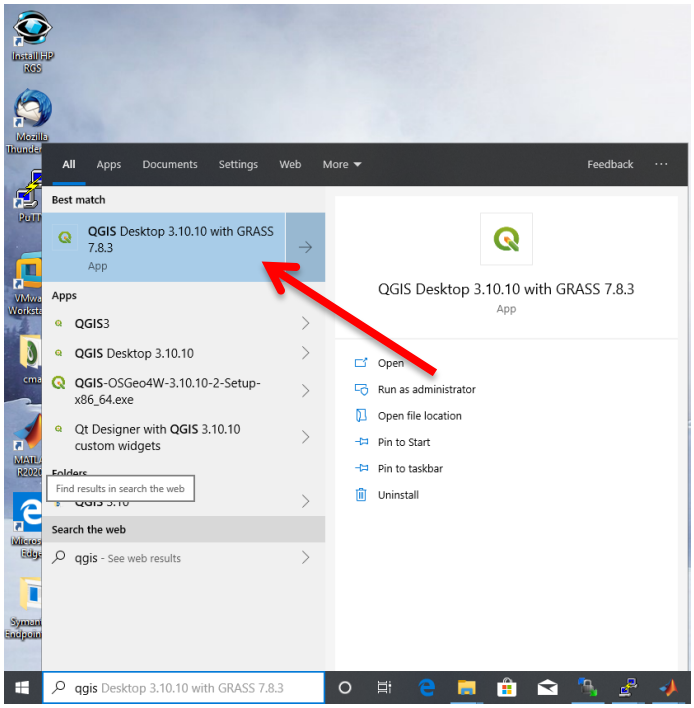
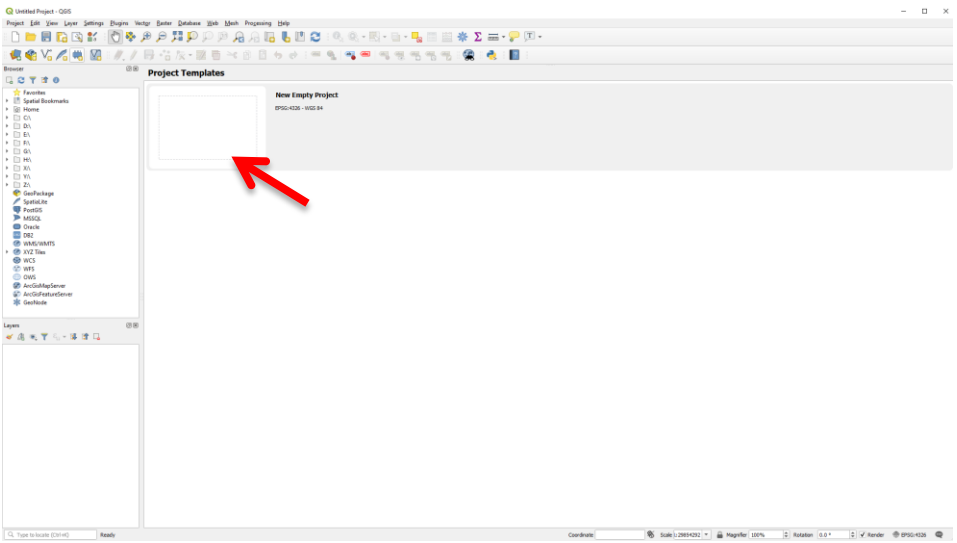
CATCHMENT DELINEATION USING "QGIS"

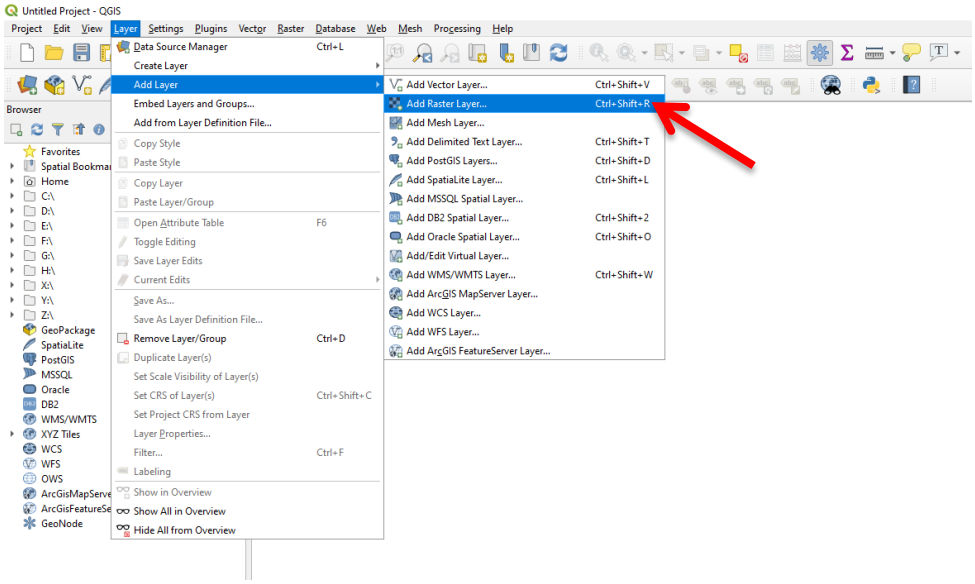
1. Open ***QGIS Desktop 3.10.XX with GRASS 7.8*** from the PC's desktop or Go to start and search "**QGIS**" and click on ***QGIS Desktop 3.10.xx with GRASS 7.8***.



