STRENGTHENING CAPACITY FOR INTEGRATING ECOSYSTEM SERVICES IN THE FOREST LAND USE PLANNING PROCESS TO ENHANCE CLIMATE RESILIENCE AND POVERTY REDUCTION IN THE PHILIPPINES

Methodology Report

June 2018

White Cover Copy

Photo Cover: Left - Upper Marikina River Basin Protected Landscape (UMRBPL); upper right: Points of Interests Map of Castilla and Sorsogon City, Sorsogon; lower right: FGD in Talacogon, Agusan Del Sur

Photo Credit: DENR-WB-PROFOR Project Secretariat

Layout and Design: Ambientmedia

Acknowledgment

This Methodology Report on “Strengthening Capacity for Integrating Ecosystem Services in the Forest Land Use Planning process to enhance climate resilience and poverty reduction in the Philippines” was compiled and developed through the shared technical knowledge and experiences from the PROFOR-funded Technical Assistance I and II and the collaborative effort done by the Project Secretariat (Forest Management Bureau, Foreign-Assisted and Special Projects Service, River Basin and Control Office and The World Bank).

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CONTENTS

Background of the Report

The Department of Environment and Natural Resources (DENR) implemented the PROFOR- funded Technical Assistance (TA) on “The role of forests in reducing poverty and enhancing climate resilience: a case study of the Philippines”. Two overarching messages relating to forests and development emerged from the PROFOR PH TA I: that forests are crucial in enhancing climate resilience and forests are relevant for income and wealth because they serve as a safety net to avoid poverty and potentially increase access to economic opportunities. A follow-up study, PROFOR PH TA II (Strengthening Capacity for Integrating Ecosystem Services in the forest land use planning process to enhance climate resilience and poverty reduction in the Philippines), identified FMB’s forest land use planning (FLUP), as a critical program for highlighting the role that Forests and Forest Lands (FFL) play in providing ecosystem services

Accordingly, a major component of this TA was on capacity building of government officials at the national, regional and local levels for use of the tools and approaches introduced as part of the PROFOR-funded TA. Capacity building was done through a series of hands-on training sessions provided to government staff on the use of the tools introduced under this TA. It is anticipated that by documenting and disseminating the methods for use of these tools, that the capacity building can continue even after the TA has ended.

This methodology report on the tools used for the PROFOR study was therefore compiled as a resource for the Philippine government and civil society to support replication and upscaling. The three part report provides details and step-by-step guidance on the approaches and tools: Part 1 describes the key steps for ecosystem service modeling; Part 2 describes the key steps used for ecosystem service valuation; and in Part 3 the steps used for forest use analysis are described.

As with any methodology document, users are encouraged to apply caution in the application and adaptation of the methods to their circumstance.

Part 1
Ecosystem Services Modeling Methods

1. Introduction

Modeling ecosystem services (ES) is a procedural method that requires combined elements of technical skills, data input, and correct software to use. It requires considering among others physical and mathematical representation of ecosystem functions and processes, such as those underpinning hydrology, soil stabilization, and carbon sequestration, spatial heterogeneity of the ecosystem, temporal resolution, and required model accuracy (Hein, et.al. 2015).

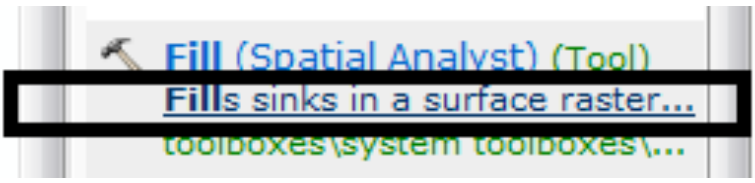
The methods used to model ES for the PROFOR study started from pre-processing of raw data up to final model results interpretation. A core modeling group equipped with a series of training and mentoring led the modeling work.

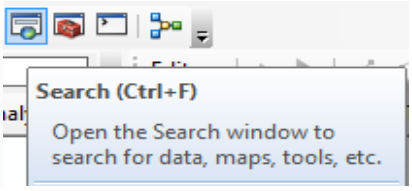
This chapter describes all methods used in ES modeling for the PROFOR study with step by step processes and guide illustrations. The chapter is divided into 6 major parts to comprehensively guide readers on how the modeling work has been done. The use of modeling software and results interpretation will be the gist of this document (how to's) and is targeted at audiences with at least basic understanding and experience of GIS/ modeling.

This chapter is accompanied by modules and templates indicated per section. The methodologies for modeling cover topics ranging from basic concepts and processing to specific ecosystem service. The software used is ArcGIS version 10.2. Other versions (10.1 or 10.3) can also be used but may have differences in the interface. The Soil and Water Assessment (SWAT) extension tool which has a separate installer was used for ES Modeling. Please access the file with the modules and templates using the following link: http://forestry.denr.gov.ph/profor/references.php.

2. Methods

All GIS operations from an ArcGIS interface are 'searchable'. Detailed descriptions of every GIS operation can be seen from the link below the command operation, for example





2.1 Pre-processing of raw data.

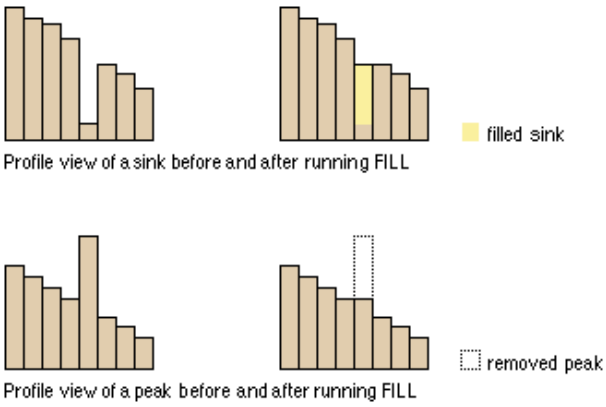
Raw data preprocessing is a data mining technique that involves any type of processing performed on a raw data for further processing, in this case, what we call modeling.

There are a number of different GIS tools and methods used for preprocessing, including: sampling, extraction clipping, denoising or filling, etc. Real world data is often incomplete, inconsistent, or is likely to contain many errors. Preprocessing is a proven method of resolving such issues.

The following are some of the methods of preprocessing of the key spatial data for modeling.

2.1.1 Digital Elevation Model (DEM). A DEM is a 3D representation of a terrain's surface, which is in a bare, void of vegetation and manmade structures. It is a representation of continuous elevation values over a topographic surface in a raster format. Forest Management Units (FMUs) or watershed boundaries are easily digitized and generated from DEMs. It can also be used to generate stream networks and stream orders that are formerly done manually using topographic maps.

The DEM should be free of sinks to avoid pits or holes that could make your DEM not topographically sound. Operate 'fill' by simply uploading DEM.

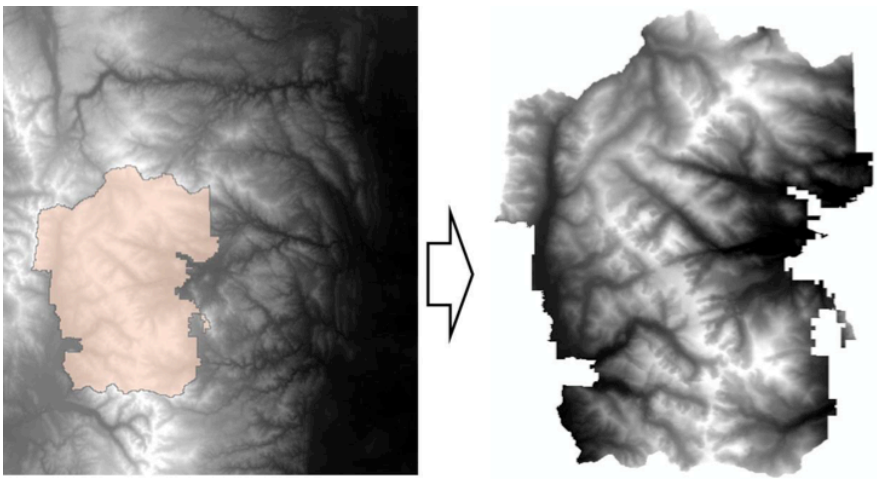


edndoc.esri.com

BOTTOMLINE: DEM should be 'filled"

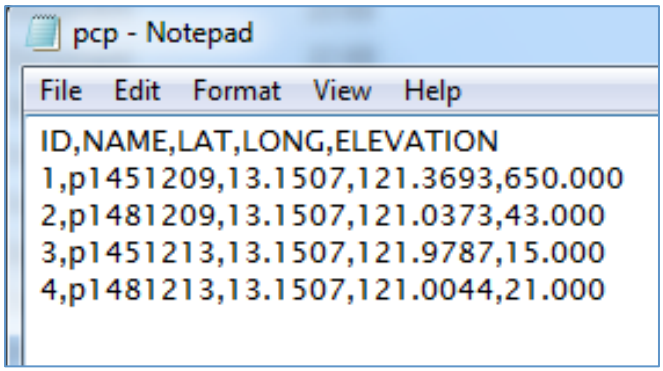
DEM SOURCES:
-ASTER (open source)
-SRTM (open source)
-DTM/IFSAR (DENR-FMB, NAMRIA)

It is important that the DEM file you have on hand contains the location of your area of interest. The next step is to extract the DEM of your area of interest using the "Extract by Mask" tool in ArcGIS. Please note that to be able to extract the DEM, you need the boundary of the area in shapefile format.



The preprocessed data output for this is the masked boundary (in raster format) of the watershed of interest.

2.1.2 Weather data. Climatological parameters or often called weather data such as rainfall, temperature (max and min), relative humidity, wind speed, and solar radiation should be in proper format, as seen in the image below. The coordinates of the weather stations can be found from the data source. Refer to **Module 1** for complete steps. Weather datasets can be obtained from PAGASA.



BOTTOMLINE: Weather data should be 'SWAT formatted'

SOURCES:
-PAGASA
-Global Climate Data (open source)

2.1.3 Land use/crop data. SWAT is a crop-specific software which includes a comprehensive crop database. Also called as the land cover/plant growth database, contains the parameters for all land covers simulated in a watershed. Since the SWAT software was generated using data from the US, we need to program it to simulate or represent the Philippine setting. The primary data used is the latest Land Cover Map of the National Mapping and Resource Information Authority (NAMRIA) which has fourteen (14) categories and the list of crops planted in each of the land cover category:

NAMRIA Land Cover Category	Land Use/Crop Data
1. Closed Forest	Forest Evergreen
2. Open Forest	Forest Evergreen and Forest Mixed
3. Mangrove Forest	Wetlands Forested
4. Wooded Grassland	Switchgrass
5. Grassland and Fallow	Pasture and Range grasses
6. Shrubland	Range bush
7. Annual Crop	Rice, Corn and Cassava
8. Perennial Crop	Coconut, Banana, Mango, Citrus, Coffee, Papaya, and Pineapple
9. Open/Barren	Range - southwest US
10. Inland Water and Fishpond	Water

NAMRIA Land Cover Category	Land Use/Crop Data
11. Marshland	Wetlands
12. Built-up	Urban-Rural

The challenge for modelers is to find a way to match actual land use/crop data into the SWAT database. Note that this can be relative to the characteristics of the area of interest. Hence, the team deviced the above data to fit into the model. Two steps were undertaken to determine the actual land use of the area with respect to its land cover: focus groud discussions (FGDs) with the communities, and literature review of data from the Bureau of Agricultural Statistics (BAS). Module 2 provides a step-by-step process for this.

BOTTOMLINE: The preprocessed data should include **the raster file of the land cover of the watershed** and the **localised crop database.**

1	CROP	CPNM		IDC	BIO_E	HVSTI	BLAI	FRGRW1	LAIMX1	FRGRW2	LAIMX2	DLAI	C
2	Annual Crop			4	23.41	0.59	4.84	0.26	0.01	0.65	0.95	0.75	
3	*Rice*	*RICE*	*AGRR*	*4*	*22*	*0.5*	*5*	*0.3*	*0.01*	*0.7*	*0.95*	*0.8*	
4	*Corn*	*CORN*	*AGRR*	*4*	*39*	*0.5*	*6*	*0.15*	*0.05*	*0.5*	*0.95*	*0.7*	
5	*Cassava*	*CASS*	*AGGR*	*5*	25	0.95	4	0.15	0.01	0.5	0.95	0.6	
6	Closed Forest	FRSE	FRSE	7	15	0.76	5	0.15	0.7	0.25	0.99	0.99	
7	*Forest-evergreen*												
8	Grassland												
9	*Pasture*	*PAST*	*PAST*	6	*35*	*0.9*	*4*	*0.05*	*0.05*	*0.49*	*0.95*	*0.99*	
10	*Range-Grasses*	*RNGE*	*RNGB*	6	*34*	*0.9*	*2.5*	*0.05*	*0.1*	*0.25*	*0.7*	*0.35*	
11	Inland Water	WATR	WATR	6	0	0	0	0	0	0	0	0	
12	Open Forest			7	15	0.76	5	0.11	0.44	0.31	0.974	0.99	
13	*Forest-evergreen*	FRSE	FRSE	7	15	0.76	5	0.15	0.7	0.25	0.99	0.99	
14	Forest-mixed				15	0.76	5	0.05	0.05	0.4	0.95	0.99	
15	Open Barren	BARR	SWRN	6	0.01	0.01	0.01	0.05	0.05	0.49	0.95	0.99	
16	Perennial Crop	AGRR	AGRR		24.53	0.51	4.63	0.11	0.46	0.31	0.96	0.99	
17	*Coconut*	*COCO*	*AGGR*	*7*	*24*	*0.56*	*5*	*0.15*	*0.7*	*0.25*	*0.99*	*0.99*	
18	*Banana*	*BANA*	*AGGR*	*7*	*30*	*0.44*	*4.5*	*0.05*	*0.05*	*0.4*	*0.95*	*0.99*	
19	*Mango*	*FRSE*	*FRSE*	*7*	15	0.76	5	0.15	0.7	0.25	0.99	0.99	
20	*Citrus (Calamansi and Mandarin)*	*ORAN*	*AGGR*	*7*	15	0.14	2	0.1	0.15	0.5	0.75	0.99	
21	*Coffee*	*COFF*	*AGGR*	*7*	10	0.15	1.35	0.05	0.05	0.4	0.95	0.99	
22	*Papaya*	*PAPA*	*AGGR*	*7*	30	0.44	4.5	0.05	0.05	0.4	0.95	0.99	
23	*Pineapple*	*PINP*	*AGGR*	*7*	30	0.7	4	0.05	0.05	0.4	0.95	0.99	
24	Shrubs			6	34	0.9	2	0.05	0.1	0.25	0.7	0.35	
25	Wooded grassland			6	15	0.729	4.85	0.1475	0.6725	0.2625	0.978	0.99	

2.1.4 Soil data. Similar to Item 2.1.3, SWAT also contains a soil database which houses information about the physical characteristics/parameters of the soil in the watershed. The soil map (in shapefile) and parameters are readily available from the Bureau of Soils and Water Management (BSWM) soil reports. Note that the spatial data should coincide with the parameters in tabular form, meaning, whatever soil type is present in the area should have an equivalent set of parameters. There are cases where one or two soil types in a particular watershed has relatively small area in terms of hectares. In this case, merging these small areas with the adjacent soil type with large areas should be done to minimize insignificant results.

1	SNAM	TEXTURE	SOL_Z	SOL_BD		SOL_AWC	SOL_AWC mm/mm	SOL_CBN	SOL_K	SOL_K
2	Antipolo Clay		840	80.81	1.29445	1.29	0.1075	2.61	0.02	0.
3	Antipolo Clay Loam		840	87.81	1.40658	0.18	0.0150	2.34	0.18	4.
4	Antipolo soils (undifferentiated)		840	86.95	1.39281	1.45	0.1208	1.95	0.02	0.
5	Binangonan clay		1500	86.68	1.38848	1.35	0.1125	3	8.7E-07	2.21
6	Binangonan clay (Lowland Phase)		1500	84.79	1.35821	1.44	0.1200	3.5	0.04	1.
7	Guadalupe clay		1500	85.32	1.3667	1.4	0.1167	2	0.01	0.
8	Guadalupe clay adobe		1500	89.72	1.43718	1.45	0.1208	1.82	0.04	1.
9	Marikina clay loam		1030	85.3	1.36638	1.51	0.1258	2.8	0.06	1.
10	Marikina loam		1030	89.37	1.43157	1.59	0.1325	2.2	0.18	4.
11	Marikina silt loam		1030	77.27	1.23775	2.05	0.1708	4.5	0.59	14.
12	Novaliches clay loam		1000	86.73	1.38928	1.57	0.1308	2.24	0.08	2.
13	Novaliches clay loam adobe		1000	92.16	1.47626	1.4	0.1167	2.24	0.16	4.
14	Novaliches loam		1000	79.89	1.27972	1.53	0.1275	1.22	0.06	1.
15	Quiangua silt loam		3000	86.23	1.38128	1.86	0.1550	3	0.66	16.
16					0					

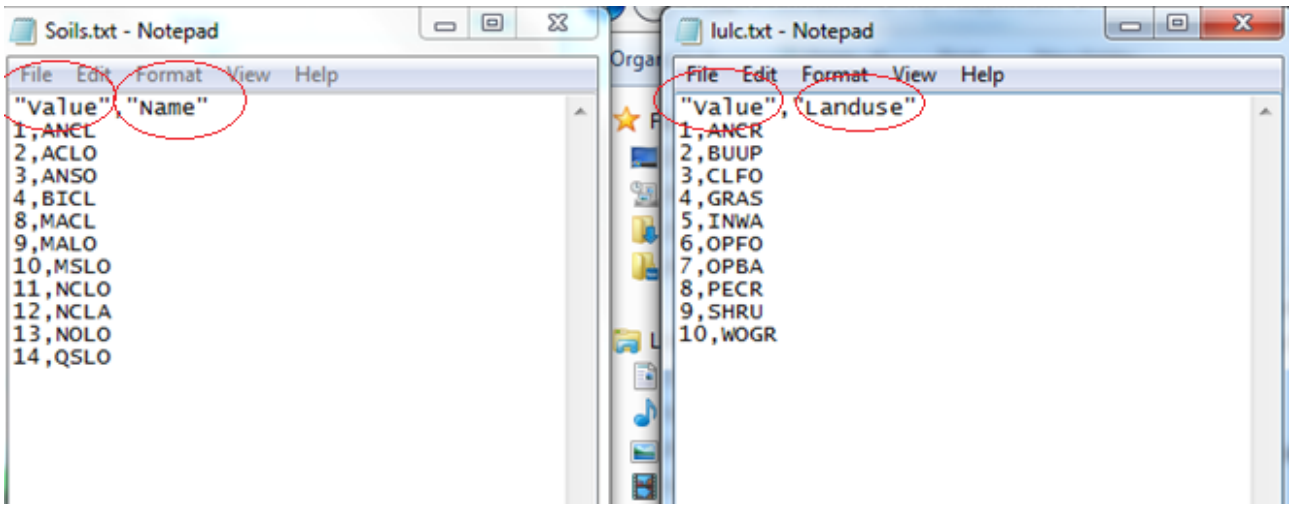
As seen in the figure above, the soil parameters needed to be gathered are the following:

Acronym	Meaning	Importance
SNAM:	Soil Name (printed in the HRU summary tables)	[optional]
HYDGRP:	Soil Hydraulic Group (A, B, C, or D)	[required]
SOL_ZMX:	Maximum rooting depth of soil profile (mm)	[required]
ANION_EXCL:	Fraction of porosity (void space) from which anions are excluded. If no value is entered, the model will set = 0.50	[optional]
SOL_CRK:	Potential or maximum crack volume of the soil profile	[optional]
TEXTURE:	Texture of soil layer	[optional]
SOL_Z(layer #):	Depth from soil surface to bottom of layer (mm)	[required]
SOL_BD(layer #):	Moist bulk density (Mg/m^3 or g/cm^3). Values should fall between 1.1 and 1.9 Mg/m^3.	[required]
SOL_AWC(layer #):	Available water capacity of the soil layer (mm H_2O/mm soil)	[required]
SOL_K(layer#):	Saturated hydraulic conductivity (mm/hr)	[required]
SOL_CBN(layer #):	Organic carbon content (% soil weight)	[required]
SOL_CLAY(layer #):	Clay content (% soil weight)	[required]
SOL_SILT(layer #):	Silt content (% soil weight)	[required]
SOL_SAND(layer #):	Sand content (%s soil weight)	[required]
SOL_ROCK(layer #):	Rock fragment content (% total weight)	[required]
SOL_ALB(top layer):	Moist soil albedo	[required]
USLE_K(top layer):	USLE equation soil erodibility (K) factor (units: 0.013 (metric ton m^2 hr)/(m^3- metric ton cm)).	[required]

<u>BOTTOMLINE</u>: The preprocessed data should include **the raster file of the soil map of the watershed** and the **localised soil database.**

2.2 SWAT Input Preparation

Lookup table / Database Updating. Lookup tables are database tables that translate a complex set of categorical codes (like what is contained in the crop and soil SWAT database), to one or more generalized category or schemes. Lookup tables are usually done in notepads or MS Excel. In this study, .txt files are created for the crop and soil input maps to match with the data in the database.



