

Modeling Ecosystem Services and Natural Capital using InVEST model

Hands on Training Manual

Project: Empowering Civil Society and Governmental Agencies to Mainstream Biodiversity and Ecosystem Service Values into Development Plans for the Chindwin River Basin, Myanmar



Training Manual

Disclaimer

The manual is developed based on the InVEST model manual and open data sources. This manual is provided to key stakeholders of the Chindwin Biodiversity and Ecosystem Services (CBES) Project with the express knowledge and understanding that the Authors will not be responsible or in any way liable for the results of any act done or omitted to be done on the basis of information contained in this manual, nor for any errors or omissions in the said information. The authors expressly disclaim all and any liability for any loss or damage which resulting by any person in the use of this information in this manual.

Table of Content

Introduction	4
Background of case study used in exercise	5
Exercise 1: Getting Started	6
Downloading and installing InVEST model	6
Water Yield	7
Theory	7
Running the model	8
Output files	10
Sediment Delivery Ration.....	11
Theory	11
Running the model	12
Output files	14
Nutrient Retention	15
Theory	15
Running the model	16
Output files	18
Carbon Storage.....	19
Theory	19
Running the model	19
Output files	21

Introduction

Ecosystems produce a range of services that are vital to human wellbeing. These services include the production of goods (e.g. food), life support processes (e.g. water purifications), and life-fulfilling conditions (e.g., beauty, opportunities for recreation), and the maintenance of biodiversity (e.g., genetic diversity for future use). Collectively these services are often referred to as natural capital and are often taken for granted that has resulted in degradation and depletion associated with anthropogenic activities. The challenge that we face as a global community is how do we effectively manage this critical resource in a sustainable manner that ensures the continued provisioning and supply of these goods and services.

Integrated Valuation of Ecosystem Services and Tradeoff (InVEST) is an open-source software model used to map and value goods and services from nature that sustain and fulfill human life. InVEST models are spatially-explicit, using maps as information sources and producing maps as outputs. InVEST returns results in either biophysical terms (e.g., tons of carbon sequestered) or economic terms (e.g., net present value of that sequestered carbon).

The software enables decision makers to assess quantified tradeoffs associated with alternative management choices and to identify areas where investment in natural capital can enhance human development and conservation. The toolset currently includes eighteen distinct ecosystem service models designed for terrestrial, freshwater, marine, and coastal ecosystems, as well as a number of “helper tools” to assist with locating and processing input data and with understanding and visualizing outputs. For more information please visit <https://www.naturalcapitalproject.org/invest/>

This manual will provide hands on training on mapping and valuing ecosystem services related to water yield, sediment retention, nutrient retention and carbon storage services using the Chindwin River Basin (CRB) as a worked example. The tool can be run independently or as a script tool in ArcGIS Arc ToolBox environment. This manual will demonstrate how to run the model independently. We will be using QGIS to view the results and basic skills in GIS is prerequisite.

Example data for the exercise can be found inside the folder **Data**. The folder contains the following files:

Data files for the training:

- *CRB_outline.shp*: Vector file of CRB
- *CRB_subbasin.shp*: Vector file of CRB and sub-basin
- *DEM.tif*: Raster file of Digital Elevation Model of CRB
- *ET0.tif*: Raster file of Reference Evapotranspiration of CRB
- *Rainfall_Annual.tif*: Raster file of annual rainfall of CRB
- *Root_depth.tif*: Raster file of Depth to Root restricting layer of CRB
- *PAWF.tif*: Raster file of plant available water fraction of CRB
- *LULC.tif*: Raster file of Landuse/Landcover of CRB
- *Rain_erosivity.tif*: Raster file of Rainfall erosivity Index of CRB
- *Soil_erodibility.tif*: Raster file of Soil erodibility of CRB
- *Biotable_water.csv*: Biophysical table for water yield model
- *Biotable_SDR.csv*: Biophysical table for sediment delivery model
- *Biotable_NDR.csv*: Biophysical table for nutrient delivery model
- *Biotable_C.csv*: Biophysical table for carbon storage model

Case study: Chindwin River Basin

The Chindwin River Basin (CRB) in Myanmar is located in the North Western part of the country situated between 21° 30' and 27° 15' N Latitude and between 93° 30' and 97° 10' E Longitude. The catchment spans over 46 townships in 4 regions namely, Sagaing, Kanchin, Chin and Magway covering an area of 113,800 km². The annual average flow of the Chindwin River is 4,500 m³/s.

The Chindwin is the largest tributary of the Ayeyarwady contributing approximately 40% to its average annual flow. The average rainfall over the catchment varies from 1500-4200 mm and the temperature ranges from 23°C in the upper part to 28°C in the lower part of the basin.

About 84 percent of the basin is covered by forest and shrubs followed by other land covers that include agriculture and water bodies (**Figure 1**) (**Table 1**: Legend for Landuse map used for exercise). About 17% of the basin is covered by agriculture where rice, wheat, maize, millets, groundnut, sesame, pulses and vegetables are cultivated. About six million people depend upon the natural resources and ecological services of the basin for meeting essential needs such as drinking water, food and fuel as well as livelihoods, including fisheries, navigation and tourism.

