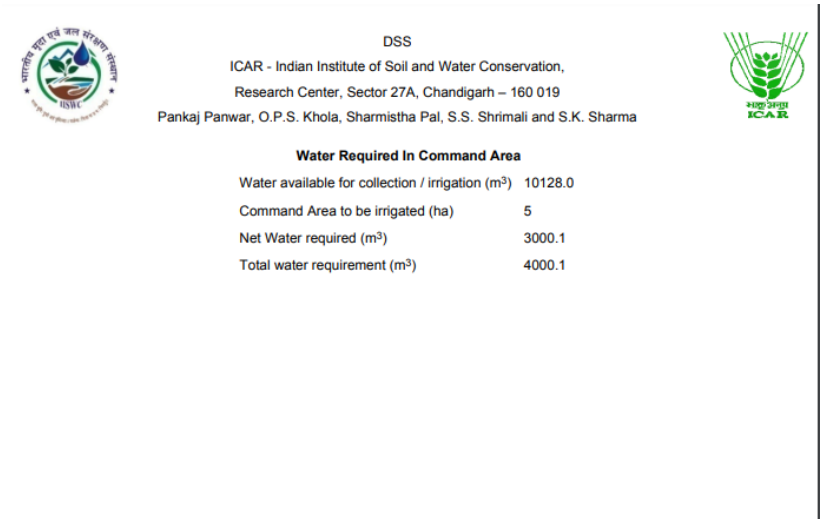


Fig. 6. Printable format of results of Water requirement in command area submodule

C) Designing of Pond

Once runoff water availability and demand of water for catchment area is known, strategy for designing of farm pond can be worked out. While designing of farm pond care is taken that, the designing is done on the basis of water availability from catchment and water requirement in command whichever is lower. Because, if designing is done on the basis of higher water availability from catchment, it will lead to economic losses as our requirement is less in command area. Excess stored water will be of no use to the farmer. On the other hand if designing is done on the basis of command requirement only, the pond may be overdesigned and it will not be filled from the runoff from catchment, again leading to economic loses. Thus designing of farm pond is done on the basis of water availability from catchment and water requirement in command whichever is lower.

Either the link from the left side of the screen is used or button “Design of Pond” is pressed. Fig. 7 shows the screen for design of farm pond. While using the button from the previous submodule the lowest amount of volume of water will be displaced for calculation in submodule “Design of Pond”. In this case the water available from catchment is 10128 m^3 and water required in command area is 4000 m^3. Out of the two, lowest is water requirement in command area, hence designing of pond would be done for 4000 m^3 volume which is displayed automatically in “Design of pond” module.