The number of value will depend on the number of classification present on the soil and land use maps. In this study, 14 soil types and 10 land use categories were recorded in one of the study sites. These .txt files will be uploaded in the SWAT interface to create a land use/ soil map with the data from the SWAT database.

Database updating on the other hand is done to modify the SWAT database using localised data. Modifying parameters can be done in two ways: (1) for land use/crop types, copy data from Template 1 and paste directly in SWAT2012 Database; (2) for soil parameters, manually input data in the SWAT interface.

The 14 land cover categories should then be aggregated into 12 major categories and can be matched with the crop classification of the SWAT database as follows:

NAMRIA Land Cover Category	SWAT Classification
1. Closed Forest	FRSE
2. Open Forest	FRST
3. Mangrove Forest	WETF
4. Wooded Grassland	SWCH – Should be split into: 30% FRSD and 70% RNGE in the 'Land Use Refinement Tab' since it is the characteristics of a wooded grassland in the country.
5. Grassland and Fallow	RNGE
6. Shrubland	RNGB
7. Annual Crop	RICE
8. Perennial Crop	COCO

NAMRIA Land Cover Category	SWAT Classification
9. Open/Barren	BARR
10. Inland Water and Fishpond	WATR
11. Marshland	WETL
12. Built-up	URML

In the soil database, using newly created codes or proxy soil classification codes from SWAT (i.e. Antipolo Clay = ANCL or Mountain Soil = PAXTON) and encoding of all parameters are required and can be a bit tidious. You can refer to Module 3 for complete steps.

BOTTOMLINE: edit parameters either in SWAT 2012 (copy-paste from *Template 1)* or manual input at SWAT interface

HRU thresholds. Hydrologic Response Unit (HRU) is the basic unit of all model calculations in SWAT. The purpose of assigning a HRU threshold is to represent each sub-basin considering the combination of land use, soil and slope. However, there is no current reasonable guideline for selecting HRU thresholds yet (Strauch, 2014) so the team improvised a method to select the HRU threshold to be used. Ensuring that modeling results will be accurate, thresholds (%) are preferred to be near zero.

In HRU Definition interface, there are three (3) thresholds to be filled-up, these are: (i) Land use percentage over sub-basin area; (ii) Soil class percentage over land use area; and (iii) Slope class percentage over soil area. To fill-up these thresholds, full HRU report generated by SWAT is used and data on sub basin area, land use area, soil class area and slope class area per sub-basin are to be collected. After that, get the percentage of land use area over sub-basin area, soil class area over land use area and slope class area over soil class area on each sub-basin. The minimum percentage among values generated from the computation will be chosen as the thresholds for the model.

3. Model Runs

Running SWAT is easier if all data inputs are intact. **Module 7** shows the step by step process from creating a project up to saving outputs. Take note that the outputs will be automatically uploaded to the *Default* folder[1] (and not to the saved folder) after saving the simulation.

1. Opening a Project
2. Watershed Delineator
3. HRU Analysis
4. Write Input Tables
5. Edit SWAT Input
6. SWAT Simulation

BOTTOMLINE: All SWAT input should be ready first before running the steps – *DEM, landuse, soil, weather data*

[1] This might seem a bug depending on software compatibility and specs.

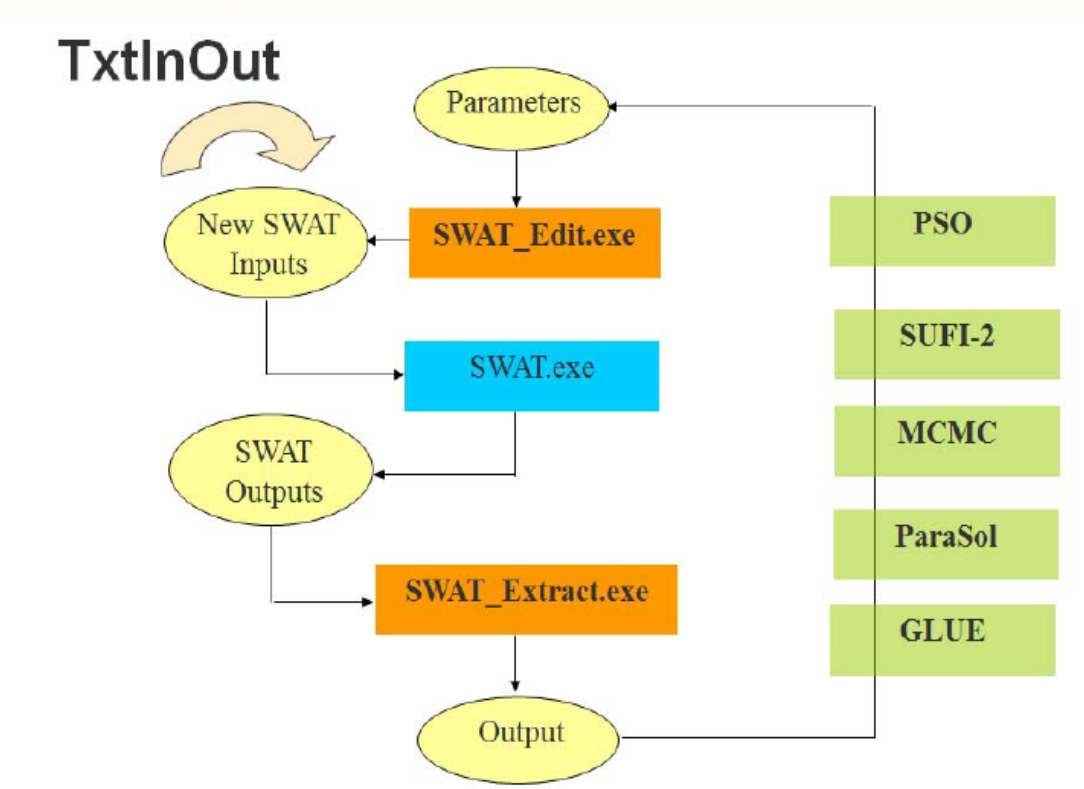
4. Calibration and Validation

4.1 Manual calibration. Calibration is a technique that compares simulated data to observed data in order to assess accuracy of the model. Three common measures for assessing the "goodness" of prediction are Nash Sutcliffe Efficiency (NSE) ratio, Percent Bias (PBIAS), and regression analysis (R). **Module 8** includes guidelines for manually calibrating *Flowout* results of SWAT.

The following parameters will serve as basis for calibration:

1. NSE prediction satisfactory rate is above 0.6.
2. PBIAS < 10% prediction is satisfactory; <25% is unsatisfactory
3. $r^2 > 0.5$ is satisfactory

4.2 Calibration using SWAT-CUP. This is a SWAT extension stand-alone program which provides easy link to SWAT via *TxtinOut* folder. The link is shown below:



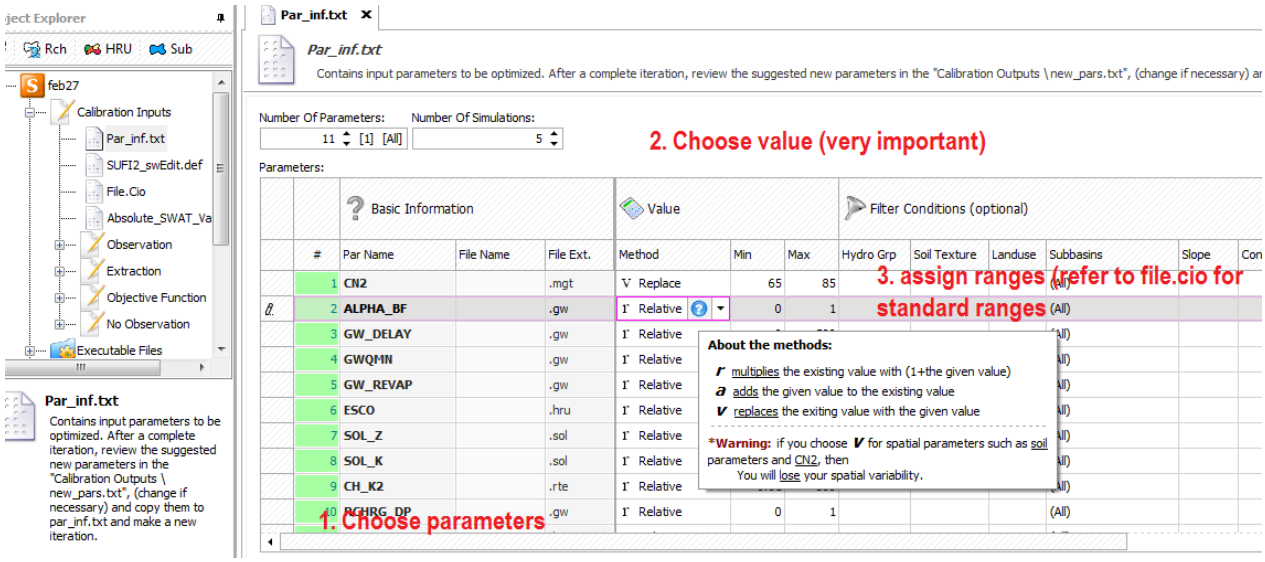
The most common calibration method is the SUFI-2 wherein uncertainty in parameters is expressed in ranges with uniform distribution. It accounts for all sources of uncertainties such as driving variables (e.g. rainfall), conceptual model, and measured data. The measure of result is coded as *95PPU* to quantify the fit between simulation and observed

data. Two statistics are produced namely R and P factor that give thickness and % of observed data enveloped by the model results, respectively.

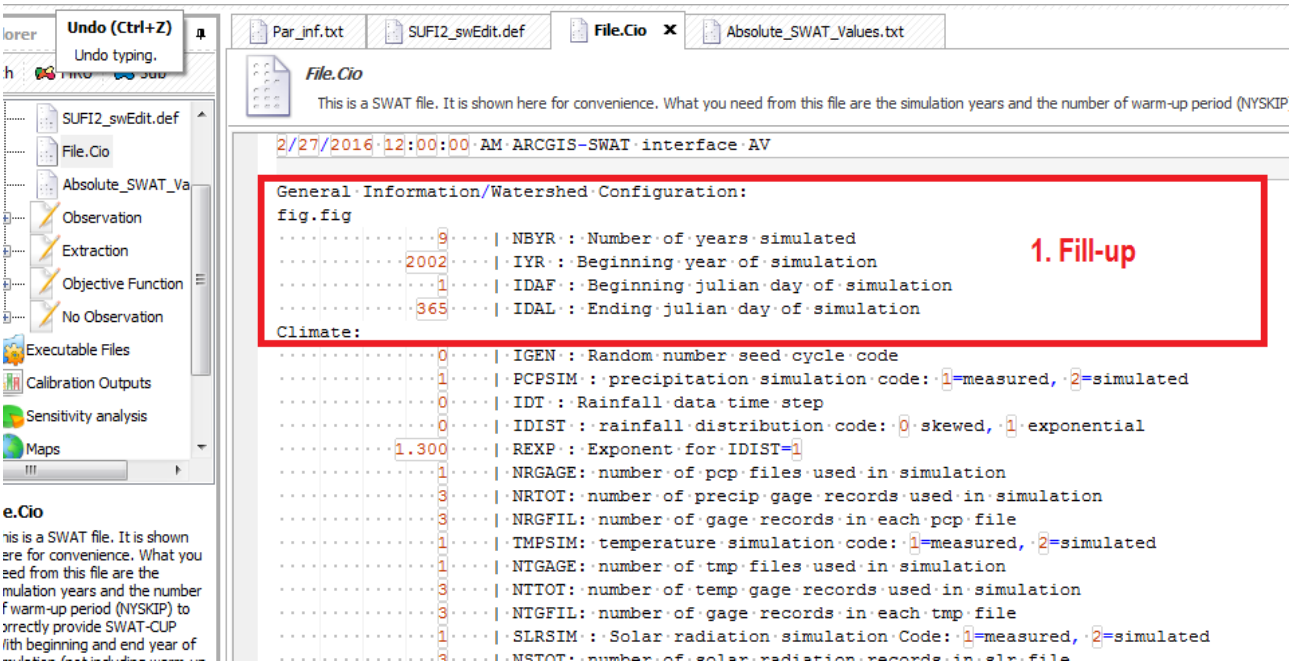
Format the observed data accordingly. Take note that the day format is the Julian day; use **Template 2** for guidance. Divide observed data into two parts – one part for calibration and the other part for validation (e.g. 2000-2004-calibration, 2005-2010-validation).

4.3 Sensitivity analysis. Two types of sensitivity analysis can be used: global and one-at-a-time. Usually, the former is used since it gives all sensitive parameters after iteration.

4.4 Calibration Inputs. Key steps here include a uploading desired parameters to be optimized and choosing the appropriate *value.*



Fill-out the file.cio accordingly.

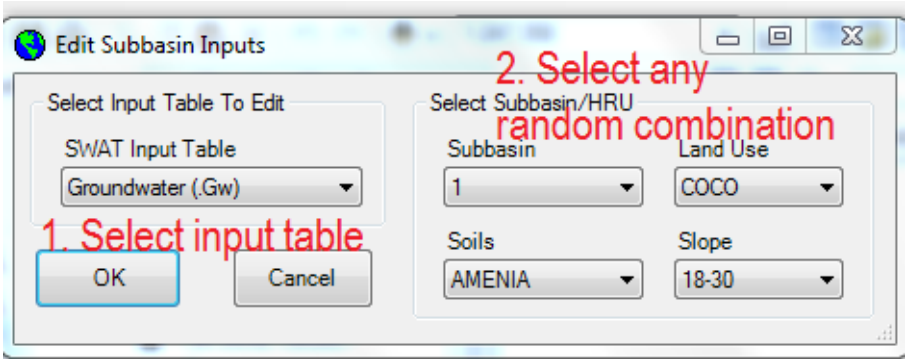


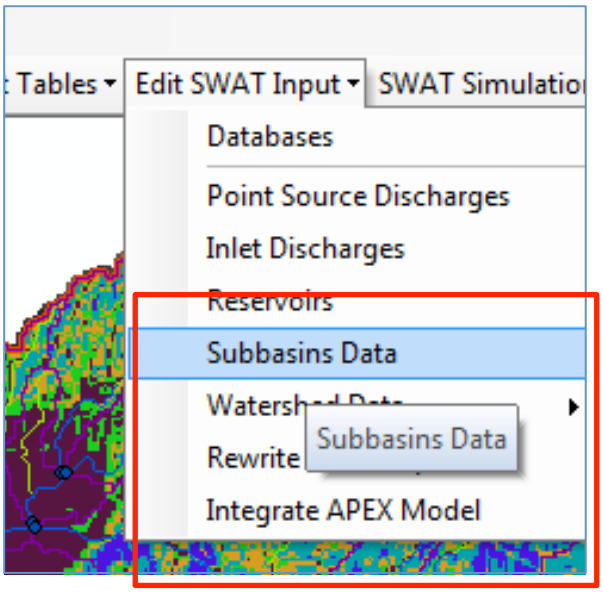
BOTTOMLINE: Perform sensitivity analysis first before validation; Have many simulations if necessary; Ideal number of iterations is at least 10 (change parameters accordingly in every iteration

Paste the daily observed data for calibration to *observed_rch.txt* at observation tab and observed.txt at objective function tab. The comprehensive step by step details can be found **on Module 9 pp.25-34.**

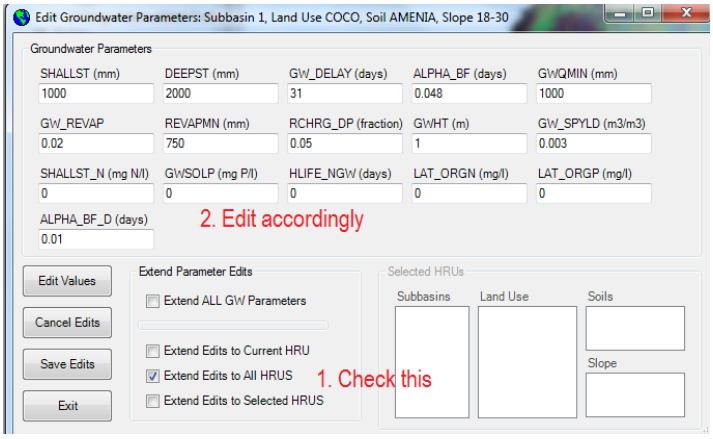
4.5 Iterations. In every iteration, there are eight types of outputs. Key results would be the 95ppu plot which shows a graph comparing simulated and observed values as well as its fitness (green curve); best parameters and simulation; and the new parameters which contain a new set of values used to overwrite the previous set.