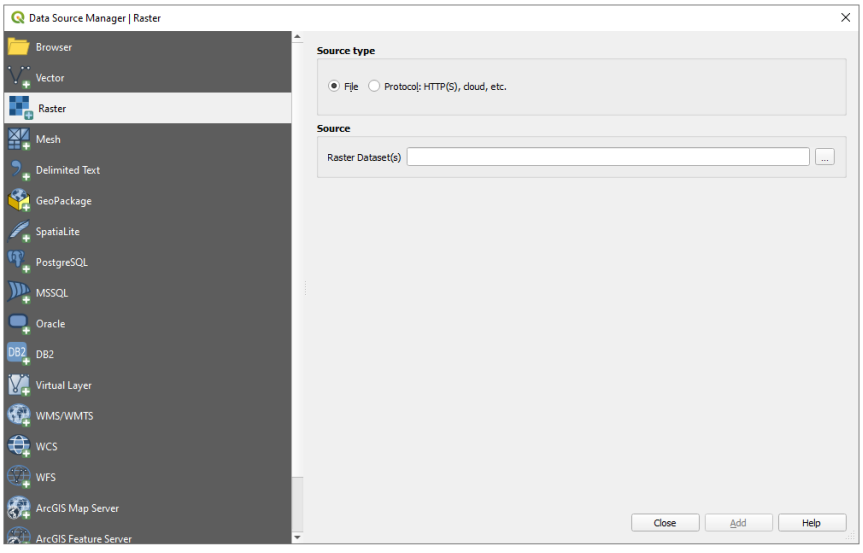
2. ***QGIS Desktop 3.10.XX*** opens. Click on *New Empty Project*.



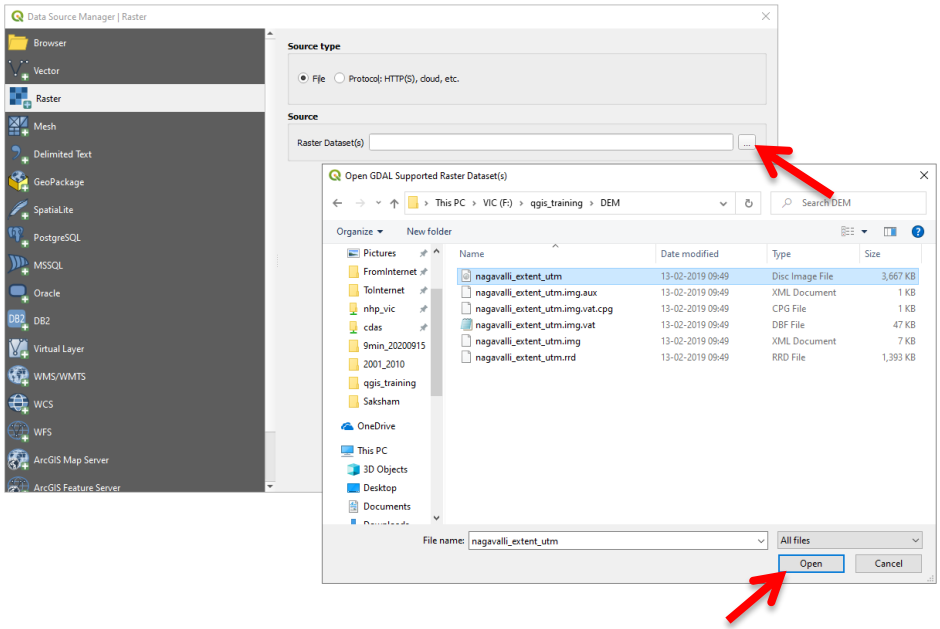
3. Click on **Layer** from toolbar and click on **Add layer** from the drop down. Now click **Add Raster Layer** to add the DEM.



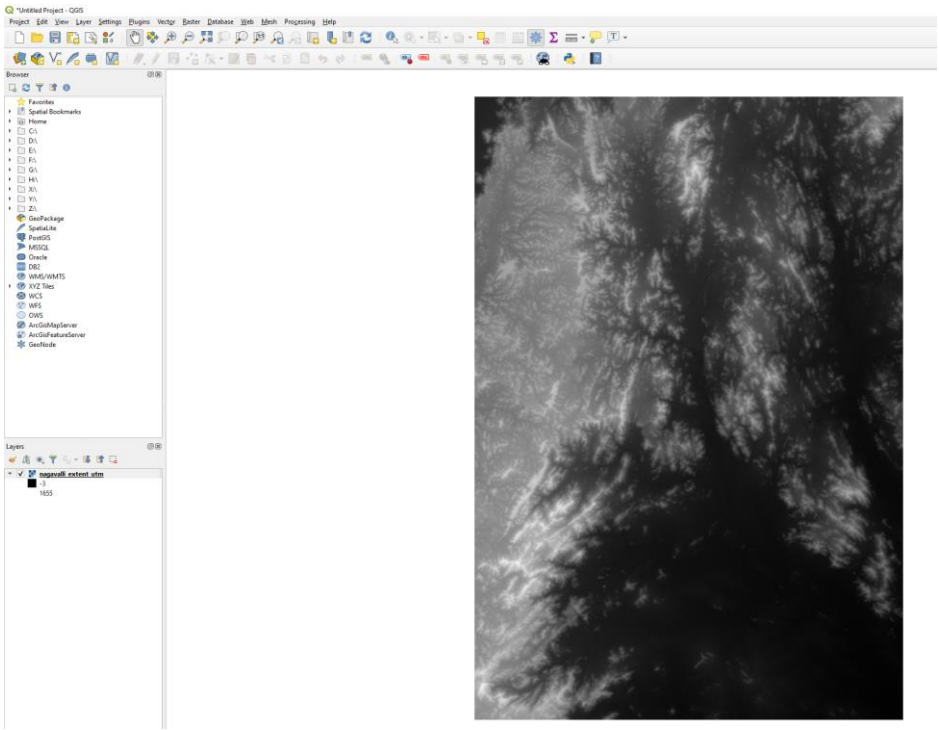
4. *Add **Raster Layer** dialog box appears*.