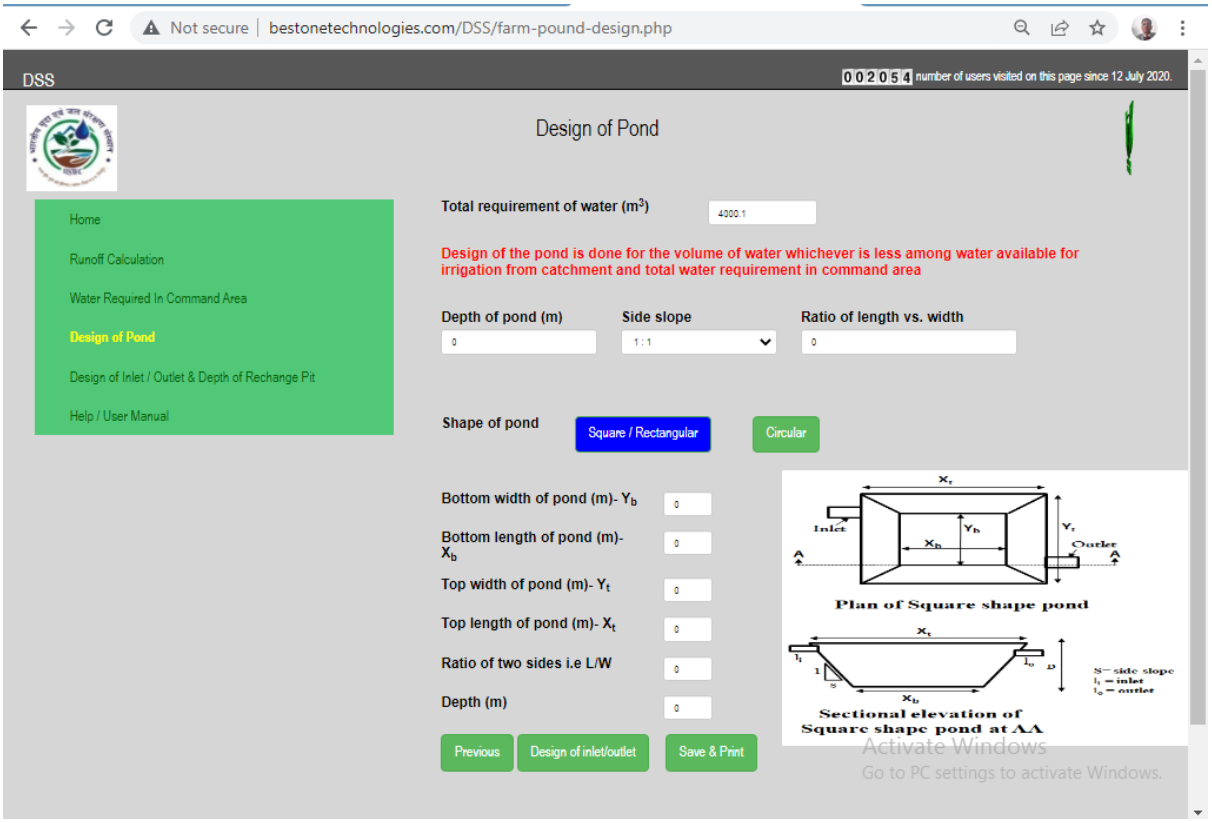


Fig. 7. Design of Pond

The depth of the pond, side slopes and ratio of length and width of pond is entered by the user. Depth of pond is in meters, side slope is selected from drop down menu. Ratio of length Vs width determines the shape of the pond. If length vs width ratio is 1, it means pond is square. If this ratio varies from 1 the pond shape will be rectangular. The circular pond does not require ratio of length Vs width.

Example 3: Square pond

Net requirement of water (m^3) : 4000

Depth of Pond (m) : 2
Side slope : 1:1.5
Ratio of Length Vs width : 1 (if square pond; and other values e.g 1.2, 1.5 *etc* if rectangular pond)

Since it is square pond press Square/Rectangular button to get the design

Bottom width of Pond (m) - Y_b : 41.7
Bottom length of Pond (m) - X_b : 41.7
Top width of Pond (m) - Y_t : 47.7

Top length of Pond (m) - X_t : 47.7

Since it is a square pond thus bottom width and length and top width and length would be same (Fig. 8.)