4.6 Validation and Parameterization. Run in a similar way to calibration but using validation observed data and check whether the results are similar. If results are favorable, go back to SWAT at GIS interface and change the parameters manually.





After editing, all changed parameters will be applied to all HRUs and sub-basins.



5. Results Interpretation

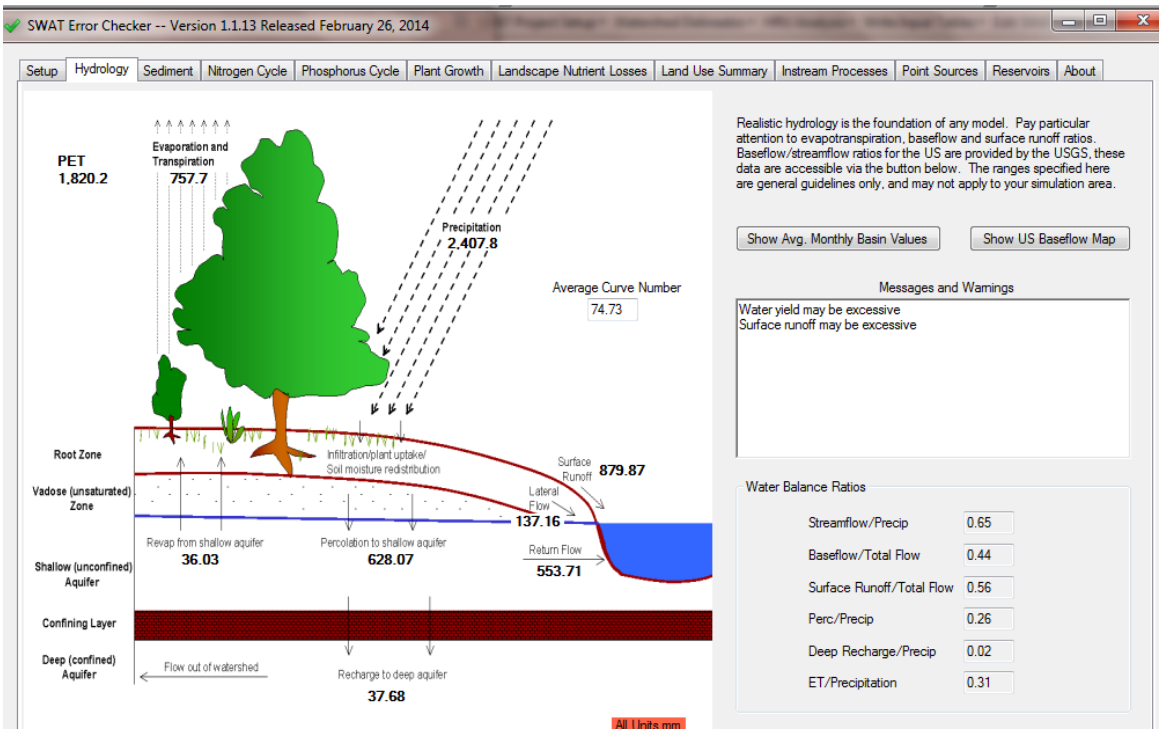
5.1 Compiling results. SWAT outputs can be seen at *TablesOut* sub-folder from scenario folder in MS Access format. Filter the desired sub-basin and its *FLOW_OUT.* Copy (by highlighting column) and paste in an excel sheet. Copy *SED_OUT* for sediment yield. Add the following columns to the excel sheet: year, month, day, and precipitation. Do this for all land cover scenarios.

N17

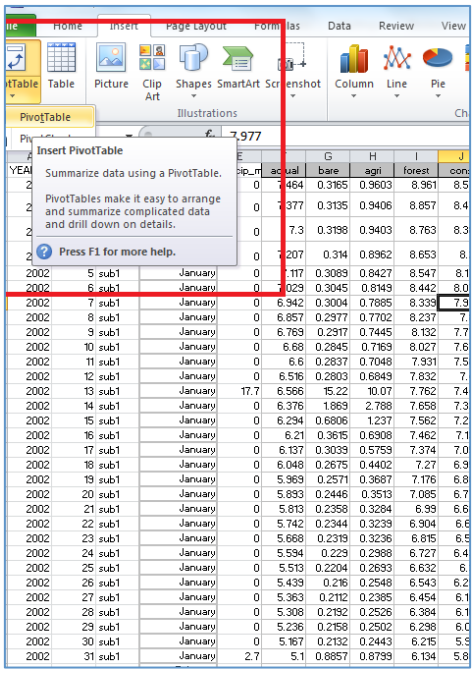
	A	B	C	D	E	F	G	H	I	J
1	YEAR	day	SUB	YEAR	precip_m	actual	bare	agri	forest	cons
2	2002	1	sub1	January	0	7.464	0.3165	0.9603	8.961	8.575
3	2002	2	sub1	January	0	7.377	0.3135	0.9406	8.857	8.475
4	2002	3	sub1	January	0	7.3	0.3198	0.9403	8.763	8.385
5	2002	4	sub1	January	0	7.207	0.314	0.8962	8.653	8.28
6	2002	5	sub1	January	0	7.117	0.3089	0.8427	8.547	8.178
7	2002	6	sub1	January	0	7.029	0.3045	0.8149	8.442	8.077
8	2002	7	sub1	January	0	6.942	0.3004	0.7885	8.339	7.977
9	2002	8	sub1	January	0	6.857	0.2977	0.7702	8.237	7.88
10	2002	9	sub1	January	0	6.769	0.2917	0.7445	8.132	7.779
11	2002	10	sub1	January	0	6.68	0.2845	0.7169	8.027	7.678
12	2002	11	sub1	January	0	6.6	0.2837	0.7048	7.931	7.586
13	2002	12	sub1	January	0	6.516	0.2803	0.6849	7.832	7.49
14	2002	13	sub1	January	17.7	6.566	15.22	10.07	7.762	7.446
15	2002	14	sub1	January	0	6.376	1.869	2.788	7.658	7.325
16	2002	15	sub1	January	0	6.294	0.6806	1.237	7.562	7.233
17	2002	16	sub1	January	0	6.21	0.3615	0.6908	7.462	7.137
18	2002	17	sub1	January	0	6.137	0.3039	0.5759	7.374	7.053
19	2002	18	sub1	January	0	6.048	0.2675	0.4402	7.27	6.953
20	2002	19	sub1	January	0	5.969	0.2571	0.3687	7.176	6.862
21	2002	20	sub1	January	0	5.893	0.2446	0.3513	7.085	6.775
22	2002	21	sub1	January	0	5.813	0.2358	0.3284	6.99	6.684
23	2002	22	sub1	January	0	5.742	0.2344	0.3239	6.904	6.601
24	2002	23	sub1	January	0	5.668	0.2319	0.3236	6.815	6.517
25	2002	24	sub1	January	0	5.594	0.229	0.2988	6.727	6.432
26	2002	25	sub1	January	0	5.513	0.2204	0.2693	6.632	6.34
27	2002	26	sub1	January	0	5.439	0.216	0.2548	6.543	6.255
28	2002	27	sub1	January	0	5.363	0.2112	0.2385	6.454	6.169
29	2002	28	sub1	January	0	5.308	0.2192	0.2526	6.384	6.103
30	2002	29	sub1	January	0	5.236	0.2158	0.2502	6.298	6.021
31	2002	30	sub1	January	0	5.167	0.2132	0.2443	6.215	5.941
32	2002	31	sub1	January	2.7	5.1	0.8857	0.8799	6.134	5.864
33	2002	32	sub1	February	6.71	5.189	15.56	8.537	6.087	5.926
34	2002	33	sub1	February	0	5.002	1.87	2.513	6.005	5.746

BOTTOMLINE: raw table came from various *FLOW_OUT* tables from SWAT

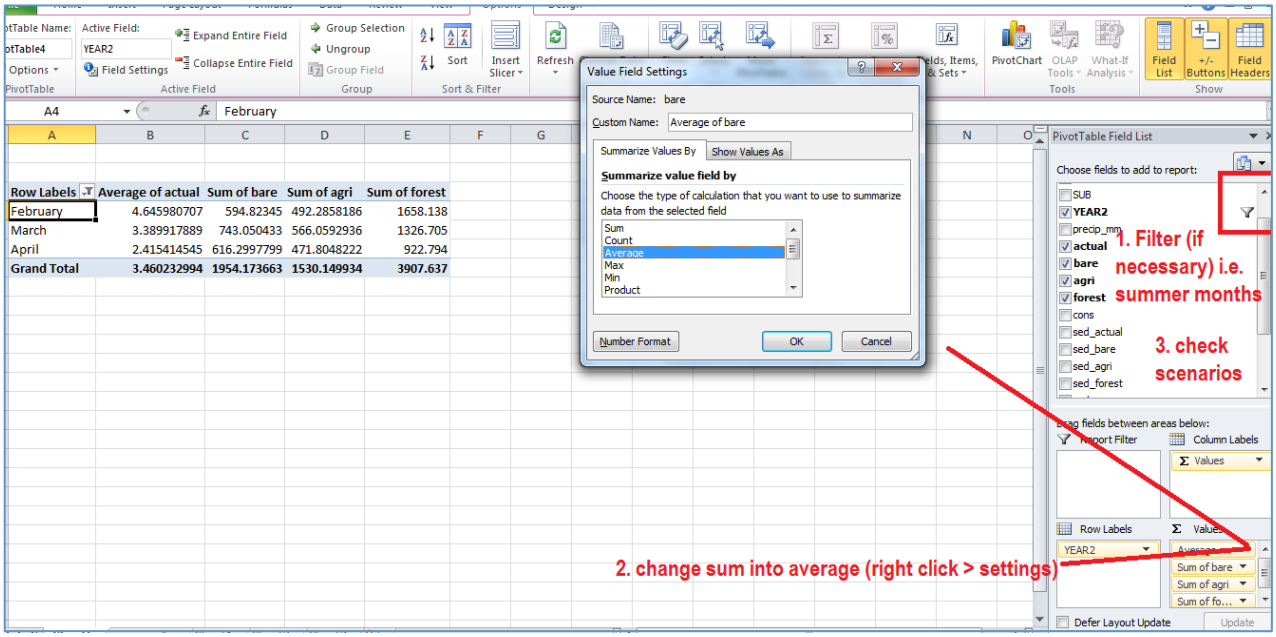
5.2 Using water balance ratios. SWAT provides a comprehensive summary of your model. It gives ratios on groundwater flow, baseflow, evapotranspiration, and run-off relative to total flow. These ratios can be used to derive the said flows using the *FLOW_OUT* output. A Sheet with sample data and formula for using ratios can be seen in **Template 2**.



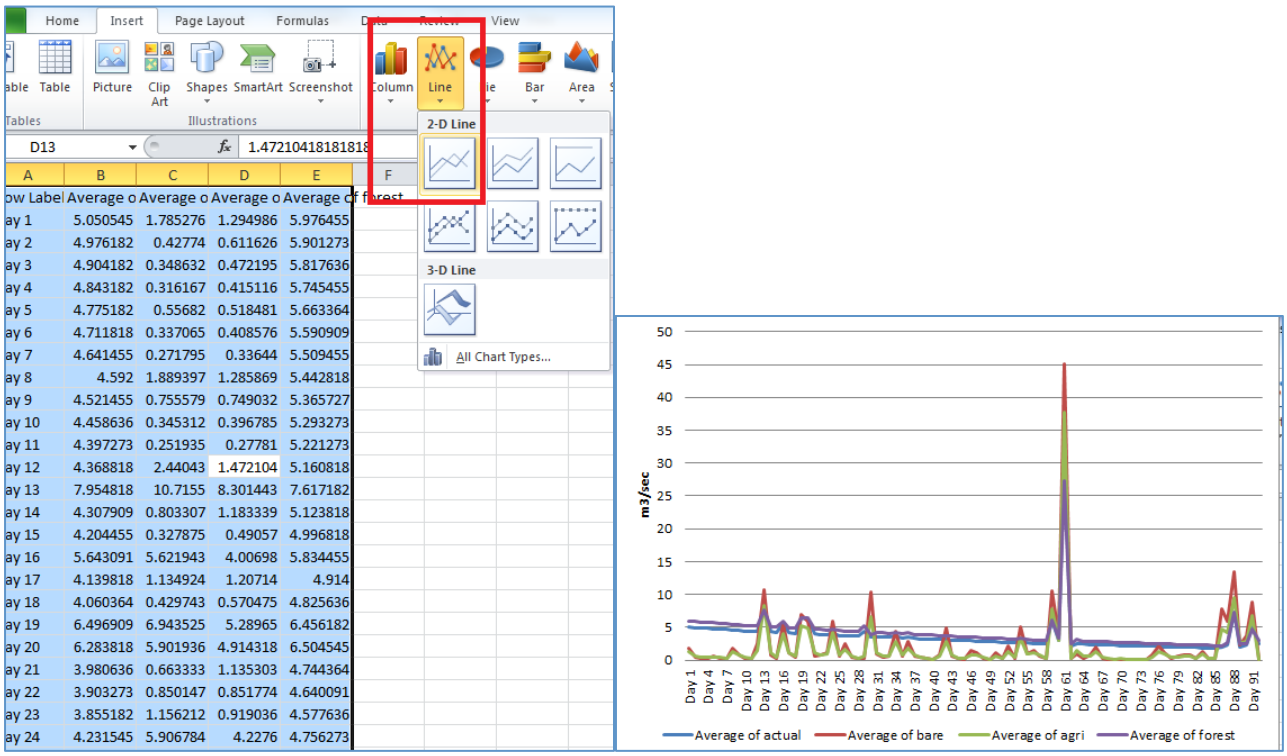
5.3 Pivot table. After compiling results, a pivot table can now be made – it is an excel command to summarize and organize raw tables. Inputs can be filtered. Arrange accordingly depending on your interpretation target i.e. monthly, yearly, and seasonal.



Check the desired inputs of the table first and filter if necessary i.e. summer months. The values are in 'sum', by default so change it to show average values.



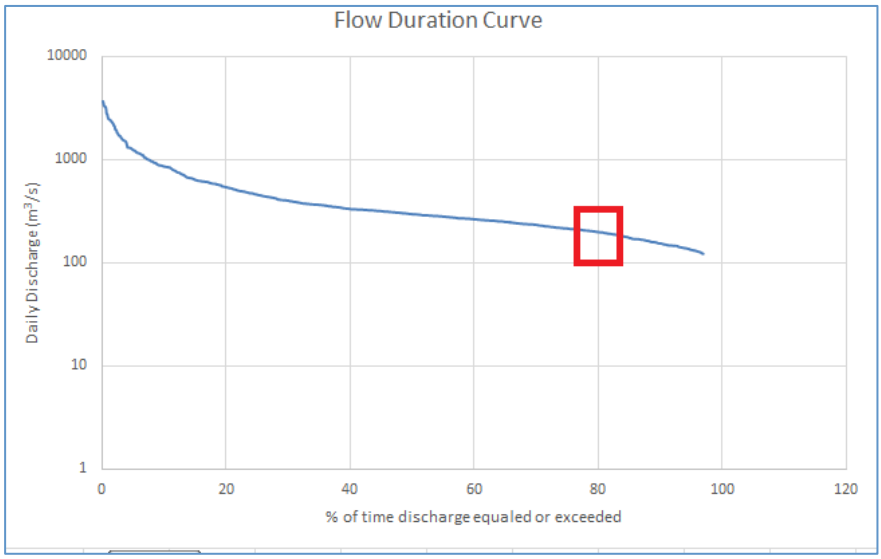
5.4 Graphs. Graphs help to visualize key results of the model. Make sure that you have all information you want from the pivot table. For analyzing seasonal flows, add daily column and create a new table for it. Delete the sub-total rows from the pivot table after copying. Select all and click *insert* > *line.* Format into desired graph layout (make sure it's properly labeled and color-coded). Guide in analyzing results is shown in **Module 10**.



6. Results per ES

6.1 Water yield

Dependable flow rate (DFR). This indicates how many days water flows can provide sufficient water to its service area during summer months (# days). A step by step guide for computing the DFR is shown in **Module 10**. Extract summer days and arrange them chronologically. A line graph will be produced in the sheet and the 80% (DFR threshold) must be used. Put the value to *J1 cell* and create a summary table per scenario showing % of days under DFR threshold.