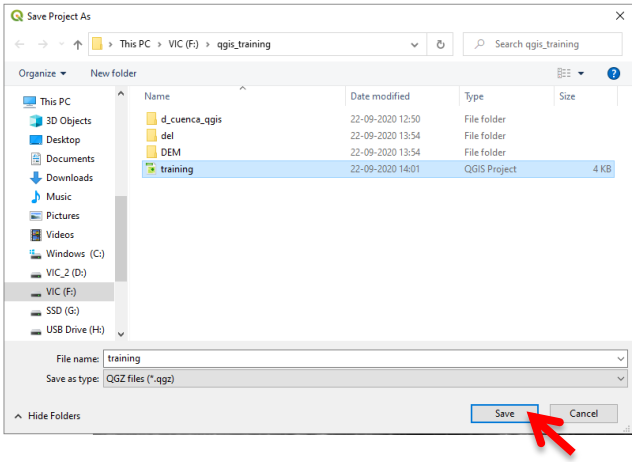
5. Click on the **browse (… icon) and select the Nagavalli_extent_utm DEM from the location and click Open→ADD.**



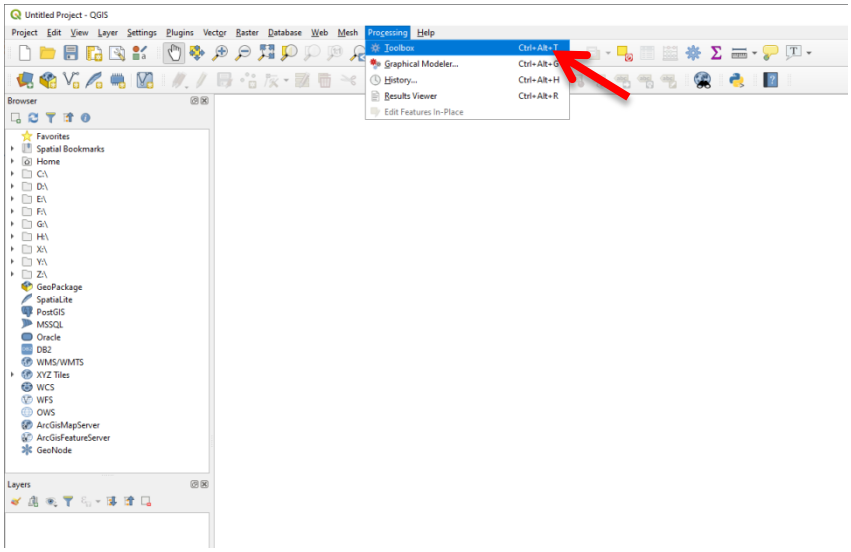
6. This adds the DEM to the Project.



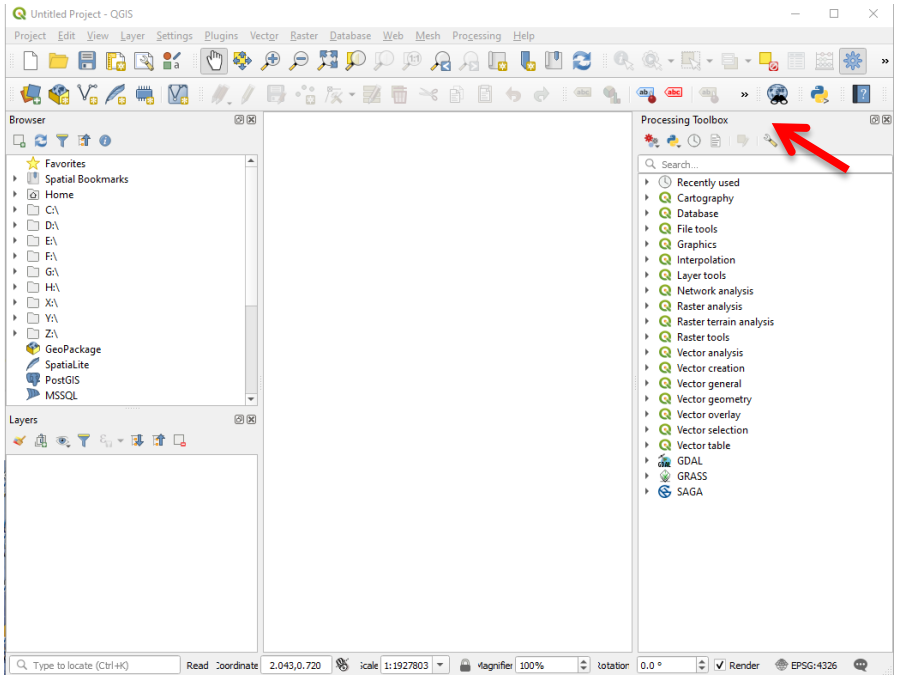
7. **Save** the project by clicking **Project→Save**. Save the project with a filename in the training folder.



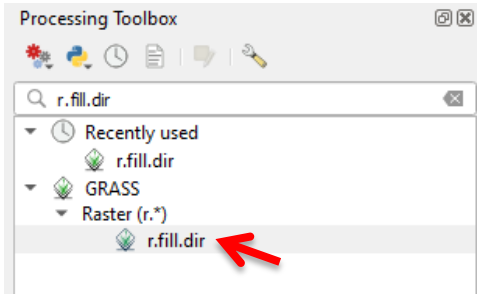
8. Click on ***Processing Tab*** in toolbar and select ***Toolbox*** from the dropdown**.**



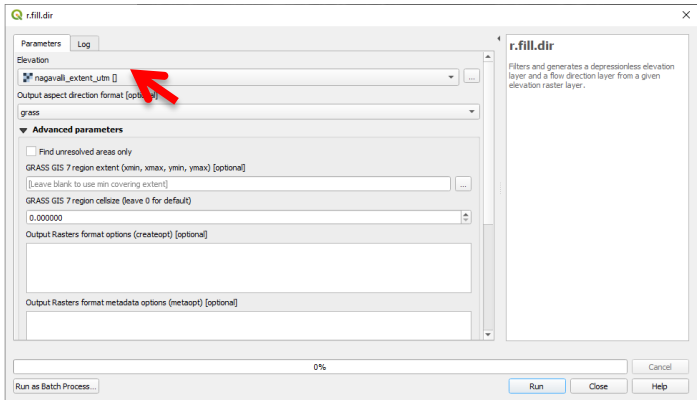
9. ***Processing Toolbox*** appears.



