Training on Research Methodology and Statistical Tools on Climate Change Study

(Report)

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Nepal Academy of Science and Technology (NAST)
Nepal Climate Change Knowledge Management Center (NCCKMC)
Khumaltar, Lalitpur, Nepal
Fax: 977-01-5547713 Phone: 01-5547714, 5550828
E-mail: climate@nast.org.np

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Contents

BACKGROUND

Nepal Climate Change Knowledge Management Center awarded climate change research grant for 25 young researchers of different academic institutions of Nepal. The researchers are doing research on climate changes issues related with thematic areas of National Adaptation Program of Action viz. (a) Agriculture and food security (b) Wetlands and water resources (c) Biodiversity and Ecosystem and (d) Livelihood and economics of vulnerable groups. All the researches are being carried out at Manasalu Conservation Area, the pristine and remote mountainous area of Nepal.

Most of the academic institutions of Nepal lack research methodology training courses for the students. In case of climate change science research, methodology is yet remained to be developed. Nepal Climate Change Knowledge Management Center envisaged that only the research funding would not be sufficient for the generation of reliable climate change knowledge and information. Hence, with purpose of enhancing research capacity of the young researchers, NCCKMC build a concept of providing training course on research methodology of climate change science and organized a week-long (March 25-March 30, 2012) training on it.

PURPOSE OF THE TRAINING

The main purpose of the training was to build capacity of young researchers to conduct climate change researches at Manaslu Conservation Area of Nepal. The objectives of the training included:

- Sharing knowledge related to climate change science
- Building researchers' capacity to conduct climate change researches through use of precise research methodologies
- Developing data analysis capacity through the application of statistical software
- Developing skills for thesis and scientific writings

EXPECTED OUTPUTS

- Enhanced the understanding of climate change science
- Understanding of research techniques on climate change and its impacts
- Application of statistical software in data analysis of climate change research
- Development of thesis, scientific reports and popular article writing skills of researchers

PROGRAM

A program was developed to run over a week-long training from 25-30 March 2012. The training consisted of four modules covering i) Basics of climate change, its impacts on wetlands, vegetation and mountain systems, Nepal's climate change scenario and adaptation options iii) Research area, research methodology and scientific writing iii) Plant identification and herbarium collections iv) Green house gas inventory reporting instructions v) Application of Endnote software for research literature citations vi) Statistical Package for Social Science software for data analysis vii) Interaction with international expert on climate change related plans and programs in Nepal. The followed program schedule of the training was given at Annex I.

PROFILE OF RESOURCE PERSONS

Resources persons were called to facilitate the training sessions and to provide support for the researchers during and after the completion of the training. The resource persons included academicians, policy makers, researchers and an international expert.

S. N	Facilitators	Designation & Institution	Area of Training
1	Dr Dinesh Raj Bhuju	Academician, NAST Team Leader, NCCKMC Course and Training Director	Thesis Writing, Report Writing, Journal Paper and Popular Article Writing
1	Dr Rajman Shrestha	Associate Professor Department of Statistics, Trichandra Multiple Campus, Kathmandu	Statistical Package for Social Science (SPSS) in Data Analysis
2.	Mr Madan K Suwal	Assistant Research Fellow-NAST/Freelance Trainer	Concept of End Note Software
3	Dr Jagadish Baral	Joint Secretary and Chief Climate Change Adaptation Promotion Cell MFSC, Kathmandu	Climate Change Impacts and Adaptation Options with Case Examples
4.	Ms Sangita Rajbhandari	Associate Professor Central Department of Botany TU, Kirtipur	Plant Identification and Herbarium Collection
5.	Professor Dr Prakash C Adhikari	Secretary, NAST, Lalitpur	Greenhouse Gas Inventory Reporting Instructions
6	Dr Madan Lal Shrestha	Academician NAST, Lalitpur	Climate Change Scenario of Nepal
7	Dr Narendra Raj Khanal	Associate Professor Central Department of Geography TU, Kirtipur	Climate Change and its impacts on Mountain System

8	Professor Dr Subodh Sharma	Aquatic Ecologist Kathmandu University, Dulikhel	Climate Change and its impacts on Lakes and Wetlands
9	Mr Madhu Chettri	Project Chief Manasalu Conservation Area Project, NTNC	Manasalu Conservation Area: Introduction
11	Mr Narayan P Gaire	PhD Fellow, NAST	Mountain Biodiversity and Vegetation Shifting
12	Professor Ram Chettri	Professor Central Department of Sociology and Anthropology, TU, Kirtipur	Social Science Research Technique
13	Mr Bryn Harding	United Nations Development Program, UN-House, Lalitpur	Climate Change Interaction
14	Mr Khilendra Gurung	Researcher	Site Selection Activity

In addition to resource persons the Program Officer, NCCKMC, Mr Bhoj Raj Adhikari was on hand to provide administrative services. The training coordinator Mr Pawan K Neupane assisted on program development and management of the training.

EXPECTATIONS FROM THE TRAINING

Before the beginning of the training all the participants were requested to write their expectations. The expectation includes:

- Gain in-depth knowledge and clear ideas on different research and field methodologies on assessing climate change and its impacts
- Be able to produce a good thesis report and article for journal
- Be able in data analysis using SPSS
- Develop scientific and report writing skills
- Know details about research area ie Manasalu Conservation Area
- Know the climatic variability and pattern relevant to our study
- Motivation and guidance to conduct research works

At the end of the training, the training expectations were reviewed and the participants made a judgment as to whether their expectations were met.

TRAINING MODULES

Training I: Statistical Tools in Climate Change Research

Duration: 13 hours

Training Module 1: Statistical Package for Social Science (SPSS) in Data Analysis
Duration: 10 hours

SN	Contents	Time (hrs)	Facilitators
1	**Introduction to SPSS** • *Starting SPSS* • *SPSS Main Menus* • *Working with Data Editor* • *SPSS Viewer* • *Importing and Exporting Data* • *Merging Files*	2	Dr Rajman Shrestha
2	**Descriptive Statistics** • *Measure of Central Tendency* • *Measure of Dispersions*	2	Dr Rajman Shrestha
3	**Comparing Means** • *One sample t-test* • *Independent Samples t-test* • *Dependent Samples t-test* • *Analysis of Variance*	2	Dr Rajman Shrestha
4	**Chi Square Test** • *Test of Independence* • *Contingency Table*	2	Dr Rajman Shrestha
5	**Correlation and Regression Analysis**	2	Dr Rajman Shrestha

Training Module 2: Concept of End Note Software
Duration: 3 hours

1	**Introduction** • *Installation* • *Introduction to Endnote Library* • *Creating Library*	1	Mr Madan K Suwal
2	**Entering New Reference (of different types)**	1	Mr Madan K Suwal
3	**Citing while writing and Changing different formats of references**	1	Mr Madan K Suwal

Training II: Climate Change Research Methodology

Duration: 21 hours

Training Module 1: Research Area, Research Technique and Research Writing

Duration :9 hrs

SN	Contents	Time (hours)	Facilitator
1	**Manasalu Conservation Area: Introduction** • *Location* • *Landscapes* • *Demography* • *Biodiversity* • *Accessibility*	1	Mr Madhu Chettri
2	**Social Science Research Technique Sampling** • *Methods of Estimation Sample Size* • *Process of Selecting Sample* • *Methods of Data Collection* • *Effective Questionnaire Development and Survey*	2	Prof Dr Ram Chettri
3	**Thesis Writing** • *Features of Thesis* • *Note taking and Recording* • *Parts of Thesis* • *Reference quoting* **Report Writing** • *Field Report* • *Research Report* **Journal Paper** • *Abstract* • *Review and Problem Specification* • *Objective and Methodology* • *Result and Conclusion* **Poplar Article Writing**	6	Dr Dinesh Raj Bhuju

Training Module 2:Basics of Climate Change Science

Duration: 6 hrs

1	Climate Change and its impacts on Lakes and Wetlands	1	Prof Dr Subodh Sharma/

2	Climate Change Scenario of Nepal	1	Dr Madan Lal Shrestha
3	Climate Change and its impacts on Mountain System	1	Dr Narendra Raj Khanal
4	Mountain Biodiversity and Vegetation Shifting	1	Mr Narayan P Gaire
5	Climate Change Impacts and Adaptation Options with Case Examples	2	Dr Jagadish Baral

Training Module 3: GHGs Inventory and Plant Identification
Duration:2hrs

1	Plant Identification and Herbarium Collection	1	Dr Sangeeta Rajbhandary
2	Greenhouse Gas Inventory Reporting Instructions	1	Prof Dr Prakash Chandra Adhikari

Training Module 4: Climate Change Interaction with International Experts
Duration: 4hrs

1	Climate Change Interaction	4	Mr Brian Harding

INAUGURAL SESSION

On March 25, the Vice Chancellor of Nepal Academy of Science and Technology Professor Dr Surendra Raj Kafle inaugurated the training by lighting lamp amidst a gathering of young researchers, their supervisors, senior scientists of NAST and academicians. Also present in the ceremony were the members of climate change research grant advisory committee. Addressing the session the Vice Chancellor stated that excellent researchers will be given opportunities to conduct future researches at NAST. He hoped that the training will help the researchers to conduct the research smoothly and uplift the climate change researches in Nepal. He stated that a good research team of Nepal is going to bring a detail information on climate change impacts from a pristine research area of Nepal ie Manaslu Conservation Area. He reiterated to bring reliable information.

A member of evaluation committee of the proposals and advisory committee, Professor Dr Fanindra P Neupane stated that unique system of research grant program has been initiated under the support of Climate and Development Knowledge Network. He alerted the researcher not to manipulate the research result and worked for reliable information. He further stated that nobility in research is important rather than the volume and wished the researcher for their success.

Speaking in the session, Secretary of NAST, Professor Dr Prakash C Adhikari stated that the young researchers are future generation and they must know about the impacts of climate change in their future. He urged to focus the research on impacts of climate change on livelihoods.

The team leader of NCCKMC, Dr Dinesh R Bhuju had highlighted the importance of training program while Deputy Team Leader, had welcomed all the participants of the program.

TRAINING SESSIONS

Altogether 24 training sessions were run during the training period facilitated by the resource persons. The methods applied included i) Lecture Method and ii) Power Point Presentation. Before wrapping the session reflection of each day was made through participatory approach.

Sessions	Resource Persons	No. of Sessions
SPSS in Data Analysis	Dr Rajman Shrestha	5
Introduction to End Note Software	Mr Madan K Suwal	3
Report/Thesis Writing	Dr Dinesh R Bhuju	2
GHG Inventory Reporting Instructions	Professor Dr Prakash C Adhikari	1
Manasalu Conservation Area: Introduction	Mr Madhu Chettri	1
Climate Change Impacts on Lakes and Wetlands	Professor Dr Subodh Sharma	1
Scientific Writing	Dr Dinesh R Bhuju	1
Writing for Scientific Journal	Dr Dinesh R Bhuju	1
Research Results in Popular Article	Dr Dinesh R Bhuju	1
Mountain Biodiversity and Vegetation Shifting	Mr Narayan P Gaire	1
Climate Change Scenario of Nepal	Dr Madan L Shrestha	1
Climate Change Impacts and Adaptation Options	Dr Jagadish C Baral	1
Plant Identification and Herbarium Collection	Dr Sangita Rajbhandari	1
Climate Change Impacts on Mountain System	Dr Narendra R Khanal	1
Site Selection Activity	Mr Khilendra Gurung	1
Climate Change Programs in Nepal: An Interaction	Mr Brian Harding	1
Social Science Research Techniques	Professor Ram Chettri	1

CLOSING SESSION

At the last day of training, a Closing Program was organized under the chairmanship of Professor, Dr Prakash C Adhikri, Secretary, NAST. Addressing the closing session Dr Adhikari stated that all trainees must apply their learning from training while conducting their research works. He further added that training of these types would help to build qualified researchers in Nepal.

Two participants representing the trainees gave their feedbacks in the program. Ms Sangita Pant from Central Department of Environmental Science presented learning of the training and stated that the training had enhanced their research capabilities. She said the training also developed their scientific writing and data analysis skills. Mr Bhojan Dhakal from Institute of Agriculture and Animal Science said that the training not only gave opportunity to learn research methodologies but also enthused to conduct research works in team. Finally, the training coordinator Mr Pawan K Neupane thanked all the participants for their cooperation and wished for the success of their research works.

EVALUATION OF THE TRAINING

The participants were asked to evaluate their experience of the training at the end of the training. They completed a questionnaire to evaluate the training. Two participants reflect their views during the closing session of the training. The participants gave an overall rating of the training being good. The participants expressed satisfaction with respect to the program content (60% good & 24% excellent), interaction during training session ((40% excellent & 32 % good), achievements of the expectations (52% good & 16% excellent). The comments with respect to what the participants thought about the facilitators, what they liked most and least of the workshop and their suggestions to improve future trainings are captured in the following form.

Training Evaluation Form

Please give us your evaluation, suggestions and construction criticisms to help us improve future trainings.

Rating Scale

1=well below expectations/unacceptable
2=below standard
3=acceptable
4=good
5=excellent/outstanding

No	Aspect	1	2	3	4	5
1.	**Program Content**					
1.1	How relevant was the program content?	0	4	24	56	16
1.2	Was the content of the training interesting and useful?	4	0	12	60	24
1.3	Were the objectives of the training made clear?	0	4	20	36	40
1.4	Were these objectives achieved?	0	0	28	44	28
1.5	Did the training meet your expectations?	0	0	32	52	16
2.	**Interaction with and within the group**					
2.1	Was there sufficient interaction-questions, discussions and activities?	0	4	24	32	40

3. Comments on Presentation and facilitation skills

- More than expectation and superb
- Interesting and Knowledgeable
- Good and effective within short duration
- Done as per our level and understanding
- Clear, informative, beneficial and motivate
- Reward for novice researchers

4. What did you like most about the training?

- SPSS and End note sessions
- Research Methodology sessions by Dr Dinesh Bhuju
- Interaction with Brian Harding at UNDP
- Training Management

5. What did you like least about the workshop?

- Power cut problems
- Rushing immediately after the lunch to training hall
- Less refreshments
- Important topics should be prioritized and given much emphasis and time

6. What can be improved upon?

- More interaction programs with international experts
- Training contents
- Duration of training and sessions for GIS
- Time for Refreshments
- More interactions within groups
- Need assessment of trainees
- More group exercises

ANNEX I: PROGRAM SCHEDULE

Nepal Academy of Science and Technology
Nepal Climate Change Knowledge Management Center
Training on Research Methodology and Statistical Tools on Climate Change Study
March 25-March 30 2012
NAST-NCCKMC

Training Schedule

DAY I (March 25, 2012)

Inaugural Session: 0945-1100

Chief Guest: Professor Dr Surendra Raj Kafle, Vice Chancellor, NAST
Session Chair: Professor Dr Prakash C Adhikari, Secretary, NAST

0945-1000: Participants' Registration & Arrival of Invited Guests

Welcome Speech

Ms Ramila Raut,
Chief, Promotion Division and Deputy Team Leader, NCCKMC

Program Introduction & Objectives

Dr Dinesh Raj Bhuju
Course Director/Academician, NAST

Program Inauguration and Remarks

Professor Dr Surendra Raj Kafle

Remarks and Closing of Session

Professor Dr Prakash C Adhikari

Refreshments

TRAINING SESSIONS

Time	Contents	Resource Persons
1100-1200	Scientific Writing	Dr Dinesh R Bhuju
1200-0100	Lunch	
0100-0200	SPSS in Data Analysis	Dr Rajman Shrestha
0200-0210	Tea Break	
0210-0310	SPSS in Data Analysis	Dr Rajman Shrestha
0310-0410	GHG Inventory Reporting Instructions	Prof. Dr Prakash Adhikari
	Tea and Wrap-up of day	

DAY II (March 26, 2012)

Time	Contents	Resource Persons
0830-0900	Arrival of Participants and Refreshments	
0900-1000	Introduction to End Note Software	Mr Madan K Suwal
1000-1100	Manasalu Conservation Area: Introduction	Mr Madhu Chettri
1100-1200	Climate Change Impacts on Lakes and Wetlands	Prof. Dr Subodh Sharma
1200-0100	Lunch	
0100-0200	Report/Thesis Writing (I)	Dr Dinesh R Bhuju
0200-0210	Tea Break	
0200-0410	SPSS in Data Analysis	Dr Rajman Shrestha
	Tea and Wrap-up of day	

DAY III (March 27, 2012)

Time	Contents	Resource Persons
0830-0900	Arrival of Participants and Refreshments	
0900-1000	Report/Thesis Writing (II)	Dr Dinesh R Bhuju
1000-1100	Writing for Scientific Journal	Dr Dinesh R Bhuju
1100-1200	Mountain Biodiversity and Vegetation Shifting	Mr Narayan P Gaire
1200-0100	Lunch	
0100-0200	Climate Change Scenario of Nepal	Dr Madan L Shrestha
0200-0210	Tea Break	
0210-0410	SPSS in Data Analysis	Dr Rajman Shrestha
	Tea and Wrap-up of day	

DAY IV (March 28, 2012)

Time	Contents	Resource Persons
0830-0900	Arrival of Participants and Refreshments	
0900-1000	Introduction to End Note Software	Mr Madan K Suwal
1000-1200	Climate Change Impacts and Adaptation Options	Dr Jagadish C Baral
1200-0100	Lunch	
0100-0200	Research results in popular article	Dr Dinesh R Bhuju
0200-0210	Tea Break	
0210-0410	SPSS in Data Analysis	Dr Rajman Shrestha
	Tea and Wrap-up of day	