D	E	F	G	H	I	J	K	L	M	N	O
YEAR	low_actua	flow_bare	flow_agri	low_fores	flow_cons	2.9	Actual	Bare-Urba	Agriculture	Forest	onservati
February	5.189	15.56	8.537	6.087	5.926		5.189	15.56	8.537	6.087	5.926
February	5.002	1.87	2.513	6.005	5.746		5.002	No	No	6.005	5.746
February	4.925	0.7093	0.9654	5.92	5.66		4.925	No	No	5.92	5.66
February	4.856	0.3717	0.5006	5.839	5.582		4.856	No	No	5.839	5.582
February	4.786	0.2627	0.29	5.756	5.502		4.786	No	No	5.756	5.502
February	4.715	0.2223	0.2126	5.672	5.422		4.715	No	No	5.672	5.422
February	4.649	0.1934	0.1643	5.594	5.347		4.649	No	No	5.594	5.347
February	4.631	3.601	2.054	5.532	5.317		4.631	3.601	No	5.532	5.317
February	4.555	4.56	3.504	5.462	5.233		4.555	4.56	3.504	5.462	5.233
February	4.479	1.172	1.261	5.386	5.149		4.479	No	No	5.386	5.149
February	4.423	0.4848	0.511	5.319	5.085		4.423	No	No	5.319	5.085
February	4.363	0.2747	0.2362	5.248	5.016		4.363	No	No	5.248	5.016
February	4.3	0.2174	0.1711	5.173	4.945		4.3	No	No	5.173	4.945
February	4.239	0.3126	0.2607	5.101	4.875		4.239	No	No	5.101	4.875
February	4.183	0.2071	0.1532	5.033	4.81		4.183	No	No	5.033	4.81
February	4.126	0.1844	0.1201	4.965	4.746		4.126	No	No	4.965	4.746
February	4.06	0.1539	0.08227	4.888	4.671		4.06	No	No	4.888	4.671
February	4.007	0.1563	0.07743	4.824	4.61		4.007	No	No	4.824	4.61
February	3.948	0.1436	0.07294	4.754	4.543		3.948	No	No	4.754	4.543
February	3.903	0.1476	0.07252	4.698	4.49		3.903	No	No	4.698	4.49
February	3.841	0.1391	0.07022	4.626	4.42		3.841	No	No	4.626	4.42
February	3.779	0.1361	0.04189	4.553	4.35		3.779	No	No	4.553	4.35
February	3.732	0.131	0.05675	4.496	4.296		3.732	No	No	4.496	4.296
February	3.678	0.129	0.04586	4.432	4.234		3.678	No	No	4.432	4.234
February	3.631	0.129	0.04931	4.375	4.18		3.631	No	No	4.375	4.18
February	3.581	0.127	0.04632	4.315	4.122		3.581	No	No	4.315	4.122
February	3.524	0.1197	0.02847	4.248	4.058		3.524	No	No	4.248	4.058

BOTTOMLINE: follow the excel template (with formula) using 80% DFR threshold

6.2 Water regulation

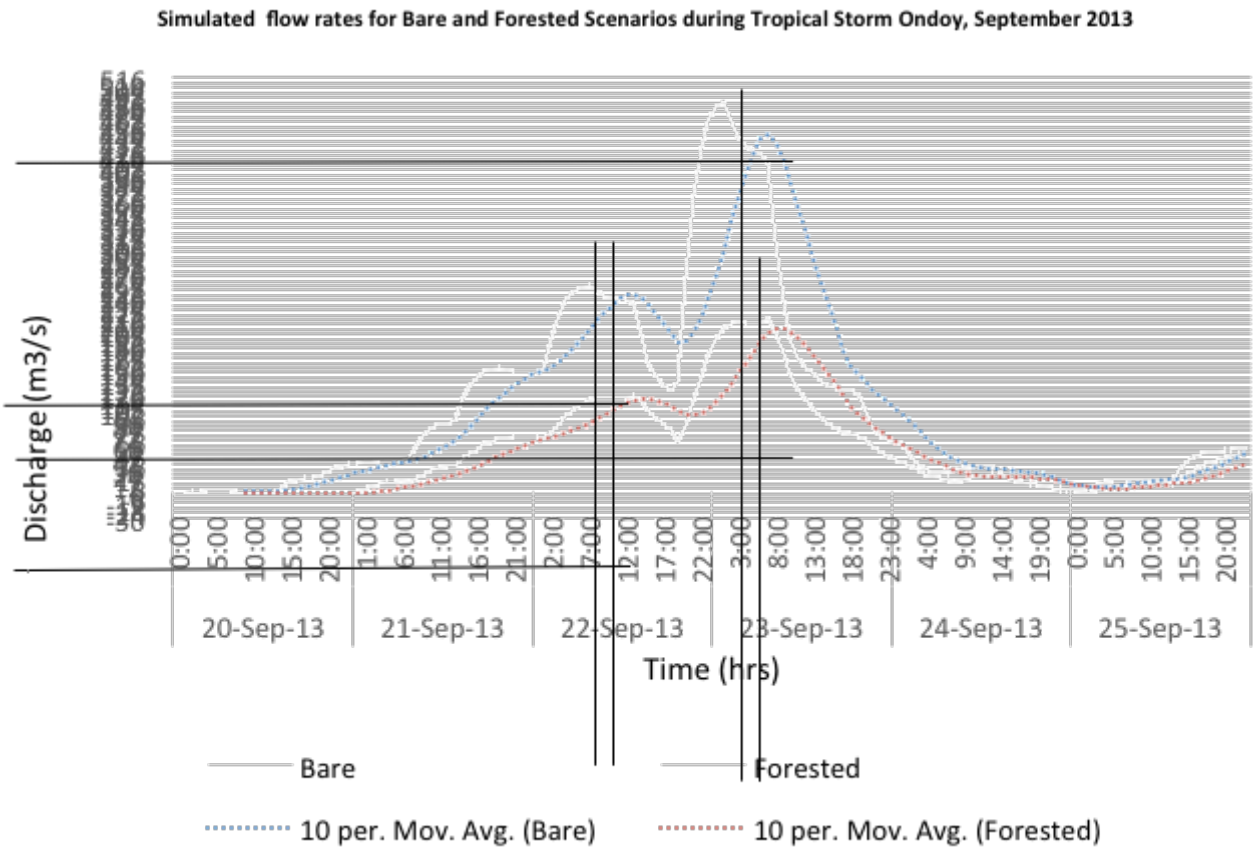
6.2.1 Irrigation use. Service area for irrigation is a primary ES indicator measured as hectares irrigated. To capture this actual and bare/urban scenario water flows during cropping season (especially 'summer season') should be used. Minimum flow of the watershed should be deducted to the total flows as a rule of thumb. Paste the cropping season average daily flows of **Template 3**. Analyze results per cropping season and deduct results of bare/urban from the actual scenario to capture the ES.

BOTTOMLINE: use cropping season in summer months to analyze the service better

Key inputs for this model include number of cropping days used, cropping months, and amount of water needed for a full cropping.

6.2.2 Storm event. HEC-HMS is used to model hourly discharge of storm and rainy events. It is an events-based model used to replicate rainfall-runoff process. It simulates the movement of water in the study area through representation of hydrological methods. The computation of run-off generation was derived by parting the basin's hydrological system into various components, boundaries of the study and hydrologic condition of the basin. Parameters to create desired scenario i.e. Forested Scenario can be done by modifying the curve numbers along with other loss and routing parameters. Refer to **Module 10** for the HEC-HMS module.

Using sub-daily results of a given storm event, a forested scenario will have a lower peak discharge, a longer lag time, and lower sediment generation and sediment flow compared to a bare/urban scenario. The best indicator for this ES would be hectares of inundated areas or number of households affected. For the PROFOR study, the analysis is limited to the hydrograph particularly on its elements comparing lagtime of bare/urban and forested scenario (x hours). Guidance for analyzing hydrographs can be seen in **Module 11**.



BOTTOMLINE: sub-daily data represents water regulation better than daily data

6.3 Sediment Regulation

SWAT generates output databases after the SWAT run. This can be found in the following folder location of the model run: Scenarios > Default > TablesOut >SWATOutput. The "rch" database contains the daily sediment outflow for all the sub-basins during the period of the model run, under the parameter SED_OUTtons.

To analyze the daily, monthly, or annual sediment outflow for each sub-basin or subwatershed in MS Excel, export the file SWATOutput by clicking External Databases > Export to Excel Spreadsheet. Insert a pivot table and filter by subwatershed or sub-basin, and/or the desired time period of analysis (daily/monthly/annual). Also select the parameter, SED_OUTtons and select "sum" in the value settings. This generates the total sediment outflow per each sub-basin per day/month/year.

Sediment regulation is interpreted as the total sediment avoided by a particular landscape, when that same landscape is converted into a bare landscape.

In ES Modeling this is computed by getting the difference between the sediment outflow of the bare scenario and the sediment outflow of the BAU/actual scenario.

6.4 Erosion Control

Erosion control is treated similarly as sediment regulation, although using a different parameter in SWAT, SYLD.

SWAT generates output databases after the SWAT run. This can be found in the following folder location of the model run: Scenarios > Default > TablesOut >SWATOutput. The "sub" database contains the daily hillslope erosion for all the sub-basins during the period of the model run, under the parameter SYLD.

To analyze the daily, monthly, or annual erosion for each sub-basin or subwatershed in MS Excel, export the file SWATOutput by clicking External Databases > Export to Excel Spreadsheet. Insert a pivot table and filter by subwatershed or sub-basin, and/or the desired time period of analysis (daily, monthly, and annual). Also select the parameter, SYLD and select "sum" in the value settings. This generates the total erosion per each sub-basin per day/month/year.

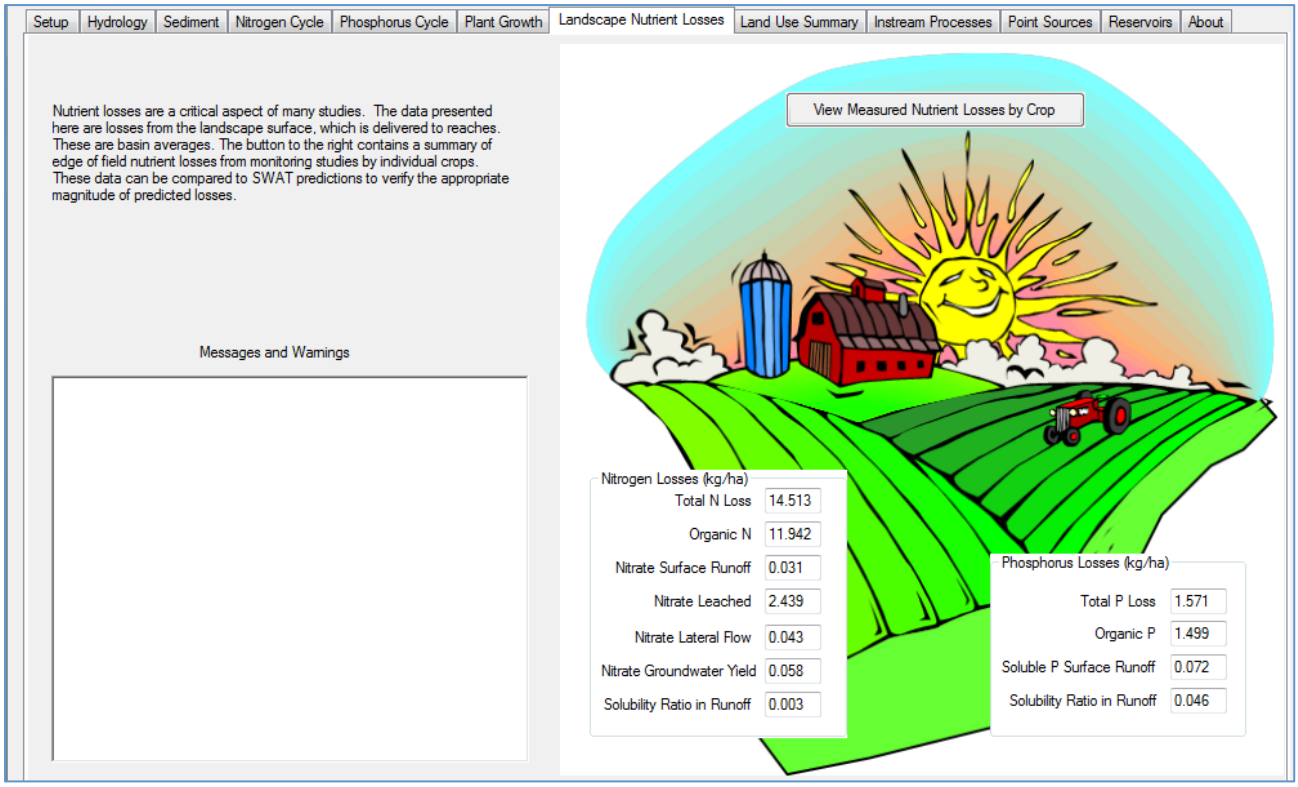
Erosion control is interpreted as the total erosion avoided by a particular landscape, when that same landscape is converted into a bare landscape.

In ES Modeling this is computed by getting the difference between the SYLD of the bare scenario and the SYLD of the BAU/actual scenario.

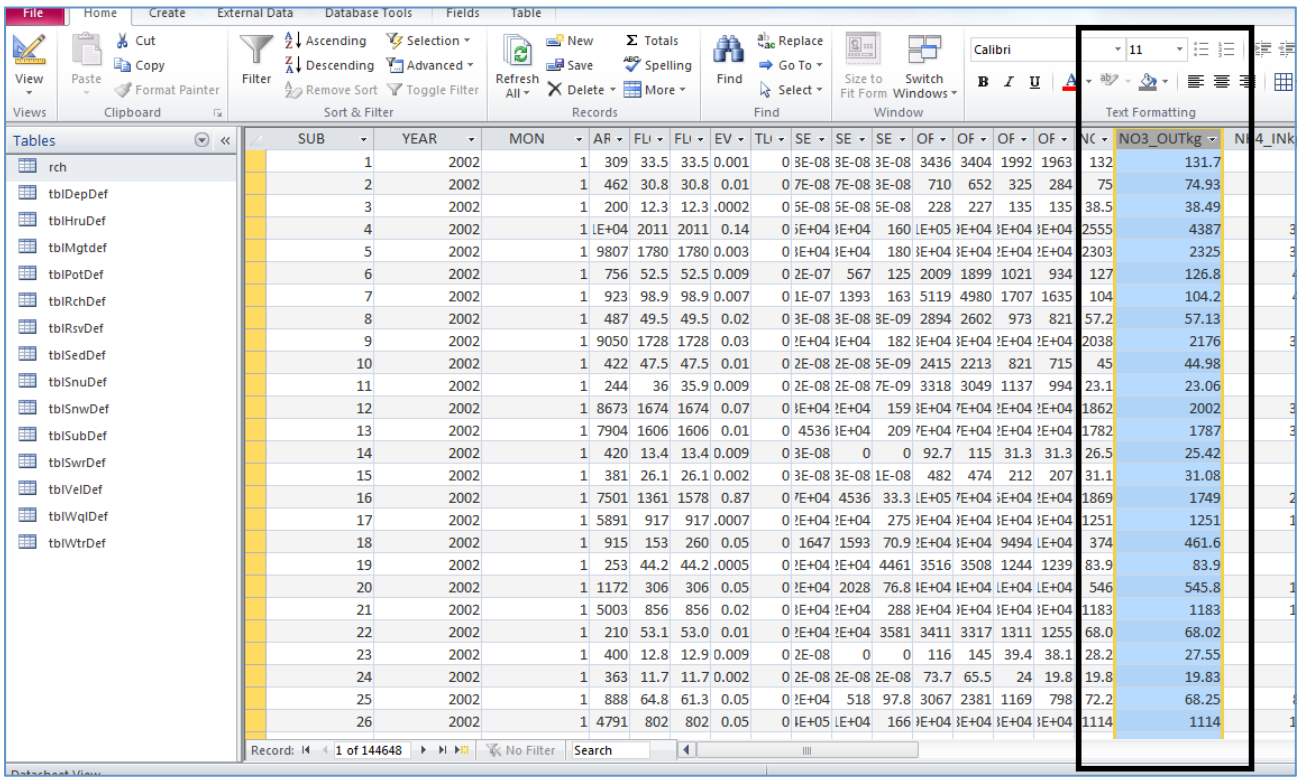
6.5 Water Purification

In watersheds that rely in groundwater as domestic water source, water purification is an essential ecosystem service. The use of contour and riparian buffer strips planted with perennial vegetation has been found to improve surface water quality by reducing NO3-N and sediment outflow from cropland to a river (Sahu and GU 2009).

From the 'SWAT output run SWAT check', click 'landscape nutrient losses' tab to analyze nitrate values and compare per land cover scenario.



For daily results, NO3 values are included in the **.rch database**



SUB	YEAR	MON	AR	FL	FL	EV	TL	SE	SE	SE	OF	OF	OF	OF	NO	NO3_OUTkg	NH4_INk
1	2002	1	309	33.5	33.5	0.001	0	3E-08	3E-08	3E-08	3436	3404	1992	1963	132	131.7	
2	2002	1	462	30.8	30.8	0.01	0	7E-08	7E-08	3E-08	710	652	325	284	75	74.93	
3	2002	1	200	12.3	12.3	.0002	0	5E-08	5E-08	5E-08	228	227	135	135	38.5	38.49	
4	2002	1	LE+04	2011	2011	0.14	0	E+04	E+04	160	LE+05	E+04	E+04	E+04	2555	4387	3
5	2002	1	9807	1780	1780	0.003	0	E+04	E+04	180	E+04	E+04	E+04	E+04	2303	2325	3
6	2002	1	756	52.5	52.5	0.009	0	2E-07	567	125	2009	1899	1021	934	127	126.8	4
7	2002	1	923	98.9	98.9	0.007	0	1E-07	1393	163	5119	4980	1707	1635	104	104.2	4
8	2002	1	487	49.5	49.5	0.02	0	3E-08	3E-08	3E-09	2894	2602	973	821	57.2	57.13	
9	2002	1	9050	1728	1728	0.03	0	E+04	E+04	182	E+04	E+04	E+04	E+04	2038	2176	3
10	2002	1	422	47.5	47.5	0.01	0	2E-08	2E-08	5E-09	2415	2213	821	715	45	44.98	
11	2002	1	244	36	35.9	0.009	0	2E-08	2E-08	7E-09	3318	3049	1137	994	23.1	23.06	
12	2002	1	8673	1674	1674	0.07	0	E+04	E+04	159	E+04	7E+04	E+04	E+04	1862	2002	3
13	2002	1	7904	1606	1606	0.01	0	4536	E+04	209	7E+04	7E+04	E+04	E+04	1782	1787	3
14	2002	1	420	13.4	13.4	0.009	0	3E-08	0	0	92.7	115	31.3	31.3	26.5	25.42	
15	2002	1	381	26.1	26.1	0.002	0	3E-08	3E-08	1E-08	482	474	212	207	31.1	31.08	
16	2002	1	7501	1361	1578	0.87	0	7E+04	4536	33.3	LE+05	7E+04	E+04	E+04	1869	1749	2
17	2002	1	5891	917	917	.0007	0	E+04	E+04	275	E+04	E+04	E+04	E+04	1251	1251	1
18	2002	1	915	153	260	0.05	0	1647	1593	70.9	E+04	E+04	9494	LE+04	374	461.6	
19	2002	1	253	44.2	44.2	.0005	0	E+04	E+04	4461	3516	3508	1244	1239	83.9	83.9	
20	2002	1	1172	306	306	0.05	0	E+04	2028	76.8	E+04	E+04	LE+04	LE+04	546	545.8	1
21	2002	1	5003	856	856	0.02	0	E+04	E+04	288	E+04	E+04	E+04	E+04	1183	1183	1
22	2002	1	210	53.1	53.0	0.01	0	E+04	E+04	3581	3411	3317	1311	1255	68.0	68.02	
23	2002	1	400	12.8	12.9	0.009	0	2E-08	0	0	116	145	39.4	38.1	28.2	27.55	
24	2002	1	363	11.7	11.7	0.002	0	2E-08	2E-08	2E-08	73.7	65.5	24	19.8	19.8	19.83	
25	2002	1	888	64.8	61.3	0.05	0	E+04	518	97.8	3067	2381	1169	798	72.2	68.25	8
26	2002	1	4791	802	802	0.05	0	E+05	LE+04	166	E+04	E+04	E+04	E+04	1114	1114	1

6.6 Carbon Sequestration

Carbon sequestration, in line with the SEEA Framework (UN et.al, 2014) is considered as an ecosystem service. The physical and monetary value of carbon provide insights in the contribution of forests in reducing the impacts of climate change, and are important to facilitate the advancement of REDD+ in the study sites.

In the case of the three (3) study sites, carbon sequestration was computed in three (3) scenarios namely: forested, conservation and agricultural scenarios. Physical values were derived by directly multiplying the forest area (in hectares) by the annual carbon sequestration per hectare. The annual carbon sequestration per hectare were computed using the following assumptions (Table 1) and equations.