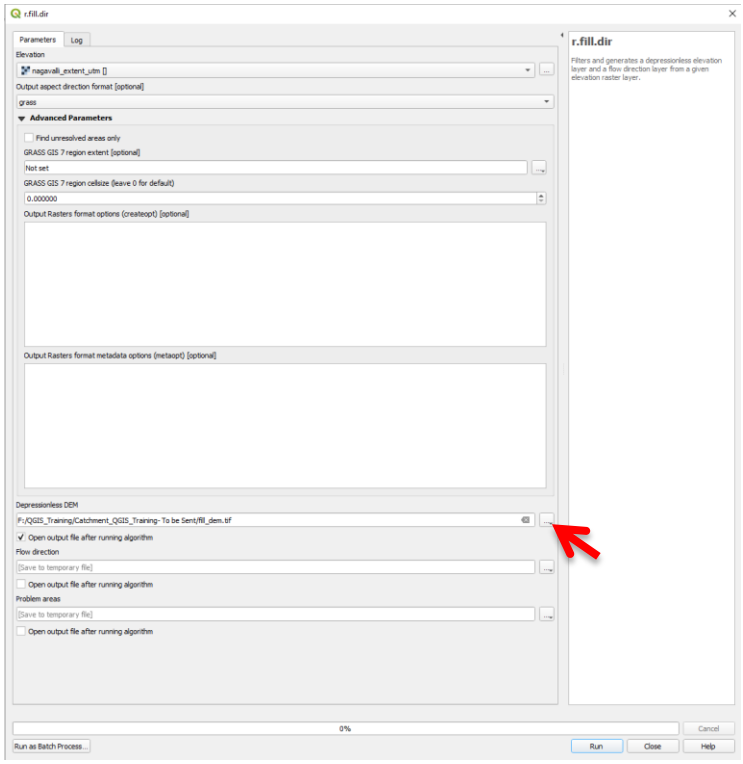
10. Now Search **r.fill.dir** in the processing toolbox and Click **r.fill.dir** tool under **GRASS**.



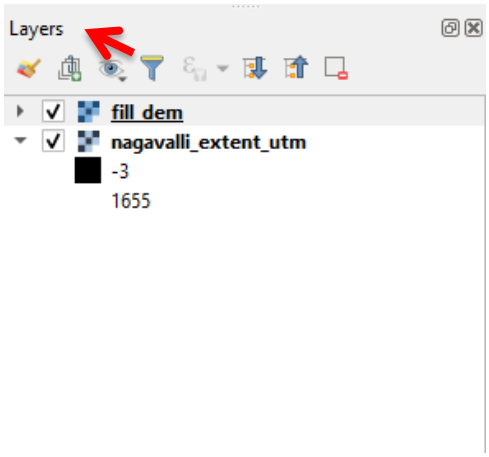
11. **r.fill.dir** dialog box appears. Now in the **Elevation** field, use the DEM of the basin to be delineated.



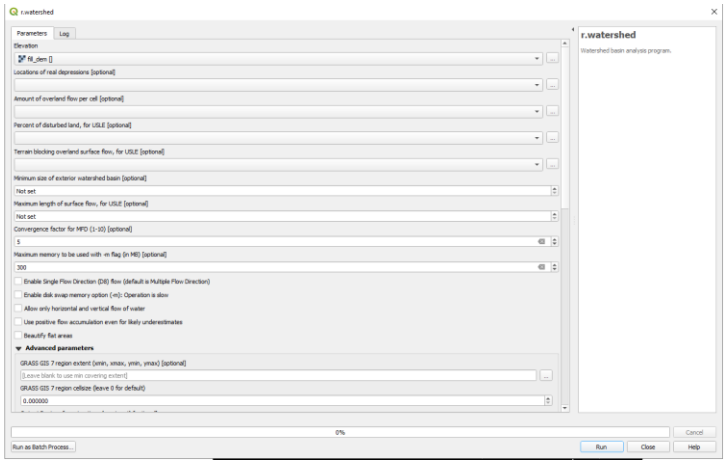
12. Create a folder in the training folder. Save all the outputs such as **Depressionless Dem** as **fill_dem.tif** in the same folder. Click **Run**.



13. The outputs will be displayed in the **Layers** toolbox.



14. The next process is to obtain the accumulation, to do this search **r.watershed** in processing toolbox.

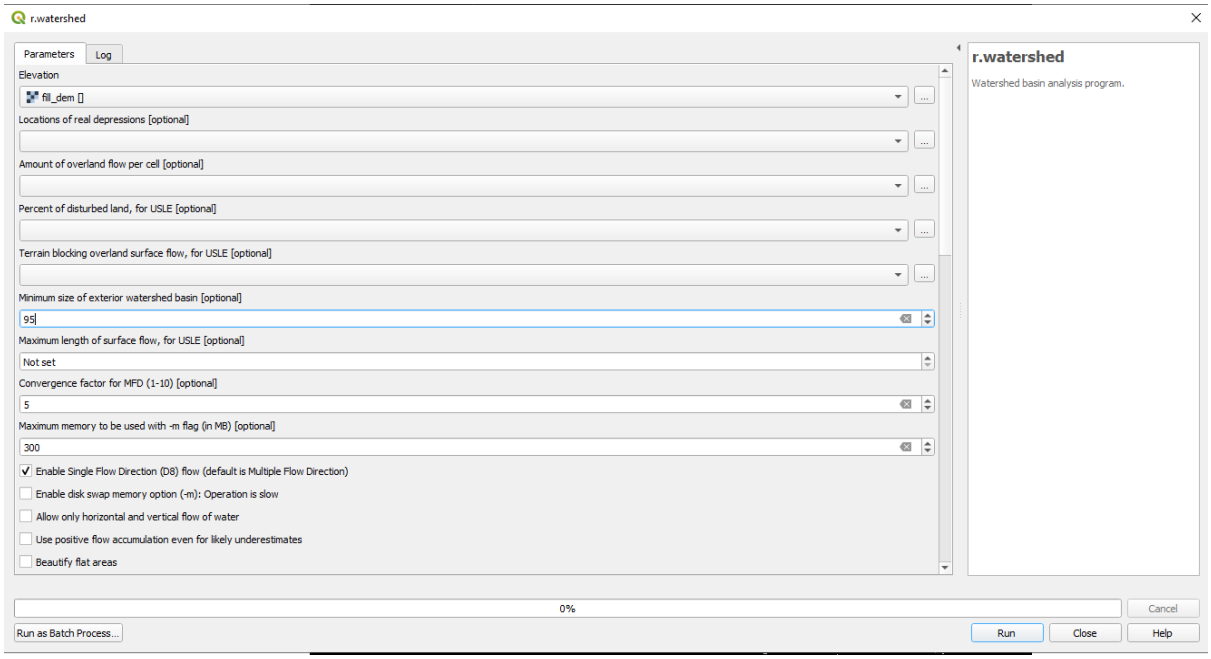


15. In the **r.watershed** tool it is recommended to configure only the following fields:

Elevation - Select the corrected DEM (**fill_dem.tif**).