DAY V (March 29, 2012)

Time	Contents	Resource Persons
0830-0900	Arrival of Participants and Refreshments	
0900-1000	Introduction to End Note Software	Mr Madan K Suwal
1000-1100	Reflection of Training Program	Dr Dinesh R Bhuju
1100-1200	Plant Identification and Herbarium Collection	Dr Sangita Rajbhandari
1200-0100	Lunch	
0100-0200	Climate Change Impacts on Mountain System	Dr Narendra R Khanal
0200-0210	Tea Break	
0210-0410	SPSS in Data Analysis	Dr Rajman Shrestha
	Tea and Wrap-up of day	

DAY VI (March 30, 2012)

Time	Contents	Resource Persons
0830-0900	Arrival of Participants and Refreshments	
0900-1100	Site selection activity	
1100-1200	Climate Change Interaction at UNDP	Mr Brian Harding
1215-0115	Lunch	
0115-0315	Social Science Research Techniques	Professor Ram Chettri
	Wrap up of Training Course	

Closing Program: March 30, 2012 (0330-0400)

Chief Guest: Professor Dr Prakash C Adhikari, Secretary, NAST

Reflections of the Training
1. Ms Sangita Panta
2. Mr Bhojan Dhakal

Remarks

Dr Ram Chettri
Resource Person

Remarks

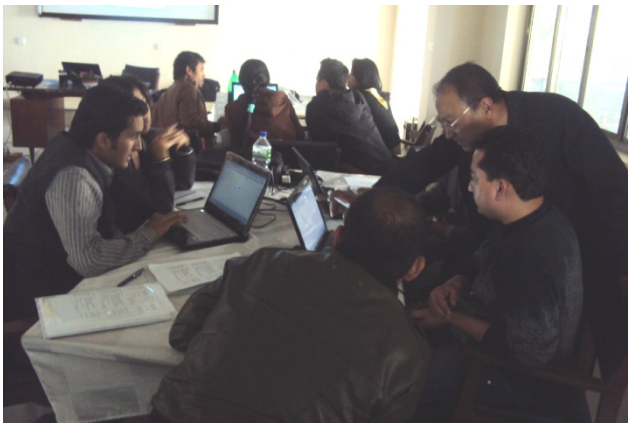
Mr Ishwor P Khanal
Chief, Faculty of Science, NAST

Closing Remarks

Professor Dr Prakash C Adhikari

Refreshments

ANNEX II: SOME GLIMPSES OF TRAINING SESSIONS




Research Methodology and Statistical Tools on Climate Change Study


Research Methodology and Statistical Tools on Climate Change Study
Materials required for plant collection


Research Methodology and Statistical Tools on Climate Change Study

SPSS
(Statistical Package for Social Sciences)

Presentation on

SPSS in Data Analysis

March 25-30, 2012 (Chaitra 12-17)

by
Dr. Raj Man Shrestha

Introduction

SPSS is a comprehensive statistical software system (statistical package) that helps to manage and analyze the research data with the statistical procedures and the interactive presentations.

Management of Data

It refers to,

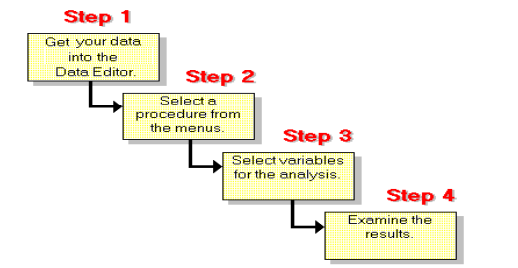
- Reading of data from other programs
- Creating and defining variables
- Entering and editing of data
- Filtering, recoding and tabulation of data
- etc

Analysis of data

It refers to,

- Construction of Frequency Distribution
- Calculation of various statistical measures such as mean, standard deviation, Sk, Kurtosis, etc.
- Correlation and regression analysis
- Testing of hypothesis
- Diagrammatic and graphic presentation
- etc.

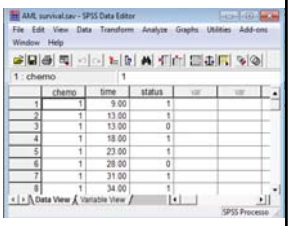
Basic Steps in Analysis



- **Get your data:** You can open a previously saved data file; read a spreadsheet, text file, or database; or enter your data directly in the Data Editor.
- **Select a procedure** from the menus to create tables, calculate statistics, or create charts.
- **Select the variables** you want to use in the analysis. The variables in the data file are displayed in a dialog box for the procedure.
- **Run the procedure** and look at the results.

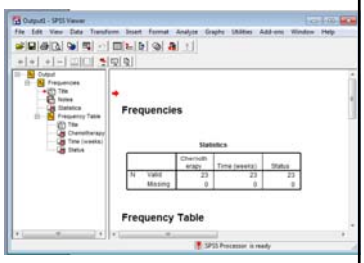
Data Editor

- When you start a session, you see the Data Editor window. Data Editor displays the contents of the working data file.



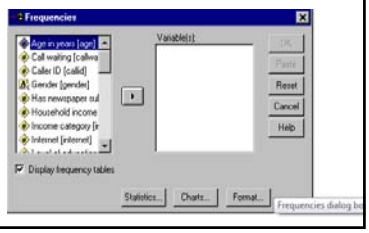
Viewer Window

- Tables, statistics, and charts are displayed in the Viewer window. The Viewer opens automatically the first time you run a command that produces output. Use the menus in either window to select files, statistics, and charts.

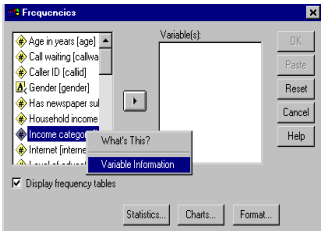


Dialog Boxes

You use dialog boxes to select variables and options for statistics and charts. You select variables for analysis from the source list. And you use the arrow button to move the variables into the target list.

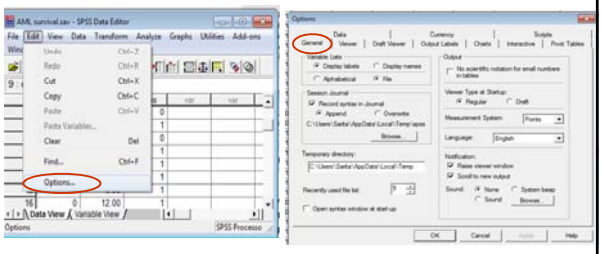


For information about a variable, click the left mouse button on the variable name to select it. Then click the right mouse button anywhere in the list and choose Variable Information from the pop-up context menu. A pop-up window displays the variable name and any descriptive labels defined for the variable and values.



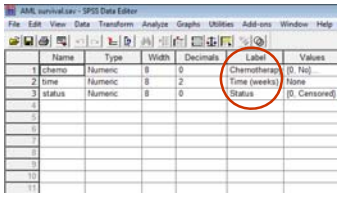
- Numeric variables are identified by a pound sign (#) icon. String (alphanumeric) variables are identified by an icon with the letter **A**. You can display variable names or descriptive variable labels in dialog boxes.

- To switch the display between variable names and variable labels, select Options from the Edit menu in any window. Then choose the setting on the General tab.



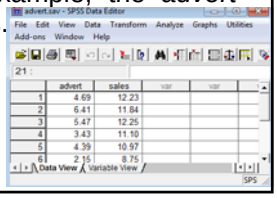
Define Labels

- To define descriptive variable labels, double-click on the *variable name* in the Data Editor or click the Variable View tab. Then click the *Label cell* for the variable and enter the label.



Basic Data File Structure

- The Data Editor reflects the basic data file structure. Each row is a single case (observation). For example, each value in the *advert* is a case. Each column is a single variable. For example, the *advert* and *sales* are variables.



- You can enter and edit data in the Data Editor. But you can't perform calculations or enter formulas in the Data Editor. Use the Transform menu to calculate new values and variables and recode data.
- You can use many different data types, including Numeric, Date, String (alphanumeric), Dollar (currency), etc.

Entering Numeric Data

- Entering simple numeric data is easy. Select a cell and enter the number. The data value appears in the cell and in the cell editor. Press Enter to record the value. If you haven't named the variable, The Data Editor assigns a unique variable name.

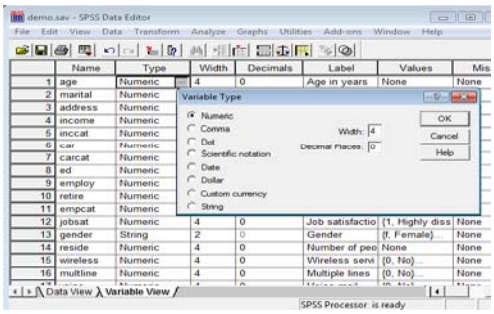
Types of variables to Enter

- There are two variable types, indicated by the icons next to each variable: **Categorical** and **scale**. All *string* variables and any numeric variables with defined value labels or *numeric* variables defined as nominal or ordinal are treated as **categorical**. All numerical variables and the numbers with comma or $ or # are considered as **scale** variable.

Entering Non-Numeric Data

- To enter non-numeric data, you first need to define the variable. Double-click on the variable name at the top of the column. Or click the Variable View tab. This displays the variable view. Click the Type cell in the row for the variable, and then click the button in the cell. Select the data type in the Variable Type dialog box. For example, to enter data values that contain letters, select String. Then click OK.

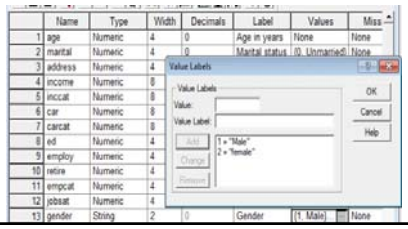
Defining Variable-Type



Defining Data

- In addition to defining data type, you can also define descriptive variable and value labels for data values. These descriptive labels are used in statistical reports and charts. For example, you could assign the labels 'Male' and 'Female' to the numeric values 1 and 2 respectively.

- To define a variable label, click the Label cell in the row for the variable. And enter the descriptive label. To define value labels, click the Label cell in the row for the variable, and then click the button in the cell. Enter the data value and the descriptive label. Click on Add to record the value label for the data value. And click on OK when you are finished.



Value Labels for Data Entry

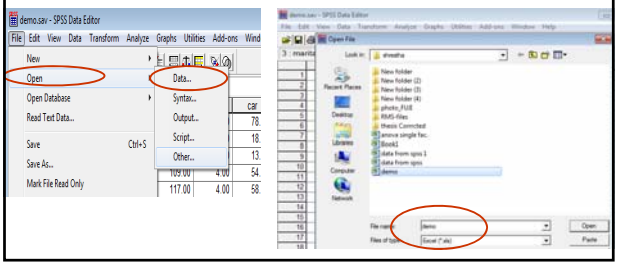
- You can use defined value labels to enter data. If value labels aren't currently displayed in the Data Editor window, select Value Labels from the View menu. Or click on the Value Labels button on the Toolbar. Click the cell where you want to enter the value. And select the label from the list. The value is entered and the value label is displayed in the cell.

Copying and Pasting Variable Attributes

- Once you have defined variable definition attributes for a variable, you can copy attributes and apply them to other variables.

Importing Files

- **Reading Excel files:** select Open from the File menu and Data from the sub-menu. Select the file type from the drop-down list. And select a file from the list. If the first row of the Excel file contains column headings or labels, click Read variable names from first row of data.

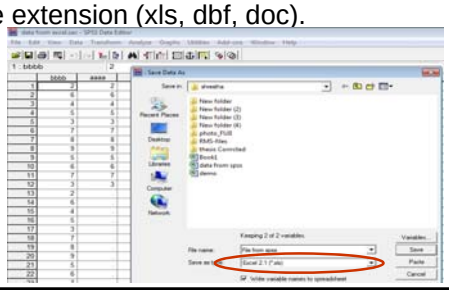


- Column headings from the Excel file are used as variable names. Since variable names cannot exceed 8 characters, column headings are truncated at 8 characters. The original column heading is preserved as a variable label. If the column heading cell is blank, a default variable name is assigned.

- **Reading database files**, in the Data Editor, select open Database from the File menu and choose New Query. Click the appropriate data source in the Database Wizard, and then click Next. If the data source you need isn't displayed in the list, click Add Data Source. Then use the ODBC Data Source Administrator to add the data source.

Exporting SPSS Files

- From a file with *sav* extension, you can save the file into other files (as an Excel, Access, Word, etc) using *save as* menu with the extension (xls, dbf, doc).



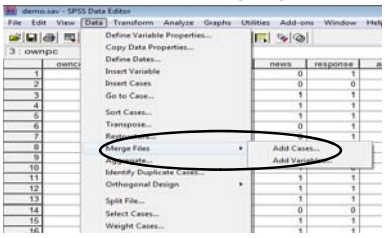
Merging Files

Two files with same or different variables can be merged in this operation.

Files can be merged in two ways.

1. Merging two files with **adding cases** (values) of the same variable'
2. Merging two files with **adding new variables** to the opening file from the located (unopened) file.

File merging



Transforming Data Values

- To compute new data values based on numeric transformations of existing variables.
- Select Compute from the Transform menu. Enter the name of the target variable. Enter the numeric expression. You can paste variables from the source list. Numbers and operators from the calculator pad. And functions from the function list. For example (demo1.sav), you could calculate a new variable, yyy, based on age. The new variable is added to the end of the data file.

Data Analysis

- Descriptive Analysis
- Inferential Analysis
- Graphic Analysis

Descriptive Analysis

- Descriptive analysis displays univariate summery statistics, such as frequency, sum, averages, range, dispersion, skewness, kurtosis, etc. and calculate *z*-scores.

Inferential Analysis

- Inferential analysis gives the results that aids drawing inferences (conclusions) about the problem/s. For example, correlation and regression, testing of hypothesis, ANOVA, estimations, etc.

Graphic Analysis

- Graphic analysis displays the summary and trends of variable/s with interactive charts (Line graph, Bar, Pie, etc.).

Descriptive Statistics

Averages

- Arithmetic Mean
- Median
- Mode

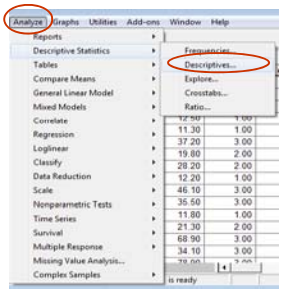
Dispersion

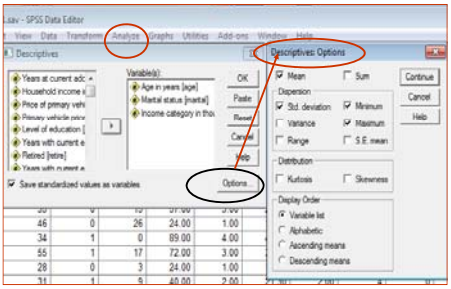
- **Standard Deviation**

To Obtain Descriptive Statistics

From the menus choose:

- Analyze
  -Descriptive Statistics
  -Descriptives...
- Select one or more variables.
- Optionally, you can:
- Select **Save standardized** values as variables to save z scores as new variables.
- Click **Options** for optional statistics and display order.





Comparing Means

- The Means procedure calculates subgroup means and related univariate statistics for dependent variables within categories of one or more independent variables. Optionally, you can obtain a one-way analysis of variance, eta, and tests for linearity.

Statistics under Means

Sum, number of cases, mean, median, grouped median, standard error of the mean, minimum, maximum, range, variable value of the first category of the grouping variable, variable value of the last category of the grouping variable, standard deviation, variance, kurtosis, standard error of kurtosis, skewness, standard error of skewness, percentage of total sum, percentage of total N, percentage of sum in, percentage of N in, geometric mean, and harmonic mean. Options include analysis of variance, eta, eta squared, and tests for linearity R and R2.

T test

- One-Sample T test tests whether the mean of a single variable differs from a specified constant.
- For each test variable: test procedure gives the statistics of mean, standard deviation, and standard error of the mean. It tests the average difference between each data value and the hypothesized test value. T test tests that this difference is 0 at a given level of confidence interval for this difference (you can specify the confidence level).

- There are other procedures which you can use to test the assumption of normality. See One-Sample Kolmogorov-Smirnov Procedure for more information.
- Use the Runs Test procedure to check the assumption that the value of the test variable is independent of the order of observation.

See the following texts for more information on the one-sample *t* test:

- Hays, W. L. 1981. *Statistics.* New York: Holt, Rinehart, and Winston.
- Norusis, M. 2004. *SPSS 13.0 Guide to Data Analysis.* Upper Saddle-River, N.J.: Prentice Hall, Inc..
- Norusis, M. 2004. *SPSS 13.0 Statistical Procedures Companion.* Upper Saddle-River, N.J.: Prentice Hall, Inc..

ANOVA

- The ANOVA analysis tools provide different types of variance analysis. The tool to use depends on the number of factors and the number of samples you have from the populations you want to test.

One Way ANOVA Table

ANOVA of 1996 Sales (in tens of thousands of dollars) for Three Regions

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6952.09	2	3476.04	13.26	.00
Within Groups	93562.26	357	262.08		
Total	100514.34	359			

In one-way ANOVA, the total variation is partitioned into two components.

ANOVA: Single Factor

This tool performs a simple analysis of variance on data for two or more samples. The analysis provides a test of the hypothesis that each sample is drawn from the same underlying probability distribution against the alternative hypothesis that underlying probability distributions are not the same for all samples. If there were only two samples, the worksheet function, T_TEST, could equally well be used. With more than two samples, there is no convenient generalization of T_TEST and the Single Factor Anova model can be called upon instead.