The basin also houses 14 Key Biodiversity Area designated by the International Union for Conservation of Nature (IUCN) which are home to over 38 globally threatened species. The Chindwin river provides freshwater for people, environment and economic development in the basin. The forest of the Chindwin stores million tons of carbon and helps to retains millions of tons of sediment and nutrients supporting and regulating different ecosystem services.

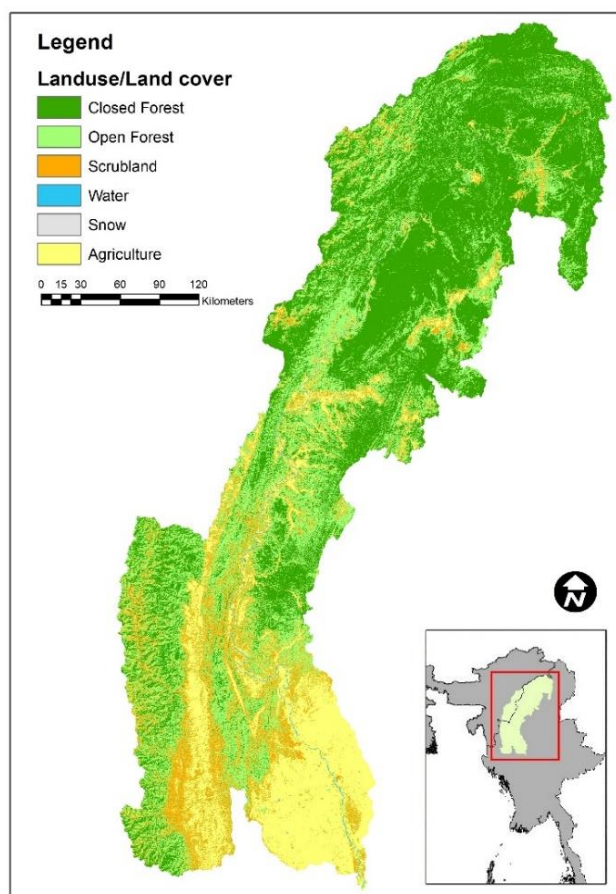


Figure 1: Landuse/Land Cover in Chindwin River Basin

Table 1: Legend for Landuse map used for exercise

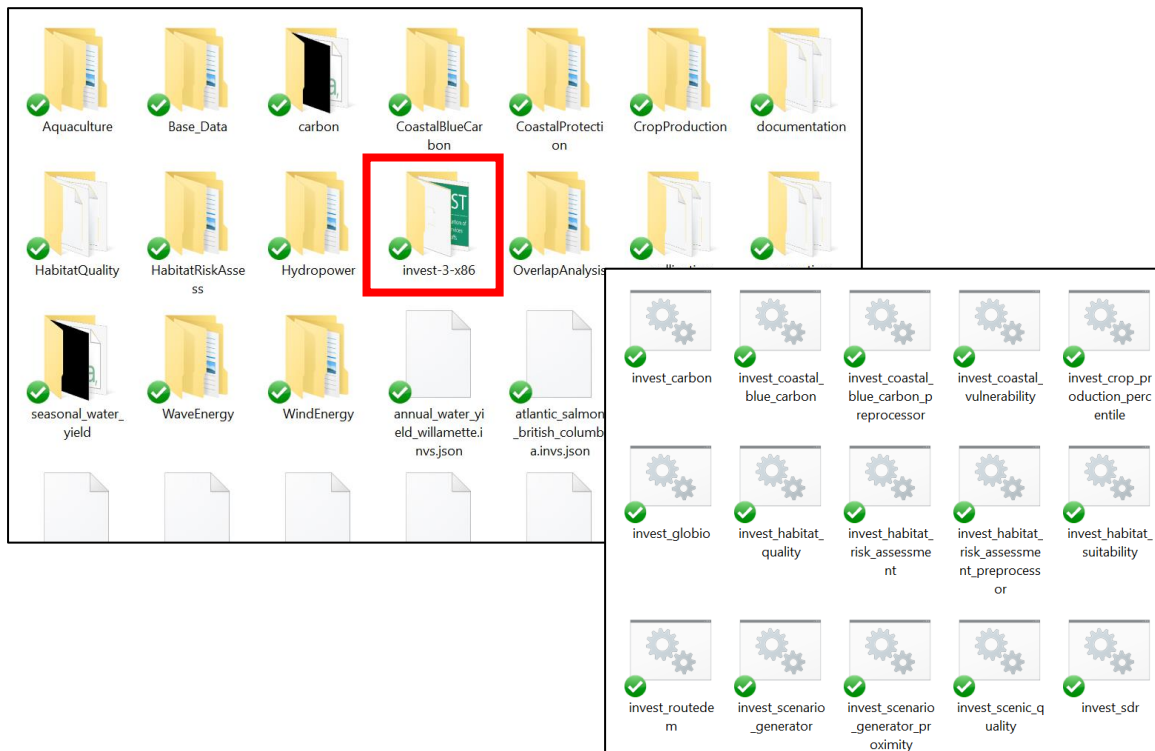
Landuse class)	Percentage of area	Value in the GIS file
Closed Forest	42.80%	1
Open Forest	28.99 %	2
Scrubland	11.51%	3
Water	0.33%	4
Snow	0.01%	5
Agriculture	16.38%	6

Exercise 1: Getting Started

Downloading and installing InVEST model

The InVEST model was developed by Stanford University, the Chinese Academy of Sciences, the University of Minnesota, The Nature Conservancy, and the World Wildlife Fund under the Natural Capital Project (<https://www.naturalcapitalproject.org/>). The InVEST model can be downloaded using the link <https://www.naturalcapitalproject.org/invest/>. Download the software compatible for your operating system. Once the download is completed, install InVEST in a folder of your choice.