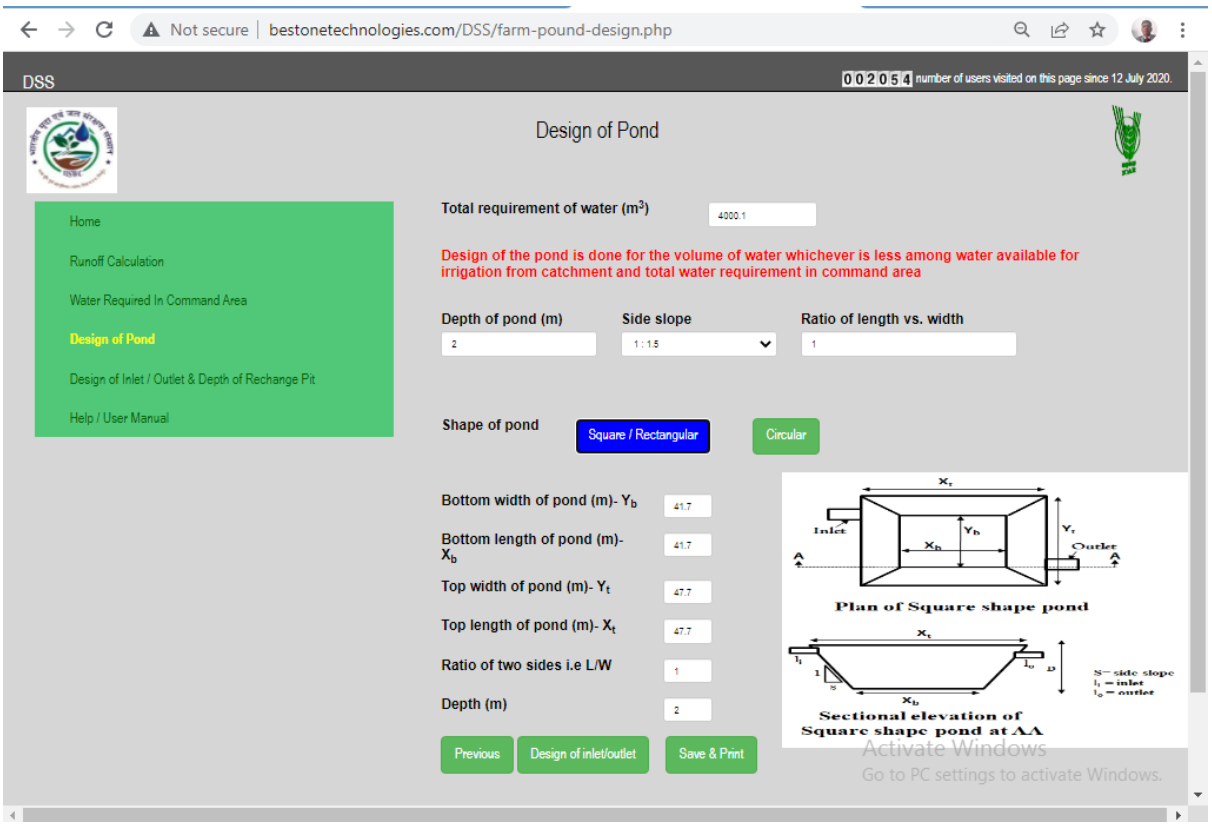


Fig. 8. Design of square pond

Example 4: Rectangular pond

Net requirement of water (m^3) : 4000

Depth of Pond (m) : 2
Side slope : 1:1.5
Ratio of Length Vs width : 1.5 (if square pond; and other values e.g 1.2, 1.5 *etc* if rectangular pond)

Since it is rectangular pond press Square/Rectangular button to get the design

Bottom width of Pond (m) - Y_b : 34.0
Bottom length of Pond (m) - X_b : 51.0
Top width of Pond (m) - Y_t : 40.0

Top length of Pond (m) - X_t : 57.0

Since it is a rectangular pond thus bottom width and length and top width and length are different (Fig. 9.)