ANOVA: Two-Factor With Replication

This analysis tool is useful when data can be classified along two different dimensions. For example, in an experiment to measure the height of plants, the plants may be given different brands of fertilizer (for example, A, B, C) and might also be kept at different temperatures (for example, low, high). For each of the 6 possible pairs of {fertilizer, temperature} we have an equal number of observations of plant height. Using this ANOVA tool we can test:

- Whether heights of plants for the different fertilizer brands are drawn from the same underlying population; temperatures are ignored for this analysis.
- Whether heights of plants for the different temperature levels are drawn from the same underlying population; fertilizer brands are ignored for this analysis.
- Whether having accounted for the effects of differences between fertilizer brands found in step 1 and differences in temperatures found in step 2, the 6 samples representing all pairs of {fertilizer, temperature} values are drawn from the same population. The alternative hypothesis is that there are effects due to specific {fertilizer, temperature} pairs over and above differences based on fertilizer alone or on temperature alone.

ANOVA: Two-Factor Without Replication

- This analysis tool is useful when data are classified on two different dimensions as in the Two-Factor case With Replication. However, for this tool we assume that there is only a single observation for each pair (for example, each {fertilizer, temperature} pair in the example above. Using this tool we can apply the tests in steps 1 and 2 of the ANOVA: Two-Factor With Replication case but do not have enough data to apply the test in step 3.

Example: ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
1993 Sales * REGION	Between Groups		2.90E+09	2	1.45E+09	1.65	.19
	Within Groups		2.69E+11	305	8.81E+08		
	Total		2.72E+11	307			
1996 Sales * REGION	Between Groups		1.15E+11	2	5.75E+10	16.68	.00
		Linearity	5.87E+08	1	5.87E+08	.17	.68
		Deviation from Linearity	1.14E+11	1	1.14E+11	33.18	
	Within Groups		1.05E+12	305	3.45E+09		
	Total		1.17E+12	307			

An ANOVA compares the means for the different groups.

- The total variation is partitioned into two components.
- Between Groups represents variation of the group means around the overall mean.
- Within Groups represents variation of the individual scores around their group means.
- Small significance values (<.05) indicate group differences.
- In this example, the significance level for ***1993*** sales exceeds .05 (ie 0.19), indicating that the three regions do not differ.
- The significance level for ***1996*** sales is less than .05 (ie 0.000), indicating that at least one of the regions differs from the others.

- Linearity reflects variation due to a linear relationship between the variables.
- No linear relationship exists between region and 1996 sales (high sig. value of 0.68)
- Small significance values (<.05) indicate that nonlinear relationships exist. (Dev. From Lin.)

Measures of Association

	R	R Squared	Eta	Eta Squared
1993 Sales * REGION	.101	.010	.103	.011
1996 Sales * REGION	.022	.001	.314	.099

- R and R^2 are appropriate if a linear relationship exists.
- Nonlinear relationships cannot be accurately described by R squared.
- R Squared reflects the proportion of variation in the dependent variable accounted for by the linear model.
- In this example, differences between the regions account for 10% of the variation in 1996 sales.

Notes

- The One-Way ANOVA procedure is used to test the hypothesis that several sample means are equal.
- You can alternately use the Means procedure (under Compare Means) to obtain a one-way analysis of variance with a test for linearity.
- If your test variable does not meet the conditions of analysis of variance, you can use the Kruskal-Wallis *H* test in the Tests for Several Independent Samples procedure.
- If you have multiple factors, use the GLM Univariate procedure to obtain two-way analysis of variance, analysis of covariance, and more.

See the following texts for more information on analysis of variance:

- Brown, M. B., and A. B. Forsythe. 1974. Robust tests for the equality of variances. *Journal of the American Statistical Association,* 69:, 264-267.
- Levene, H. 1960. Robust Tests for the Equality of Variance. In: *Contributions to Probability and Statistics*, I. Olkin, eds. Palo Alto, CA: Stanford University Press.
- Milliken, G., and D. Johnson. 1992. *Analysis of Messy Data: Volume 1. Designed Experiments.* New York: Chapman & Hall.
- Neter, J., W. Wasserman, and M. H. Kutner. 1990. *Applied Linear Statistical Models.* Homewood, IL: Irwin.
- Norusis, M. 2004. *SPSS 13.0 Guide to Data Analysis.* Upper Saddle-River, N.J.: Prentice Hall, Inc..
- Norusis, M. 2004. *SPSS 13.0 Statistical Procedures Companion.* Upper Saddle-River, N.J.: Prentice Hall, Inc..
- Welch, B. L. 1951. On the Comparison of Several Mean Values: An Alternative Approach. *Biometrika,* 38:, 330-336.

GLM Univariate Analysis

The GLM Univariate procedure provides regression analysis and analysis of variance for one dependent variable by one or more factors and/or variables. The factor variables divide the population into groups.

Using this General Linear Model procedure

- you can test null hypotheses about the effects of other variables on the means of various groupings of a single dependent variable.
- You can investigate interactions between factors as well as the effects of individual factors, some of which may be random. In addition, the effects of covariates and covariate interactions with factors can be included.
- For regression analysis, the independent (predictor) variables are specified as covariates.

- Both balanced and unbalanced models can be tested. A design is balanced if each cell in the model contains the same number of cases. In addition to testing hypotheses, GLM Univariate produces estimates of parameters.
- Commonly used a priori contrasts are available to perform hypothesis testing. Additionally, after an overall F test has shown significance, you can use post hoc tests to evaluate differences among specific means.
- Estimated marginal means give estimates of predicted mean values for the cells in the model, and profile plots (interaction plots) of these means allow you to easily visualize some of the relationships.

- Residuals, predicted values, Cook's distance, and leverage values can be saved as new variables in your data file for checking assumptions.
- WLS Weight allows you to specify a variable used to give observations different weights for a weighted least-squares (WLS) analysis, perhaps to compensate for a different precision of measurement.

Notes

- **Data**. The dependent variable is quantitative. Factors are categorical. They can have numeric values or string values of up to eight characters. Covariates are quantitative variables that are related to the dependent variable.
- **Factors.** **Categorical** predictors should be selected as **factors** in the model. Each **level** of a factor can have a different linear effect on the value of the dependent variable.
- **Fixed-effects factors** are generally thought of as variables whose values of interest are all represented in the data file.
- **Random-effects factors** are variables whose values in the data file can be considered a random sample from a larger population of values. They are useful for explaining excess variability in the dependent variable.
- **Assumptions**. The data are a random sample from a normal population; in the population, all cell variances are the same. Analysis of variance is robust to departures from normality, although the data should be symmetric. To check assumptions, you can use homogeneity of variances tests and spread-versus-level plots. You can also examine residuals and residual plots.

Correlation and Regression

Bivariate Correlations

- The Bivariate Correlations procedure computes Pearson's correlation coefficient, Spearman's rho, and Kendall's tau-b with their significance levels. Correlations measure how variables or rank orders are related.
- **Pearson's correlation coefficient** is a measure of linear association. Two variables can be perfectly related, but if the relationship is not linear, Pearson's correlation coefficient is not an appropriate statistic for measuring their association.

Data Consideration

- Use quantitative variables for Pearson's correlation coefficient and quantitative variables or variables with ordered categories for Spearman's rho and Kendall's tau-b.

Obtaining Bivariate Correlations

- From the menus choose:
- Analyze
  Correlate
  Bivariate...
- Select two or more numeric variables.

Notes

- **Correlation Coefficients**: For quantitative, normally distributed variables, choose the Pearson correlation coefficient. If your data are not normally distributed or have ordered categories, choose Kendall's tau-b or Spearman, which measure the association between rank orders.
- Correlation coefficients range in value from –1 (a perfect negative relationship) and +1 (a perfect positive relationship). A value of 0 indicates no linear relationship. When interpreting your results, be careful not to draw any cause-and-effect conclusions due to a significant correlation.

- Test of Significance: You can select two-tailed or one-tailed probabilities. If the direction of association is known in advance, select One-tailed. Otherwise, select Two-tailed.
- Significant *P* value: Correlation coefficients significant at the 0.05 level are identified with a single **asterisk**, and those significant at the 0.01 level are identified with two asterisks.

Partial Correlations

- The partial correlation coefficients describe the linear relationship between two variables while controlling for the effects of one or more additional variables. Correlations are measures of linear association. Two variables can be perfectly related, but if the relationship is not linear, a correlation coefficient is not an appropriate statistic for measuring their association.

Example

Is there a relationship between ***healthcare funding*** and ***disease rates***? Although you might expect any such relationship to be a negative one, a study reports a significant positive correlation: as ***healthcare funding*** increases, ***disease rates*** appear to increase. Controlling for the ***rate of visits to healthcare providers***, however, virtually eliminates the observed positive correlation. healthcare funding and disease rates only appear to be positively related because more people have access to healthcare when funding increases, which leads to more reported diseases by doctors and hospitals.

Obtaining Partial Correlations

- From the menus choose:
  - **Analyze**
    - **Correlate**
      - **Partial...**
- Select two or more numeric variables for which partial correlations are to be computed.
- Select one or more numeric control variables.
- Data: Required quantitative data.

Linear Regression

- Linear Regression estimates the coefficients of the linear equation, involving one or more independent variables, that best predict the value of the dependent variable. For example, you can try to predict a salesperson's total yearly sales (the dependent variable) from independent variables such as age, education, and years of experience.

Data Consideration

- The dependent and independent variables should be quantitative. Categorical variables, such as religion, major field of study, or region of residence, need to be recoded to binary (dummy) variables or other types of contrast variables.

Obtaining a Linear Regression Analysis

- From the menus choose:
  - **Analyze**
    Regression
    Linear...
- In the Linear Regression dialog box, select a numeric dependent variable.
- Select one or more numeric independent variables.

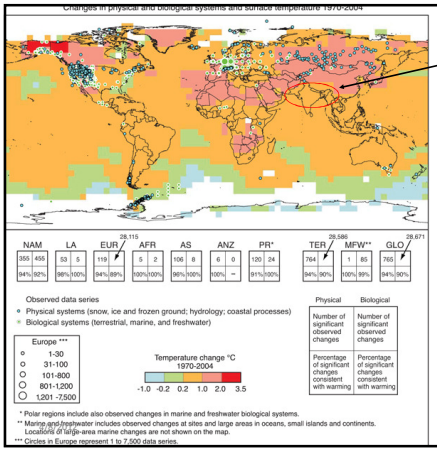
Optionally, you can:

- Group independent variables into blocks and specify different entry methods for different subsets of variables.
- Choose a selection variable to limit the analysis to a subset of cases having a particular value(s) for this variable.
- Select a case identification variable for identifying points on plots.
- Select a numeric WLS Weight variable for a weighted least squares analysis.

Climate Change Effects on Aquatic Ecosystems

Subodh Sharma
Subodh.sharma@ku.edu.np

WATER TOWER OF ASIA



Lack of data in the Himalayan region

"Arctic, Sub-Saharan Africa, Small Island States, and Asian mega deltas are the most vulnerable in the context of global climate change"

Source: IPCC 2007

Climate change effects on aquatic organisms and ecosystems

Climatic changes

↓

Effects in aquatic organisms

↓

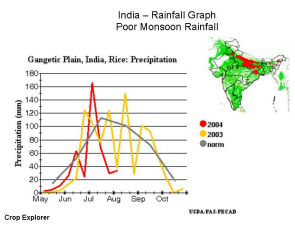
Biological and ecological responses

↓

Assessment of responses

1. Climatic Changes

- Increased CO_2 in atmosphere
- Increased air temperature
- Altered precipitation regimes



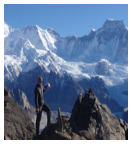
Heavy rain and flooding in parts of northern India, Nepal and Bangladesh in 2004 left 1,800 dead and millions stranded.

- Nojumba glacier

- Epi-glacial lakes in Nojumba glacier

2. Effects in aquatic ecosystems

- Increased water temperature, altered flow, increased snowmelt
- Altered evapo-transpiration, reduced ice cover, increased sea levels
- Increased salinity/altered water chemistry, increased CO_2 in waters, altered stratification regime



A retreat rate of 50m per year is recorded in the last 50 years.

Thinning by 0.3-1m/year

Melting is faster in recent decades.

(source: ICIMOD, Feb. 2008)

3. Biological and Ecological Responses

Individual

(altered vital rates)

⇩

Population

(altered demographic rates)

⇩

Community

(altered species tolerances and interactions)

⇩

Ecosystem

(altered energy flow and cycling)

4. Assessment of responses

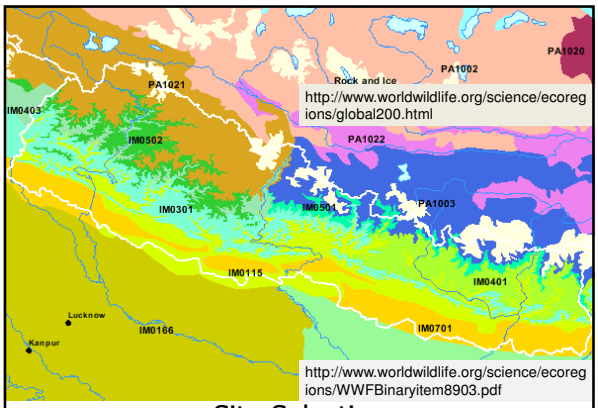
- Responses can be measured using indicators
  - Benthic macroinvertebrates are the most common assemblages
  - Fish assemblages are the second most prevalent assemblage
  - Use of multiple assemblages increase the robustness of the overall bioassessment
  - Periphyton or algae is of interest to many as an added assemblage

Benthic Macroinvertebrates as indicators

- Categories:
  - Richness measures
  - Composition measures
  - Tolerance/intolerance measures
  - Feeding measures
  - Habitat measures

Richness measures	Composition measures	Tolerance/in tolerance measures	Feeding measures	Habitat measures
Total number of taxa	% EPT	Number of intolerant taxa	% Filterers	Number of clinger taxa
Number of EPT taxa	% Ephe.	% Tolerant organisms	% Grazers and scrapers	% Clingers
Number of Ephemereoptera taxa		% Dominant taxon		
Number of Plecoptera taxa				
Number of Trichoptera taxa				

U.S. EPA. (2008)



Site Selection

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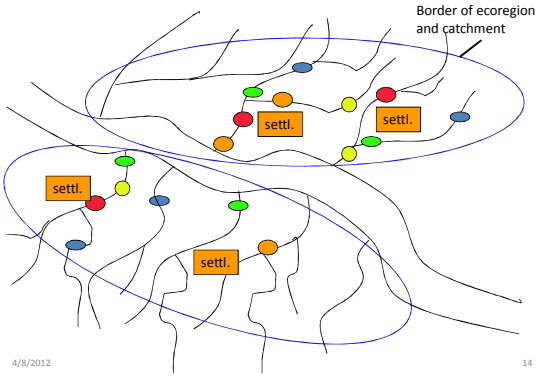
Site Selection for climate change studies



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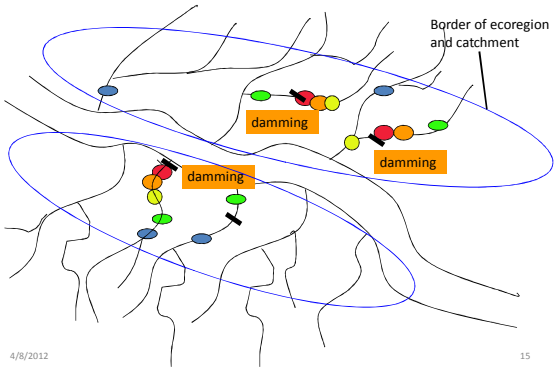
Selection of Sites impaired by damming



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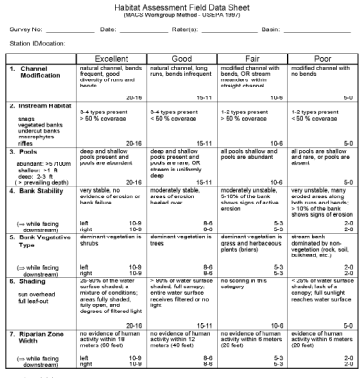
Habitat Assessment field data Sheet

http://www.epa.gov/bioiweb1/pdf/MACS-FieldandLabMethods.pdf



Habitat Assessment Field Data Sheet
(MACS Workgroup Method - USEPA 1997)

Survey No: _____ Date: _____ Rater(s): _____ Basin: _____

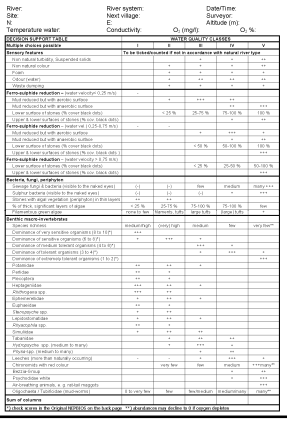
Station ID/location: _____

	Excellent	Good	Fair	Poor
1. Channel Modification	natural channel, bends frequent, good diversity of runs and bends 20-19	natural channel, long runs, bends infrequent 19-11	modified channel with bends, OR stream consistently within straight channel 10-9	modified channel with no bends 9-0
2. Instream Habitat snags vegetated banks undercut banks macrophytes riffles	5-4 types present > 50 % coverage 20-16	3-4 types present < 50 % coverage 15-11	1-2 types present > 50 % coverage 10-6	1-2 types present < 50 % coverage 5-0
3. Pools abundant: >o /100m shallow: >1 ft deep: 2-3 ft (= prevailing depth)	deep and shallow pools present and pools are abundant 20-16	deep and shallow pools present and pools are rare; OR, stream is uniformly deep 15-11	all pools shallow and pools are abundant 10-6	all pools are shallow and rare, or pools are absent 5-0
4. Bank Stability (= while facing downstream)	very stable, no evidence of erosion or bank failure left 10-9 right 10-9	moderately stable, areas of erosion healed over 8-6 8-6	moderately unstable, 5-10% of the bank shows signs of active erosion 5-3 5-3	very unstable, many eroded areas along bank runs and banks > 10% of the bank shows signs of erosion 3-0 3-0
5. Bank Vegetative Type (= while facing downstream)	dominant vegetation is shrubs left 10-9 right 10-9	dominant vegetation is trees 8-6 8-6	dominant vegetation is grass and herbaceous plants (briars) 5-3 5-3	stream bank dominated by non-vegetation (rock, soil, bulkhead, etc.) 3-0 3-0
6. Shading sun overhead full leaf-out	20-16	15-11	10-6	5-0
7. Riparian Zone Width (= while facing downstream)	no evidence of human activity within 18 meters (60 feet) left 10-9 right 10-9	no evidence of human activity within 12 meters (40 feet) 8-6 8-6	no evidence of human activity within 6 meters (20 feet) 5-3 5-3	evidence of human activity within 6 meters (20 feet) 3-0 3-0
column totals	_____	_____	_____	_____

4/8/2012

Rapid Field Screening

www.assess-hkh.at



4/8/2012

Case study 1: Examining the potential vulnerability of biomonitoring programs and assessment methods to biological changes that result from climate change

Research Questions:

1. How do we detect impairment under climate change?
2. How does climate change affect our ability to identify causes of biological impairment?
3. Are there analytical or monitoring design approaches that will allow managers to effectively identify and manage stressors independently of climate change?