Table 1. Assumptions for computing carbon sequestration rates per forest cover

	MAI – ABG Growth (tonnes dry matter/ha/yr)	Ratio of ABG to BGB	Sequestration Rate (tons of CO_2/ha/yr)
Closed Forest	2.10	0.32	4.58
Open Forest	3.50	0.32	7.63
Plantation Forest	9.10	0.32	19.84
Mangrove Forest	5.20	0.33	11.42

ABG – above-ground biomass
BGB – below-ground biomass

Use ***Equation 1.0*** to compute for the sequestration rate per type of forest using the above assumptions:

Equation 1.0

Annual Sequestration Rate = MAI(AGB)*(1+BGB)*Carbon Fraction*CO_2 global warming potential of 3.67)

Equation 2.0 finally computes the total carbon sequestered per forest type:

Equation 2.0

Carbon Dioxide Sequestered (tons CO2e/year) = Annual Sequestration Rate*Area (in ha)

The same computation was adopted in the following scenarios:

(a) No-Use (Forested) Scenario

The government prioritizes protection over multiple use management, leading to increase in the extent of closed forest to 92% of the study site. Areas below 8% slope are planted with annual crops (4% of land area), built up areas (3% of land area) and inland waters (1% of land area). Minimal activities are allowed, and practically no harvesting of natural resources is permitted.

(b) Wise-Use (Conservation) Scenario

Priority has been given for the protection of old growth forests and environmentally critical areas such as those located above 1,000 meters above sea level, 50% slope and riparian zones resulting in forest cover of 72% in the study sites. Perennial crop and Agroforestry cover 20%, annual crops at 4%, built up areas at 3% and inland waters 1% of the watershed.

(c) Ag-Use (Agricultural) Scenario

Government has prioritized food security over forest protection leading to massive forest conversion to crops. The former closed forest covering 92% of the study site is now planted with perennial crops. Annual crops remain at 4%, Built up area at 3% and inland water, 1% of land cover.

6.7 Timber Provision

Since 2011, there has been a moratorium on the harvest of timber from natural forests (both old growth and residual) by virtue of Executive Order No. 23. Before 2011, timber harvesting has been banned in protected areas.

While timber (and the wood products derived from timber) is a market good, there are currently no legal transactions for timber from natural forests due to EO 23. It was for this reason that valuation of timber provisioning service can be done on areas where there are many tree plantations, like Region 13 (CARAGA). EO 23 does not prohibit the harvesting of timber from tree plantations.

The net present value (NPV) method, which is one of the methods suggested by the SNA and SEEA Central Framework to approximate the market value of environmental assets where market prices are unavailable or unsuitable, was used. The NPV is the value of discounted net benefits, and may be obtained using the following formula:

$$NPV = \sum \frac{Rt - Ct}{(1 + i)t}$$

where:

Rt	=	revenue in year t
Ct	=	cost in year t
i	=	discount rate
t	=	any year within the rotation

7. Valuation Inputs

Irrigation water. Water flow net of the minimum flow for the cropping season of dry months is used to account for irrigation water. A full rice paddy requirement from pre-production up to harvest assumption of 16,500 m^3 per day, per hectare is used (Ragab et. al., 2012) along with the number of cropping days.

Sedimentation for check-dams. The trapping capacity of check-dams is derived form from key informants who are well-aware of the dam design which is around 500 m^3. It is based on the desiltation volume which is around 400-500 sacks, assuming 1 sack is equals to 225 kg. Along the series of check-dams there could be 10% reduction in trapping capacity. As a result, the average check-dam capacity used is 400 m^3. The sediment yield generated by SedNet per sub-basin is converted into kilograms. Lastly, the number of check-dams needed is derived by dividing the sediments over the storage capacity. The assumptions are shown in the table below.

Table 3. Assumptions in the computation of sedimentation for check-dams.

Assumptions	Assumptions		Reference
sediments avoided (kg) - SedNet	277,935,235		model result
checkdam storage (kg) / checkdam	90,000.00		from desiltation volume, rate
checkdam needed (count)	**3,088**		
desiltation sacks/year @ 1sack=225kg	500		KII, budget-dependent
trapping capacity (10% decrease along the series)	silt (kg)	10% decrease	KII, PaSU
check-dam 1	500.00	1	
check-dam 2	450.00	0.9	
check-dam 3	400.00	0.8	
check-dam 4	350.00	0.7	
check-dam 5	300.00	0.6	
Average	**400**		

Erosion for coco-mats or erosion blankets. Assumptions for this model came from a study that tested the erosion blanket durability using an extreme scenario of 120mm/hr rain at 1.5 m^2 plot at 5.47 kg/m^3 of surface run-off (SRO) per hour. The total flow-SRO (image below) is used to capture the SRO of the watershed. Since the experiment is too extreme, the event return period is considered to be 1:100. Per unit area of SRO is computed by dividing watershed size (m^2) from SRO (m^3). These are used to derive kg/hr of SRO per plot by multiplying to 1.5 (plot size). It is blown-up to annual values and is the divisor of the sediments avoided derived from SedNet results to capture the hectares or area of *cocomat*. The assumptions are shown in the table below.

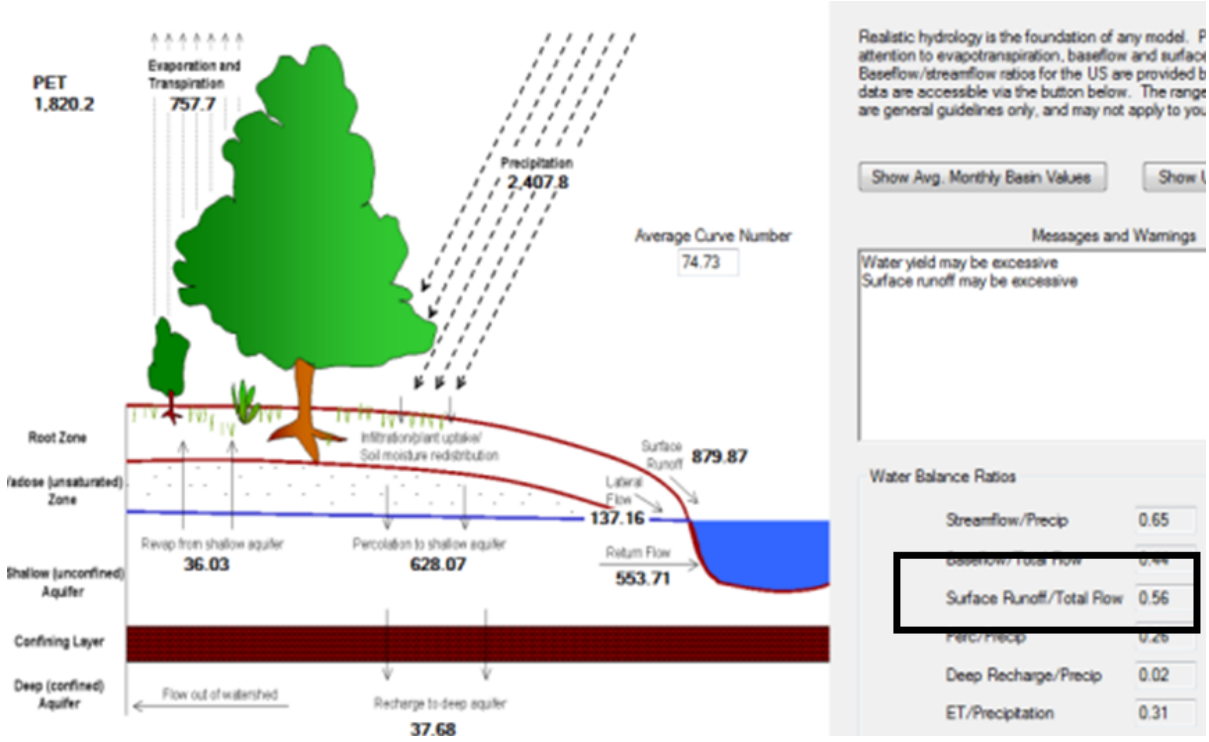


Table 4. Valuation inputs for erosion coco-mats/blankets.

Value provided	Unit	Remarks
5.47	kg/m^3 SRO per plot per hour of 1.5m^2	at 120mm/hr simulation
50,457,600	m^3 SRO/year from totalflow-runoff ratio	ratio at 0.64 from water balance of SWAT
32,949,000	m^2 size of watershed	size of sub-basin 12
400	PhP per coco mat m^2	from DENR data
Computed value		
0.0547	kg/m^3 of SRO per plot per hour of 1.5m^2	1:100 return period assumption due to very extreme condition used in the study
0.6530	m^2/m^3 SRO ratio per plot	
0.0536	kg/hr of SRO per plot	
469	kg/year per plot of sediments prevented	
2,625,440,084	kg avoided (service)/yr	from SedNet result; used 0.1 HSDR or Hillslope Delivery Ratio (0.9 assumed to be retained within hillslopes); to justify similarity of UM to Pagsanjan-Lumban (study site of SedNet paper)
5,593,759	m2 cocomat needed	
559	**ha cocomat needed**	

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Part 2
Ecosystem Services Valuation Methods

1. Valuation of Forest Ecosystem Services

This chapter focuses on the methods used to estimate the values of selected forest-based provisioning and regulating ecosystem services under the project "The role of forests in reducing poverty and enhancing climate resilience– a case study of the Philippines", implemented by the Department of Environment and Natural Resources, The Program on Forests (PROFOR) and The World Bank. In line with the System of National Accounts (SNA) 2008 and System of Environmental and Economic Accounting (SEEA) 2012, ***exchange values*** were used.

SNA 2008 and SEEA 2012 differentiates two valuation concepts, namely welfare economic values and exchange values, as follows: the welfare economic value concept "entails obtaining valuations that measure the change in the overall costs and benefits associated with ecosystem services and assets"; while the exchange value concept "entails obtaining valuations of ecosystem services and assets that are consistent with values that would have been obtained if a market for the ecosystem services or assets had existed" (SEEA 2012, 5.9).

Since the valuation of forest ecosystem services in the PROFOR study was undertaken in the context of SNA 2008 and SEEA 2012, the focus was estimate valuations that allow comparison with or will augment valuations in standard national accounts. The use of exchange values as provided in the SNA 2008 and SEEA 2012 ensure the consistency of approaches with other ongoing initiatives, including the Wealth Accounting and Valuation of Ecosystem Services (WAVES) project in the Philippines, and enable the capture of all relevant ecosystem services.

Exchange value reflects the actual outlays and revenue for all quantities of a product that are transacted. It is equal to the market price multiplied by the quantity transacted. It is based on the assumption that all purchasers pay (and producers receive) the same price on average, and hence excludes consumer surplus. Exchange values are those that underpin national and business accounting frameworks, as they can be estimated based on observed transactions (SNA 2008, 5.21).

2. Valuation Approaches

The valuation approaches that may be used for ***provisioning services*** are market prices, market price equivalents (proxy market prices) and unit ressource rent. For ***regulating services***, the approaches that may be used are market prices, replacement cost, cost of treatment, damage cost avoided, and the production function approach.

Market price refers to the amount of money that willing buyers pay willing sellers to acquire a good, service or asset. Under a perfectly competitive market, only one price will prevail for a specific good, service or asset at a particular time. In reality, however,

markets are seldom perfectly competitive. The market prices used in the national accounts will vary across buyers and over time. They should be distinguished from a general market price that indicates the average price for exchanges in a good, service or asset for a given period of time (SEEA 2012, 5.38).

Market price equivalent *is* based on the price of the same or similar items, and is used when a market price for a good or service cannot be observed. This approach assumes that 1) the price of the good or service is independent of all other goods and services, and 2) that the equivalent prices used have been set in an incentive-compatible manner (SEEA 2012, 5.44).

Unit resource rent is the difference between the benefit price and the unit costs of labor, produced assets and intermediate inputs (SEEA 2012, 5.79) and provides an estimate for the price of the ecosystem service. It assumes that 1) the resource is extracted or harvested sustainably, and 2) the owner of the resource seeks to maximize resource rent. It is commonly used for the outputs of agriculture, forestry and fishery, especially when land leases and prices cannot be used as an indicator of the price of ecosystem services.

In the ***replacement cost method,*** the value of the ecosystem service is based on the costs associated with mitigating actions if the ecosystem service would be lost. It assumes that 1) the alternative to the ecosystem service provides the same services and is the least cost alternative, and 2) society will choose to replace the ecosystem service if it were lost (SEEA 2012, 5.84). The replacement cost method is commonly applied to regulating services like water purification and flood control.

The ***cost of treatment method*** estimates the value of the ecosystem service based on the costs of repairing damages that would result from the absence of the ecosystem service, and is relevant to regulating services like soil erosion control, sedimentation control, air purification (SEEA 2012, 5.86) and water purification.

The ***damage cost avoided method*** estimates the value of the ecosystem service based on the value of property protected or the cost of actions to avoid damages (ecosystemvaluation.org, n.d.), as in the case of the flood regulation service of forests.

The replacement cost and cost of treatment methods aim to estimate the price of a single ecosystem service, and not a basket of ecosystem services (SEEA 2012, 5.87).

The ***production function method*** estimates the contribution of ecosystem services to production processes based on their contribution to the value of the final product traded in the market (SEEA 2012, 5.98). This involves separating the contribution of the ecosystem from those of other production factors, and is similar to the use of resource rent as a proxy for the monetary value of provisioning services.

3. Application of Valuation Approaches

The ecosystem services that were modeled in the project, and for which values were estimated, are summarized in Table 1.

Table 1. Forest ecosystem services that were modeled and valued in the project

Ecosystem Service	Interpretation	Upper Marikina	Libmanan-Pulantuna	Agusan
Water Provision	Supply of water or water yield	Yes	Yes	Yes
Water Regulation	Regulated water supply	Yes	Yes	Yes
Water Purification	Reduced sediment/ nutrient load in waterways due to retention by vegetation	No	Yes	Yes
Erosion Control	Avoided soil erosion	Yes	Yes	Yes
Sediment Control	Reduced sediment load in waterways	Yes	Yes	Yes
Carbon Sequestration	The amount of CO2 sequestered by standing forests	Yes	Yes	Yes
Timber Provision	Supply of timber traded in a market or used for subsistence	No	No	Yes, tree plantations
NTFP Provision	Supply of NTFPs traded in a market or used for subsistence	In forest use analysis	In forest use analysis	In forest use analysis

3.1 Water Provision: Domestic Water Use by Households

The ecosystem service of water provisioning is the amount of water (before treatment) that is extracted from a surface water source or a shallow aquifer (SEEA 2012, A.314). The water provision service may be based on how households use surface and ground water. Ideally, data regarding the water usage of households may be gathered through household surveys. In the case of the project, time constraint necessitated the use of key informant interviews to estimate the volume of water used per household for various purposes. Secondary data regarding the number of households, the average household size, income, and other household characteristics are important to supplement the primary data gathered from key informant interviews[2].

[2] Secondary data sources include the Philippine Statistics Authority and annual reports

The quantity of water used by households per year (Q) may be estimated for different uses, *i*, (drinking, cooking, washing dishes, washing clothes, bathing and cleaning houses) as follows:

Q_i = average volume of water per use per household/year * number of households

As applied in this study, two approaches may be used to determine the replacement cost of water for domestic use.

Under the first approach, the price of water may be based on the cost of replacing the water used by the households if it were delivered, under a scenario that the household can no longer get water from the watershed. For this, water delivery service providers in the area may be interviewed for the price of delivered water for drinking and non-drinking purposes to households in accessible and less accessible areas.

The second approach made use of rainwater harvesting as a replacement for surface and ground water that households use. Rainwater harvesting using storage tanks is common in rural areas where there are no water districts or barangay water systems yet.

3.2 Water Provision: Irrigation

For this study, the ecosystem service of providing water for irrigation was interpreted as the additional area that can be irrigated under the actual and forest scenarios over what a bare/urban watershed could irrigate. The modeling component of the project estimated the annual average water yields for the dry and wet seasons under various scenarios, to be used in computing the potential paddies (in ha) that could be irrigated for each season.

The value of this provisioning service is based on the resource rent of rice production, given by the following formula (SNA 2008):

$$RR = TR - (IC + CE + CFC + NP + T - S)$$

Where:

RR = resource rent, P/ha
TR = total revenue based on the farmgate price of palay
IC = intermediate consumption, or the value of goods and services consumed as inputs by a production process, excluding fixed assets
CE = labor costs or compensation for employment, including remuneration in kind
CFC = consumption of fixed capital (depreciation, or the decline in the current value of assets due to physical deterioration, normal obsolescence or normal accident damage)
NP = normal profit or return to produced assets
T = taxes
S = subsidies

The data used in computing the resource rent for rice were obtained from the Philippine Statistical Authority (psa.gov.ph).

3.3 Erosion Control

The ecosystem service of erosion control, or the volume of erosion avoided (kg/year) was based on the soil loss estimates the actual and bare (no-forest) scenarios generated from the SedNet models. The capacity of coco matting to reduce erosion was derived from the study of Candelaria et al. (n.d.), while the price of coco matting was based on the contract price used by the DENR in the installation of coco matting, particularly in UMRBPL.

To arrive at the value of the cost of replacing the erosion control ecosystem service, the following are computed:

1. Quantity of erosion blankets required (sq m/year) =

$$\frac{\text{Erosion avoided (kg/year)}}{\text{Trapping capacity of coco matting (kg/sq m)}}.$$

2. Replacement cost of erosion control ES (P/year) =
   Quantity of erosion blankets (sq m/year) * Price of coco matting (P/sq m)

3.4 Sediment Control

The outputs of the biophysical models are the sediment yields in t/year under the actual and bare (no-forest) scenarios, with the difference representing avoided sediment due to the presence of forests. The Sednet software was used to generate models to estimate the total suspended sediments (TSS) in t/year.

The number of check dams that can provide this equivalent service of avoiding TSS may be computed as follows:

1. Average volume of silt impounded per check dam = Total silt impounded/ Number of check dams

2. Conversion of TSS avoided per sub-basin in t/year to cu m/year using the appropriate conversion factor

3. Number of check dams required to provide equivalent ES = TSS avoided/ average volume of silt impounded per check dam

In the absence of data about the configuration of streams that would determine the designs and sizes of check dams in the study sites, the following were computed using data from UMRBPL in constructing the check dams[3,4]:

1. Average volume of check dam structure (including footing, main structure, and two wings)

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[3] Data about check dam cost and capacity were obtained from the UMRBPL Accomplishment Report CY 2012-2015

[4] 203 units of check dams with a total volume of 20,900 cu m constructed from 2012-2015; 44,235.79 cu m total silt impounded

2. Average cost per check dam = average volume per check dam * cost per cu m of check dam
3. Cost of check dams by sub-basin = number of check dams required per sub-basin * average cost per check dam

The cost of replacing the sediment control ES came from the construction of check dams (one-time cost) and the removal of silt from the check dams every year (recurring cost). Since the ES is expressed in P/year, the following may be computed:

1. Annualized cost of check dams, using lifespan of 8 years[5] and a discount rate of 15%[6], using the formula

   $A = V_0 \quad [i \ (1+i)^n]/[(1+i)^n-1]$

2. Desiltation cost per year = TSS avoided in cu m/year * desiltation cost per cu m[7]

For each sub-basin, the replacement cost for the sediment control ES may be obtained by adding the annualized cost of check dam and the desiltation cost per year.