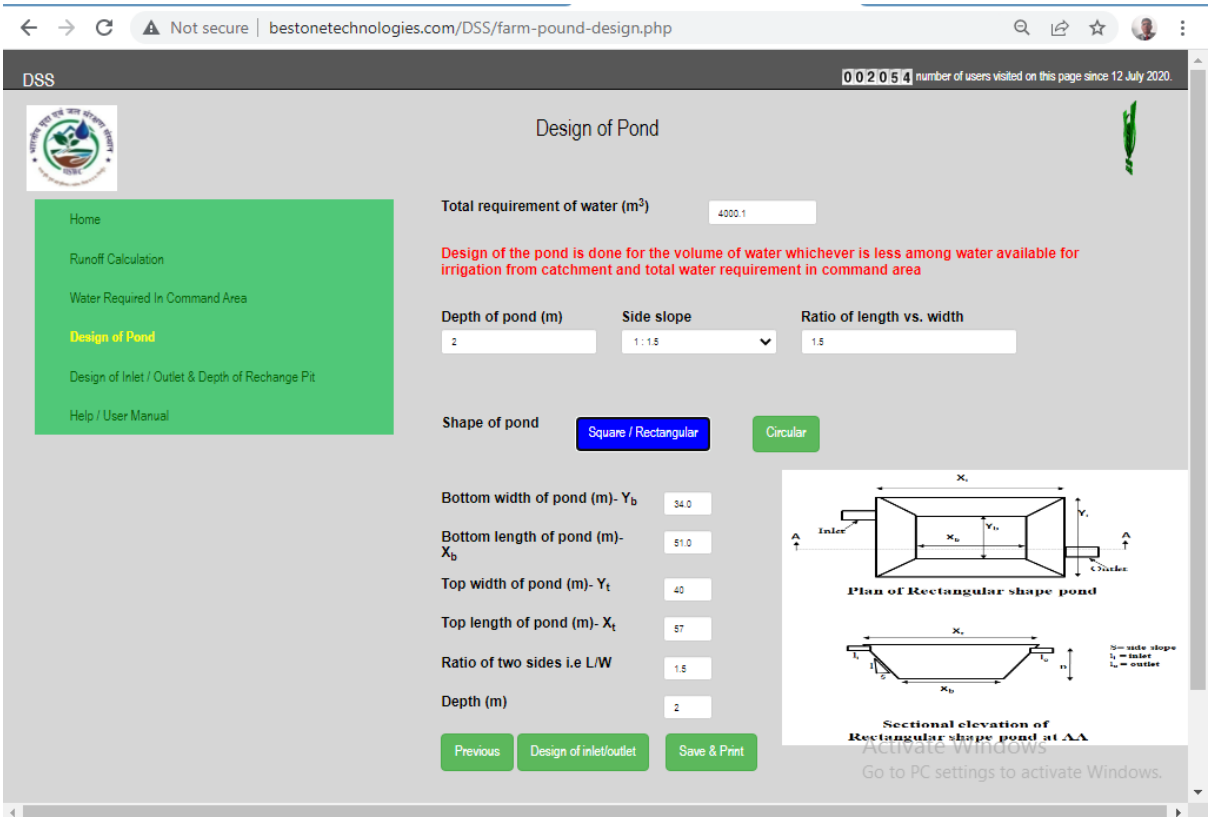


Fig. 9. Designing of rectangular pond

Example 5: Circular pond

Net requirement of water (m^3) : 4000

Depth of Pond (m) : 2
Side slope : 1:1.5
Ratio of Length Vs width : Nil

Since it is circular pond thus ratio of Length Vs width is not required. Press "Circular" button to get the design

Diameter at bottom (m) - D_b : 47.4
Diameter at top (m) - D_t : 53.4

Since it is a circular pond only bottom and top diameter are required (Fig. 10.)

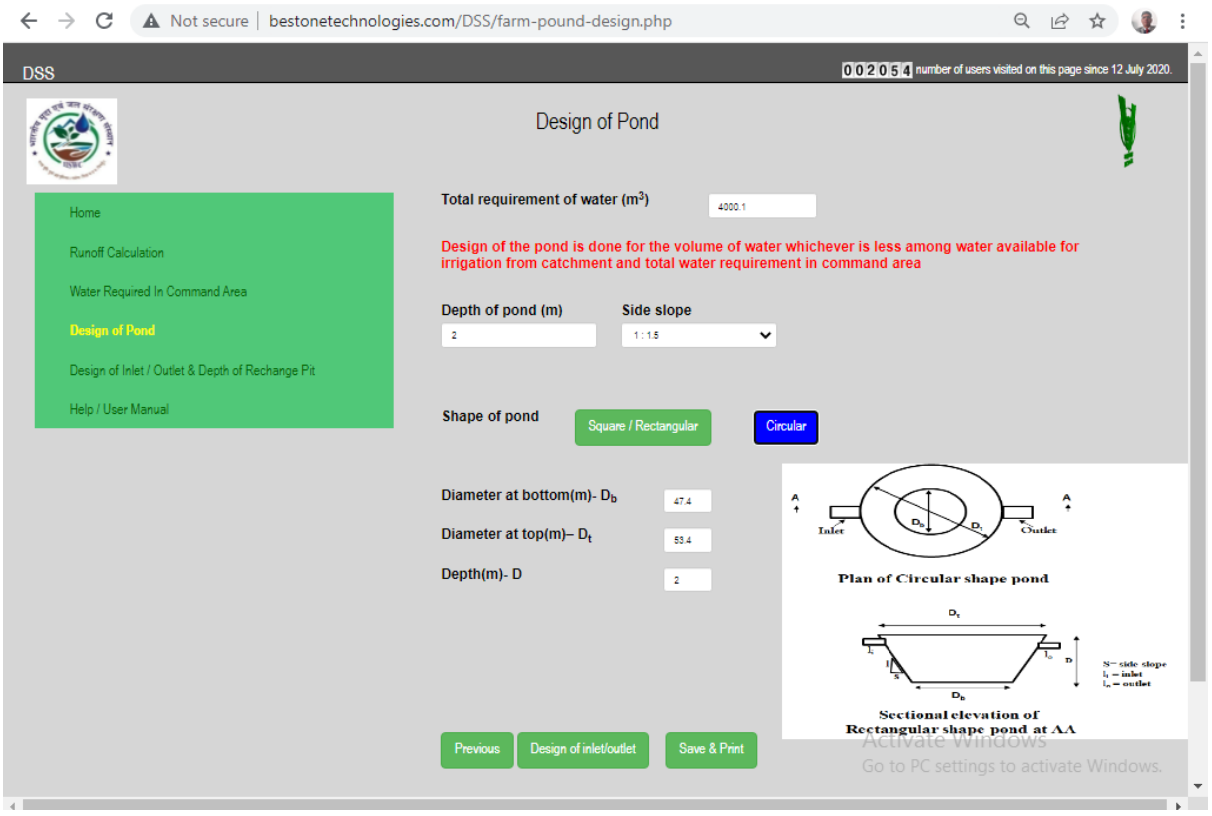


Fig. 10. Designing of circular pond

The result can be printed and saved as pdf file (Fig. 11) in similar manner as done for “Runoff Calculation” above.