Once installation is complete you will see a number folders and files (see screenshot below). Each folder is named after ecosystem model which consists of an example input data. The executing file for each of the ecosystem services is under *invest-3-x86* folder.



Water Yield

Theory

Water yield is the amount of water produced by a basin. Provision of fresh water is an ecosystem services that contributes to the welfare of society in many ways like drinking water, water for agriculture, hydropower and other regulating services.

The Water Yield model runs on a gridded map and determines the amount of water running in each pixel as the water remaining after removing evapotranspiration. The model however, does not differentiate between surface, subsurface and baseflow, but assumes that all water yield from a pixel reaches the point of interest via one of these pathways.

The water yield model is based on the Budyko curve and annual average precipitation. The annual water yield is determined ($Y(x)$) for each pixel on the landscape x as follows:

$$Y(i) = \left(1 - \frac{AET(i)}{P(i)}\right) \cdot P(i)$$

Where, $AET(i)$ is the annual actual evapotranspiration and $P(i)$ is the annual precipitation for pixel i .

$\frac{AET(i)}{P(i)}$ for a vegetated LULC is based on Budyko curve proposed by Fu (1981) and Zhang et al. (2004):

$$\frac{AET(i)}{P(i)} = 1 + \frac{PET(i)}{P(i)} - \left[1 + \left(\frac{PET(i)}{P(i)}\right)^\omega\right]^{\frac{1}{\omega}}$$

where $PET(i)$ is the potential evapotranspiration and $\omega(i)$ is a non-physical parameter

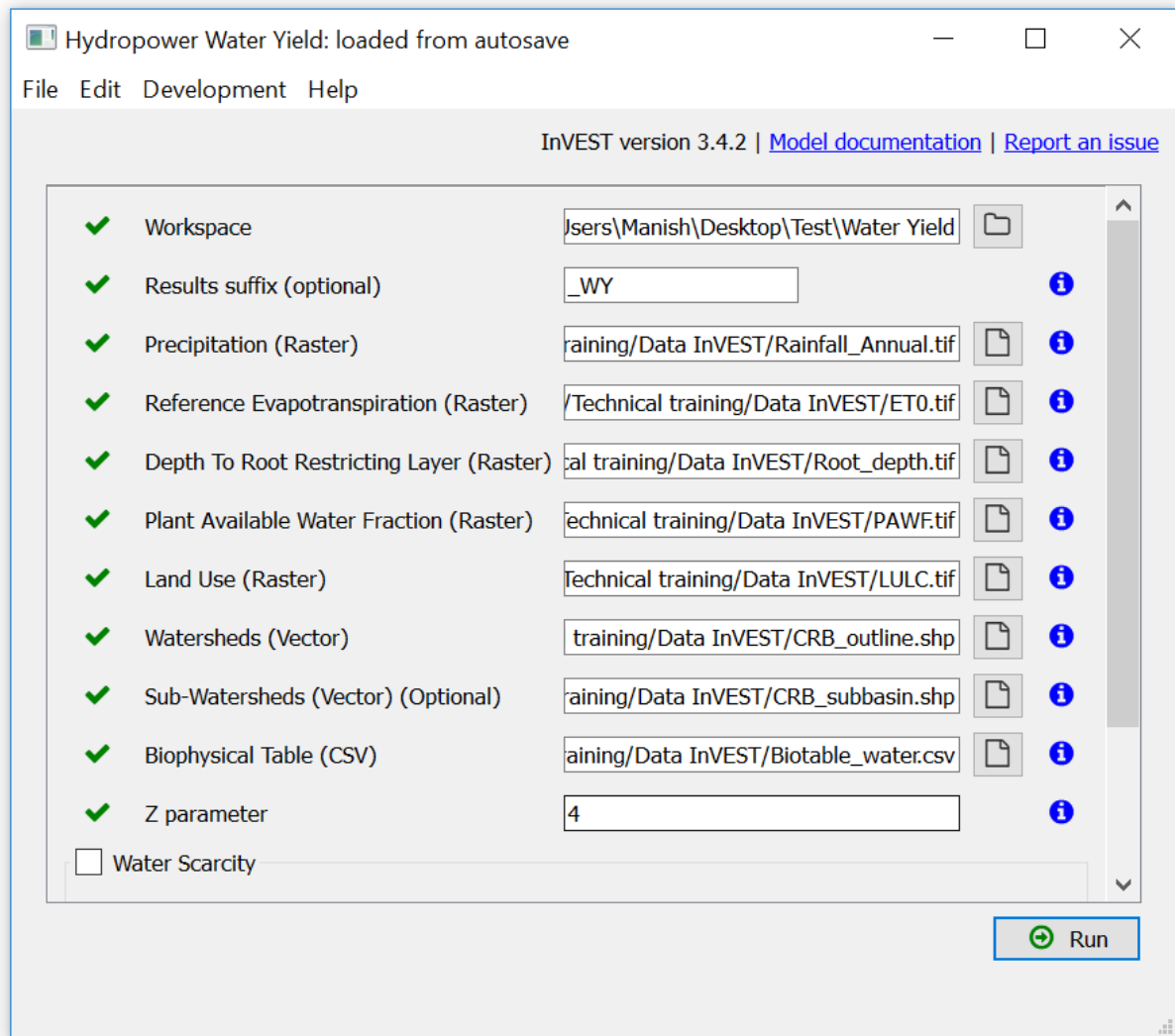
$\omega(x)$ is an empirical parameter that can be calculated as

$$\omega(i) = Z \frac{AWC(i)}{P(i)} + 1.25$$

where $AWC(i)$ is the plant available water content and Z is an empirical constant and can be used as the calibration parameter.