Minimum size of exterior watershed basin - Select the cell size of the DEM (94.8550785 m). (You can see it in the layer properties information)

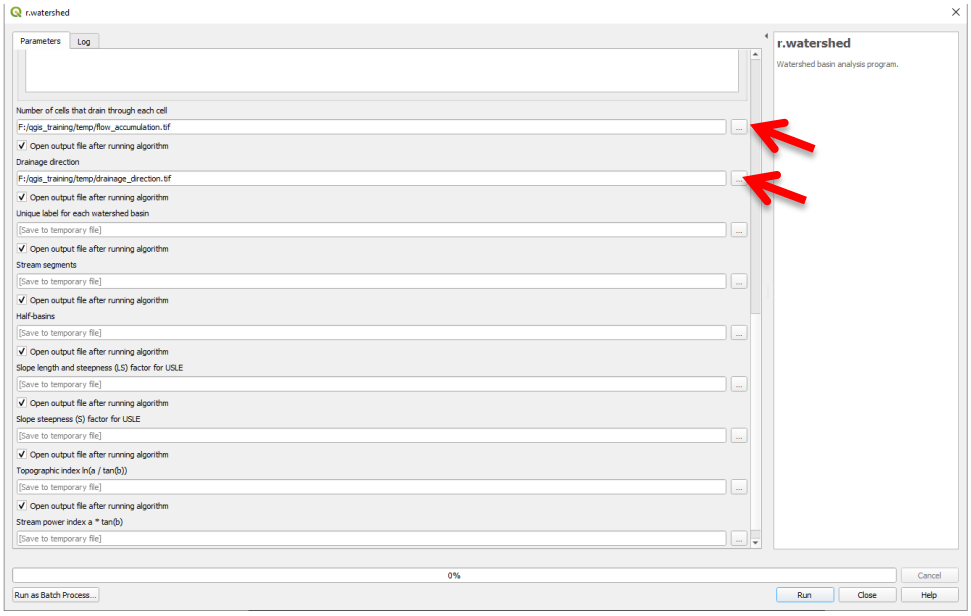
Enable Single Flow Direction (D8) - Check the box.



16. **Number of cells that drain through each cell** - Select a directory and name for the accumulation raster as **flow_accumulation.tif**.

Drainage direction - Select a directory and name for the direction raster as **drainage_direction.tif**.

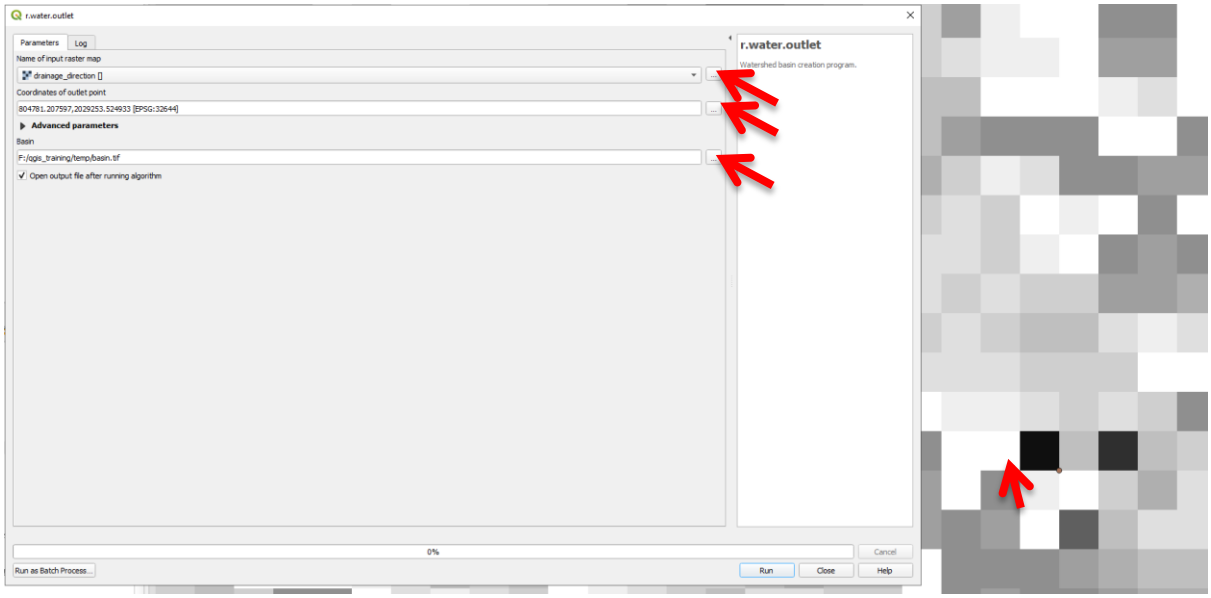
Click **Run**.



17. In order to delineate the basin open the tool **r.water.outlet**, determine the exit point in the drainage direction raster (which shows the “water network”).