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Methodology

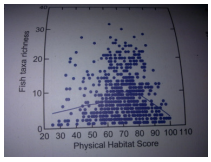
- Data collected from 1320 randomly located benthic samples in the Piedmont and Highland regions over 10 years (1994-2004)
- The main analytical focus was on 2 fish taxon richness, and the Maryland B-IBI Score, and the EPT taxon richness.
- The selected indicators are all responsive, general indicators of stress but are not diagnostic of any particular stressor.

Observed Stressor-Responses

1. Physical Habitat
2. Hydrology
3. Water Quality
4. Temperature

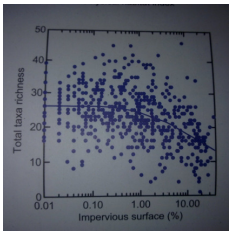
1. Physical Habitat

- Both fish and benthic macroinvertebrate measures were correlated with overall physical habitat.
- Fish taxon richness was not correlated with the habitat index
- Fish IBI and the Total Benthic Taxon Richness and Total EPT taxon richness were strongly correlated.



2. Hydrology

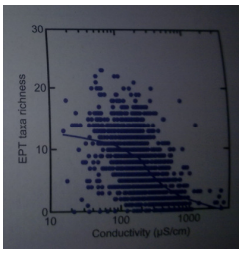
Macroinvertebrate indicators declined with impervious surface in a catchment , but the fish indicators did not.



3. Water Quality

The invertebrate indicator EPT taxa declined as the stressors increased: Stressors were DOC, TP, and conductivity.

The strongest association was with conductivity.



4. Temperature

- Fish taxon richness increased with temperature in warm – water streams.
- There was no detectable relationship in the cold water.
- EPT and Total macroinvertebraes taxon richness were reduced in the cold-water Highland streams where late summer temperatures exceeded 18-20 deg C.
- No detectable relationship between temperature and benthic macroinvertebrates in some ecoregions.

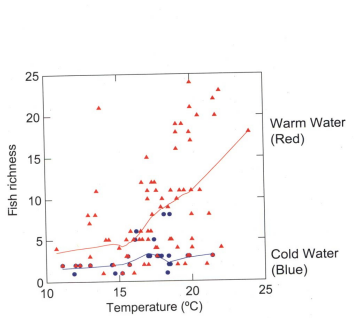
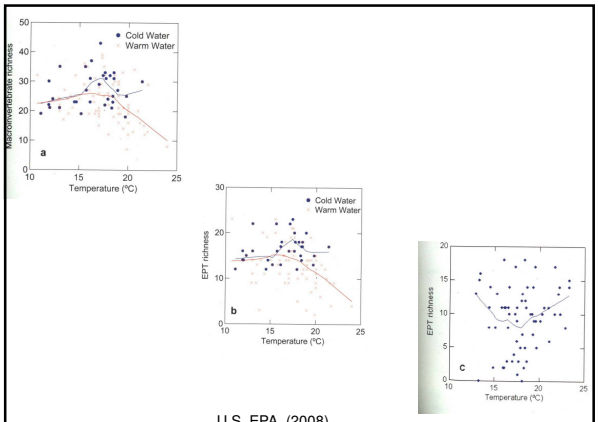


Figure 5-3. Fish richness vs. temperature in Highland reference streams. Lines are LOWESS estimates.

U.S. EPA. (2008)



U.S. EPA. (2008)

Estimates of Climate Change Effects

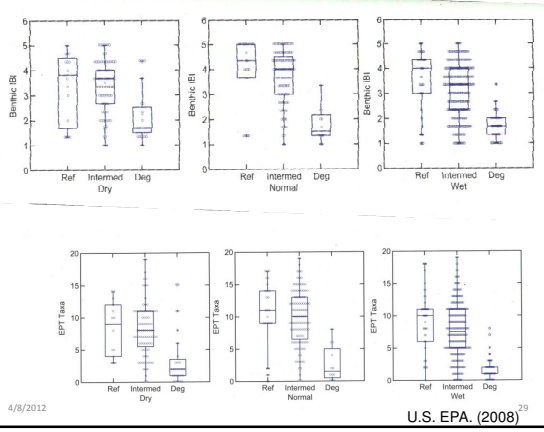
Temperature:

- Global average air temperatures are expected to increase by at least 2 deg C by 2100
- Invertebrate taxa per site may decrease in Highland streams
- No change in streams that remain well below 18 Deg. C. in late summer

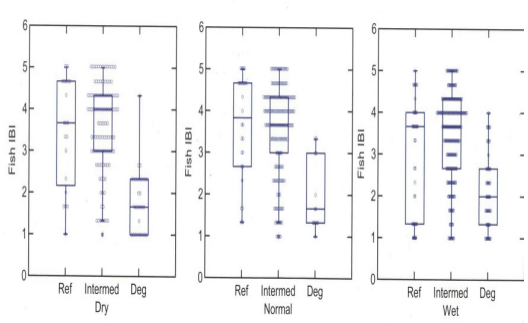
Estimates of Climate Change Effects

Hydrology:

- Samples taken in relatively dry conditions (Dry)
- Samples taken in approx normal conditions (Normal), and
- Samples taken in relatively wet conditions (Wet)



U.S. EPA. (2008)



U.S. EPA. (2008)

Case 2: Climate Change Effects in the Himalaya

The specific objectives of the present research work include:

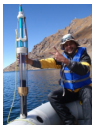
1. Investigating/bathymetry and morphometry of three main lakes
2. Analyzing water quality (physical, chemical and biological parameters)
3. Observing the impact of climate change on indicator species (diatoms and macroinvertebrates)
4. Monitoring the hydrological systems and studying the permafrost distribution in micro-scale level
5. Tracing the past history of climate change with chironomids subfossils as proxy

Sediment core – Lake Gokyo

Sediment core – Lake Gosaikunda

Sampling Techniques

Sediment:



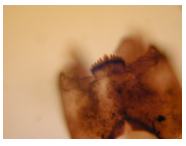
Sampling Techniques

Water:

Temperature:

Findings (continued)

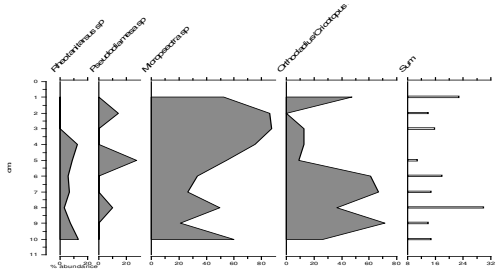
Cold water species (*Pseudodiamesa* sp)



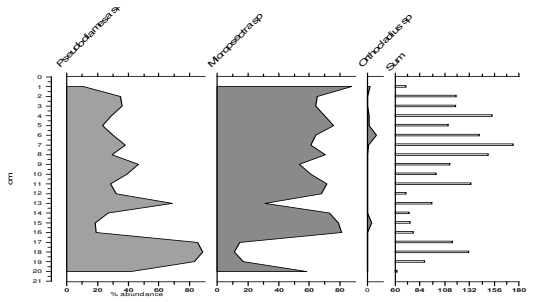
Warm water species (*Micropsectra* sp.)

Findings (continued)

sedimentation rate = 0.07 cm per annum



Chironomid stratiography of Lake Gokyo in core 1 (Sharma et al. 2012 in prep.)



Lake Gosaikunda : Chironomid taxa are given as % abundance; sum represents the total number of head capsules per sample (Sharma et al. 2012 in prep.)

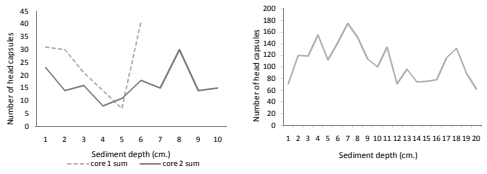


Fig. Chironomid head capsules in Gokyo lake (left) and Gosaikunda lake (right) (Sharma et al. 2012 in prep.)

Conclusion and Recommendations

1. Conduct regular and repeat reference site sampling
2. Consider strategies for the maintenance and protection of reference sites and areas.
3. Expand sampling seasons.
4. Improve temperature and hydrological data collection.
5. Retrieve historical data records to establish a basis for evaluating climate change.

A B C ABOUT CLIMATE CHANGE ADAPTATION

Jagadish C Baral PhD

PRESENTATION OUTLINE

- Context Setting
  - Worrisome today and scary tomorrow
  - Facts and Figure
  - Picture
- Option For fighting Climate Change
  - Mitigation
  - Adaptation
    - Definition
    - Types
    - Principle of Good Adaptation.
    - Implication
    - Evolution of Concept and Initiative
      - Global
      - National- NAPA/LAPA and Projects
    - Examples of Adaptation Intervention.
    - Issues of NAPA Implementation.

CONTEXT SETTING

- Global warming (0.74 degree in 100 years)
- Extreme Drought or extreme rainfall
- Melting of ice/glaciers
- Drying of water sources (drinking and irrigation)
- Loss of biodiversity

CONT....

- Livelihood threats leading to
  - -Starvation / food security
  - -Disease
  - -Displacement
  - -Forest encroachment
  - -Peace and security
- What if 6 degree temperature rise?
- Countries like Nepal will suffer most because
  - Warming rate higher- 6 degrees already
  - Inaccessibility
  - Diverse physiography
  - Poor coping capacity

NATIONAL CONTEXT

Disaster	Year	Damage	Remarks
Cloudbursts / floods	July 1993	•1,460 people died •73,606 families seriously affected, •39,043 houses completely destroyed, •43,330 hectares of cultivated land washed away •damage to367 km of roads and 213 large and small bridges	South-Central Nepal
Flooding	2008	•26 died •8 missing •2,152 houses completely damaged •18923houses partially damaged •5,647 households lost entire stocked grains •12,552 households lost stocked grains partially.	Kailali and Kanchanpur of Far west Nepal
Koshi Flooding	August 2008	• 65,000 people displaced in Nepal • 3 million in India's Bihar displaced	Sunsari / bihar District

CONT..

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Koshi Flooding	August 2008	• 65,000 people displaced in Nepal • 3 million in India's Bihar displaced	Sunsari / bihar District

Source: Dixit 2010 & NAPA 2010

Deserted cropland in Ghoksila
-
Poor are left with little alternatives.

The famous *Ghoksila Pokhari* which never dried before has now dried

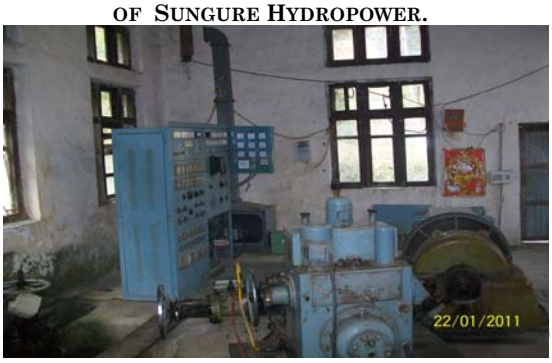
All ponds are virtually drying.

Torrential rain of 1984 has devastated fertile fields.

Slides threatening the villages.

Sick and dying forest in *Kathjor* - Lagerstroemia is the first victim

GHOKSILA KHOLA DRIED WITH VARIOUS IMPLICATION: ONE EXAMPLE IS SHUTTING DOWN OF SUNGURE HYDROPOWER.



Water Stress : Marriage ceremony may not take place unless supported with a jar of water on the part of invitees.

DESPERATE MANTHALI PEOPLE HAVE LITTLE ALTERNATIVE.THE HEADQUARTER IS FORCED TO PUMP WATER FROM TAMAKOSHI FOR WATER SUPPLY.

PARADOX:

- Nepal : Negligible emitter (0.025 per cent) - 4th most vulnerable country.

MAJOR OPTION TO DEAL WITH THE SITUATION

Mitigation
Adaptation

MITIGATION:

An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC, 2001a).

WHAT IS ADAPTATION ?

Adaptation to climate change is any activity that reduces the negative impacts of climate change and/or takes advantage of new opportunities that may be presented.

Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation.(IPCC AR4 Glossary 2007).

TYPES

- **Anticipatory Adaptation** - ***Adaptation that takes place before impacts*** of climate change are observed. Also referred to as proactive adaptation.
- **Reactive Adaptation** - ***Adaptation that takes place after impacts of*** climate change have been observed.
- **Autonomous Adaptation** - ***Adaptation that does not constitute a conscious*** response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
- **Planned Adaptation**
- **Private Adaptation**
- **Public Adaptation**

GUIDING PRINCIPLE OF GOOD ADAPTATION:

- Sustainable
- Integrated.
- Collaborative and Open
- Flexible and Effective.
- Efficient
- Equitable.

IMPLICATION

Adaptation: Largely local
(Vs Mitigation: Essentially global)

EVOLUTION OF CONCEPT

- UNFCCC 1992
- Mrrakech Accord COP7, 2002:LDC fund
  - LDC work Program
  - Support for NAPA Preparation.
- Nairobi Work Plan COP12, 2006: Action Plan for implementation
- Bali Action Plan 2007: Adaptation as one of the main pillars
- Cancun/Durban 2010/2011: Green Climate Fund

NATIONAL INITIATIVES

National Adaptation Program of Action (NAPA)

- **6 Thematic area and 9 combined project profile.**

Thematic Area

- **Agriculture and Food security.**
- **Water Resources and Energy.**
- **Forests and Biodiversity.**
- **Public Health**
- **Urban settlement and infrastructure.**
- **Climate Induced Disaster.**

Combined Project Profiles:

- **Promoting Community Based Adaptation through Integrated Management of Agriculture, Water, Forest and Biodiversity.**
- **Building and Enhancing Adaptive capacity of vulnerable communities through improved system and Access to Services Related to Agriculture Development.**
- **Community Based Disaster Management for Facilitating Climate Adaptation.**
- **The GLOF monitoring and Disaster Risk Reduction.**
- **Forest and Ecosystem management for supporting Climate Led Adaptation Innovations.**
- **Adapting to Climate Change in Public health.**
- **Ecosystem Management for Climate Adaptation.**
- **Empowering Vulnerable Communities through Sustainable Management of Water Resources and clean Energy Supply.**
- **Promoting Climate Smart Urban Settlement.**

LAPA Framework

- Climate Change Sensitization.
- Climate Vulnerability and Adaptation Assessment.
- Prioritization of Adaptation option.
- LAPA Formulation
- LAPA Integration into planning process.
- LAPA implementation.
- LAPA Progress Assessment

- Projects in climate portal: 57
- Major projects
  - PPCR
  - DFID/EU- Nepal Climate Change Support Program (NCCSP)
  - UNDP –Ecosystem Based Adaptation

Some Examples of Adaptation Interventions

Sector	Climate Change Issues	Adaptation Responses
Water and Energy	Water scarcity due to drying of springs, ponds, rivers and natural springs; Energy crisis *Climatic Factor: Rainfall Variability*	Water harvesting technology (collection of rain water and water management in the upstream improve technology by building water-supply systems in rural areas; improve technology by repairing wells), Alternative energy promotion (Improved cook stove, biogas etc)
Agriculture	Outbreak of pest and diseases, Declining yield Land degradation, Changes in cropping Pattern *Climatic factors: Rainfall variability and increased temperature*	Integrated Pest Management Promotion of environment stress tolerant crop Varieties New technologies (System of rice intensification shifting to grow new varieties and kinds of crops from rice as rice had became inappropriate under the present climate condition, Drip irrigation, diversification of home gardens, saving seeds-seed bank, organic farming, farming in degraded lands e.g. Bagare Kheti); institutional strengthening and raising awareness and capacity of communities, early seasonal forecasting

Cont…

Sector	Climate Change Issues	Adaptation Responses
Forest and Biodiversity	Outbreak of Fire, loss of species, spread of invasive species *Climatic factors: Rainfall variability and increased temperature*	Community based fire management, Use of various technologies to utilize bi product of invasive species (e.g. bio briquette from Banmara); community based plantation in degraded areas
Land	Soil erosion and land degradation *Climatic factors: Rainfall variability*	Integrated Hedgerow technology, Zero tillage practices, sustainable soil management, rehabilitation of degraded land through plantation (broom grass and multipurpose species), land zonation
Cross Cutting	Deal with major Climatic Hazards	Awareness raising (drama, poetry journey, local caravan, school based programme, fair etc) and capacity building (training, re visit etc), Policy engagement (communication material, policy brief, travelling seminar)

Issues on NAPA implementation

- Lack of fund
- Access of Fund
- 'I want to pick what I want' approach
- CC centre yet to be established
- CC council yet to be effective

Cont..