Running the model

- The water yield model can be found in *invest-3-x86 >> invest_hydropower_water_yield*. Double click on the file and the following dialog box will appear.



- Click on folder icon and browse the data file and input the files shown in Table 2 to corresponding tab. If the correct format is selected, a green tick mark will appear. All the files can be found inside the *Data_InVEST* folder.
- Click on Run

Table 2: Data and value for water yield model

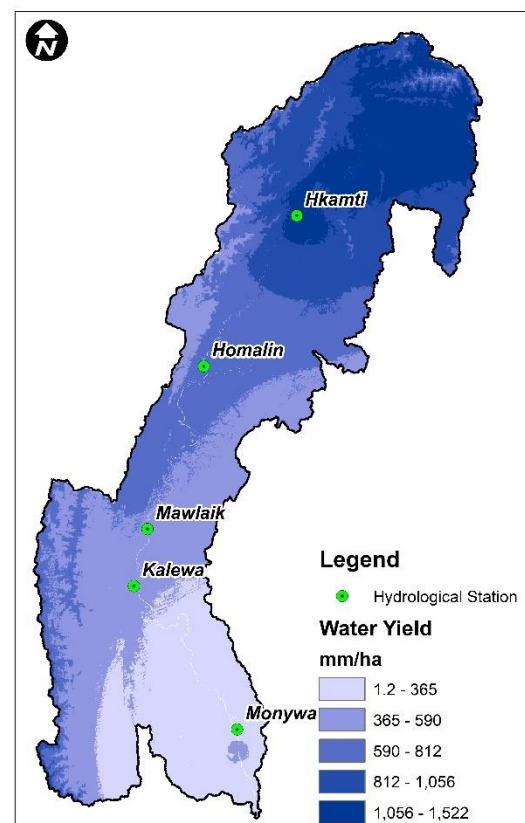
Water yield model input	File Name/Value	Remarks
Workspace	Water Yield	
Result suffix (optional)	_WY	All generated result files will have _WY suffix
Precipitation (Raster)	Rainfall_Annual.tif	Precipitation value in mm
Reference Evapotranspiration (Raster)	ET0.tif	Calculated using Thornthwaite method. Value in mm.
Depth To Root restricting layer (Raster)	Root_depth.tif	Derived from the Harmonized World Soil Database , and guidance table in the InVEST user guide about assigning K values based on % organic matter in different USDA soil classes
Plant Available Water Fraction (Raster)	PAWF.tif	Obtained by dividing Available Water Content by soil depth. Values derived from Harmonized World Soil Database
Land use (Raster)	LULC.tif	Custom map developed by WWF from Google Earth Engine (2013-2014), where agriculture is defined by administrative district, 150m resolution
Watersheds (Vector)	CRB_outline.shp	Chindwin River Basin Myanmar territory only
Sub watersheds (Vector) (Optional)	CRB_subbasin.shp	22 Sub basins including Myanmar territory only
Biophysical table (CSV)	Biotable_water.csv	The maximum root depth (mm) was obtained from Canadell et al (1996) K _c values derived from the Harmonized World Soil Database , and guidance table in the InVEST user guide about assigning K values based on % organic matter in different USDA soil classes (Table 2)
Z parameter	4	Z is an empirical constant and can be used as a calibrating parameter

Output files

The results of the simulation can be found in the workspace you specified. Various results are generated that include final products along with a range of intermediate products. The major output files are as follows:

- *aet_WY.tif*: Estimated actual evapotranspiration per pixel (mm)
- *wyield_WY.tif*: Estimated water yield per pixel (mm)
- *subwatershed_results_wyield_WY.shp* and *subwatershed_results_wyield_WY.csv*: Shapefile and table containing biophysical output values per subwatershed, with the following attributes:
 - *precip_mn (mm)*: Mean precipitation per pixel on the sub-watershed.
 - *PET_mn (mm)*: Mean potential evapotranspiration per pixel on the subwatershed.
 - *AET_mn (mm)*: Mean actual evapotranspiration per pixel on the subwatershed.
 - *wyield_mn (mm)*: Mean water yield per pixel on the sub-watershed.
 - *num_pixels*: Number of pixels per sub-watershed.
 - *wyield_vol (m3)*: Volume of water yield in the sub-watershed.
 - *wyield_ha (m3)*: Volume of water yield in the sub-watershed per hectare.
- *watershed_results_wyield_WY.shp* and *watershed_results_wyield_WY.csv*: Shapefile and table containing output values per watershed:
 - *precip_mn (mm)*: Mean precipitation per pixel on the watershed.
 - *PET_mn (mm)*: Mean potential evapotranspiration per pixel on the watershed.
 - *AET_mn (mm)*: Mean actual evapotranspiration per pixel on the watershed.
 - *wyield_mn (mm)*: Mean water yield per pixel on the watershed.
 - *num_pixels*: Number of pixels per watershed.
 - *wyield_vol (m3)*: Volume of water yield in the watershed.
 - *wyield_ha (m3)*: Volume of water yield in the watershed per hectare.