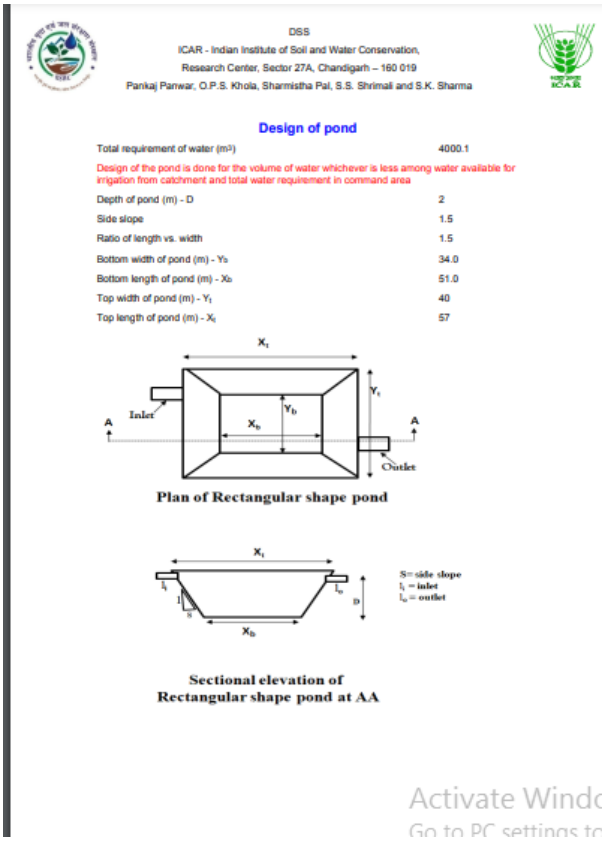


Fig. 11. Print of the results of design of pond

D) Designing inlet and outlet of pond and recharge pit

Design of inlet and outlet of the pond is important so that inlet and outlet channel are able to accommodate the maximum runoff volume expected from the catchment. Under design would lead to breach of the pond bunds and over design will lead to economic losses.

In DSS the Inlet and out let is designed by selecting “Design of inlet/outlet” button or link. The screen that will appear is given in Figure 12.

In addition to channel design of recharge pit is also estimated. The recharge pit is prepared after the outlet channel so that excess water enter the recharge pit and recharge the ground water. The diameter of the recharge pit is kept static i.e 2 m. It is done because the land resources is precious and farmer would seldom spare his land for natural resource conservation activity which would not directly provide economic benefit. Higher width will also create problem of sliding of side slopes.