3.5 Carbon Sequestration

The carbon sequestration rate of forests ***(Q, in tCO_2/year)*** may be estimated using timber inventory data. The mean annual increment (MAI) above-ground biomass (AGB) growth (t dm/ha/year) and the ratio of above-ground biomass to below-ground biomass (BGB) is obtained per forest type (closed, open, plantation, mangrove). The carbon sequestration rate (t CO_2/ha/year) and the CO_2 sequestered per forest type (t CO_2 e/year) are obtained using the following formulas:

Sequestration rate = (MAI(AGB)*(1+BGB)*Carbon Fraction*CO_2 global warming potential)

CO_2 Sequestered = Area * Sequestration rate

The CO_2 sequestered by the four forest types is then summed up to obtain the total CO_2 sequestered in the study site.

The carbon sequestration service may be valued using the Social Cost of Carbon (SCC, in USD/tC converted to P/tCO_2), which was also used by PhilWAVES Southern Palawan. The SCC estimates the value of economic damages caused by each additional ton of CO_2 released to the atmosphere (Ackerman and Stanton 2010).

The value of the carbon sequestration service is expressed in P/year.

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[5]Temporary check dams have a lifespan of 3 to 8 years; since the check dams in Upper Marikina are made of concrete, a lifespan of 8 years was adopted (http://www.sswm.info/content/check-dams-gully-plugs)

[6] National Economic Development Authority (NEDA)

[7] The unit cost of desiltation used by UMRBPL is P400/cu m

3.6 Timber Provision

Since the project did not involve the survey and inventory of tree plantations in these areas, the volume of timber of different species harvested per year ***(Q in cu m/year)*** may be obtained from DENR statistics and reports, and yields per hectare of various tree species. The Philippine Forestry Statistics has log production data by region and province of planted tree species.

The price of timber will be based on the stumpage value ***(P in P/cu m)***, which is analogous to resource rent, to be computed using the following formula:

P (Stumpage Value) = Log Market Price - Log Production Cost - Margin for Profit and Risk

Log market prices, production costs and profit and risk margins may be obtained from key informant interviews and secondary sources.

The value of the timber provision service is expressed in P/year.

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Part 3
Forest Use Analysis Methodology

1. Background

Forest use analysis was undertaken for the PROFOR study to better understand and quantify where possible how communities living within and around forest used forest resources, and the benefits that they derived from forest ecosystem services. A two part approach for forest use analysis was undertaken. The first was the undertaking of a series of focus group discussions with residents of the Upper Marikina River Basin Protected Landscape (UMRBPL), the Libmanan-Pulantuna watershed, and Middle Agusan River Basin. The second approach was the undertaking of a deep-dive forest use analysis in the UMRBPL using wealth and gender lens for analysis.

Focus group discussions (FGDs) were conducted: (i) to identify the ecosystem services that forests provide to the local community; (ii) to assess the availability of forest ecosystem services to the local community in the light of climate change; (iii) to determine how the community uses forest ecosystem services to cope with climate and economic shocks. An FGD interview guide was developed from the draft "National socio-economic surveys in forestry: Guidance and survey modules for measuring the multiple roles of forests in household welfare and livelihoods" produced by the Food and Agriculture Organization (FAO), the Center for International Forestry Research (CIFOR), the International Forestry Resources and Institutions Research Network (IFRI), PROFOR and The World Bank. It was not possible to include in the FGD all barangays inside the sub/basin due to time and resource constraints. Instead, representative barangays were selected. On the other hand, the participants were selected based on their knowledge of river basin conditions due to many years of residence in the area, gender, livelihood, and participation in reforestation/restoration programs like NGP.

The Poverty-Forests Linkages Toolkit developed by the PROFOR was used to guide forest use analysis for the PROFOR study. The toolkit is a field manual designed to aid practitioners on data collection and analysis in understanding forest dependency and thereby reducing vulnerability among poor upland communities, and consists of a set of eight (8) modules on participatory appraisal/assessment; see Table 1. This chapter presents details on the methodology used for forest use analysis with a gender-wealth lens as part of the PROFOR Study. Results of the Forest Use Analysis are also provided. This chapter thereby provides instruction for how this type of assessment could be replicated.

Table 1. Field Tools and Their Purpose

Tool No.	Title	Purpose
1	Wealth Ranking	Understand how poor households use and depend on forest resources
2	Local Landscape Situation Analysis	Understand how villagers use local resources
3	Timeline and Trends	Record changes in forest resources, agriculture, local livelihood strategies and income
4	Livelihood Analysis	Determine subsistence reliance on forests and the annual income from forests

5	Forests Problem and Solution Matrix	Identify and rank forest problems and suggest solutions
6	Ranking Forest Products	Rank forest products by importance for cash or subsistence use
7	Millennium Development Goals (MDGs) Chart	Show the contribution of forests to the achievement of the MDGs
8	Monetary Values	Express the contribution of forestry in monetary terms

Source: www.profor.info/node/3

2. Process

The PROFOR study applied Tools 1, 2, 4, 5 and 6, and excluded Tools 3, 7 and 8 to achieve efficient and effective data collection and analysis strategies. In preparation for the field work, the PROFOR Secretariat of DENR were trained as facilitators and enumerators, especially on how to implement the activities prescribed by the toolkit. However, during the training, the team discovered new strategies by which these tools can be accomplished given the available data and context. Thus, modifications were incorporated during the implementation of the tools prescribed in the PROFOR Toolkit in the field. These modifications were discussed among the PROFOR Team members during their training in order to orient them of possible scenarios during the conduct of the study.

3. Training

A facilitator's training was conducted among the PROFOR study team, and followed the sessions and activities presented in Table 2.

Table 2. Summary of Training Sessions and Activities

Tool Number	Tool Name	Participatory or Analytical?	Who is involved?	Materials Needed
1	Wealth ranking	Participatory	Facilitators alone	Census survey Random numbers
2	Landscape analysis	Participatory	Village informants and facilitators	Community maps generated during the first round Manila paper Markers Pens
4 Step 1	Livelihood analysis	Participatory	16 villagers and facilitators	Meta-cards for templates Beans in bags
4 Step 2		Participatory	16 villagers and facilitators	Meta-cards for templates Beans in bags
4 Step 3		Participatory	16 villagers and facilitators	Meta-cards for templates Beans in bags
4 Step 4		Analytical	Facilitators alone	Templates, Formulas

5	Problem and solution matrix	Participatory	16 villagers and facilitators	Meta-cards for templates Beans in bags
6	Ranking forest products	Analytical	Facilitators alone	Templates, Formulas

4. Implementation of field work

Nine barangays were selected for site visits and FGDs.

4.1 Data Collection Tools

In the conduct of these sessions, there were a number of procedural modifications identified that would efficiently and effectively assist during actual fieldwork. First, the toolkit was modified to focus on five tools which would promote stronger focus on gender and wealth issues.

Second, the selection of participants was not left to the discretion of the village chieftains (i.e., Barangay Captains in the Philippine context). A simple random sample (SRS) was used to sample community members based on the recently concluded 2012 Survey and Registration of Protected Area Occupants (SRPAO) for the UMRBPL. SRPAO is governed by the implementing guidelines issued by the DENR Administrative Order (DAO) 2013-20 to construct an official listing of the household members occupying protected areas to determine not only the population size but also the location, boundaries and extent of such occupancy.

Third, the SRPAO was used to generate statistical inferences out of the quantitative data based on the demographic profiles of participants as well as the tools and templates provided in the PROFOR toolkit.

Henceforth, the succeeding sections discuss the procedures and pointers in the tools adopted in the study, namely: (1) Tool 1 (Wealth Ranking); (2) Tool 2 (Local Landscape Situation Analysis; (3) Tool 4 (Livelihood Analysis); (4) Tool 5 (Forests Problem and Solution Matrix); (5) Tool 6 (Ranking Forest Products).

4.1.1 Tool 1 – Wealth Ranking

Originally, Tool 1 is designed to select participants to represent the local population that will carry out the Toolkit exercises. The following procedures are prescribed in the Poverty-Forests Linkages Toolkit Manual:

(1) Step 1 – Local Definitions of “Extreme Poverty”, “Poverty”, “Average” and “Wealthy”, wherein the participants decide and define based on broad economic

categories what they refer t as “poor”, “average” and “rich” in their own community context;

(2) Step 2 – Which Households, which involves classifying each household under the rubrics of key indicators they have previously decided and defined as broad economic categories;
(3) Step 3 – Selecting Households to Interview, which draws sample from the categories to avoid biases.

The SRPAO list contains self-reported incomes from the participants, and was used as the basis for recruitment of respondents. Use of the SPRAO helped to avoid bias among Barangay captains, who might select the participants based on partisan affiliation especially that the context surrounding the study was the Philippines' national elections. Also, the use of the SRPAO helped maintain the integrity of the randomization process.

The team generated broad economic categories of “Relatively Rich Male” (RRM), “Relatively Rich Female” (RRF), “Relatively Poor Male” (RPM), and “Relatively Poor Female” (RFM) to incorporate both gender and wealth aspects into the Deeper Dive study. To do such categorization, the team considered the political units (i.e., barangays) covering the Upper Marikina River Basin and Protected Landscape (UMRBPL) in ranking the households based on their income. Thus, there were nine (9) barangays that were included in the listing; Barangays San Juan, Pintong Bukawe, Calawis, Cuyambay, Mascap, San Jose, Puray, Pinugay and San Rafael.

In each barangay, the complete list of the respondents was secured. The list contains names of female and male respondents. Given pertinent information on the names, marital status and names of spouses (if applicable), the team divided the list based on gender (i.e., male and female population per barangay). The team ranked the participants based on the annual average income of the households, and took the median income. This median value served as the divide between the “relatively rich” (i.e., participants with income values above median) and “relatively poor” (i.e., participants with income values below median) wherein the upper half of the median was designated as “relatively rich” households and the lower half of the median was designated as the “relatively poor” households. Such division was applied to both male and female groups. Using a macro in the Microsoft Excel software, the team randomly selected names to constitute the four groups per barangay. While this consultant was aware of the other variables that factor in the forest use of different forest user groups such as educational attainment, security of tenure over land, and age, the team decided to pursue the two most important layers to the study, that is, the gender and wealth and their interaction.

Thus, a total of 144 respondents were randomly selected for the Deep-Dive FGD. Moreover, the team reserved 8 replacements per group which were also randomly drawn in case that the original respondents were not available on the day of the FGD or that they did not want to participate in the study. After the lists had been completed, they were communicated to the respective Barangay Captains for them to verify the names of the respondents (i.e., whether they are bona fide residents of the barangay or not, and whether they still reside in the area). If the original respondent and his/her replacement

could not be located, the team had instructed the Barangay Captain to use the next replacement on the list until the entire set of 16 participants for each barangay was complete.

The participants were drawn from barangay listing were categorized in the following groups to signify the differences between and among them in terms of gender and wealth criteria:

(a) Group A – relatively rich male respondents;
(b) Group B – relatively poor male respondents;
(c) Group C – relatively rich female respondents; and,
(d) Group D – relatively poor female respondents.

Ideally, each category was given 4 participants each; totaling to 16 participants per barangay and 144 participants for the entire study. The team also provided for replacements, which were also drawn from the SRPAO list under the categories of gender and wealth. Table 3 presents the actual number of participants per barangay as grouped accordingly to gender and wealth categories set by the PROFOR Team.

Table 3. Actual Number of Respondents per Barangay

Code	Barangay	A	B	C	D	Total
01	San Juan	2	3	4	4	13
02	Pintong Bukawe	2	3	4	3	12
03	Calawis	3	4	3	4	14
04	Cuyambay	3	0	3	0	6
05	Mascap	4	4	2	4	14
06	San Jose	4	4	3	1	12
07	Puray	3	1	1	2	7
08	Pinugay	1	3	4	4	12
09	San Rafael	4	1	4	4	13
	TOTAL	26	23	28	26	103

In actual, a total of 103 randomly selected individuals was recruited as study participants, with 49 male and 54 female respondents. This sample provided for 72% response rate, computed against the target n=144. Such number of respondents gave robust results especially in the quantitative analysis, which is discussed in the succeeding section.

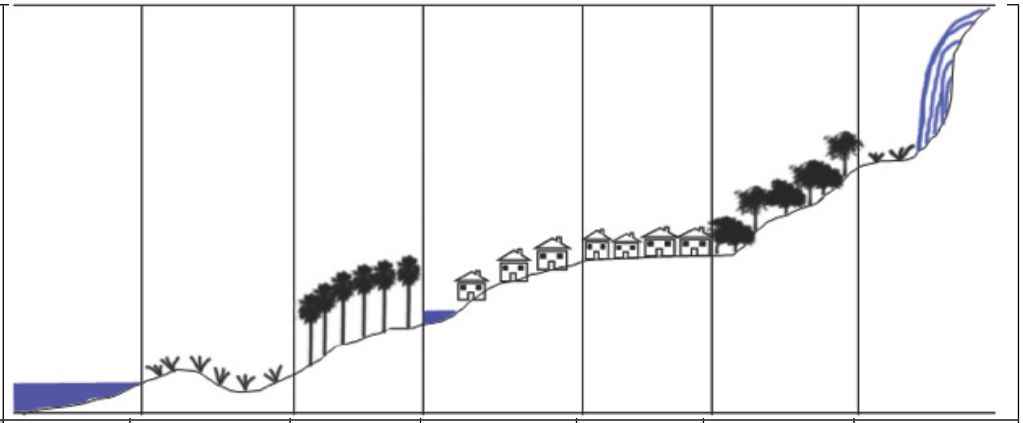
4.1.2 Tool 2 – Local Landscape Situation Analysis

The aim of this tool is to allow the field team to understand how community/village members use their local resources by visiting the resources that are available to them. In this study, the team adopted the following modifications:

(1) The team opted for a "windshield transect" wherein the team members visited the resources using the main road of the community to map out the area.
(2) A local key-informant, usually members of the Barangay Council (i.e., highest government unit in the community) or Barangay Tanod (i.e., community patrol) was asked to accompany the team in order to provide relevant information regarding the biophysical boundaries of the area.
(3) The team also used Global Positioning System (GPS) device to ascertain the area being drawn on the larger map of the entire watershed.
(4) The draft map was presented to groups A, B, C and D separately. Overlay maps were used in order to capture each group's inputs into the map. These inputs were summarized and presented using the template provided below.

This template juxtaposes the biophysical and socio-demographic profiles in order to show how local resources are being used and distributed by and among the community members. The biophysical characteristics present the various local resources and their relative location along the transect line. The socio-economic characteristics, on the other hand, look into the ownership, use/access, knowledge, control and decision-making participation among male and female population.

Table 4. Sample Template of Local Landscape Situation Analysis

ZONES							
DIMENSION	**Water Resources**	Rice fields (irrigated)	Private plantation	Recreational Area	Residential Area	Forests (NGP Plantation)	Swidden farming
Bio-physical Characteristics							
Vegetative cover		Rice	(mango, banana, dalandan, calamansi)			NGP plantation	Kaingin (B and D) Upland Rice fields (C)
Soil							
Water source	Calawis river						Bunsuran falls
Infrastructures				Recreational facilities i.e. Resort, Camps,	Church, Schools, brgy hall, community center		
Socio-economic Characteristics							
Ownership	Male/ Female	Male (A) Male/Female (B, C, D)	Male	Male/Female (A, C, D) Male (B)	Male/ Female	Male IPs (D)	Male/ Female Male (B)
Use/**A**ccess	Male/ Female	Male/ Female	Male (D)	Male/Female	Male/ Female	Male/ Female	Male/ Female
Knowledge	Male/ Female	Male/ Female	Male/ Female	Male/Female	Male/ Female	Male/ Female	Male/ Female
Control	Male/ Female	Male	Male	Male	Male/ Female Male (B, C)	Male Male/ Female (D)	Male/ Female Male (B)
Decision-making participation	Male/ Female	Female (A) Male (B, C) Male/Female (D)	Female (A) Male (B, C, D)	Male	Male/ Female Male (B, C)	Male Male/ Female (C)	Male/ Female Male (B, D)
Problems	Wastes from piggery go straight to the Calawis river; Fish poisoning	Fire incidence; Pests	Typhoons		Other claimants refuse to plant		Volume of water decreases during dry season
Opportunities	Domestic purposes; additional income			Additional income; Employment	Additional income	Employment	Tourism

Legend: Where as: O (ownership) refers to who has legal and/or informal position ove the area/resource
U/A (use/access) refers to the ability of individuals to consume/exploit the resources
K (knowledge) refers to familiarity, experiences and information that individuals have over their location
C (control) refers to the ability of individuals to dictate who, when, where, how and for whom resources are to be used
D (decision-making participation) refers to opportunity given to the individuals to make and come to a decision

For example, based on this template, there are a number of male-dominated areas, which the groups of participants have identified. These include rice fields (C), private plantations (O, U/A, C), recreational facilities (C, D/P) and NGP plantation (O). Such control emanates from the fact that the male population provides mostly the labor requirements in these workplaces. No group has identified specifically female-dominated areas since women's works in these areas are considered as supplemental or complimentary to male activities.

In similar manner, all the 9 landscape analysis maps will be consolidated to weave in a common narrative of the experiences of men and women as far as the resources are concerned.

4.1.3 Tool 3 – Livelihood Analysis

The aim of this tool is "to discover the extent of cash and subsistence reliance on forest resources and the proportion of the total annual livelihood (from all sources) that comes from forest resources."

(1) Step 1 – An Overview of the Main Cash Components of the Household's Annual Livelihood
(2) Step 2 – An Overview of the Main Non-Cash Components of the Household's Annual Livelihood
(3) Step 3 – Proportion of the Household's Entire Annual Income that comes from Cash Sources, and Proportion which comes from Non-Cash Sources

In this study, the team followed the prescribed procedures in the PROFOR Toolkit except on the following:

(1) The team assigned numbers to each of the participants in each group. For instance, in Group A, which is labeled as RRM, Juan de la Cruz was given number 1. Mr. de la Cruz maintained this number assignment all throughout the exercises requiring individual responses such as ranking of cash and non-cash sources of income, proportions, and problems. This strategy allowed the team to trace the responses per participant and convert the data for statistical analysis, which was not part of the original PROFOR Toolkit. These individual opinions were counted and presented in Tables 5, 6, 7 and 8.
(2) Collective responses were generated in Tool 6 wherein opinions on the problem solutions as well as the scenario-building exercises were expressed as group. The PROFOR team gathered these responses from Groups A, B, C and D separately. The results of this are presented in Tables 9 and 10, with each group expressing opinions on the identified priority problems and the existing laws and regulations governing the entire watershed area.

Table 5 presents the summary of the cash components of the household's annual income as expressed accordingly by the 4 groups.