Ministries yet to be ready

- No special unit for climate
- No environment for fusion/sectoral worldview persist
- Role of MLD in NAPA-confusing

- MOE
  - -Not having grassroot level institution
  - -Lacking coordination among the line agencies
  - -Concerned more on fund procurement than actual intervention
- Learning school is the need of the time

Comments and Suggestions are highly Welcome ....

धन्यवाद !

Thank you very much !

Climate Change Impacts on Mountain System

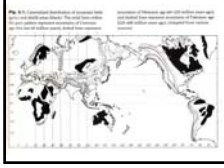
Narendra Raj Khanal, Ph.D
Professor
Central Department of Geography, TU
nrkhanal.geog@gmail.com

Structure of the presentation

- Mountain environment and mountain specificities
- Implications of mountains in climate
- Climate change (observed trend in Nepal)
- Impacts of climate change in mountain areas
  - Water resources
  - Landscape and biodiversity

Mountain Specificities and Hazards and Risk: Background

- Physical elements
  - Tectonics
  - Altitude
  - Slope
  - Aspect
  - Location
- Mountain specificities
  - Inaccessibility
  - Fragility (dynamics)
  - Marginality
  - Diversity
  - Niche
  - Human adaptation mechanism (traditional resource management practices)

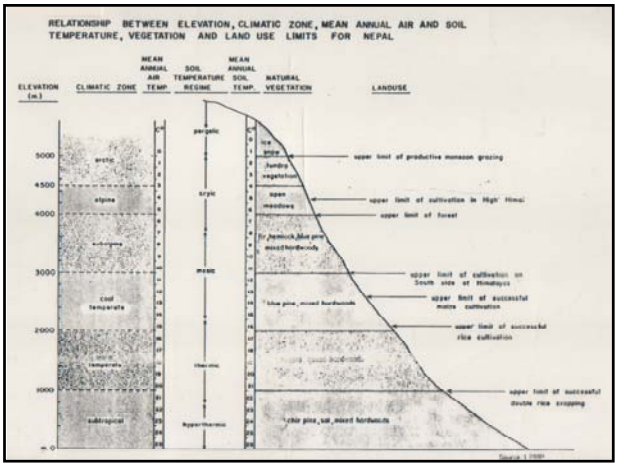


Mountain Climate

- Major climatic controls
  - Latitude
  - Altitude
  - Continentality
  - Topographic barrier: damming (prevent the passage of an air mass across), deflection (when air mass is dammed, the winds are usually deflected), blocking (mountains are a center of cold air, the storms may detour around mountains) forced ascent (when moist air blows perpendicular to a mountain range the air is forced to rise, as it rises it becomes cooled eventually precipitation occurs), forced descent (characteristics in the lee of mountains)
  - Slopes: south and north facing slopes, east and west facing slopes are affected differently by the sun's rays (south-west slope more drier)

Mountain Climate

- Great variation with time and space
- Decrease in temperature, air density, water vapor, carbon dioxide, suspended particular materials and increase in precipitation windier, thinner and clearer air and higher levels of solar radiation as well as cosmic-ray gamma radiation (short-wave length energy) with altitude
- Effect of mountain mass (increase in temperature due to reduction in cloudiness and greater sunshine.
- Temperature inversion (the thermal belt- higher night temperature; cold air is heavier than warm air. When slopes are cooled at night, the cold air begins to move downward, flowing underneath and displacing the warm air in the valley)



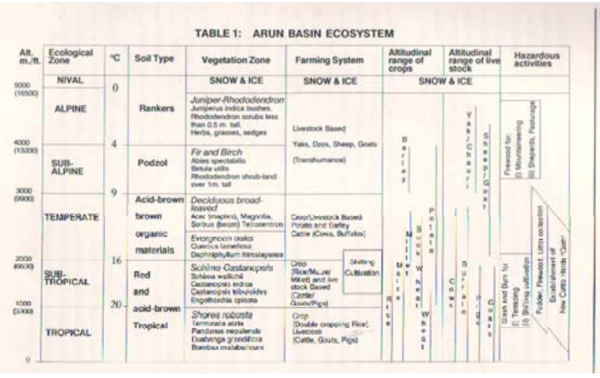
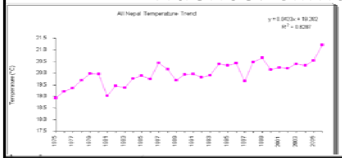
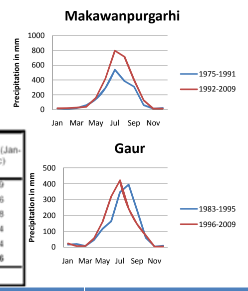


TABLE 1: ARUN BASIN ECOSYSTEM

Alt. m./ft.	Ecological Zone	°C	Soil Type	Vegetation Zone	Farming System	Altitudinal range of crops	Altitudinal range of live stock	Hazardous activities
5000 (16500)	NIVAL	0		SNOW & ICE	SNOW & ICE	SNOW & ICE		
4000 (13200)	ALPINE	4	Rankers	*Juniper-Rhododendron* Juniperus indica bushes, Rhododendron scrubs less than 0.5 m. tall, Herbs, grasses, sedges	Livestock Based Yaks, Dzos, Sheep, Goats (Transhumance)	Barley	Yak/Chauri, Sheep/Goat	Firewood for: (i) Mountaineering (ii) Shepards, Pasturage
3000 (9900)	SUB-ALPINE	9	Podzol	*Fir and Birch* Abies spectabilis, Betula utilis, Rhododendron shrub-land over 1m. tall				
2000 (6600)	TEMPERATE	16	Acid-brown brown organic materials	*Deciduous broad-leaved* Acer (maples), Magnolia, Sorbus (beam) Tetracentron; *Evergreen oaks* Quercus lamellosa, Daphniphyllum himalayense	Crop/Livestock Based Potato and Barley Cattle (Cows, Buffalo)	Potato, Buckwheat, Millet	Cows	Fodder, Firewood, Litter collection; Establishment of New Cattle Herds 'Goth'
1000 (3300)	SUB-TROPICAL	20	Red and acid-brown	*Schima-Castanopsis* Schima wallichii, Castanopsis indica, Castanopsis tribuloides, Engelhardia spicata	Crop (Rice/Maize/Millet) and live stock Based (Cattle/Goats/Pigs); Shifting Cultivation	Maize, Wheat	Buffalo, Pigs	Slash and Burn for (i) Terracing (ii) Shifting cultivation
0	TROPICAL		Tropical	*Shorea robusta* Terminalia alata, Pandanus nepalensis, Duabanga grandiflora, Bombax malabaricum	Crop (Double cropping Rice) Livestock (Cattle, Goats, Pigs)	Rice, Wheat	Goats	

Evidence: Climate change





Region	Seasonal: Winter (Dec-Feb)	Pre-monsoon (Mar-May)	Monsoon (Jun-Sep)	Post-monsoon (Oct-Nov)	Annual (Jan-Dec)
Trans-Himalayas[§]	0.12	0.01	0.11	0.1	0.09
Himalayas	0.09	0.05	0.06	0.08	0.06
Middle Mountains	0.06	0.05	0.06	0.09	0.08
Siwaliks	0.02	0.01	0.02	0.08	0.04
Terai	0.01	0	0.01	0.07	0.04
All Nepal	**0.06**	**0.03**	**0.051**	**0.08**	**0.06**

[§]Trend for 1977-1994

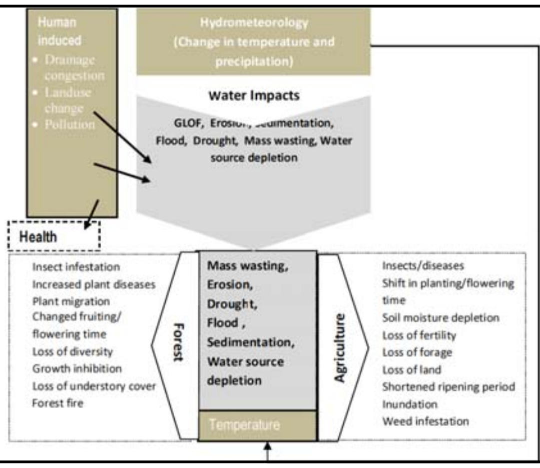
Increasing high intensity precipitation events (> 50 mm)

	Temperature (° C)	Mean annual Precipitation (%)
2030	0.5-2.0	-35 to + 22
2060	1.3-3.8	-36 to + 67
2090	1.8-5.8	-38 to + 80

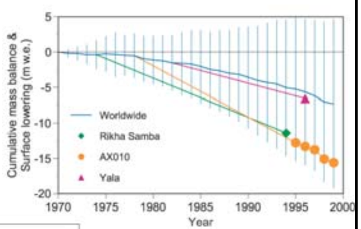
TABLE 1. Anticipated climate change impacts in Nepal.

Temperature	• Significant rise in temperature: ➢ 0.5 to 2.0 °C by 2030 ➢ 1.3 to 3.8 °C by 2060 ➢ 1.8 to 5.8 °C by 2090 • Increase in the number of days and nights considered hot by current climate standard • Highest temperature increases during the months of June to August and at higher ele
Precipitation	• Wide range of mean annual precipitation changes: ➢ -34 to +22% by the 2030s ➢ -36 to +67% by the 2060s ➢ -43 to 80% by the 2090s • Increase in monsoon rainfall towards the end of the century: ➢ -14 to 40% by the 2030s ➢ -40 to +143% by the 2060s ➢ -52 to +135% by the 2090s
Runoff	• Higher downstream flows in the short term, but lower downstream flows in the long to retreating glaciers and snowmelt and ice-melt • Shift from snow to rain in winter months • Increased extreme events, including floods, droughts and GLOFs

Source: Figures for anticipated changes in temperature and precipitation (NCVST 2009; McSweeney et al. 20



Climate change impact: Water Resources



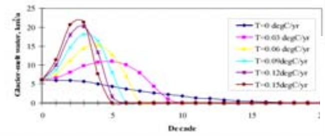


Figure 7: Sensitivity of Glacier-melt Water to Warming in the Nepal Himalayas (2000-2200). (Source: Chaulagain, 2007)

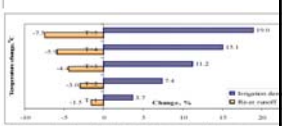
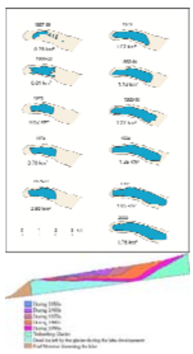
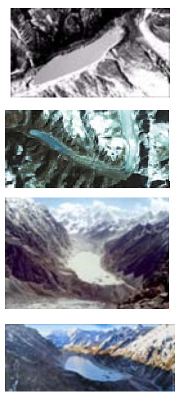


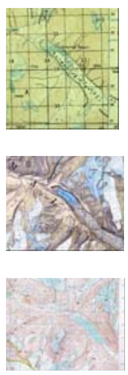
Fig. 8: Temperature Change, River Runoff and Irrigation Demand (Bagmati) (Source: Chaulag

Increasing Risks: Formation and Expansion

Tsho Rolpa glacial lake

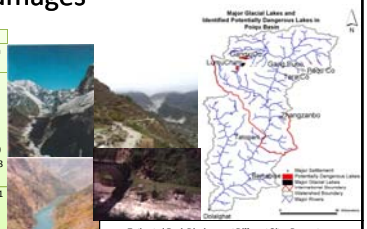


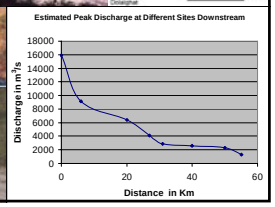




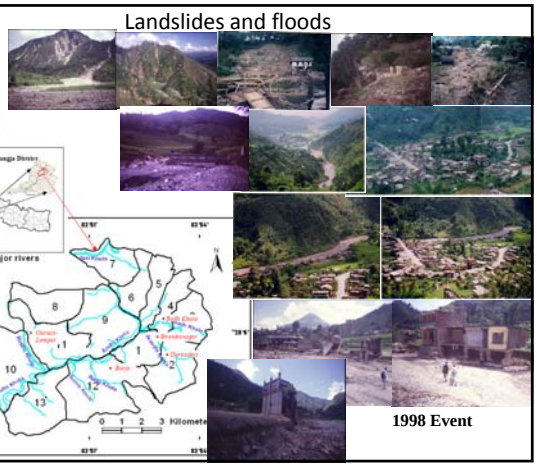
GLOF Events and Damages

Lake	Year	Downstream impact
Nare	1977	3 person, 1 building, 10 bridges down to 35 km
Zhangzanbo	1981	5 persons killed, 191 injured; 84 houses; 2 highway bridge; 10 suspension bridges; 27 km road; 1 hydro dam; 1 km transmission line; power supply cut for 31 days; road blocked for 36 days; damages NRs. 60 million; road rehabilitation cost US $ 3 million; work lasted for 3 years
Dig Tsho	1985	4-5 persons, 30 houses, 14 bridges, 1 hydropower plant, 8 km of trails, 20 ha cultivated land) down to 40 km; damages US $ 4 million; market closing and inflation.
Tam Pokhari	1998	2 persons; 3 teashops; 4 suspension bridge; 2 wooden bridge; and farm land; damages NRs. 150.66 million





Landslides and floods

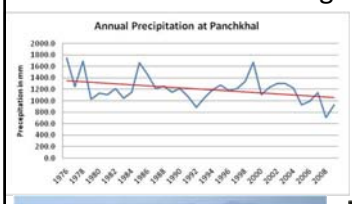


Landslide dam outburst floods (LDOFs)

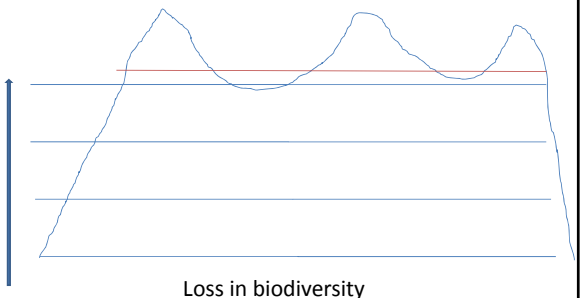
Vulnerability Assessment

Elements exposed	Flood Scenario Modeled	Maximum
Households (no)	634	1349
Houses (no)	362	797
Cultivated land (ha)	102	180
Crops (MT)	571.5	1205.5
Paddy	229.3	391.3
Wheat	42	99.7
Maize	163.6	312.6
Millet	22.5	73.8
Potato	41.5	135.9
Vegetables	59.8	169.4
Other	12.8	22.8
Infrastructure		
Schools (no)	3	6
Office building (no)	6	7
Temple (no)	4	9
Trail (km)	22.2	35.7
Road (km)	8.1	13.3
Embankment (km)	4.7	5.7
Bridge (no)	25	28
Hydropower plant (no)	3	3
Irrigation canal (km)	2	4.1
Water mill (no)	3	6
Transmission line (km)	5.9	10

Drought



Shifting of eco-zones



Thank you

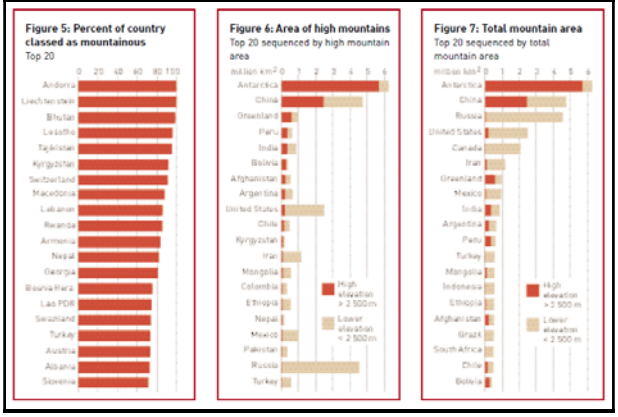
MOUNTAIN BIODIVERSITY AND VEGETATION SHIFT

Narayan Gaire
Nepal Academy of Science and Technology
March 28, 2012

Outline

- Mountain and Biodiversity
  - Key features
  - Specificities
- Threats to biodiversity
- Response of species to climate change some examples
- Approaches to study change in vegetation and biodiversity
- Dendrochronology: concepts, principles, methods, scope

Mountains: some facts



Biodiversity in Nepal: a Glimpse

Species	Number	Share on Global (%)
Lichens	465	2.3
Fungi	1,822	2.4
Algae	687	2.6
Bryophytes	853	5.1
Ptridophytes	534	4.71
Gymnoaperms	27	5.1
Angiosperms	+5856	2.7
Birds	863	9.53
Reptiles	118	1.87
Butterflies	640/2253	2.6
Mammals	181	4.52
Endemic plants	+342	Angiosperm=3800-4200
Endemic animal	160	
Ecosystem	118	
Vegetation	59	Source: GON 2009
Forest types	35	