The model simulates the data in an annual average time step. The value from *wyield_vol* (m³) should be compared to observed gauge data at the watershed outlet if available for calibration. The observed data are often in m³/s which needs to be converted to m³/year. Calibration of the model should be performed using long term average streamflow. The empirical constant, Z is often used as a calibrating parameter.



Sediment Delivery Ratio

Theory

Erosion and overland sediment retention are natural processes that govern the sediment concentration in streams. climate (in particular the rain intensity), soil properties, topography, vegetation and anthropogenic factors have a huge role in sediment erosion in a basin. Excessive sediment effecting the water quality and reservoir management. The sediment retention service provided by natural landscapes is of great interest to natural resource managers.

The InVEST Sediment Delivery Ratio (SDR) module calculates the amount of soil that is eroded from a landscape and amount that reaches waterways. For each cell, the model first calculates the amount of soil loss based on the Revised Universal Soil Loss Equation (USLE) and then the sediment delivery ratio proposed by Borselli et. al., 2008. The total catchment sediment load is calculated by summing up the values of each pixel.

The amount of annual soil loss per pixel i (tones/ha/year):

$$usle_i = R_i \cdot K_i \cdot LS_i \cdot C_i \cdot P_i$$

Where, R = rainfall/runoff erosivity factor (MJ mm/ha/h per year), K = soil erodibility factor ((ton/ha)/(MJ mm)), LS = slope length factor, C = cover management factor, and P = supporting practices factor

SDR is then calculate using

$$SDR_i = \frac{SDR_{max}}{1 + \exp\left(\frac{IC_o - IC_i}{K}\right)}$$

Where, IC is the connectivity index. SDR_{max} , IC and K are the calibration parameters.

The total sediment load from each pixel is then calculated as

$$E_i = usle_i \cdot SDR_i$$

Running the model

- The sediment delivery model can be found in *invest-3-x86 >> invest_sdr*. Double click on the file and following dialog box will appear.

Sediment Delivery Ratio Model (SDR): loaded from autosave

File Edit Development Help

InVEST version 3.4.2 | [Model documentation](#) | [Report an issue](#)

✓ Workspace	C:\Users\Manish\Desktop\Test\SDR		
✓ Results suffix (optional)	_SDR		
✓ Digital Elevation Model (Raster)	/18 Capacity Building/Technical training/Data InVEST/DEM.tif		
✓ Rainfall Erosivity Index (R) (Raster)	city Building/Technical training/Data InVEST/Rain_erosivity.tif		
✓ Soil Erodibility (Raster)	city Building/Technical training/Data InVEST/Soil_erodibility.tif		
✓ Land-Use/Land-Cover (Raster)	/18 Capacity Building/Technical training/Data InVEST/LULC.tif		
✓ Watersheds (Vector)	ty Building/Technical training/Data InVEST/CRB_subbasin.shp		
✓ Biophysical Table (CSV)	city Building/Technical training/Data InVEST/Biotable_SDR.csv		
✓ Threshold Flow Accumulation	10000		
Drainages (Raster) (Optional)			
✓ Borselli k Parameter	2.4		
✓ Borselli IC0 Parameter	0.5		
✓ Max SDR Value	0.8		

Run

- Click on folder icon and browse the data file and input the files shown in Table 3 to corresponding tab. If the correct format is selected, a green tick mark will appear. All the files can be found inside the *Data_InVEST* folder.
- Click on Run

Table 3: Data and value for sediment delivery ration model

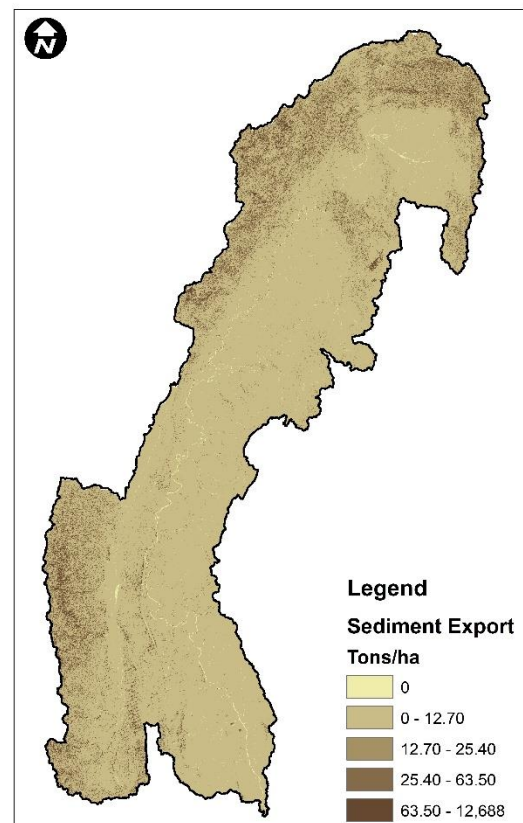
Sediment model input	File Name/Value	Remarks
Workshop	SDR	
Results suffix (optional)	_SDR	
Digital elevation model (Raster)	DEM.tif	SRTM 90m DEM
Rainfall Erosivity Index (R) (Raster)	Rain_erosivity.tif	Derived from annual SimCLIM precipitation, using the equation $R = 38.5 + 0.35 * P$ where R is rainfall erosivity (10 MJ-mm/ha-h-yr) and P is annual mean precipitation (mm/yr) Thang et al. (2005)
Soil erodibility (Raster)	Soil_erodibility.tif	Derived from the Harmonized World Soil Database , and guidance table in the InVEST user guide on assigning K values based on % organic matter in different USDA soil classes
Land-use/Land cover (Raster)	LULC.tif	Custom map developed by WWF from Google Earth Engine (2013-2014), where agriculture is defined by administrative district, 150m resolution
Watersheds (Vector)	CRB_subbasin.shp	Chindwin River Basin
Biophysical table	Biotable_SDR.csv	Values for USLE C and P derived from various sources
Threshold flow accumulation	10000	
Borselli K parametera	2.4	
Borselli IC ₀ Parameter	0.5	
Max SDR Value	0.5	