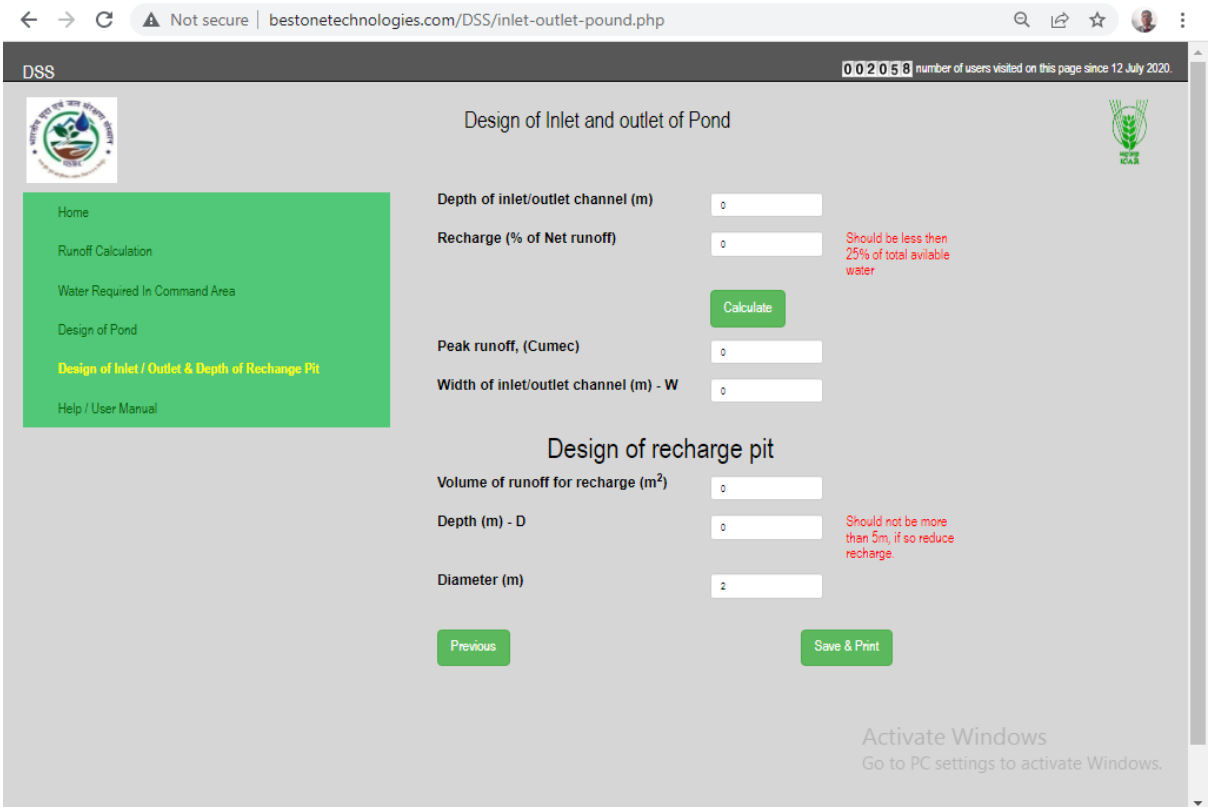


Fig. 12. Design of inlet and out let of pond

Depth of inlet and out let channel is provided along with the per cent of recharge which user would like to keep for recharging of ground water. This percentage cannot be more than 25 per cent as only 25 % water is kept for environmental flow and rest had been harvested. While selecting the percentage, riparian rights of downstream population should be kept in mind.

Example 6:

Taking into account the square design of pond as given in example 3, the design of inlet and outlet of pond is prepared below:

Net requirement of water (m^3) : 4000

Depth of Pond (m) : 2
Side slope : 1:1.5
Ratio of Length Vs width : 1
Bottom width of Pond (m) - Y_b : 41.7
Bottom length of Pond (m) - X_b : 41.7
Top width of Pond (m) - Y_t : 47.7
Top length of Pond (m) - X_t : 47.7

To design inlet and out let give depth of channel you would like to keep (say 0.2 m) and give the amount of recharge (in percent), out of the total environmental flow (which is 25 %), which you intend put to ground (say 2 %). If the depth of recharge pit exceeds 5 m, the depth will be red in colour showing warning. As depth beyond 5 m will be costly and has a chance of side walls crumbling. In such case reduce the Recharge (%).

Example:

Depth of inlet/outlet of channel (m) : 0.2

Recharge (%) : 10

Press calculate

Results are

Peak runoff (cum) : 0.67
Width of inlet/outlet of channel (m) - W : 4.38

Design of Recharge pit
Diameter of pit (m) : 2.0
Volume of runoff for recharge (cum) : 337.6
Depth (m) - D : 4.3

The result can be printed and saved as pdf file (Fig. 13) in similar manner as done for “Runoff Calculation” above.