Mountain and Mountain Perspectives

Key features of mountains

- Elevation
- Slope
- Aspect
- Local variation in Mt env
- High energy, high erosion
- Temperature(lapse rate=6.5 °C/1000m)
- Air pressure and Oxygen availability

MOUNTAIN And MOUNTAIN PERSPECTIVES

Mountain specificities

(Jodha 1992)

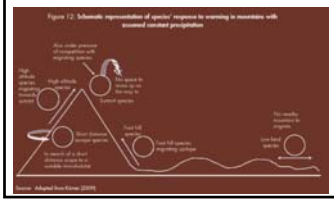
- Inaccessibility
- Fragility
- Marginality
- Diversity or Heterogeniety
- Niche or Comparative advantage
- Human adaptation mechanism

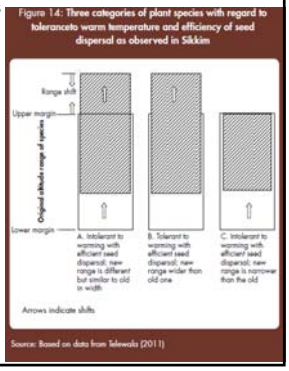
THREATS TO BIODIVERSITY

- The unsustainable harvesting of natural resources
- The loss, degradation or fragmentation of ecosystems
- Introduction of Invasive non-native or 'alien' species
- Pollution
- Climate change, etc

Response of species to CC

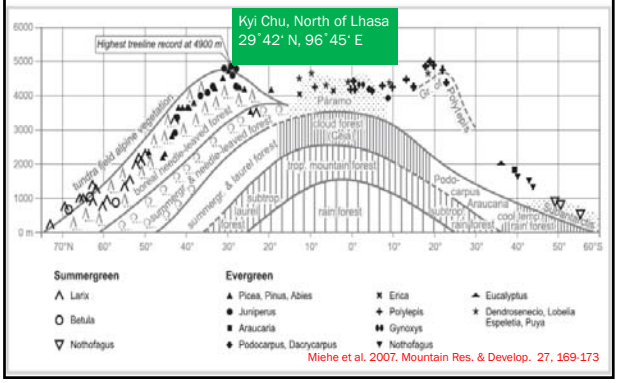
- Adapt, Escape (Relocate) or Die
- K selected species are likely losers and r selected sps are likely winners to CC
- Himalayan brown oak(Quercus semecarpifolia) is projected to loss of 40% habitat and 76% in + 2°C





TREELINES 0F THE NEPAL HIMALAYA

TREELINE AND ITS RESPONSE TO CC



Miehe et al. 2007. Mountain Res. & Develop. 27, 169-173

TREELINE'S RESPONSE TO CC

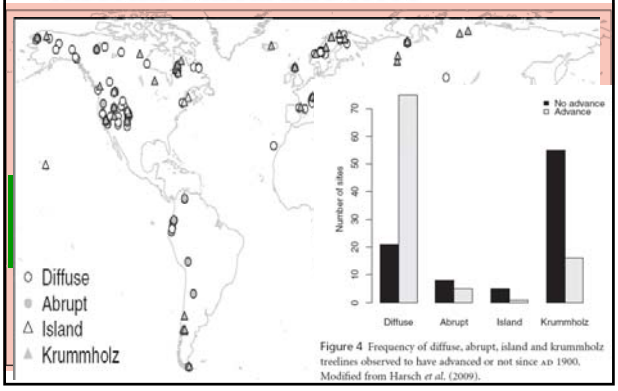


Figure 4 Frequency of diffuse, abrupt, island and krummholz treelines observed to have advanced or not since AD 1900. Modified from Harsch *et al.* (2009).

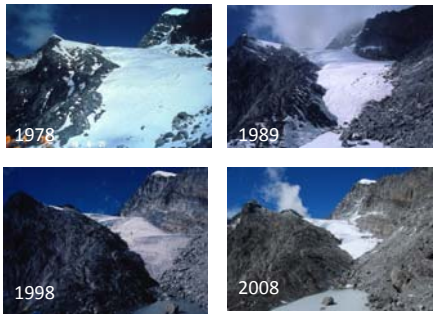
Year	Study area	Species studied	Upward shift distance(m or km)	Shift rate (m/yr)	Duration	Treeline Type	Researcher/ Reference
2012	Putorana mountains, north siberia	*Larix gmilinii*	30-50m	0.3-0.5	1901-2000	Altitudinal	Kirdynov et al 2012
2011	Italian Alps	*Larix decidua*	115m	1.15	1901–2000	Altitudinal	Leonelli et al 2011
2011	SE Tibetan Plateau, China	*Abies georgei var. smithii*	19.2m	0.02	past 400 yrs	Altitudinal	Liang et al 2011
2010	Nepal Himalaya	*Abies spectabilis*	220m	2.61	1851-2010	Altitudinal	Gaire and Bhuju 2011
2010	Italian Alps	Forest line, treeline,tundraline		1.1-2.5	1957-2003	Altitudinal	Diaz-Varela et al 2010
2010	Nepal Himalaya	*Abies spectabilis*	168	3.4	1958-2007	Altitudinal	Suwal 2010
2009	Swedish Scandes	*Betula pubescens ssp.*		0.74 ± 0.49	1915–2007	Altitudinal	Kullman and Oberg 2009
2009	Swedish Scandes	*Picea abies*		0.98 ± 0.61	1915–2007	Altitudinal	Kullman and Oberg 2009
2009	Swedish Scandes	*Pinus sylvestris*		0.81 ± 0.47	1915–2007	Altitudinal	Kullman and Oberg 2009
2009	Kootenay NP, B.C.	*Larix lyallii, P. engelmannii, A. lasciocarpa*	149m	2.2-5.7	1909-1976	Altitudinal	Roush, 2009
2009	Himalayas, Nepal	*Abies spectabilis*		1.7-2.3		Altitudinal	Vijayaprakash & Ansari, 2009
2008	Italian Alps	Multispecies distribution		2.39		Altitudinal	Gilberto Parolo, Graziano Rossi
2007	SW Yukon	*Picea glauca*	65-85m	0.8-1.0	1920-2005	Altitudinal	Danby & Hik, 2007
2006	Caledonian mountain, Sweden	*Pinus sylvestris*	150-190m	1.5-1.9	1901-2000	Altitudinal	Kullman and Kjailgren 2006
2006	Middle siberia	*Gmelin larch*	30-100 m/decade	3-10	1970s to 2000	Latitudinal	Kharuk et al 2006
2005	Polar urals		20-50m	0.22-0.56	1910-2000	Latitudinal	Shvatov et al 2005
2005	Glacier National Park, Montana, U.S.A.	*Picea engelmannii, Pinus contorta, Abies lasciocarpa*	7-16m	0.28-0.62	1800-1980	Altitudinal	Bekker 2005
2004	Siberia	Gmelin larch	30-50m	0.3-0.5	During 20th century		Esper and Schweingruber 2004
2004	Nome Creek, White Mountains	*Picea glauca*	30'100m			Latitudinal	Lloyd and Fastie 2003
2004	Spanish Pyrenees	*Pinus uncinata*	140m	0 - 4		Altitudinal	Camarero and Gutierrez 2004
2003	Polar Ural Mountain					Latitudinal	Shvatov 2003
2003	Swedish Scandis	*Betula pubescens ssp. tortuosa*	75m	0.75	1901-2000	Altitudinal	Kullman 2003
2003	Uinta Mts. UT	*P. engelmannii, A. lasciocarpa*	61-183 m	0.5-1.4	1870-2001	Altitudinal	Munroe, 2003
2003	W. Himalayas of India	*Pinu*	14-19 m	1.4-1.9	Over 10 yrs	Altitudinal	Dubey et al. 2003
2002	Scands Mts, Sweden	*Betula pubescens, Pinus sylvestris, Picea abies*	100-165 m	1.2-1.9	1915-2000	Altitudinal	Kullman 2001
2002	Western Alaska	*Fox River 122 .10*	122/10m			Latitudinal	Lloyd et al. 2002
2002	Swedish Scandes	*Betula pubescens*	315m	6.3	Since 1950s	Altitudinal	Kullman 2002
2002	Swedish Scandes	*Sorbus aucuparia*	375m	7.5	Since 1950s	Altitudinal	Kullman 2002
2002	Swedish Scandes	*Picea abies*	240m	4.8	Since 1950s	Altitudinal	Kullman 2002
2002	Swedish Scandes	*Pinus sylvestris*	340m	6.8	Since 1950s	Altitudinal	Kullman 2002
2002	Swedish Scandes	*Salix glauca*	120m	2.4	Since 1950s	Altitudinal	Kullman 2002
2002	Swedish Scandes	*S. Lanata*	165m	3.3	Since 1950s	Altitudinal	Kullman 2002

APPROACHES TO STUDY CHANGE in Biodiversity and vegetation

- Historical record and repeated photography
- Remote sensing and GIS technique
- Permanent monitoring
  - Transect or Quadrate
  - Summit approach
- Dendrochronological study

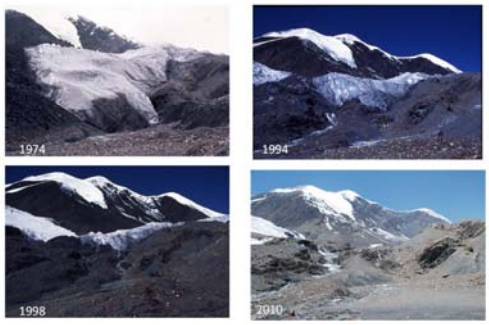
Historical record and repeated photography: examples

AX010 glacier in Shorong Himal



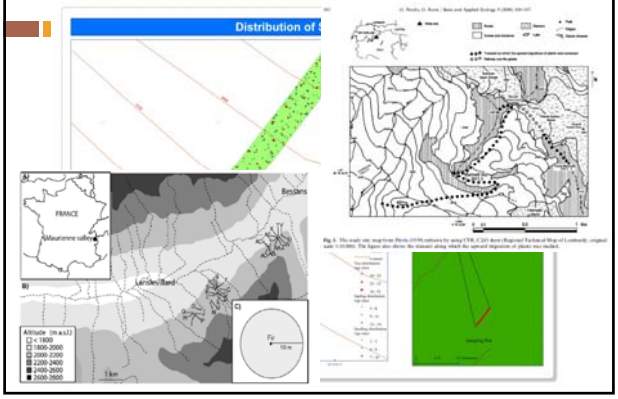
Historical record and repeated photography: examples

Evolution of Rikha Samba Glacier, Hidden Valley

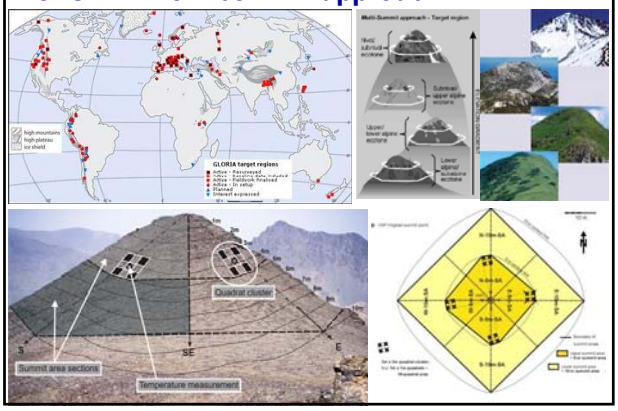


A century of vegetation change in the San Juan Mountains, Colorado analysis using repeated photography

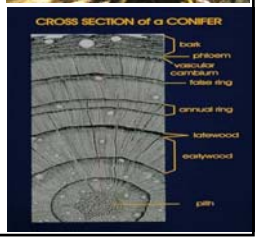
Field study by Transect and Quadrate



GLORIA Multi-summit approach



Dendrochronology



Dendrochronology

dendron (= “tree”)

chronos (= “time”)

- logy (= the study of)

The science that uses tree rings, dated to their exact year of formation, to analyze temporal and spatial patterns of processes in the physical and cultural sciences.

Tree rings are natural archives

Tree is a **recorder,** a **biological databank** that records and stores the information from the environment. Knowing the growing processes and how trees react to the different ecological factors we should be able to read and understand these information.

Natural archives

TABLE 1.2 Characteristics of Natural Archives

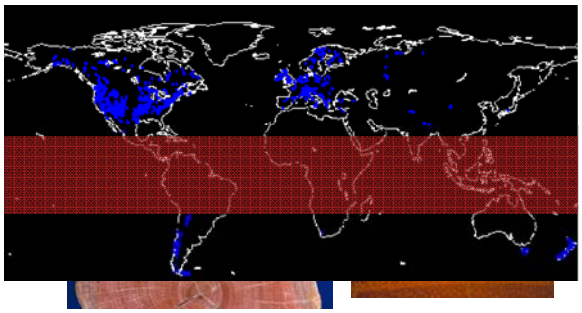
Archive	Minimum sampling interval	Temporal range (order; yr)	Potential information derived
Historical records	day/hr	$\sim 10^3$	T, P, B, V, M, L, S
Tree rings	yr/season	$\sim 10^4$	T, P, B, V, M, S
Lake sediments	yr (varves) to 20 yr	$\sim 10^4$–10^6	T, B, M, P, V, C_w
Corals	yr	$\sim 10^4$	C_w, L, T, P
Ice cores	yr	$\sim 5 \times 10^5$	T, P, C_a, B, V, M, S
Pollen	20 yr	$\sim 10^5$	T, P, B
Speleothems	100	$\sim 5 \times 10^5$	C_w, T, P
Paleosols	100 yr	$\sim 10^6$	T, P, B
Loess	100 yr	$\sim 10^6$	P, B, M
Geomorphic features	100 yr	$\sim 10^6$	T, P, V, L, P
Marine sediments	500 yr*	$\sim 10^7$	T, C_w, B, M, L, P

T = temperature
P = precipitation, humidity, or water balance (P-E)
C = chemical composition of air (C_a) or water (C_w)
B = information on biomass and vegetation patterns
V = volcanic eruptions
M = geomagnetic field variations
L = sea level
S = solar activity

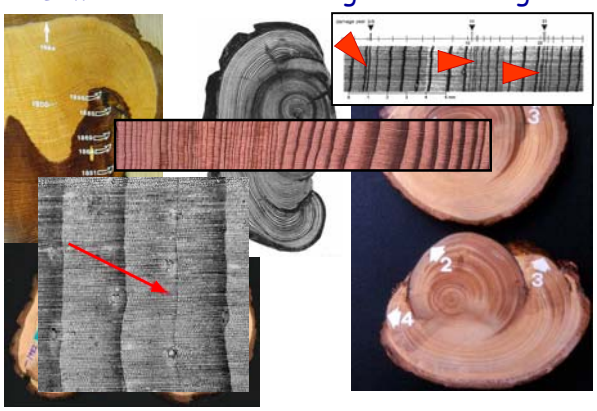
After Bradley and Eddy (1991).
* In rare circumstances (varved sediments) ≤10 yr.

0 954 929 256 9 8

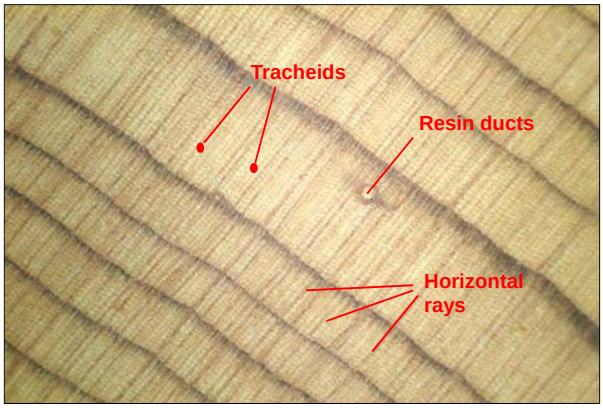
Basic condition



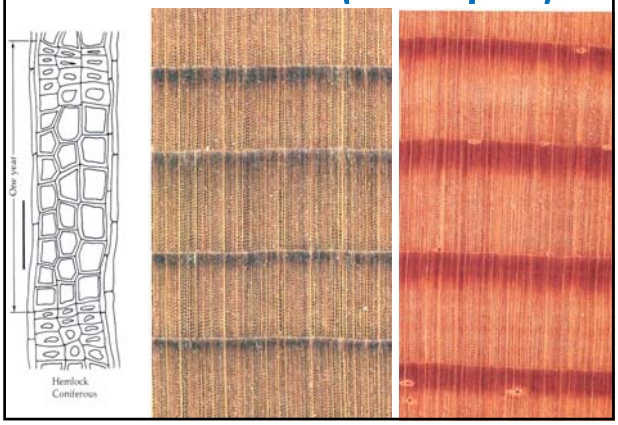
Limits and troubles using the tree rings



Conifers: radial files of cells (for most species)



Conifers: radial files of cells (for most species)



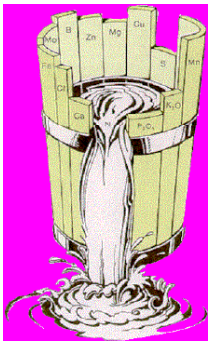
Basic Principles and Concepts of Dendrochronology

- ❑ The Uniformitarian Principle
- ❑ Principle of Limiting Factor
- ❑ Concept of Ecological Amplitude
- ❑ Site and species selection
- ❑ Sensitivity
- ❑ Principle of Repetition
- ❑ Cross Dating
- ❑ Standardization
- ❑ Modeling growth- environmental relationships and
- ❑ Calibration & Verification

(Fritts 1976)

The Principle of Limiting Factors

- Basic principle in biology
- Tree growth can proceed only as fast as allowed by the primary environmental and physiological mechanisms that restrict growth.
- Sometimes, more than one mechanism operates to restrict growth.
- The limiting factor(s) varies in space and time → variable tree growth! It/they must affect many trees together.