18. Add the **outlet_point.shp** from the training folder. Click **Layer→ Add Layer→Add Vector Layer**

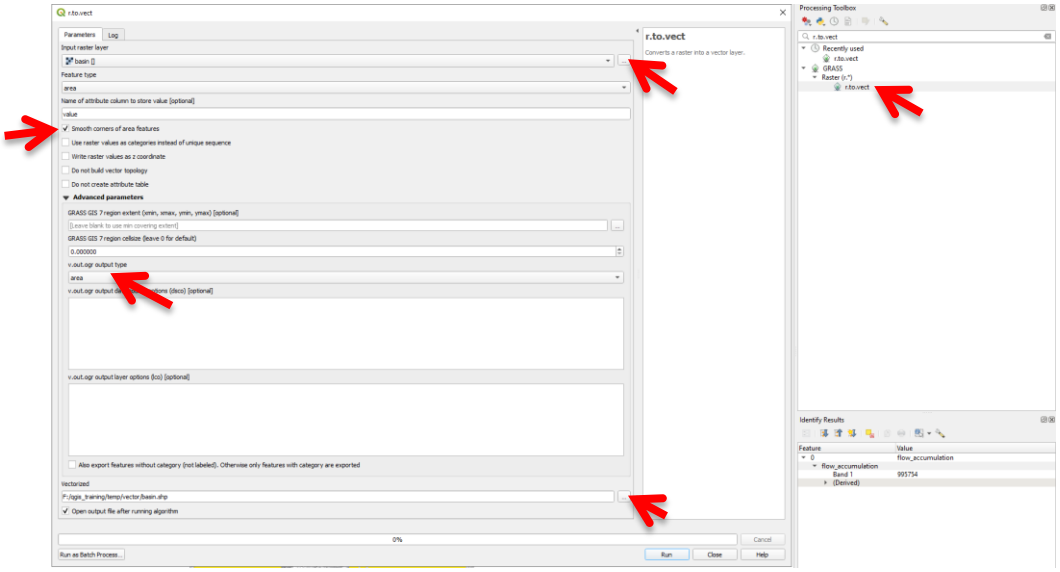
19. In the Name of **input raster map** field, select the **drainage_direction.tif**, and in Coordinates of outlet point, select the coordinate of the outlet point of the basin (you can add it directly with the marker that comes with the tool and select the outlet location near to the outlet_point.shp). Save the output file as **basin.tif**. Click **Run**.



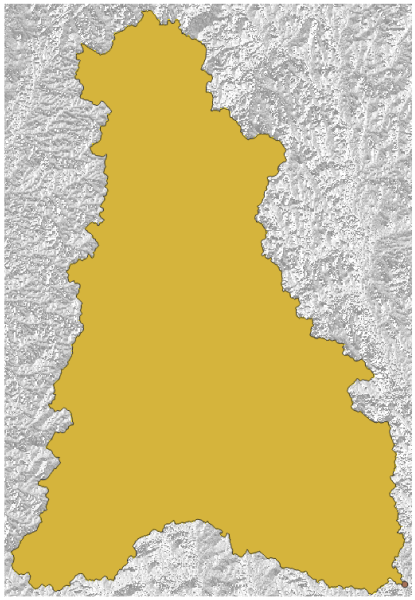
20. *Basin raster generated*.

21. To obtain the polygon of the basin, it is only necessary to convert the raster to a polygon type vector (shapefile), this can be done with the **r.to.vect** tool.

Under **Input raster layer** select the raster **basin.tif**, check the **box Smooth corners of area features** to give a smoothing to the edges, and under **Advanced parameters** → **v.out.ogr** select **area**. In the last field (**vectorized** tab), save the polygon in shapefile (**basin.shp**) format.



22. The basin polygon is generated.



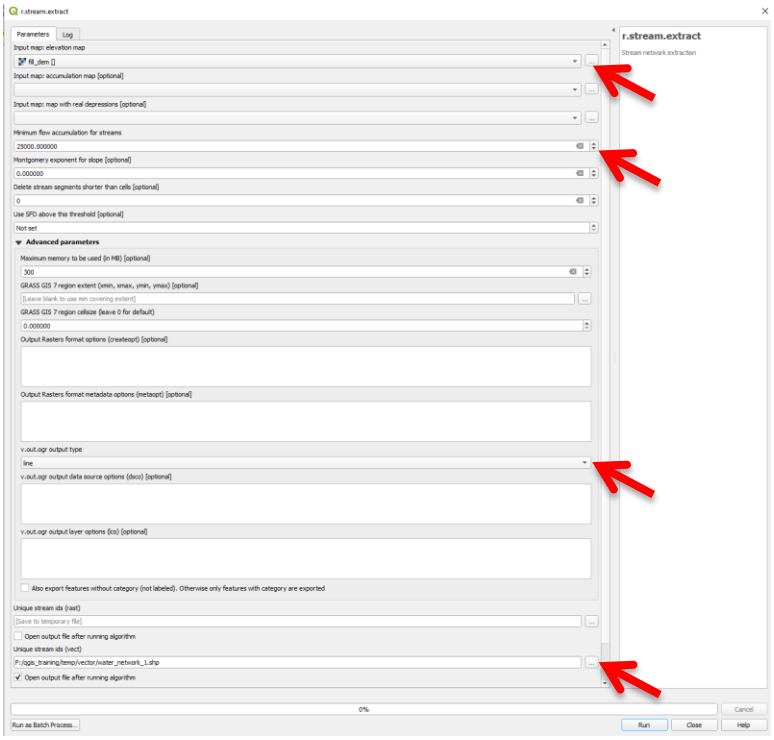
23. To obtain the vector of the water network use the **r.stream.extract** tool.

Input map - elevation map - Select from the corrected DEM (**fill_dem.tif**)

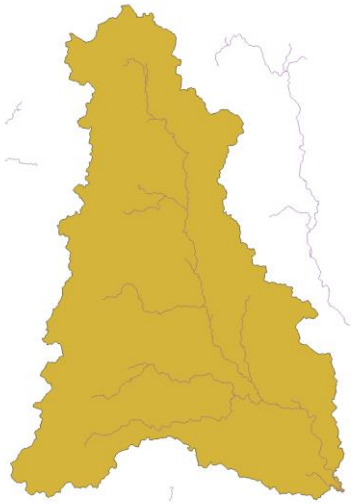
Minimum flow accumulation for streams - Select a value to set the density of the water network, in this example 25000 is used, but it can be increased or decreased (this value depends on the size of the raster pixel, if you need to decrease the density you must increase the value or vice versa, this can also be done with a raster calculator).

