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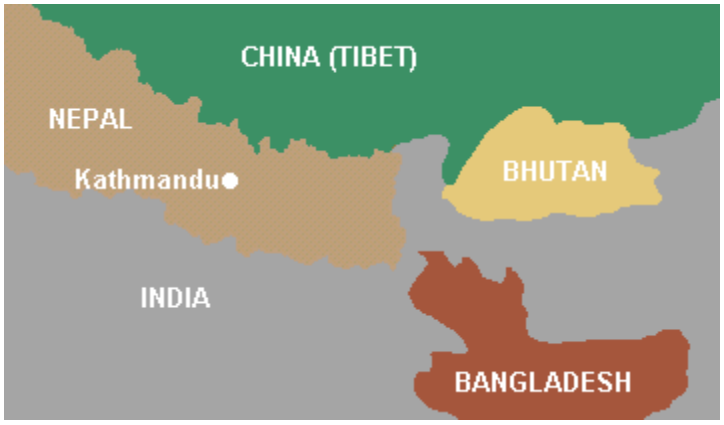
Our Goal

The goal of the watershed project is to conduct research on key natural resource management issues to help improve the livelihood of the local people and to maintain the integrity of resources for future generations. The focus is on community based natural resource management with full participation of farmers.

Location of Bhutan



Major Issues

- Drinking and irrigation water shortages
- Declining forest resources
- Low crop yield
- Crop diversification
- Soil fertility concerns
- Rehabilitation of degraded land
- Improve livelihood

Team

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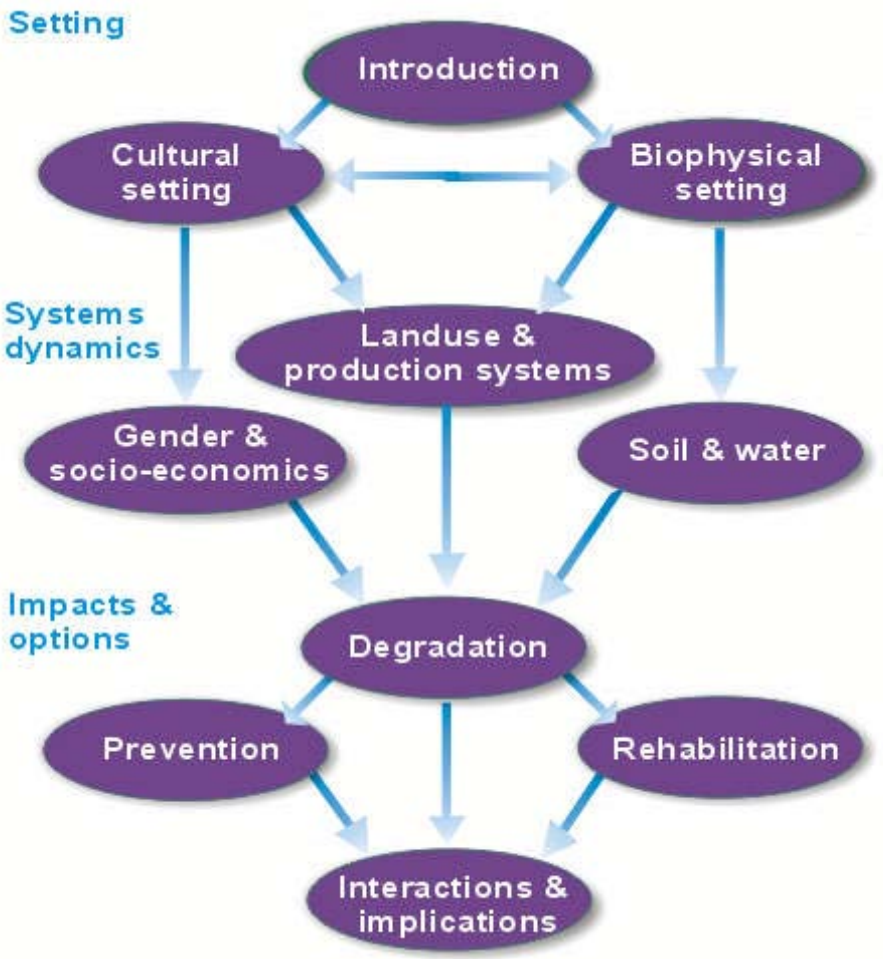
Aims of The Research