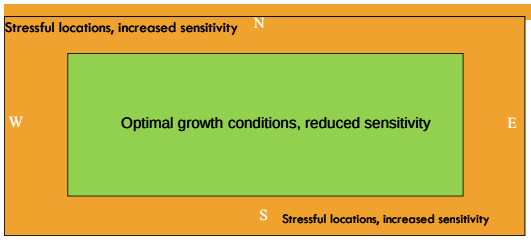


The Uniformitarian Principle

- This principle states that physical and biological processes that link current environmental processes with current patterns of tree growth must have been in operation in the past.
- "The present is the key to the past" (Hutton 1785).
- Illustrates the "trajectory of science," past, present, and future:
  - A. Study processes as they occur at present
  - B. Improved understanding comes from the past
  - C. Extrapolate/predict the future = applied!

James Hutton
(1740-1820)

The Principle of Ecological Amplitude

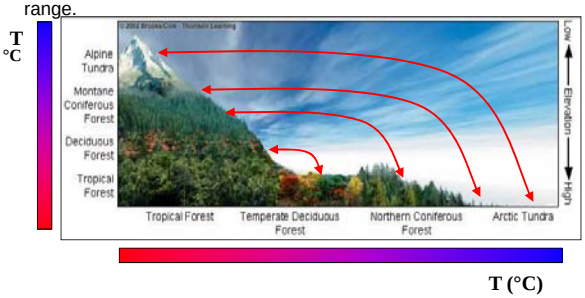


- ❑ A tree species will be more responsive and sensitive to changes in environmental conditions in the outer limits of its range.
- ❑ This limit could be either latitudinal or longitudinal

The Principle of Ecological Amplitude

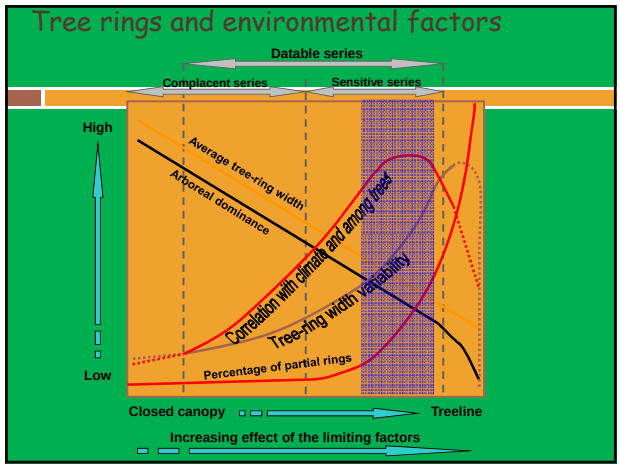
A tree species will be more responsive and sensitive to changes in environmental conditions in the outer limits of its range.

This limit could also be elevational



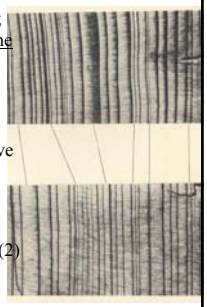
Principle of Site and Trees Selection

Tree rings and environmental factors

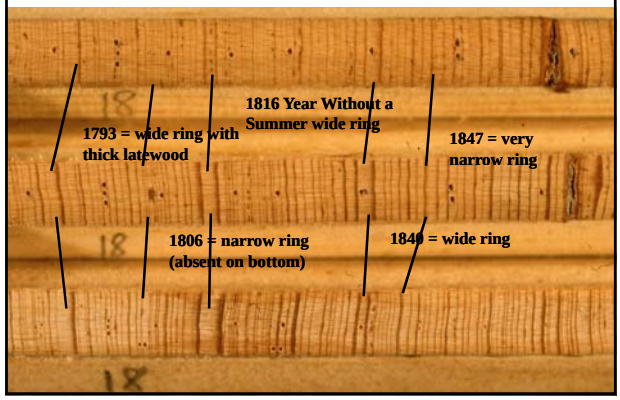


The Principle of Crossdating

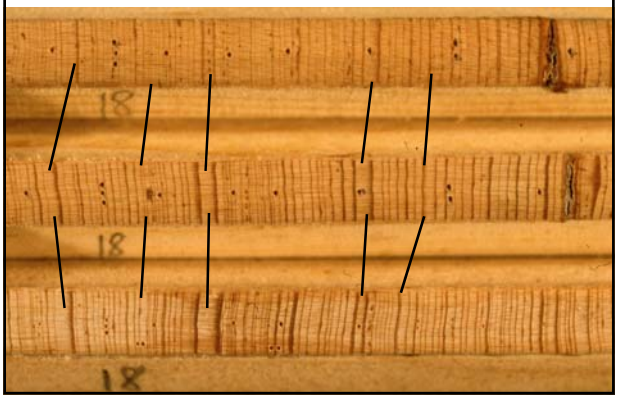
- Matching patterns in ring widths or other ring characteristics (such as ring density patterns) among several tree-ring series allows the identification of the exact year in which each tree ring was formed.
- Both a principle and a technique. Without either, dendrochronology is unscientific ring-counting.
- The Principle of Crossdating concerns why trees have the same ring patterns.
- The Technique of Crossdating concerns how we can use this property to (1) ensure we have precisely assigned the correct calendar year to each tree ring, (2) at the same time, account for those problem rings, such as false or locally absent rings and (3) extend a tree-ring series back in time.



These three cores (taken from three trees growing in El Malpais National Monument in New Mexico) have ring patterns in common. For example…

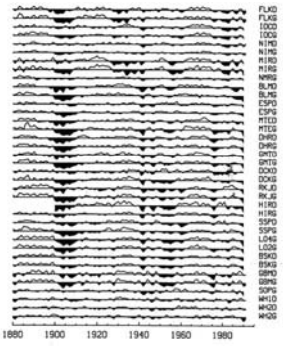


Notice that crossdating uses both wide rings and narrow rings, although the narrow rings are (for some reason) easier to visually key in on.

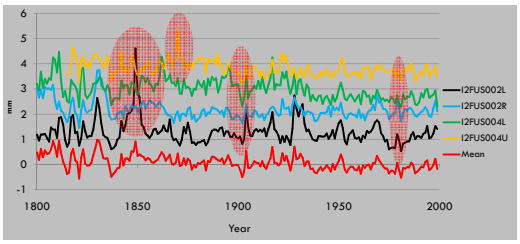


The Principle of Replication

- The environmental signal being investigated can be maximized (and the amount of noise minimized) by sampling more than one stem radius per tree and more than one tree per site.
- Obtaining more than one increment core per tree reduces the amount of "intra-tree variability" = the amount of undesirable environmental signal peculiar to only that tree.
- Obtaining numerous trees from one site (and perhaps several sites in a region) ensures that the amount of "noise" is minimized.



The Principle of Replication

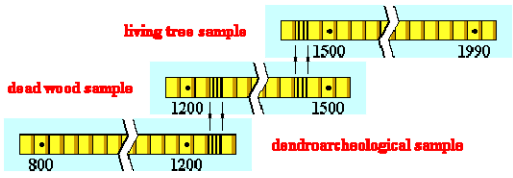


Crossdating to extend tree-ring series

- Crossdating can also be used to extend a chronology back in time by overlapping older and older samples.

How to build a chronology

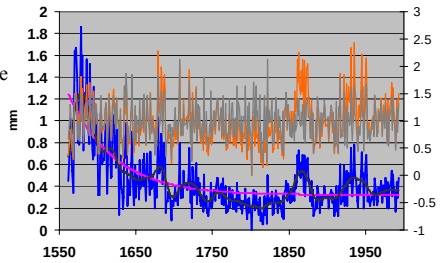
1. Crossdating (skeleton plot) – US way
2. Measuring
3. Crossdating (Alignment plot) – EU way
4. Measurement checking
5. Series selection and chronology computation
6. Standardizing, indexing, modeling



Standardization

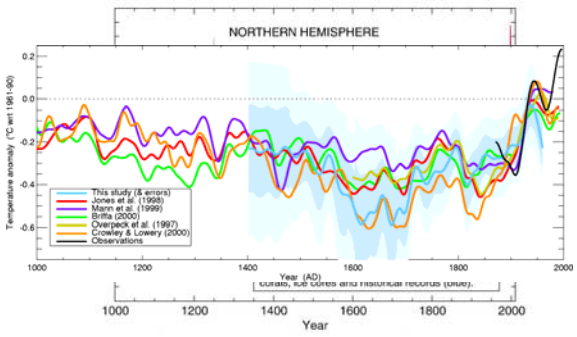
The original values are tranformed into adimensional indeces.

Regressions
Moving average
Filtering
Spline
Differencing
….



This process simultaneously removes the growth trend and stabilizes the variance such that the mean and variance of the tree-ring indices no longer systematically change with time

Climate reconstructions and future trends



The Principle of Aggregate Tree Growth

This principle states that any individual tree-growth series can be "decomposed" into an aggregate of environmental factors, both human and natural, that affected the patterns of tree growth over time.

$$R_t = A_t + C_t + \delta D1_t + \delta D2_t + E_t$$

The Principle of Aggregate Tree Growth

$$R_t = A_t + C_t + \delta D1_t + \delta D2_t + E_t$$

$N_t+CA_t+EO_t+E_t$

- R_t : observed ring parameter for year t (e.g. width, density, chemistry)
- A_t : age (size) related growth trend
- C_t : growth related to climate
- $D1_t$: endogenous disturbance pulse (related to tree dynamics; e.g. branch loss, dwarf mistletoe infestation)
- $D2_t$: exogenous disturbance pulse (related to stand dynamics; e.g. fire, western spruce budworm defoliation)
- E_t : error variance (e.g. genetic variability)
- N_t : annual variability in nutrient availability
- CA_t : annual variability in carbon allocation within a tree (e.g. masting)
- EO_t : errors made by the operator

The Principle of Aggregate Tree Growth

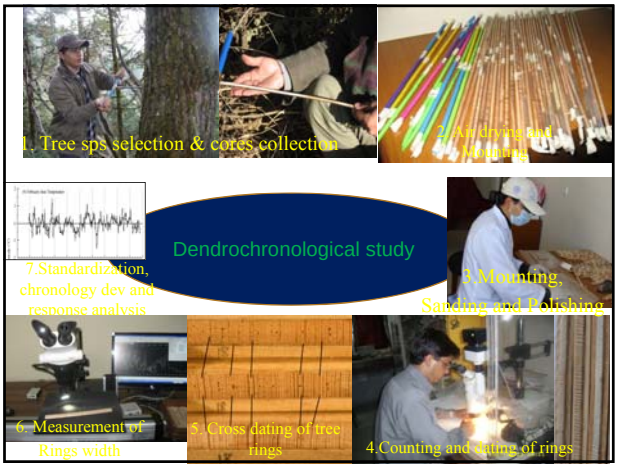
Tree growth can be "decomposed" into five basic parts:

$$R_t = A_t + C_t + \delta D1_t + \delta D2_t + E_t$$

- Only ONE can be the desired signal. All OTHERS constitute noise. We wish to maximize the signal to noise (S/N) ratio.
- For example, if climate is our desired signal, we must (1) sample to ensure no other noise affects tree growth in our study area, and (2) mathematically remove the effects of other parts.

Flow chart of steps of Dendrochronological study

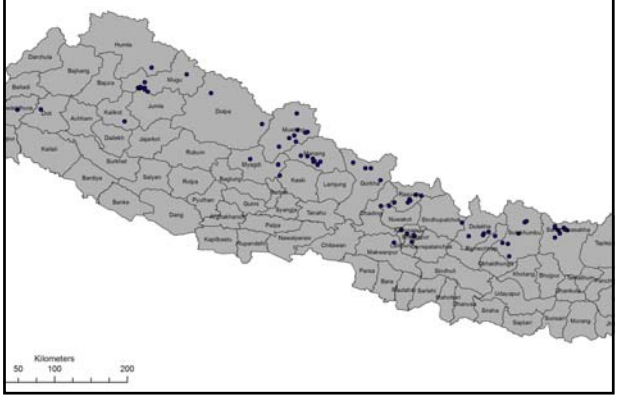
1. Field visit and sample collection
2. Processing of the samples (Mounting, sanding, polishing)
3. Counting and Dating
4. Measurement
5. Cross dating- alignment plotting, math graphs
6. Error checking - COFECHA
7. Standardization and Chronology dev- ARSTAN
8. Climate- growth(Response- function) analysis
9. Dendroclimatic reconstruction



Scope of Dendrochronology

- Dendroclimatology- reconstruction of past climate
- Dendroecology- ecological processes, events eg- demography, productivity, diseases, forest fires,etc.
- Dendroarchaeology
- Dendrohydrology
- Dendrogeomorphology,
- Dendrochemistry
- Dendroglaciology,etc.

Spatial coverage of tree ring studies in Nepal




THANK
YOU

CLIMATE CHANGE SCENARIO IN NEPAL

Training on Research Methodology and Statistical Tools in Climate Change Study

March 25-30, 2012
NAST-NCCKMC

CLIMATE CHANGE

Statistical significant variation

- in the mean state of the climate
- in its variability

CAUSES

- Natural internal process
- External forcings
- Persistence anthropogenic changes

Climate Change

"A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."

(UNFCCC)

Greenhouse effect

Greenhouse gases

- Water vapor
- Carbondioxide
- Methane
- Nitrous oxide
- Chloroflurocarbons, etc.

- **Weather** consists of those meteorological events, such as rain, wind, and sunshine that can change day by day, even hour by hour.
- **Climate** is the average of all these events over a period of time, like a year or several years.

OBSERVATIONS

- Twelve of the last thirteen years (1995-2007) rank among the warmest years since 1850. The years 1998, 2005, and 2007 were the warmest on the record.
- Eighteen heat waves were reported in India between 1980 and 1998. A heat wave in 1988 caused 1300 deaths, while another one in 2003 caused more than 3000.

- In 2006, Bhutan reported loss of life from more frequent flash floods and landslides due to melting of glaciers.
- The glaciers in the Himalayas, the "water Towers of Asia", are melting rapidly. They are receding at an average of 10-50 meters per year. The Himalayas contribute crucially to the water supply of 1.3 billion people, feeding into nine of Asia's greatest rivers.
- The Sunderbans in Bangladesh and in India face threats from the rise in sea-level.

Warmest Years in Series

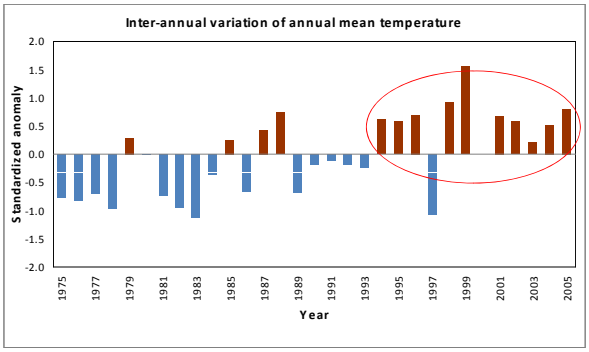
Global

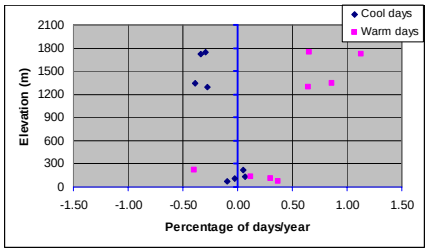
S. No.	Year	Anomaly (°C)
1	1998	0.52
2	2005	0.48
3	2003	0.46
4	2002	0.46
5	2004	0.43
6	2006	0.42
7	2001	0.40
8	1997	0.36
9	1995	0.28
10	1999	0.26
11	1990	0.25
12	2000	0.24
13	1991	0.20
14	1983	0.19
15	1987	0.17
16	1988	0.16
17	1994	0.16
18	1981	0.13
19	1996	0.12
20	1980	0.10

Nepal

S. No.	Year	Temp. (°C)	Anomaly (°C)
1	1999	20.7	0.7
2	2005	20.6	0.6
3	1998	20.5	0.5
4	1987	20.5	0.5
5	1996	20.4	0.5
6	1994	20.4	0.5
7	2003	20.4	0.5
8	1995	20.4	0.4
9	2004	20.3	0.4
10	2001	20.3	0.3
11	2002	20.2	0.2
12	1988	20.2	0.2
13	2000	20.1	0.2
14	1991	20.0	0.0
15	1979	20.0	0.0
16	1980	20.0	0.0
17	1990	20.0	0.0
18	1993	19.9	0.0
19	1985	19.9	-0.1
20	1992	19.8	-0.1
21	1984	19.8	-0.2
22	1986	19.8	-0.2
23	1989	19.7	-0.2
24	1978	19.7	-0.3
25	1997	19.7	-0.3
26	1982	19.5	-0.5
27	1983	19.4	-0.5
28	1977	19.4	-0.6
29	1976	19.2	-0.7
30	1981	19.0	-0.9
31	1975	18.9	-1.0

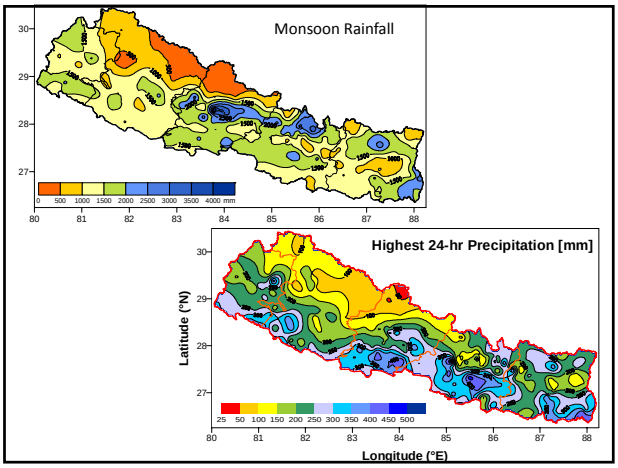
Temperature variation





Cool days = Percentage of days when TX<10th percentile

Warm days = Percentage of days when TX>90th percentile



Major Weather Systems

- Northern limit Of the Tropics.
- Southern lap of the Himalayas
- Mountainous country
- Topographically complex
- Affected by monsoon In summer and western disturbances in winter

CLIMATE PROJECTIONS and SCENARIOS

CLIMATE PROJECTIONS

Projection of the response of the climate system

-emission of GHGs

-aerosols

-assumptions of future socioeconomic and technological development (uncertainity)

- **CLIMATE SCENARIO**: A plausible and often simplified representation of the future climate.
- **CLIMATE CHANGE SCENARIO?**

EMISSION SCENARIOS

A1

The A1 storyline and scenario family describes a future world of rapid economic growth, global population that peak in mid-century and declines thereafter, and a rapid introduction of new and more efficient technologies.