Advanced parameters - v.out.ogr - select line.

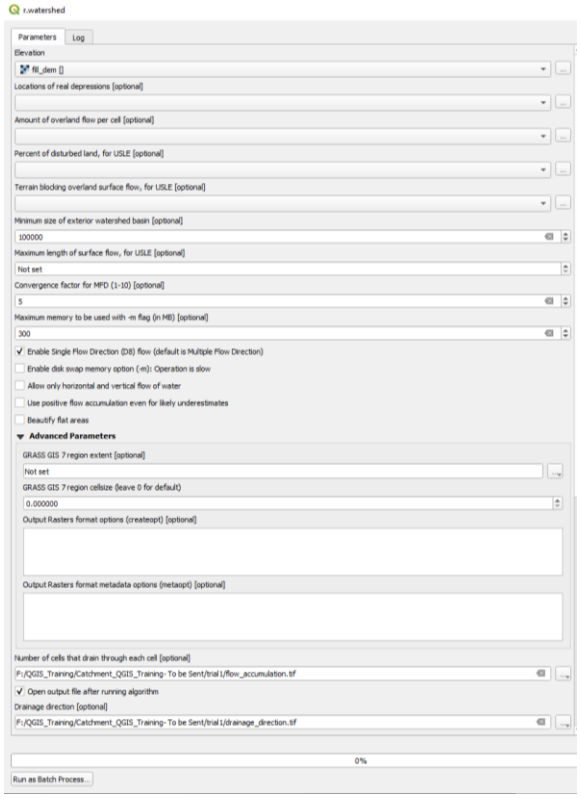
Unique streams ids (vect) -Select a directory and name for the water network vector.

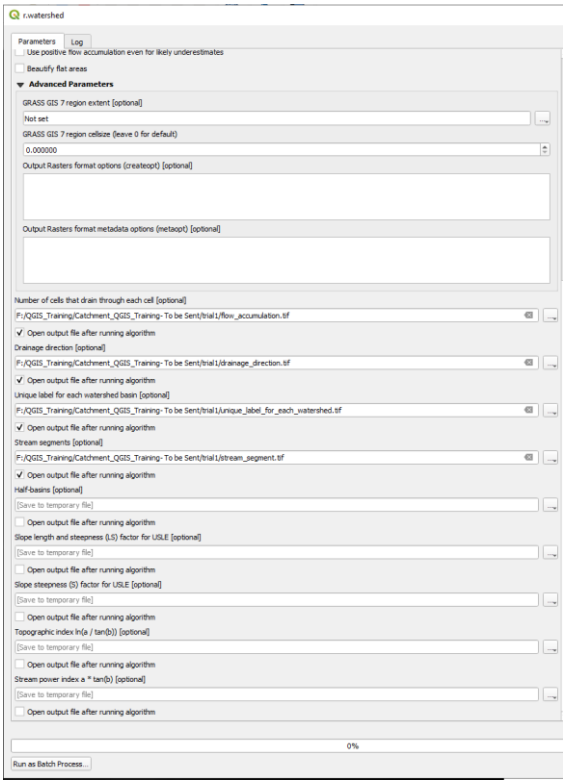


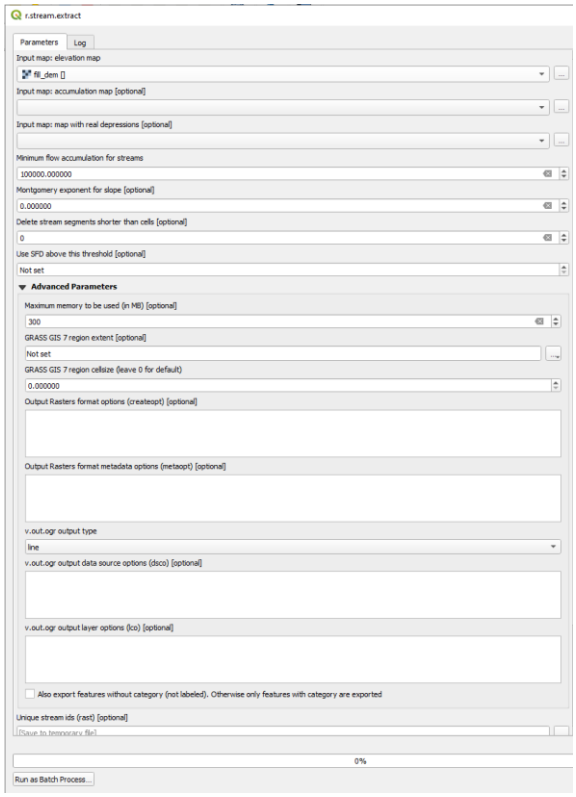
24. Final stream network is generated.

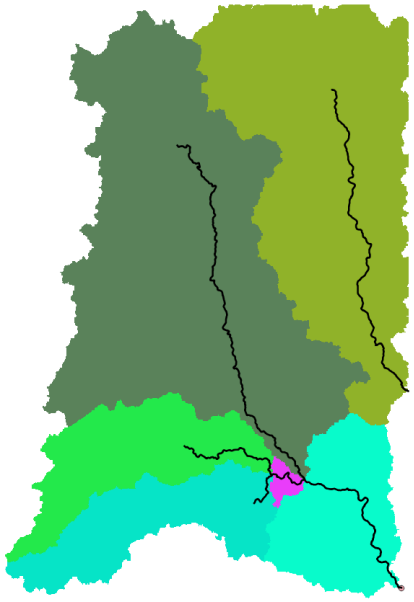


25. In order to delineate individual sub basins, the value of minimum size of exterior watershed basin has to be changed accordingly. Repeat step 23.