Output files

The results of the simulation can be found in the workspace specified. Various results are generated including final and intermediate products. The major output files are as follows:

- *sed_export_SDR*: The total amount of sediment exported from each pixel that reaches the stream (tons/pixel)
- *sed_retention_SDR.tif*: Map of sediment retention with reference to a bare watershed (tons/pixel)
- *watershed_results_sdr_SDR*: Shapefile containing biophysical output values per sub-watershed, with the following attributes:
 - *sed_export* (tons/watershed): Total amount of sediment exported to the stream per watershed.
 - *usle_tot* (tons/watershed): Total amount of potential soil loss in each watershed calculated by the USLE equation.
 - *AET_mn* (mm): Mean actual evapotranspiration per pixel on the sub-watershed.
 - *sed_retention* (tons/watershed): Difference in the amount of sediment delivered by the current watershed and a hypothetical watershed where all land use types have been cleared to bare soil.

Value of *sed_export* should be compared to any observed sediment loading at the outlet of the watershed. IC_0 and K_b are used to calibrate the model. IC_0 value is independent of landscape and in often time the model is more sensitive to K_b parameter, meaning small change in value of K_b can have larger change in value of sediment export.



Nutrient Retention

Theory

Point sources, e.g. industrial effluent or water treatment plant discharges, and non-point sources, e.g. fertilizer used in agriculture and residential areas dramatically modifies the natural nutrient cycle. Ecosystems can provide a purification service by retaining or degrading pollutants before they enter the stream. For instance, vegetation can remove pollutants by storing them in tissue or releasing them back to the environment in another form.

The nutrient retention module calculates the amount of nutrient (Nitrogen and Phosphorus) retained and exported either at watershed, sub-watershed or cell level. Initially, annual runoff is calculated for each pixel (See water yield section for more details).

In the second step, the Adjusted Loading Value (ALV_i) for each pixel is computed based on the export coefficient the user inputs (pol_i) and hydrological Sensitivity score (HSS_i).

$$ALV_i = HSS_i \cdot pol_i$$

$$HSS_i = \frac{\lambda_i}{\lambda_w}$$

Where λ_i is the runoff index at pixel i , calculated using the following equation, and λ_w is the mean runoff index in the watershed of interest.

$$\lambda_i = \log(\sum Y_u)$$

Where $\sum Y_u$ is the sum of the water yield of pixels along the flow path above pixel i (it also includes the water yield of pixel i).

Once, nutrient export for each pixel is determined, load retained by each pixel downstream can be calculated as surface runoff moves the pollutant toward the stream. The model then aggregates the loading that reaches the stream from each pixel to the sub-watershed then to the watershed level.

Running the model

- The nutrient delivery model can be found in *invest-3-x86 >> invest_ndr*. Double click on the file and the following dialog box will appear.

Nutrient Delivery Ratio Model (NDR): loaded from autosave

File Edit Development Help

InVEST version 3.4.2 | [Model documentation](#) | [Report an issue](#)

✓ Workspace	C:\Users\Manish\Desktop\Test\NDR		
✓ Results suffix (optional)	_NDR		
✓ DEM (Raster)	/18 Capacity Building/Technical training/Data InVEST/DEM.tif		
✓ Land Use (Raster)	/18 Capacity Building/Technical training/Data InVEST/LULC.tif		
✓ Nutrient Runoff Proxy (Raster)	ty Building/Technical training/Data InVEST/Rainfall_Annual.tif		
✓ Watersheds (Vector)	ty Building/Technical training/Data InVEST/CRB_subbasin.shp		
✓ Biophysical Table (CSV)	ity Building/Technical training/Data InVEST/Biotable_NDR.csv		
☒ Calculate phosphorous retention			
☒ Calculate Nitrogen Retention			
✓ Threshold Flow Accumulation	10000		
✓ Borselli k Parameter	2.4		
✓ Subsurface Critical Length (Nitrogen)	90		
✓ Subsurface Critical Length (Phosphorous)	90		
✓ Subsurface Maximum Retention Efficiency (Nitrogen)	0.8		
✓ Subsurface Maximum Retention Efficiency (Phosphorous)	0.8		

Run

- Click on folder icon and browse the data file and input the files shown in Table 4 to corresponding tab. If the correct format is selected, a green tick mark will appear. All the files can be found inside the *Data_InVEST* folder.
- Click on Run