Three groups of A1(Technological emphasis)

- **A1F1**: fossil-intensive
- **A1T**: non-fossil energy sources
- **A1B**: a balance across all sources

A2

The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

B1

The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures towards a service and information economy, with reduction in material intensity and the introduction of clean and resource-efficieeint technologies.

B2

The B2 storyline and scenario family describes a world in which the emphasis is on local solutions in economic and social and environmental sustainability. It is a world with continuously increasing population, at a lower rate than A2, intermediate levels of economic development, and more diverse technological change than in B1 and A1 storylines.

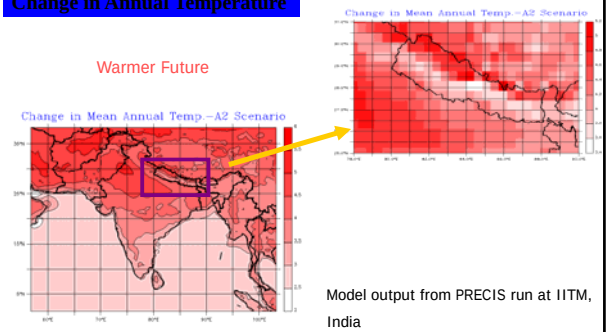
CLIMATE CHANGE SCENARIOS

PRECIS
REGCM

Climate Change Projection- Late 21st Century

Change in Annual Temperature

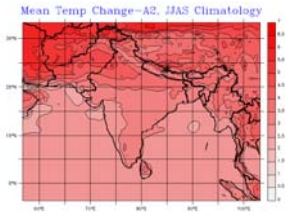
Warmer Future



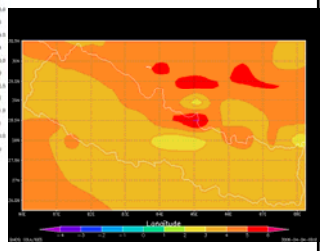
Model output from PRECIS run at IITM, India

Climate Change Projection- Late 21st Century

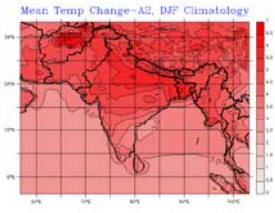
Change in Seasonal Temperature



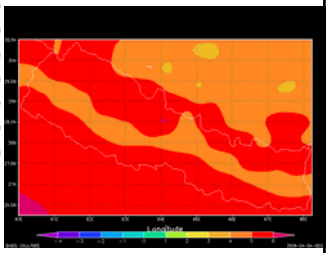
Warm Summer



- 2º to 4º C increase in temperature
- 5º C increase only in some small places in the north



Warmer Winter

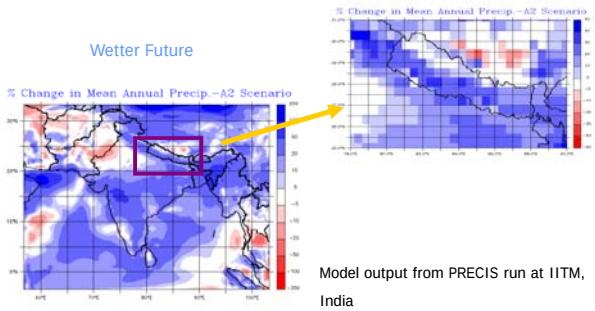


- 3º to 5º C increase in temperature
- Warming is more pronounced in winter

Climate Change Projection- Late 21st Century

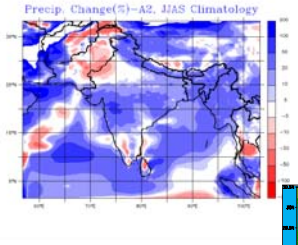
Change in Annual Rainfall

Wetter Future

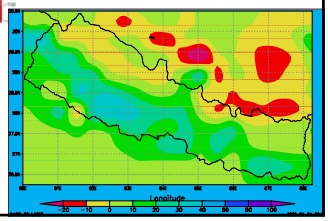


Model output from PRECIS run at IITM, India

Climate Change Projection- Late 21st Century

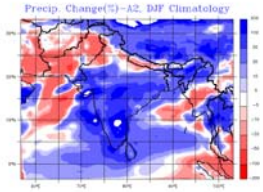


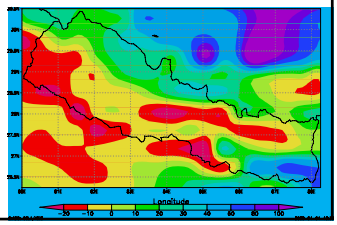
Change in Seasonal Rainfall



Wetter Summer

Drier Winter

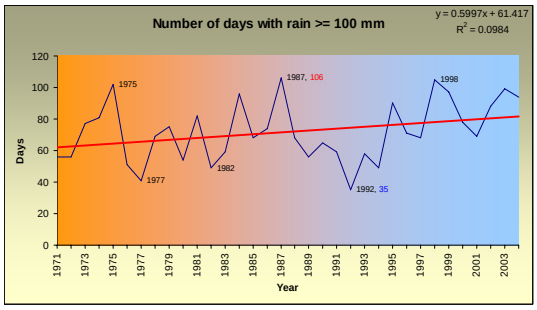




Have a nice field trip
and
Wish you all the best

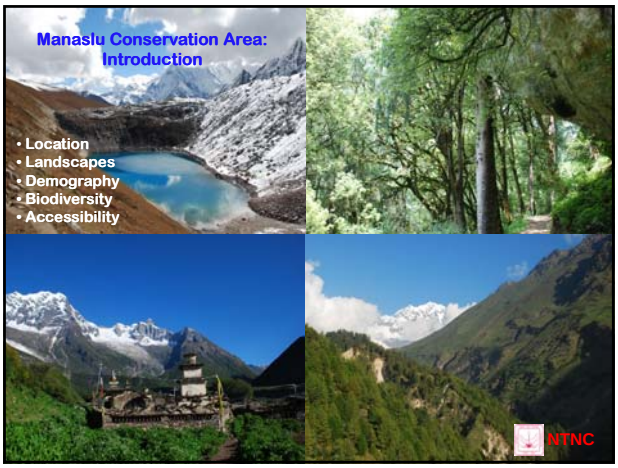
This is just a beginning

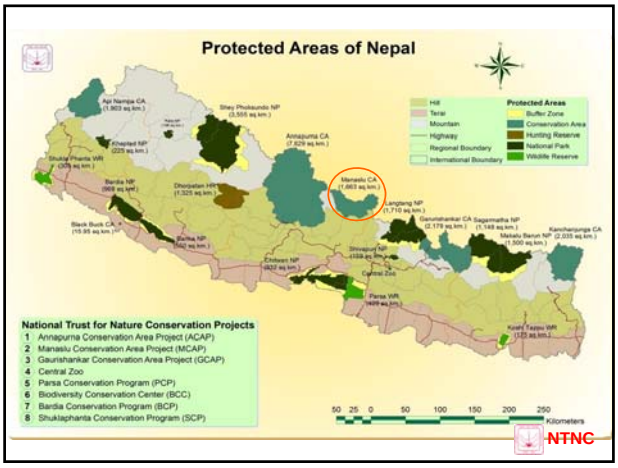
Rainfall Extremes ……

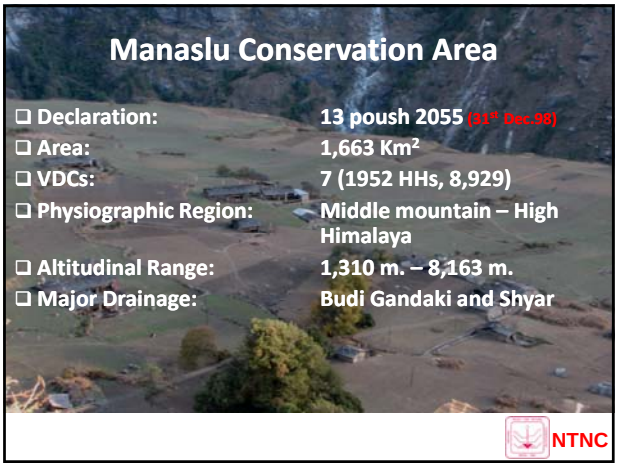


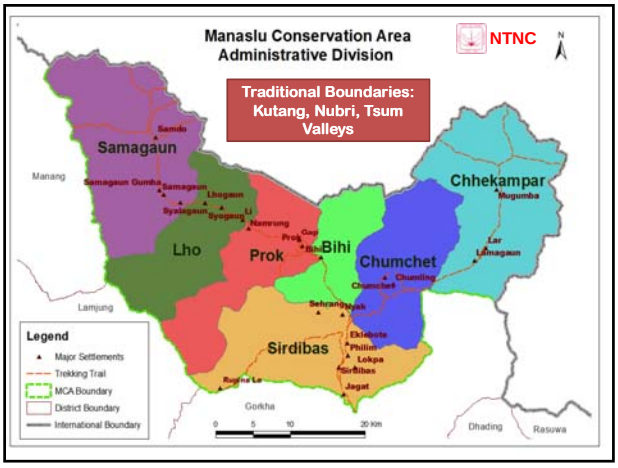
Increase in number of heavy rainfall events (> 100 mm/day)


National Trust For Nature Conservation
Manaslu Conservation Area
Madhu Chetri


Manaslu Conservation Area: Introduction
• Location
• Landscapes
• Demography
• Biodiversity
• Accessibility
NTNC


Protected Areas of Nepal
National Trust for Nature Conservation Projects
1 Annapurna Conservation Area Project (ACAP)
2 Manaslu Conservation Area Project (MCAP)
3 Gaurishankar Conservation Area Project (GCAP)
4 Central Zoo
5 Parsa Conservation Program (PCP)
6 Biodiversity Conservation Center (BCC)
7 Bardia Conservation Program (BCP)
8 Shuklaphanta Conservation Program (SCP)
Kilometers
NTNC


Manaslu Conservation Area
Declaration: 13 poush 2055 (31st Dec.98)
Area: 1,663 Km²
VDCs: 7 (1952 HHs, 8,929)
Physiographic Region: Middle mountain – High Himalaya
Altitudinal Range: 1,310 m. – 8,163 m.
Major Drainage: Budi Gandaki and Shyar
NTNC


Manaslu Conservation Area
Administrative Division
NTNC
Traditional Boundaries: Kutang, Nubri, Tsum Valleys
Samagaun
Chhekampar
Lho
Prok
Bihi
Chumchet
Sirdibas
Manang
Lamjung
Gorkha
Dhading
Rasuwa
Legend
Major Settlements
Trekking Trail
MCA Boundary
District Boundary
International Boundary


NTNC
Kutang Valley
Philim
Nyak village
Google earth


NTNC
Nubri Valley
Google earth


NTNC
Tsum Valley
Google earth


Mt. Manaslu 8163m
NTNC


Kutang Valley-Landscape
NTNC


Nubri Valley-Landscape
NTNC


Nubri Valley-Landscape
NTNC

Households and Population in MCA (2007/08)

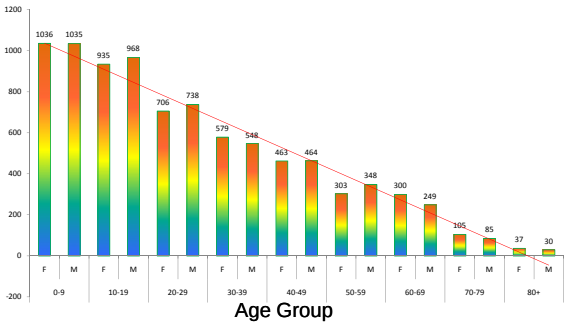
VDCs	HHs		Population			Average HH Size	Population Density (number/sqkm)
	No	%	Male	Female	Total		
Sirdibas	559	28.6	1377	1408	2785	5.0	8.8
Bihi	205	10.5	363	391	754	3.7	6.3
Prok	207	10.6	417	421	838	4.0	5.8
Lho	229	11.7	525	506	1031	4.5	5.0
Sama	166	8.5	352	385	737	4.4	2.2
Chumchet	268	13.7	603	536	1139	4.3	5.0
Chhekampar	318	16.3	828	817	1645	5.2	5.2
Total	1952	100.0	4465	4464	8929	4.6	5.4

VDCs	Change in HHs	Change in Population			Change in Population (%)
	Number	Male	Female	Total	
Sirdibas	75	171	261	432	18.4
Bihi	11	-53	-28	-81	-9.7
Prok	-14	106	45	151	22.0
Lho	3	114	76	190	22.6
Sama	-21	43	44	87	13.4
Chumchet	6	105	27	132	13.1
Chhekampar	56	280	169	449	37.5
Total	116	766	594	1360	18.0

CBS, 2001

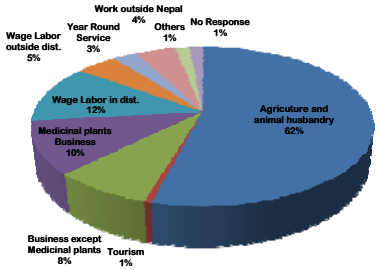
NTNC

Population Age Structure

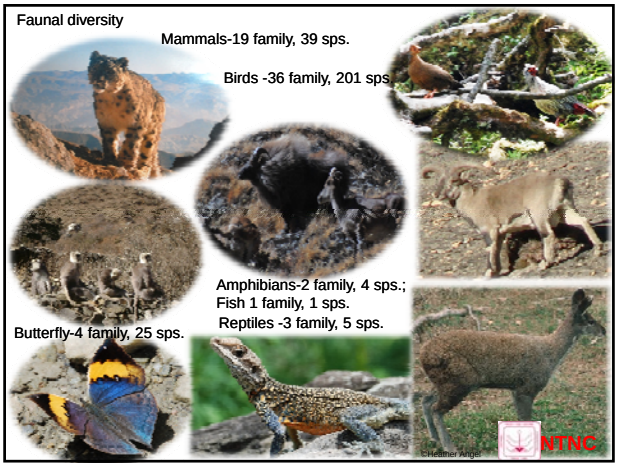


NTNC

- Gurung and Karki are the major ethnic groups in Sirdibas VDC with three households of Ghales. Except Sirdibas, major ethnic group in all VDCs are Bhotia (also known as Lama). In Namrung village of Prok VDC, there are 7 households of Thakali who migrated from Mustang District a few generations ago. There is one Kami household in Samagaon VDC.



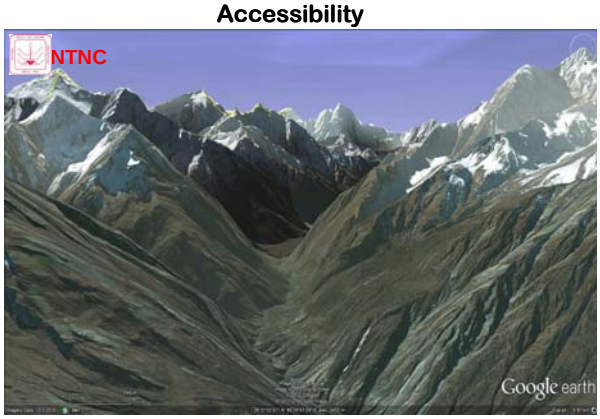
Faunal diversity



Floral Diversity: 756 species recorded so far

Angiosperms - 115 family, 696 species (Dicot family-102, 589 species, Monocot family 13, 107 species); Gymnosperms- 4 family, 13 species, Pteridophytes 18 family, 37 species, Lichen-2 family, 3 species; Mycophyta 2 family, 7 species

Accessibility



- Kathmandu-Gorkha Bazaar-Arughat
- Kathmandu-Dhanding Bensi-Arughat
- Arughat-Macchakhola
- Macchakhola-Jagat (entry point to MCA)
- Jagat-Philim
- Philim-Lokpa-Chumling
- Chumling to Chhekampar
- Philim-Gampul-Deng
- Deng-Namrung
- Namrung-Lho-Sama

NTNC