Table 5. Cash Components of Household's Annual Livelihood

Sources	A	B	C	D	Total	%
Forest Products	20	48	31	39	138	6.6%
Charcoal	4	15	2	15	36	1.7%
Bamboo products	6	29	18	24	77	3.7%
Rattan	0	0	0	0	0	0.0%
Honey	2	2	0	0	4	0.2%
Pako	0	0	0	0	0	0.0%
Fish	0	0	11	0	11	0.5%
Bush meat	6	0	0	0	6	0.3%
Cogon	0	0	0	0	0	0.0%
Lumber	2	2	0	0	4	0.2%
Farm Produce	203	189	208	223	823	39.6%
Upland rice	28	36	16	33	113	5.4%
Fruit trees	19	35	9	27	90	4.3%
Root crops	9	18	14	20	61	2.9%
Corn	8	11	22	3	44	2.1%
Banana	73	46	64	54	237	11.4%
Vegetables	66	43	83	86	278	13.4%
Other Sources of Income	297	223	341	258	1119	53.8%
OFW	0	0	9	0	9	0.4%
Business (stores, etc..)	52	47	73	32	204	9.8%
Trading	33	9	22	36	100	4.8%
UDP beneficiary	2	2	8	0	12	0.6%
Vulcanizing	2	4	0	0	6	0.3%
NGO	8	1	0	7	16	0.8%
Laundry woman	1	6	25	13	45	2.2%
Brgy Official	12	16	16	23	67	3.2%
Pension	32	20	20	7	79	3.8%
Construction worker	19	13	25	6	63	3.0%
Caretaker	5	21	0	11	37	1.8%
Technician	6	8	0	3	17	0.8%
Carpenter	7	9	0	7	23	1.1%
Driver	43	0	33	4	80	3.8%
Waiter	5	0	3	0	8	0.4%
Handicraft making	0	0	6	10	16	0.8%
Furniture making	5	0	0	0	5	0.2%
Laborer	6	2	11	11	30	1.4%
Gold panning	17	3	20	0	40	1.9%
Engineer	0	0	0	0	0	0.0%
Tenant	0	0	0	0	0	0.0%
Security guard	0	2	2	31	35	1.7%
Government employee	26	17	56	28	127	6.1%

Employee of private company	7	12	0	0	19	0.9%
Welder	2	20	5	18	45	2.2%
Mason	7	11	7	8	33	1.6%
4Ps	0	0	0	3	3	0.1%
Total	520	460	580	520	2080	100.0%

Of the cash components, the respondents reported that their incomes are mostly generated from sources other than the forest products and farm produce. Other sources of income accounted for 53.8% of the cash components of household income in the community, while incomes from forest products and farm produce accounted for 6.6% and 39.6%, respectively.

Among the forest products, the respondents reported that they have earned mostly from the production of bamboo products (3.7%) and charcoal (1.7%). The price of bamboo poles was pegged at Php 5 per piece, while charcoals were sold at Php 200 per sack. Charcoals were being produced at an average of 20-50 sacks per production, which is male-dominated and lasts for one week. The marketing of these products, however, is a female task. As one of the respondents exclaimed, "*Kaya na nila ang pagbi-benta*" (They [Women] can manage the selling alone).

Table 6, on the other hand, presents the non-cash components of the household's annual livelihood among the 4 groups. A different scenario emerged from this tool, wherein the respondents identified that in terms of benefits derived from the forests, they benefitted more from forest products, accounting for 56.5% whereas farm produce accounted for 43.50%. However, they emphasized that water is the main non-cash benefit they get from the watershed area, followed by bamboo products (8.6%) and herbal medicine (4.0%). In terms of farm produce, the respondents claimed that they collected vegetables (12.6%), banana (12.6%) and fruit trees (7.4%).

Table 6. Non-Cash Components of Household's Annual Livelihood

Sources	A	B	C	D	Total	%
Forest Products	322	271	239	298	1130	56.5%
Charcoal	18	4	11	11	44	2.2%
Bamboo products	45	61	27	39	172	8.6%
Rattan	2	0	0	0	2	0.1%
Honey	12	9	0	12	33	1.7%
Pako	3	9	4	9	25	1.3%
Wild flowers	10	7	5	0	22	1.1%
Herbal medicine	12	18	15	34	79	4.0%
Mushroom	16	9	8	20	53	2.7%
Fish	23	26	11	15	75	3.8%
Bush meat	2	1	0	1	4	0.2%
Water	139	109	153	149	550	27.5%
Cogon	13	6	0	0	19	1.0%

Lumber	27	12	5	8	52	2.6%
Farm Produce	198	189	261	222	870	43.5%
Upland rice	26	45	5	9	85	4.3%
Fruit trees	28	31	42	46	147	7.4%
Root crops	22	6	27	28	83	4.2%
Corn	15	18	16	11	60	3.0%
Banana	48	52	93	59	252	12.6%
Vegetables	59	37	78	69	243	12.2%
Total	520	460	500	520	2000	100.0%

Table 7 presents the proportion of income from cash and non-cash sources. When asked to weigh the income they get from cash components and non-cash components of their entire households

Table 7. Proportion of Income from the Forest as Cash and Non-Cash Sources

Group	Cash		Non-Cash		Total	
	No.	%	No.	%	No.	%
A	266	28%	254	22%	520	25%
B	195	21%	265	23%	460	22%
C	234	25%	356	31%	590	28%
D	238	26%	282	24%	520	25%
Total	933	100%	1157	100	2090	100

4.1.4 Tool 4 – Forests Problem and Solution Matrix

The aim of this tool is to identify and rank the main forest problems, and suggest potential solutions to these problems as well as project the possible impacts of existing laws, policy, tenure and access on them are captured through this tool. In this study, individual participants were asked to rank the main forest problems. The scores were summed up wherein the top 10 problems are presented in Table 8.

Table 8. List of Problems Identified

Access of forest resources	Quality of water from rivers is low	Unavailability of road
Tenure problems	Mining	Fire in dumpsite because of biogas
Deforestation	Subdivision establishment	Inadequate supply of water
Exhaustive charcoal-making	Forest fire	No electricity
Utilization of forest resources by consumers outside of UMRBPL	Climate change	Lack of basic services from government

Drought	Illegal logging	Hunting
Storms	Poor implementation of forest policies	Illegal fishing
Vector-borne diseases	Illegal migrants	Cows destroying crops
Floods	Water shortage	

Each group was asked to discuss these forest problems and offer possible concrete solutions at three levels of decision-making, namely: (a) Barangay (Village) Level; (b) Provincial Level; and, (c) National Level. These solutions are presented per group in Tables 9a, 9b, 9c and 9d, respectively.

Table 9a. Solutions offered for Forest Problems by Group A (Relatively Rich Male)

Rank	Problems	Solutions		
		Barangay Level	Municipal Level	National Level
1	Tenure problems	Issuance of Barangay Certification of their respective occupancy	Support and acceptance of the rights of the indigenous peoples and their ancestral domain	Provision of necessary documents for the approval of plans and titles; Awarding of land titles to the occupants; Execution of RA 8371; Easy processing of CADT application through the creation of an EO; Free or affordable cheap processing fees for cadastral survey
2	Illegal logging	Confiscation of lumber/logs even at the barangay level; Control of cutting of trees by giving the right to issue cutting permit at the barangay level; Avoid cutting of trees; Punish illegal loggers; Employment of Bantay-Gubat or forest patrols	Giving of warning notice to illegal loggers; Strict implementation of anti-illegal logging laws; Increase Bantay-Gubat or forest patrols	Imposition of heavy penalty against illegal loggers; Deployment of more forest rangers
3	Exhaustive charcoal making	Apprehend and charge those engaged in charcoal-making according to the law; Provide enough livelihood options to those into charcoal-making	Arrest stores selling charcoals without permit; Those with permit to sell charcoal must be provided with legal suppliers	Provide start-up investment to those who were not able to finish schooling; Livelihood programs
4	Floods	Avoid throwing of plastic materials in the river in order not to clog the canals during flooding; Plant more trees; Ban the construction of houses near rivers; Provide immediate evacuation	Apprehend people who do not properly dispose their garbage; Continue planting trees to avoid flooding; More reforestation programs; Provide relief goods	Planting of bamboos along river banks through DENR and NGP; Strict implementation of the laws; Remove corrupt DENR officials; Prohibit the cutting of trees
5	Water shortage	Construct deep well in the barangay	Provide enough funds to create reservoir and hose to the community	Forestry programs in order to increase the water volume; Construct deep well in each community
6	Drought	Allow cloud seeding for crops; Provide free hose to each barangay	Allow cloud seeding for crops; Be supportive of the municipal programs	Assistance for irrigation and water for household use; Remind population to save water
7	Storms	Cooperate in caring for the environment and forests; Timely notice/updates re: storm;	Formulate ordinaces to protect the environment; Provide survival kit including flashlights, life jackets, and others	

8	Deforestation	Notify officials of any incidents related to cutting of trees; Plant trees like Mahogany; Avoid cutting of trees; People must participate in planting trees and in reforestation	Designate high municipal officials as forest patrols; Avoid cutting of trees; People must participate in planting trees and in reforestation	Make available the planting materials to replace the forests; DENR must continue its work on reforestation and deputaize more Bantay-gubat
9	Vector-borne diseases	Maintain cleanliness; Employ maintenance crew in the barangay; Work jointly with other organizations on cleanliness and awareness of different vector-borned diseases	Distribute mosquito nets; Launch medical missions on health and programs on cleanliness	Enact or implement laws/regulations on restriction against illegal garbage disposal practices
10	Quality of water from rivers is low	Enact ordinances on the protection of rivers and creeks; Inculcate discipline among people regarding this	Enact ordinances on the protection of rivers and creeks; Inculcate discipline among people regarding this	Plant trees

Table 9b. Solutions offered for Forest Problems by Group B (Relatively Poor Male)

Rank	Problems	Solutions		
		Barangay Level	Municipal Level	National Level
1	Tenure problems	Create barangay representation in any decision-making regarding land and land tenure; Secure permits from the barangay regarding the any use of the land	Require proof or certification on land or tax declaration	Provide land certification to farmers on their lands/occupied lands
2	Exhaustive charcoal making	Identify people engaged in charcoal-making to provide them with small start-up funds for their livelihoods	Provide assistance for livelihood projects like vegetable growing in order to avoid charcoal-making as option for livelihood	Limit the issuance of business permits involving charcoal-making
3	Deforestation	Avoid charcoal-making; Look for alternative and stable sources of livelihood; Plant fruit trees than just trees; Stop illegal logging; Apprehend illegal loggers; Programs on tree planting	Inform the municipal offices regarding deforestation; Also inform DENR; Stop ilegal logging and arrest the illegal loggers	Let the authorities know; Stop illegal logging and arrest the illegal loggers
4	Water shortage	Construct more deep wells	Construct more deep wells	
5	Illegal ranch		DENR must stop illegal ranching activities	
6	Illegal logging	Install Bantay-gubat	Install Bantay-gubat	Adequate number of deputized Bantay-gubat
7	Drought	Creation of a barangay ordinance to ban garbage disposal in the river	Continue with the tree planting activities to avoid floods	
8	Vector-borne diseases	Establish health center per sitio; Provide financial assistance	Provide medicines or vitamins	Provide regular schedule for doctors and nurses to man the health centers
9	Fire in old dumpsite caused by biogas	Do not issue permit on activities involving burning		
10	Unavailability of roads	Request for road construction in the barangay	Request for road construction projects from the municipal offices	Request for road construction from DPWH

Table 9c. Solutions offered for Forest Problems by Group C (Relatively Rich Female)

Rank	Problems	Solutions		
		Barangay Level	Municipal Level	National Level
1	Tenure problems	Provide certification of occupancy to long-time residents of the barangay to establish their position in the land; Distribute titles to the people; Keep records on meetings regarding land; Enclose properly one's landholdings	Mayor should defend people's occupancy over their lands; they should be top priority; Distribute land titles to the people; Provide certification of land rights	Provide land titles to secure ownership over the land; Ask assistance from DAR regarding problems on land including titling; Distribute land titles to long-time occupants
2	Deforestation	Plant trees in the barangay as replacement of logged-over areas; Stop charcoal-making; Prevent forest fires so that our ozone layer will not be affected and for use not to feel "hot" weather; Give attention to forest fires	Stop the cutting of trees; Stricter implementation of forest laws; Extend programs on tree planting; Provide allowance for Bantay-gubat	Issue cutting permits
3	Floods	Maintain the cleanliness of waterways to prevent flooding; clear up clogged canals and rivers; Arrest those who commit illegal activities as deterrence to illegal loggers	Continue tree planting to prevent flooding; Provide garbage containers and plastic bags; Strict implementation of laws against illegal activities	Prevent waste disposal in rivers; Ensure waste segregation; Plant more trees; Let the municipal office approach national level regarding flooding in the barangay
4	Drought	Continue planting trees on denuded mountains	Extend financial assistance to the people	Prevent excessive logging; Provide continuously funds to support similar activities of DENR
5	Water shortage	River fenced off by Garden Cottage must be returned to the community; Assistance in securing water supply from NAWASA; Increase the number of deep wells	Assist the community in securing water rights; Mayor must negotiate with Garden Cottage to return back to the community the creek; Provide hose to connect water from the source to their households	Connect the community to NAWASA; Ration water to the community
6	Vector-borne diseases	Distribute mosquito nets every 6 months; Clean up drives; Ban illegal dumping of garbage	Provide regular staff in health centers; Efficient garbage collection (to be brought to Teresa, Antipolo, Rizal)	Leave to the national government on how to solve thse problems;
7	Illegal logging	Provide sturdy sources of livelihood options that are sustainable and adequate to their needs; Be vigilant against illegal logging; Inform the authorities regarding any illegal activities	Restrict cutting of trees; Incarcerate violators	Conduct consultation between DENR and community to prevent cutting of trees in the locality
8	Climate change	Make the community alert and ready for impening disaster related to climate change	Conduct seminars and programs to make communities aware and ready for disasters brought about by climate change	Must provide solutions since the government policies emanate from national level
9	Quality of water from rivers is low	Prohibit piggery wastes to be dumped into the river	Prohibit piggery wastes to be dumped into the river	Prohibit piggery wastes to be dumped into the river
10	Exhaustive charcoal making	Warn community members engaged in charcoal production; Apprehend if it is their third offense; Provide livelihood options even by the barangay	Impose penalty against charcoal-makers with 1st offense with 1st offense at 1000 Php, 2nd offense at 5000 Php, and 3rd offense incarceration; Continuousl provide livelihood options for communty	Provide alternative work for charcoal-making; Communicate effectively the many problems in the community like forest denudation, forest fires, and the need for Bantay-gubat

Table 9d. Solutions offered for Forest Problems by Group D (Relatively Poor Female)

Rank	Problems	Solutions		
		Barangay Level	Municipal Level	National Level
1	Tenure problems	Hold seminar on environmental protection so that the higher authority will have enough confidence to grant the community their landholdings; Plant trees along the boundaries of their lands	Grant the community their lands; Survey these landholdings	Provide necessary land-related documents to individuals
2	Illegal logging	Provide adequate sources of livelihood; Establish an anti-illegal logging task force at the barangay level; Impose penalties on illegal loggers	Strict enforcement of laws against illegal logging; Granting financial allowances to the Bantay-gubat; Designate checkpoints in the community	Impose fines and penalties against violators; Intensify campaign of task force against illegal loggers; Monitor regularly the forests; Replace the cut trees
3	Drought	Plant trees which can enhance water supply; Plant trees in respective lots	Conduct tree planting activities; Provide funding for tree planting activities in respective lots	Expand the tree planting activities; Support barangay and municipal projects; Provide funds for the planting of trees
4	Vector-borne diseases	Forge partnership with NGOs in making the government clean up the surroundings; Conduct seminars per sitio/zone regarding proper garbage disposal	Enact a city ordinance on cleaning up the community at least twice a month	Launch regular medical missions in remote barangays; Fogging in communities; Distribute dengue vaccines
5	Fire in old dumpsite caused by biogas			Tap DOH to provide health care to those who get sick because of the smoke coming fom the fire, especially those with asthma and skin diseases
6	Floods	Ban the cutting of trees; Prevent illegal dumping of wastes into waterways; Write barangay resolution on imposing penalty against illegal dumping of wastes on river	Incarcerate the violators; Plant trees; Stop issuance of permits for quarrying	Carry out activities on tree planting to prevent flooding; Provide funds to communities without NGP; Install dam along the river
7	Exhaustive charcoal making	Ban charcoal-making by enforcing laws and providing alternative livelihood; Make aware the community members regarding the impacts of charcoal-making	Assist in enforcing tasks to safeguard the forests; Provide sustainable livelihood, work or loans for the community	Release the budget for the forest protection and protectors; Give work to the people so thet will not engage in charcoal-making
8	Deforestation	Reforest; Properly monitor forest violators	Strict implementation of forest laws on cutting of trees; Stop logging; Plant more trees	Impose heavier penalty and faster litigation on forest/ environmental violators; Stop logging; Plant more trees
9	Climate change	No burning; Segregate wastesl Practice composing	Intensify forest protection	Expand the forest laws; Maintain adequate supply of medicines for victims of the effects of climate change
10	Forest fire	Create ordinances to prevent forest fires; Stricter implementation of penalty and punishment against violators	Create ordinances to prevent forest fires; Stricter implementation of penalty and punishment against violators	Create ordinances to prevent forest fires; Stricter implementation of penalty and punishment against violators

The last exercise conducted under Tool 5 is to determine how the respondents view the impacts of strict implementation of existing policies, laws, rules and regulations governing the management of the entire watershed area. These impacts are examined on 3 aspects, namely: (a) Use of forests; (b) condition of forests; and, (c) land tenure. These impacts are

presented per group in Tables 10a, 10b, 10c and 10d, respectively. The policies that were evaluated are as follows:

Table 10. List of Policies used in the Scenario-building Exercise

Policy No.	Title	Brief Description
Executive Order 23	Logging Moratorium	Signed by the President on February 1, 2011. This law declared a moratorium or ban on cutting trees which naturally grow in the forests. It also developed the Anti-Illegal Logging Task Force to implement the moratorium and lead campaigns of our Government against illegal logging.
Executive Order 26	National Greening Program	Law declared the implementation of the National Greening Program. This program is a composite of the initiative of the Departments of Agriculture, Natural Resources and Environment, and Agrarian Reform to respond to issues such as poverty reduction, food security, and climate change.
Republic Act 7586	National Integrated Protected Area System	A management system that aims to safeguard the area home to rare (rare) and endangered animals and plants, areas home to various types of wildlife whether it be on the earth / mountains or ocean law declared as a protected area (protected area). The management of these areas will be in accordance with the principle of "biological diversity" and "sustainable development".
Presidential Decree 705	Revised Forestry Code of the Philippines	The law states the principles of conservation, use and papalago forests and "forest lands" to maintain its productive condition. It also indicates the provisions to be classified lands.
Republic Act 9147	Wildlife Resources Conservation and Protection Act	This law aims to regulate and protect their lives and their homes to promote "ecological balance and foster biological diversity". It also aims to regulate the collection and sale of some life (animals and plants) as a way of protecting them.
Proclamation No. 2011-296	Marikina Watershed Reservation	This is the declaration of the President of the Philippines "Markina Watershed Reservation" conquest of the town of Antipolo, municipality of Baras, Rodriguez, San Mateo and Tanay in Rizal province as a "Protected Area" in accordance with RA 7586 or NIPAS act of 1992. it also declared the site to be called as "Upper Marikina River Basin Protected Landscape" with a size of 26 125 ha and its management is under the DENR.
Republic Act 8371	Indigenous Peoples' Rights Act of 1997	This law recognizes, protects and promotes the rights of indigenous people and their communities. By this law is established the National Commission on Indigenous Peoples under the Office of the President of the Philippines.
	Philippine Constitution 1987	The Philippines constitution contains the principle that a major basis of all laws and governance in the Republic of the Philippines. It also stated the type / classification of land, this country is the agricultural, forest or timber, mineral lands and national parks.