Table 4: Data and value for nutrient retention module

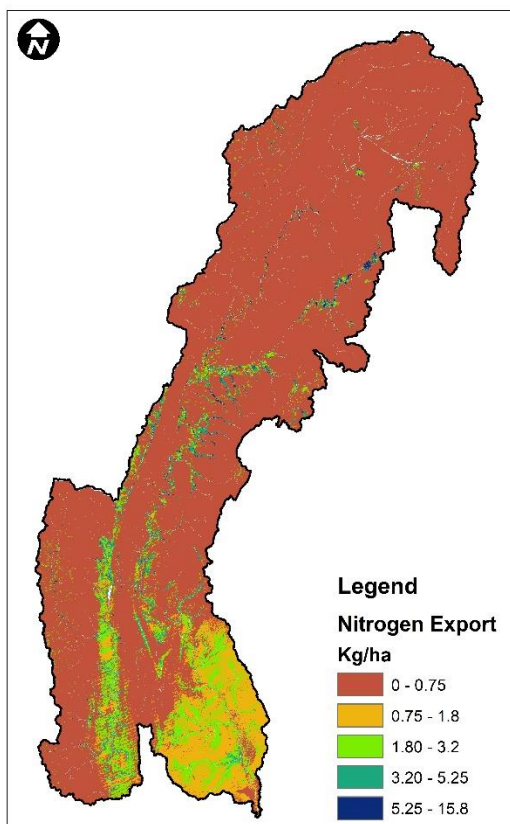
Nutrient model input	File Name/Value	Remarks
Workspace	NRD	
Results suffix (optional)	_NDR	
DEM (Raster)	DEM.tif	SRTM 90m DEM
Landuse (Raster)	LULC.tif	Customized map developed by WWF from Google Earth Engine (2013-2014), where agriculture is defined by administrative district, 150m resolution
Nutrient runoff proxy	Rainfall_Annual.tif	From annual SimCLIM precipitation in mm
Watersheds (Vector)	CRB_subbasin.shp	22 Sub basins including Myanmar territory only
Biophysical table (CSV)	Biotable_NDR.csv	Values for root depth, load_n, load_p, eff_n and eff_p derived from various sources
Calculate phosphorous retention	Check box	
Calculate nitrogen retention	Check box	
Threshold flow accumulation value	10000	
Borselli k parameter	2.4	
Subsurface Critical Length (Nitrogen or phosphorus)	90	
Subsurface Retention Efficiency (Nitrogen or phosphorus)	0.8	

Output files

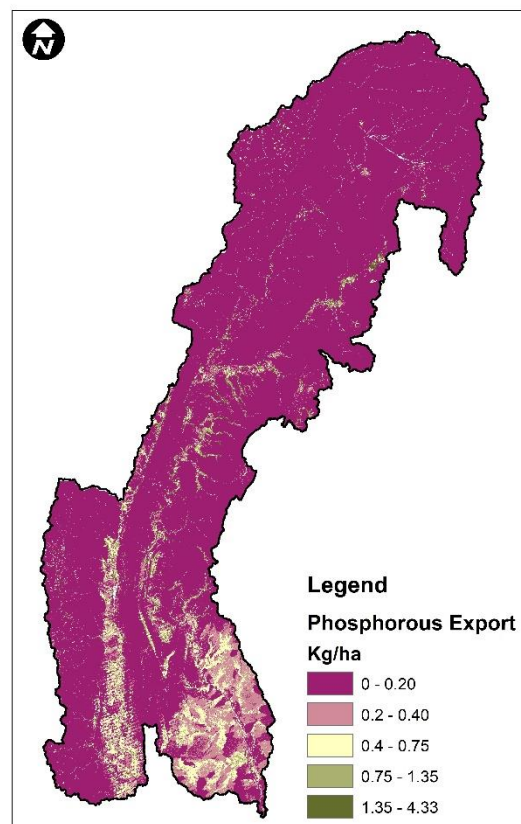
The results of the simulation can be found in the workspace specified. Various results are generated including final and intermediate products. The major output files are as follows:

- *n_export_NDR.tif*: A pixel level map showing how much nitrogen load from each pixel eventually reaches the stream (kg/pixel).
- *p_export_NDR.tif*: A pixel level map showing how much phosphorous load from each pixel eventually reaches the stream (kg/pixel).
- *watershed_results_ndr_NDR*: Shapefile containing biophysical output values per sub-watershed, with the following attributes:
 - *p_load_tot* (Kg/year): total phosphorous loads in the watershed, i.e. the sum of the phosphorous nutrient contribution from all LULC without filtering from the landscape.
 - *p_exp_tot* (kg/year): total phosphorous export from the watershed.
 - *n_load_tot* (Kg/year): total nitrogen loads in the watershed, i.e. the sum of the nitrogen nutrient contribution from all LULC without filtering from the landscape.
 - *n_exp_tot*: total nitrogen export from the watershed

Value of *p_exp_tot* and *n_exp_tot* should be compared to any observed loadings at the outlet of the watershed. Borselli *K* is used to calibrate the model which is generally the most sensitive parameter.