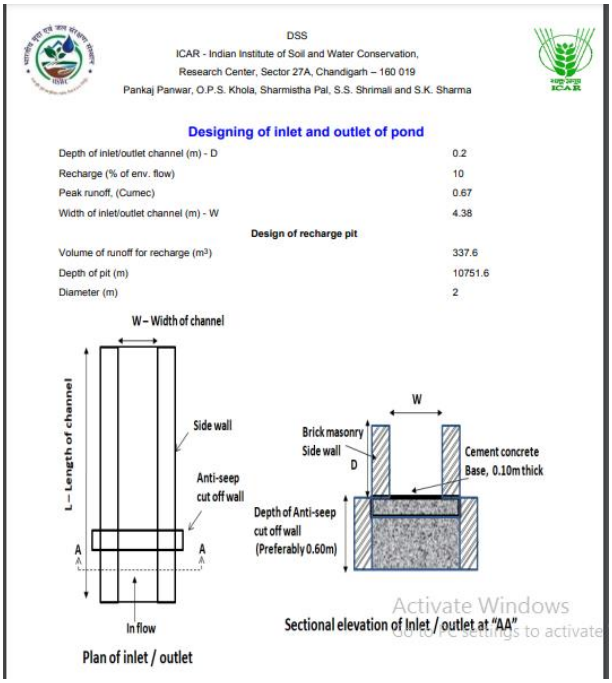
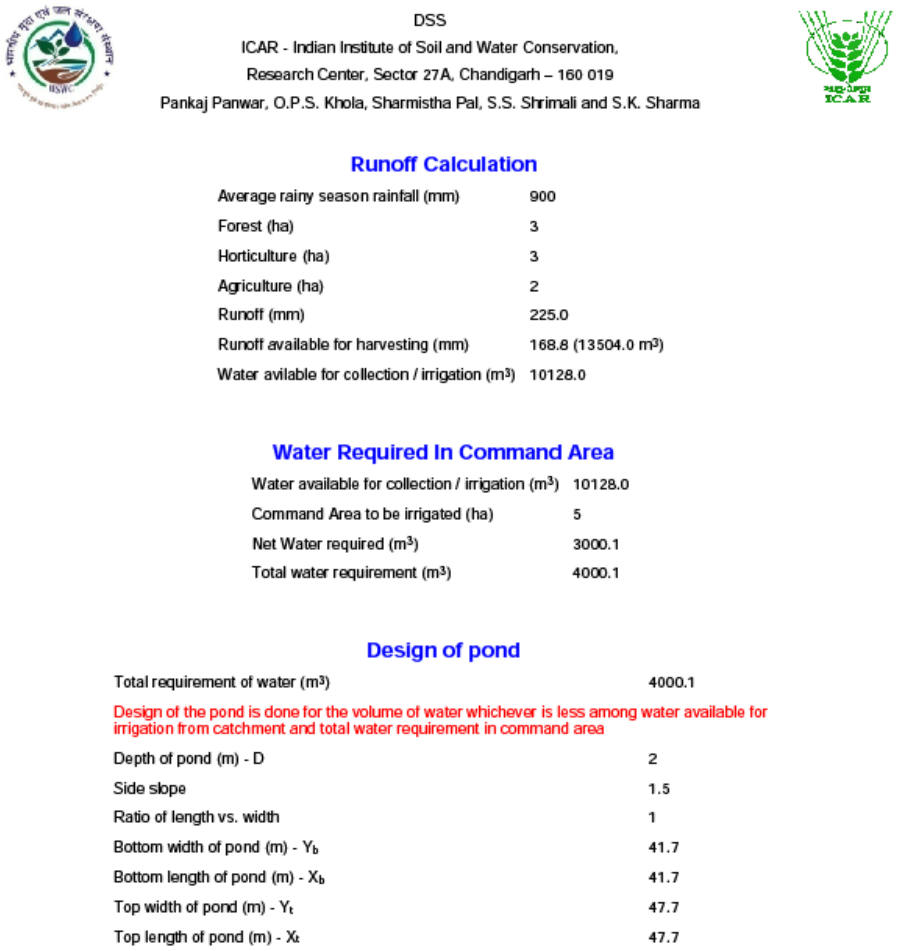


Fig. 13. Print of the results of design of Inlet/out and Recharge pit

E) Printing of Results

The results obtained from the DSS can be printed directly or the results obtained can be saved in pdf format. The results can be printed or saved parameter wise/ sub-module wise (Runoff calculation, water requirement in command area, Design of pond, Design of inlet/outlet and recharge pit) or all the parameters can be saved and printed in a single page (Fig. 14).



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Runoff Calculation

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Forest (ha)	3
Horticulture (ha)	3
Agriculture (ha)	2
Runoff (mm)	225.0
Runoff available for harvesting (mm)	168.8 (13504.0 m^3)
Water avilable for collection / irrigation (m^3)	10128.0