Table 11a. Policy Impacts as Perceived by Group A

Policy	Impacts		
	Use of Forests	Condition of Forests	Land Tenure
EO 23	**Positive:** No landslide; Sources of water will not dry out; No Climate Change; Monitor logging; Violators will be apprehended; Issuance of permits by DENR; Provision for livelihood options; No effect on their livelihood activities as they will not be reduced or restricted; Provision of job opportunities	**Positive:** No Climate Change; Enhanced protection of wildlife; Greener forests; Proliferation of wild animals; Decrease in erosion rate; Forest preservation; Changes are for the environment and future youth	
EO 26	**Positive:** NGP as a good law in maintaining the beauty of the environment; establish appropriate land use zones for agriculture or mining Negative: Limitation in the areas that can be used for agriculture	**Positive:** No water sources and forests shall be damaged; Greener forests; Increase in wildlife population; Reduction of incident heat; Increased water flow; Increased number of trees; Prevent landslides **Negative:** Restrictions on the movement of people especially that they no longer can practice kaingin (swidden farming)	
NIPAS	**Positive:** Pro-poor environmental program; Create a conducive environment for the reproduction of planting stocks through tree nursery production; More forest trees	**Positive:** Forests will be replenished and maintained; Protection of the forests	
Proc. 2011-296	**Positive:** Prevent developers from "owning" the lands since there should be no one to own them in the first place; Set aside funds for the protection of watershed that can be used by the local people; More trees to be planted **Negative:** People will have limited access and use of forests; limited action on the land and trees; no cutting of trees	**Positive:** Forests will be maintained and protected	**Negative:** How about the community? Where will they live? Water becomes polluted if there are occupants living near it; Eviction must be compensated monetarily **No impact:** The people are still being allowed to plant in their landholdings, especially among indigenous peoples;
RA 9147	**Positive:** An important law for wild animals; Dumagat (IPs) are given a priority over hunting ground; **Negative:** Need for permit in order to save injured or captive animals; Establish strong coordination with higher officials; Enforcement is difficult because it is the monkeys which destroy crops	**Positive:** Forests are protected; Prohibit the capture of the animal; Wildlife population will flourish; **Negative:** Loss of income fron hunting	
RA 8371	**Positive:** Applies very well to indigenous people especially that most of them are illiterate; a good law to be used to safeguard the forests; Delineate the ancestral domains; Entails recognition of **Negative:** Loss of livelihood among indigenous peoples **No impact:** Continue their activities because the IPs recognize them/their presence	**Positive:** Forests are properly protected; more wildlife	**Positive:** Forests are properly protected; assurance of the IPs over their place/community **Negative:** Fear of losing ground to the IPs

PD 705	**Positive:** Increase population of wildlife; Increase awareness among people regarding the importance of forests; there still remains area for usage (multiple use zone); water sources will be conserved and will be able to supply daily needs of the people **Negative:** Negative impact on the financial capability of the people depending on the forests; must have alternative livelihood options	**Positive:** Maintain and preserve the forests; deter forest violators	

Table 11b. Policy Impacts as Perceived by Group B

Policy	Impacts		
	Use of Forests	Condition of Forests	Land Tenure
EO 23	**Positive:** Safeguard the forest for the future generations; replace trees; may provide supplemental income; will ensure that the forests will not be degraded **Negative:** Will not have impacts except on people whose livelihood is dependent on cutting trees	**Positive:** No cutting of trees; plant fruit trees instead to improve conditions of the soil such as cacao and coffee; will be able to protect land against landslide and floods; increase the number of trees and forest animals	**Negative:** Unsure where to get water since their lands are covered by the Marikina watershed area; no construction of houses because of lack of materials; no source of fuelwood for household consumption
EO 26	**Positive:** Will ensure protection of the forests **Negative:** Areas designated for NGP will not be used for planting bananas and other fruits	**Positive:** Will protect the forest resources and produce lots of trees	**No Impact:** No effect on them because there are still a lot of lands where they can plant
NIPAS	**Positive:** Will prevent the destruction of the forests especially in preventing illegal hunting **No Impact:** We are not covered by the protected area	**Positive:** Forests will be protected because kaingin-making will be prohibited especially in areas near river or springs	**Negative:** We will not have access to our landholdings;
Proc. 2011-296	**Positive:** We still have free access to the forests; prevent the degradation of the forests **Negative:** We might lose our lands if they will be covered by the Marikina watershed; this law was passed without consultation with the people living within the Marikina watershed area	**Positive:** Protect forests and improve the conditions	**Negative:** Since ISF will no longer stand, there will be no contract for any land use for the community
RA 9147	**Positive:** Safeguard the forests and provide shelter to birds and wildlife; prevent trading of wildlife to local pet shops **Negative:** Will not be able to kill animals which harm people, even their owners	**Positive:** Prohibit hunting of eagle, civet cat, and boar; total care for the wildlife in the forests	**Positive:** Recognition of the ancestral domains among IPs **Negative:** Ordinary people will lose their landholdings to the IPs

RA 8371	**Positive:** Protect the forests so that the IPs will have fruit trees, clean water and natural forests **Negative:** Limited use of the forests; application for CADT is delayed; not yet approved	**Negative:** It is the IPs who are consuming the forests because they claim that these forests are theirs anyway	**Negative:** If there are IP claimants or owners, then land use tenure or security will never be achieved for ordinary citizens
PD 705	**Positive:** Ensure that forest guards are designated to protect the forests; increase in plants, animals and birds; provide habitats to other forest dwellers **Negative:** it is harder to cut trees; need to secure permit	**Positive:** Improvement in the conditions of the forests if cutting is prevented and not allowed	**Positive:** Land tenure is secured because they have been occupying the area for the longest time possible **Negative:** But without title, there is still no security; we cannot farm the lands

Table 11c. Policy Impacts as Perceived by Group C

Policy	Impacts		
	Use of Forests	Condition of Forests	Land Tenure
EO 23	**Positive** Prohibit the cutting of trees; create jobs for the people; more harvests in the future **Negative:** May reduce the charcoal production; harder for the household to buy and use gas; will no longer be allowed to cut trees	**Positive:** Intensify planting of trees in order to improve the conditions of the forests; DENR need to submit appropriate budget for the tree planting programs	**Positive:** More difficult for illegal settlers to enter and establish residences within the area **Negative:** No land tenure for them since their area is covered by the UMRBPL; limited activities within the forest lands
EO 26	**Positive:** More trees; better economy; better use of forest resources; will not only benefit present but future generations	**Positive:** Enhance fresh air; increase number of forest trees; continuous supply of forest products; maintain structure and integrity of forests and environment	**Positive:** Can plant trees and other materials in the forest lands **No Impact:** Policy has no effect on them because they do not even have titles on their landholdings
NIPAS	**Positive:** Safeguard the various forms of life in the forests; increase the wildlife population by planting more trees **Negative:** More difficult to enter and access the forests	**Positive:** More wildlife population; increase in the number of trees; environment will be more pleasant to humans; must prohibit hunting of wildlife in order to achieve these; more trees will absorb flood flow; secure downtown and let people enjoy their homes and farms	**Negative:** No assurance over land tenure; people might be driven out of the protected areas
Proc. 2011-296	**Positive:** They have hopes that they will be allowed to occupy continuously the area if they can prove that they have planted trees and taken good care of the forests **Negative:** Impact on the people whose lands are covered by UMRBPL; no freedom to use the forests anymore	**Positive:** Wildlife population will increase; water resources are protected **Negative:** Strong laws; fear that if they will violate the laws, they might get incarcerated; they will not be bothered by any changes if they only are aware of the condition of their landholdings	**Negative:** Loss of agricultural land and houses; continuous desire to have land security
RA 9147	**Positive:** Protect wildlife; hoping to have more freedom to use the forests; increase in number of tourists **Negative:** This law would not be beneficial to all; more difficult to enter the forests because of the protected animals and plants; if hunting is not	**Positive:** Protect and preserve UMRBPL to maintain order and beauty; protect the watershed to increase wildlife and plants	**Negative:** No assurance that they will be given entitlements to their lands; they might even be evicted from the land **No Impact:** The policy does not have impact on some because they are not engaged in hunting

RA 8371	**Positive:** Prioritized by the government because they do not possess knowledge; promote equality for the IP **Negative:** Loss of freedom to use the forests; more difficult to obtain other forest products because of the restrictions	**Positive:** Preserve the forests; encourage more planting of trees	
PD 705	**Positive:** Protect the forest lands; prohibit hunting **Negative:** Might waste most of the products because the selling of these products are being banned	**Positive:** Increase in animal stocks; increase products to be derived from the forests; increase the planted trees	**Positive:** Wildlife and their habitats become safe from untoward harms; It would be more difficult if the people are driven away since their tendency is to misuse the planted trees and turn them into charcoal; impose securing barangay certificate of their occupancy

Table 11d. Policy Impacts as Perceived by Group D

Policy	Impacts		
	Use of Forests	Condition of Forests	Land Tenure
EO 23	**Positive:** Prevent floods and landslides; will still benefit from their planted; If they do not take good care of the forests, they might lose their landholdings **Negative:** Lack of or limited access to planted trees for trading, which is a main source of income; reduction in income from charcoal production	**Positive:** Protected landscape and sceneries; improvement of the forests	**Positive:** Controlled cutting of trees; but hopes are high that if they become good managers of the forest resources, they might be granted permanency in their lands; continue to cultivate and care for the land for future generations **Negative:** Loss of access to these resources
EO 26	**Positive:** Assist people and help in the growth of the forests; additional advantages for our forests and wildlife; more sources of food and additional revenues from the forests **Negative:** Less revenue from the forests; less ability and opportunity to plant native trees because they are not allowed to clean up the areas	**Positive:** Forest growth is ensured; restore pleasant nature of the forested areas; prevent landslide, drought and flooding **Negative:** If NGP is able to plant 1.5 million trees in the area, how can this be done if cutting of trees is not allowed?	
NIPAS	**Positive:** Limit the cutting of trees that will let plants and animals grow and multiply; Install Bantay-gubat to monitor such restriction **Negative:** Lack of access to exotic meat and foods	**Positive:** Protect the forests; prevent landslaides **Negative:** Limited use and access to forests	**Positive:** Limited but continuous access to resources allow the people to sell forest products to town proper; need to ask permission whenever they enter into the area **Negative:** Can no longer freely enter, acquire and access forests and their products
Proc. 2011-296	**Positive:** Occupants are compelled to take care of the forests; otherwise, they might get evicted from their lands **Negative:** Things that they previously get for free may be prohibited; cannot freely enter their areas	**Positive:** Improve the forests; eliminate the cullting of tress and charcoal-making **Negative:** Indigenous peoples sometimes abuse the forests in terms of hunting and sale of wild plants	**Positive:** Will safeguard the area; **Negative:** Will not be able to plant rice in their kaingin; if there are owners, they might be evicted

RA 9147	**Positive:** Forests will become more beneficial to the community if protected as it will increase water supply and prevent landslides; Deter indiscriminate hunting of wildlife and gathering of wild plants; Protection can lead to increased future income for housholds **Negative:** Decreases the income of people relying on hunting and gathering activities in the forests; negative for forest consumers	**Positive:** Forest growth can prevent natural disasters; improve the flow of water; prevent landslides	**Positive:** Forest growth is ensured; will increase soil productivity **Negative:** Land tenure is uncertain and not secure;
RA 8371	**Positive:** Prevent non-IPs to sell forest plants and animals; Indigenous peoples have the right to preserve their forest-based sources of livelihood **Negative:** Lack of access to the thriving forest resources by the non-IPs	**Positive:** Protect forests and increase the forest wild animals and plants; Preserve the forests that belong to IPs for the next generations; Secure the ancestral lands against encroachers	**Positive:** Protect IP rights; enhanced use of ancestral domains because of the familiarity of IPs of their land **Negative:** Negative impact on the non-IP because they no longer have the chance to have full rights over their occupied lands
PD 705	**Positive:** Protect forestlands for the future generations; prevent cutting of young saplings; limit the use of forests to their occupied lands **Negative:** Loss of cash incomes from the forests; strict implementation may cause fear among people who are not able to understand the policy	**Positive:** Plants that may flourish may be cure for serious and rare diseases; Prevent burning to maintain the beauty of nature	**Negative:** No security; no knowledge on what can be done if this is the case; resort to just plant the land

4.1.5 Tool 5 – Ranking Forest Products

The aim is to rank forest products by importance for cash and/or for subsistence uses. The data for this tool were deduced from Tool 4 in order to show the most valued forest products for poor and women. This case study follows the procedures designated in this tool. Table 11 presents the choices of the respondents.

Table 12. Ranking of Forest Products

Products	A		B		C		D	
	Cash	**Non-cash**	**Cash**	**Non-cash**	**Cash**	**Non-cash**	**Cash**	**Non-cash**
Forests								
Charcoal	9	10	7	17	9	10	7	12
Bamboo products	7	4	5	2	4	5	5	5
Rattan	12	18				19		
Honey	10	14		12		16		10
Pako	13	17		13		15		14
Wild flowers		16		14		14		
Herbal medicine		15		9		8		6
Mushroom		11		11		11		8
Fish	14	8		7	7	9		9
Bush meat	8	19		18		18		16
Water		1		1		1		1
Cogon	15	13		16		17		

Lumber	11	6		10		13		15
Farms								
Upland rice	3	7	3	4	5	12	3	13
Fruit trees	4	5	4	6	8	4	4	4
Root crops	5	9	6	15	6	6	6	7
Corn	6	12		8	3	7	8	11
Banana	1	3	1	3	2	2	2	3
Vegetables	2	2	2	5	1	3	1	2
Total								

4.2 Data Processing and Analysis

The study used mixed methods in the analysis of the data collected using the Poverty-Forests Linkages Toolkit. Using the results of the original toolkit, the analysis that can be done will be thick description of the collective responses on problems and solutions as well as the scenario-development exercise. Descriptive statistics can also be computed for frequencies, percentages, average and range.

However, since the respondents were drawn a simple random sampling using the SRPAO list for the UMRBPL, the team was able to conduct inferential statistics on the same dataset generated previously using the Poverty-Forest Linkages Toolkit.

4.2.1 Research Questions

Three important concerns were addressed as far as the data analysis was concerned:

1. Who owns, uses, accesses, knows, controls and decides on as far as forest resources are concerned?
2. How do men and women, and poor and rich people perceive the cash and non-cash income sources or benefits they derive from the forests?
3. How do they prioritize forest problems based on gender, wealth, and self-reported income?

4.2.2 Variables

Statistical analyses were carried out on relevant variables. For the independent variables, the analysis was conducted using the following:

(a) ***Gender***, which was coded as “Male” and “Female” based on the assumed sex categories of the respondents in SRPAO. The basis was their names and if the names sounded androgynous, the variable “Marital Status” was consulted to clarify further these categories;

(b) ***Wealth***, which was coded as “Rich” and “Poor” depending on how these categories reflect the annual average income among households represented in SRPAO;

(c) ***Gender-Wealth***, which was coded as “A”, “B”, “C” and “D” following the categories derived from Tool 1; and,

(d) ***Self-reported Income***, which was coded as annual income ranges such as follows:

Self-Reported Income Ranges			
in Peso (₱)	**in Dollars ($)**	**in Peso (₱)**	**in Dollars ($)**
✦ < 10,000	✦ < 212	✦ 130,000 – 150,000	✦ 2,754 – 3,178
✦ 10,000 – 30,000	✦ 212 – 635	✦ 150,000 – 200,000	✦ 3,178 – 4,239
✦ 30,001 – 50,000	✦ 635 – 1,059	✦ 200,001 – 400,000	✦ 4,239 – 8,475
✦ 50,001 – 70,000	✦ 1,059 – 1,483	✦ 400,001 – 600,000	✦ 8,475 – 12,716
✦ 70,001 – 90,000	✦ 1,483 – 1,907	✦ 600,001 – 800,000	✦ 12,716 – 16,954
✦ 90,001 – 110,000	✦ 1,907 – 2,331	✦ 800,001 – 1,000,000	✦ 16,954 – 21,193
✦ 110,001 – 130,000	✦ 2,331 – 2,754	✦ > 1,000,000	✦ > 21,193

$ 1 = P 47.32 (as of June 28, 2016)

The dependent variables used in the analysis included the following: (a) cash components of the household income; (b) non-cash components of the household income; (c) proportion of cash and non-cash components of the household income; (d) ranking of forest problems.

4.2.3 Quantitative Analyses

These variables were processed using Eta coefficient as a measure of association, which determines the association between quantitative dependent variable and categorical variables such as gender, wealth and gender-wealth categories. On the other hand, Spearman's rank order correlation coefficient (ρ_s) was used to measure the association between the dependent variables and self-reported income. Correlation analysis was done to determine the significant factors that are associated with the dependent variables. The degree of association of these variables (i.e., whether strong, moderate or weak) was determined only for those variables where the association was found to be significant.

4.3 Ethical Considerations

Upholding the values of the Department of Environment and Natural Resources and the World Bank, this study considered several ethical issues surrounding legitimate research endeavor. First, the study served Informed Consent forms prior to the conduct of any research activities with the target respondents. At the onset of each meeting, the PROFOR Secretariate would hold a small orientation meeting with the respondents. The respondents were asked to register their attendance for the day, and they were handed out Manila envelopes as research packets containing the Informed Consent forms. The Informed Consent forms follow the standards of confidentiality, no-harm policy, and the right to withdraw anytime from the research procedures. The informed consent was designed to give adequate information on the nature and extent of study.

Second, as the sampling was done randomly, it was only by chance that the participation of the indigenous peoples (i.e., the Dumagat in province of Rizal) was recruited into the

study. It appeared that the Dumagat dominates the population of Barangay Puray. Thus, in the FGD, there was a group of Dumagat who joined the study activities. The Informed Consent forms were distributed to these indigenous people who signed them prior to their participation in any research activity. No harm, whether physical, emotional or psychological, was done on them while participating in this research study.

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