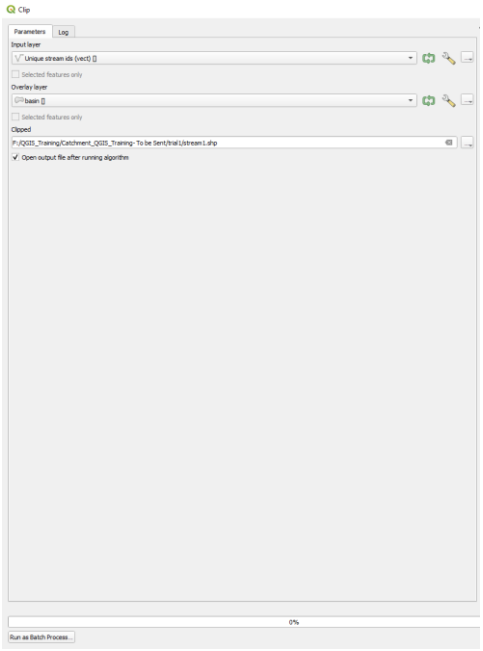

r.watershed
Parameters
Log
Elevation
fill_dem []
Locations of real depressions [optional]
Amount of overland flow per cell [optional]
Percent of disturbed land, for USLE [optional]
Terrain blocking overland surface flow, for USLE [optional]
Minimum size of exterior watershed basin [optional]
100000
Maximum length of surface flow, for USLE [optional]
Not set
Convergence factor for MFD (1-10) [optional]
5
Maximum memory to be used with -m flag (in MB) [optional]
300
Enable Single Flow Direction (D8) flow (default is Multiple Flow Direction)
Enable disk swap memory option (-m): Operation is slow
Allow only horizontal and vertical flow of water
Use positive flow accumulation even for likely underestimates
Beautify flat areas
Advanced Parameters
GRASS GIS 7 region extent [optional]
Not set
GRASS GIS 7 region cellsize (leave 0 for default)
0.000000
Output Rasters format options (createopt) [optional]
Output Rasters format metadata options (metaopt) [optional]
Number of cells that drain through each cell [optional]
F:/QGIS_Training/Catchment_QGIS_Training- To be Sent/trial1/flow_accumulation.tif
Open output file after running algorithm
Drainage direction [optional]
F:/QGIS_Training/Catchment_QGIS_Training- To be Sent/trial1/drainage_direction.tif
0%
Run as Batch Process...

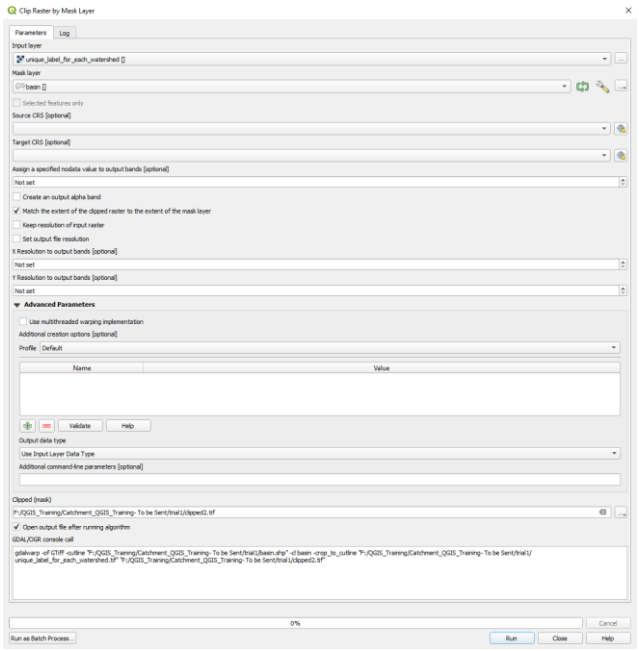

r.watershed
Parameters
Log
Use positive flow accumulation even for likely underestimates
Beautify flat areas
Advanced Parameters
GRASS GIS 7 region extent [optional]
Not set
GRASS GIS 7 region cellsize (leave 0 for default)
0.000000
Output Rasters format options (createopt) [optional]
Output Rasters format metadata options (metaopt) [optional]
Number of cells that drain through each cell [optional]
F:/QGIS_Training/Catchment_QGIS_Training- To be Sent/trial1/flow_accumulation.tif
Open output file after running algorithm
Drainage direction [optional]
F:/QGIS_Training/Catchment_QGIS_Training- To be Sent/trial1/drainage_direction.tif
Open output file after running algorithm
Unique label for each watershed basin [optional]
F:/QGIS_Training/Catchment_QGIS_Training- To be Sent/trial1/unique_label_for_each_watershed.tif
Open output file after running algorithm
Stream segments [optional]
F:/QGIS_Training/Catchment_QGIS_Training- To be Sent/trial1/stream_segment.tif
Open output file after running algorithm
Half-basins [optional]
[Save to temporary file]
Open output file after running algorithm
Slope length and steepness (LS) factor for USLE [optional]
[Save to temporary file]
Open output file after running algorithm
Slope steepness (S) factor for USLE [optional]
[Save to temporary file]
Open output file after running algorithm
Topographic index ln(a / tan(b)) [optional]
[Save to temporary file]
Open output file after running algorithm
Stream power index a * tan(b) [optional]
[Save to temporary file]
Open output file after running algorithm
0%
Run as Batch Process...


r.stream.extract
Parameters
Log
Input map: elevation map
fill_dem []
Input map: accumulation map [optional]
Input map: map with real depressions [optional]
Minimum flow accumulation for streams
100000.000000
Montgomery exponent for slope [optional]
0.000000
Delete stream segments shorter than cells [optional]
0
Use SFD above this threshold [optional]
Not set
Advanced Parameters
Maximum memory to be used (in MB) [optional]
300
GRASS GIS 7 region extent [optional]
Not set
GRASS GIS 7 region cellsize (leave 0 for default)
0.000000
Output Rasters format options (createopt) [optional]
Output Rasters format metadata options (metaopt) [optional]
v.out.ogr output type
line
v.out.ogr output data source options (dsco) [optional]
v.out.ogr output layer options (lco) [optional]
Also export features without category (not labeled). Otherwise only features with category are exported
Unique stream ids (rast) [optional]
[Save to temporary file]
0%
Run as Batch Process...



26. Clip the **unique_label_for_each_watershed** and **stream** using Basin shapefile that was generated in step 22.





27. Convert the clipped sub-basin raster into vector.