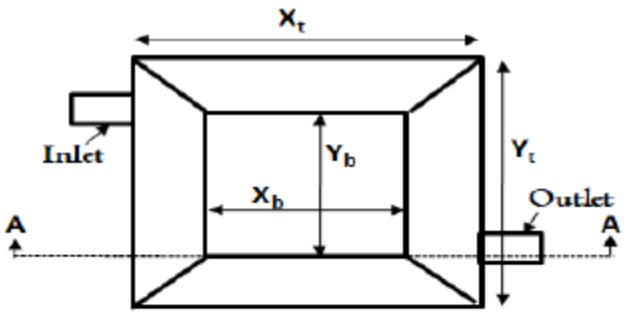
Water Required In Command Area

Water available for collection / irrigation (m^3)	10128.0
Command Area to be irrigated (ha)	5
Net Water required (m^3)	3000.1
Total water requirement (m^3)	4000.1

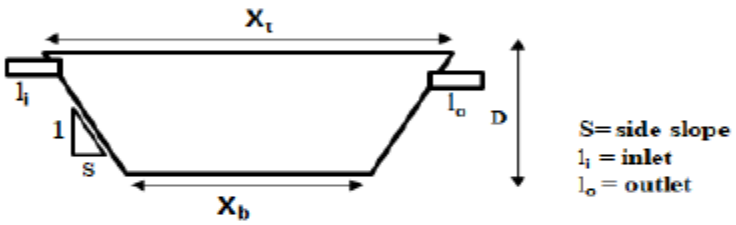
Design of pond

Total requirement of water (m^3)	4000.1
Design of the pond is done for the volume of water whichever is less among water available for irrigation from catchment and total water requirement in command area	
Depth of pond (m) - D	2
Side slope	1.5
Ratio of length vs. width	1
Bottom width of pond (m) - Y_b	41.7
Bottom length of pond (m) - X_b	41.7
Top width of pond (m) - Y_t	47.7
Top length of pond (m) - X_t	47.7

Fig. 14 . Print format of results (continued on next page)



Plan of Square shape pond



Sectional elevation of Square shape pond at AA

Designing of inlet and outlet of pond

Depth of inlet/outlet channel (m) - D	0.2
Recharge (% of env. flow)	10
Peak runoff, (Cumec)	0.67
Width of inlet/outlet channel (m) - W	4.38
Design of recharge pit	
Volume of runoff for recharge (m^3)	337.6
Depth of pit (m)	10751.6
Diameter (m)	2

Fig. 14 . Print format of results (continued on next page)

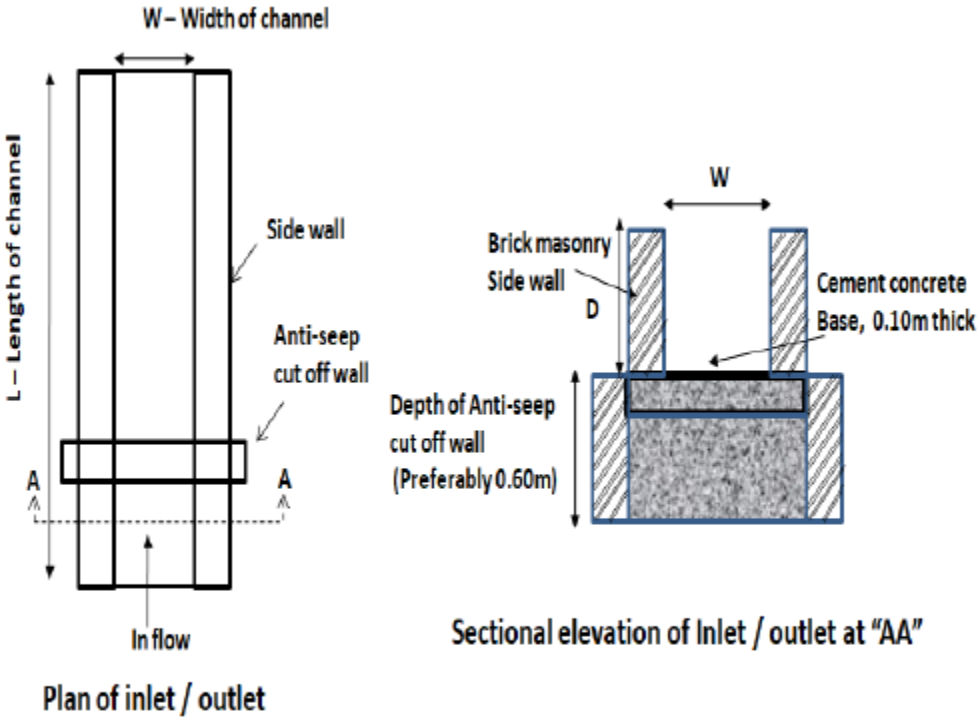


Fig. 14 . Print format of results

Good luck