Nitrogen export



Phosphorous export

Carbon Storage

Theory

Terrestrial ecosystems, which store more carbon than the atmosphere, are vital to influencing carbon dioxide-driven climate change. By storing this carbon in wood, other biomass, and soil, ecosystems keep CO₂ out of the atmosphere, where it would contribute to climate change.

The InVEST Carbon Storage and Sequestration module aggregates the amount of carbon stored in four carbon pools: aboveground biomass, belowground biomass, soil, and dead organic matter according to the land use maps and classifications produced by the user. Aboveground biomass consists of all living plant material above the soil (e.g., bark, trunks, branches, leaves). Belowground biomass comprise of living root systems of aboveground biomass. Soil organic matter is the organic component of soil and represents the largest terrestrial carbon pool and the dead organic matter includes litter as well as lying and standing dead wood. A fifth optional pool includes harvested wood products such as firewood or charcoal or more long-lived products such as house timbers or furniture.

The module aggregates the carbon in each of the four pools, providing an estimate of total carbon storage in each grid cell and across the whole landscape. The carbon stored on a pixel measured in Mg of carbon is equal to the sum of the carbon stored in each pool in the pixel at time t ,

$$C = C_a + C_b + C_s + C_o + C_p$$

Where C is total Carbon stored, C_a is carbon stored above ground, C_b is carbon stored below ground, C_s is carbon stored in soil, C_o is carbon stored in dead organic matters and C_p is carbon stored as harvest wood product

Running the model

- The Carbon Storage model can be found in *invest-3-x86 >> invest_carbon*. Double click on the file and following dialog box will appear.
- Click on folder icon and browse the data file and input the files shown in Table 5 to corresponding tab. If the correct format is selected, a green tick mark will appear. All the files can be found inside the *Data_InVEST* folder.
- Click on Run

The screenshot shows the InVEST Carbon Model interface. The title bar reads "InVEST Carbon Model: loaded from autosave". The menu bar includes "File", "Edit", "Development", and "Help". The status bar indicates "InVEST version 3.4.2" with links to "Model documentation" and "Report an issue".

The main interface contains several input fields and checkboxes:

- Workspace:** A text field containing "C:\Users\HP\Desktop\Test\Carbon" with a folder icon to its right.
- Results suffix (optional):** A text field containing "_Carbon" with an information icon to its right.
- Current Land Use/Land Cover (Raster):** A text field containing "anmar 11592/18 Capacity Building/Technical training/Data InVEST/LULC.tif" with a file icon and an information icon to its right.
- Carbon Pools:** A text field containing "11592/18 Capacity Building/Technical training/Data InVEST/Biotable_C.csv" with a file icon and an information icon to its right.
- Current Landcover Calendar Year:** An empty text field with an information icon to its right.
- Calculate Sequestration:** An unchecked checkbox with an information icon to its right.
- Future Landcover (Raster):** An empty text field with a file icon and an information icon to its right.
- Future Landcover Calendar Year:** An empty text field with an information icon to its right.
- REDD Scenario Analysis:** An unchecked checkbox with an information icon to its right.
- REDD Policy (Raster):** An empty text field with a file icon and an information icon to its right.
- Run Valuation Model:** An unchecked checkbox.

A "Run" button with a green play icon is located at the bottom right of the interface.

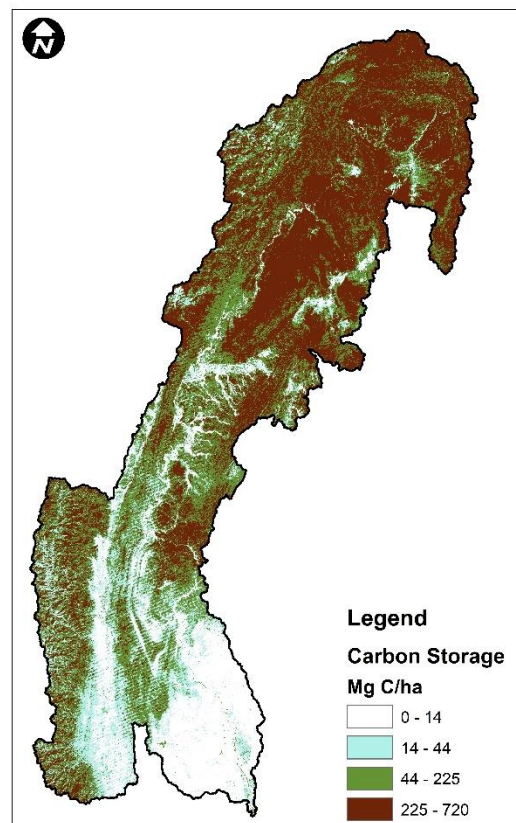
Table 5: Data and value for carbon storage module

Sediment model input	File Name	Data source/value
Workspace	Carbon	
Results suffix (optional)	_Carbon	
Current Land Use/Land Cover (Raster)	LULC.tif	Customized map developed by WWF from Google Earth Engine (2013-2014), where agriculture is defined by administrative district, 150m resolution
Carbon pools	Biotable_C.csv	Values derived from different sources. http://data.naturalcapitalproject.org/invest-releases/documentation/2_6_0/carbonstorage.html

Output files

The results of the simulation can be found in the workspace specified. Various results are generated including final and intermediate products. The main output file is shown below:

- *Tot_c_cur_C*: Raster file showing the amount of carbon stored in Mg in each grid cell. This is a sum of all the carbon pools provided by the physical table.



References:

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