The watershed serves as a training ground for integrated resource management with full community involvement. Specifically:

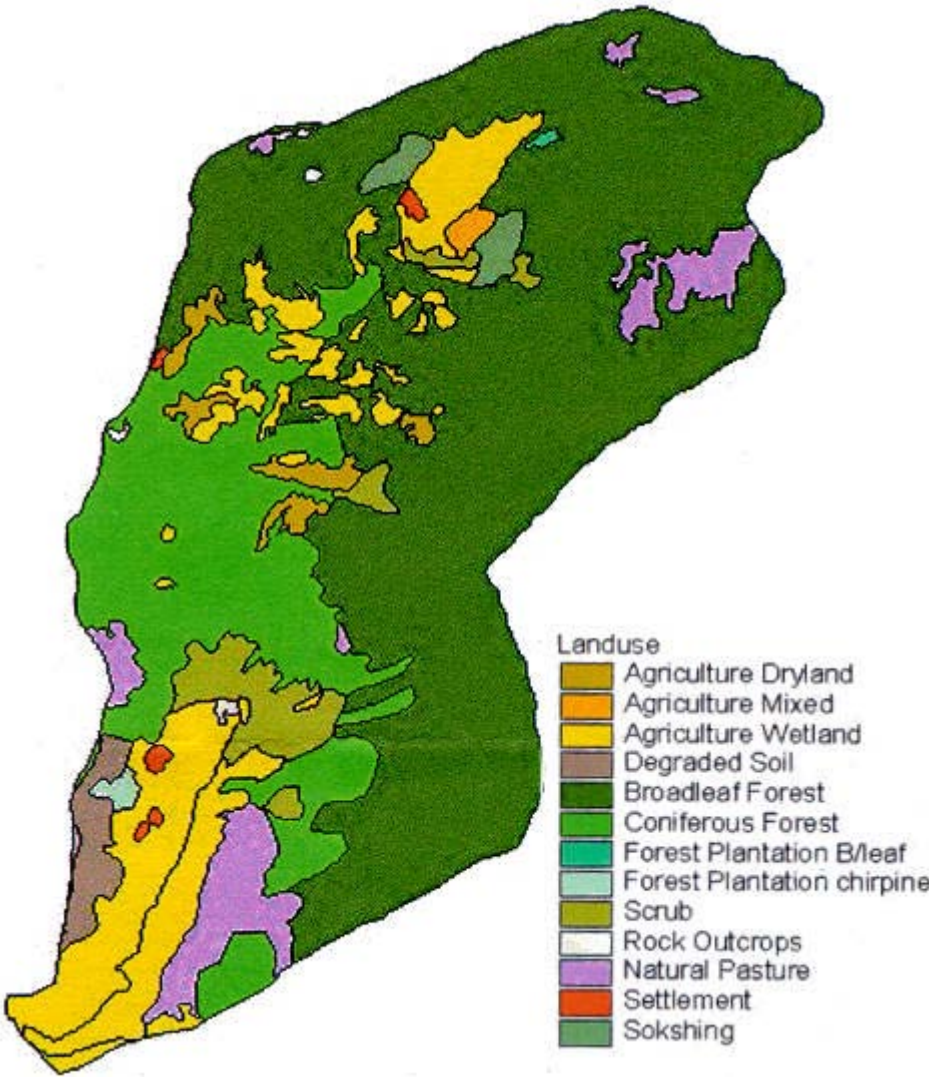
1. Water Resources: Evaluate the water resources and their use in a way that all residents have equitable access and that shortages and pollution are minimized. This includes determining a water balance as well as evaluating irrigation efficiency and water distribution systems.
2. Crop Livestock Interactions: Improve the use of crop residue (rice straw) and fodder trees.
3. Nutrient Management: Establish baseline nutrient status under different land use systems and examine nutrient balances on farms with different rotations and management approaches.
4. Agroforest and Community Forests: Understand community needs for forest products and initiate agro-forestry research on degraded lands using a community based management approach.
5. Crop Management: Examine ways to improve crop production with an emphasis on disease risk reduction and home-garden improvement.
6. Resource Mapping and Social Analyses: Gain a better understanding on improving the effectiveness of local institutions and establish community resource use maps. Social analyses are to be linked to the natural resource base. The dynamics of this interaction are then related to resource degradation.


Lingmutey Chhu: Bhutan
Watershed Project

Approach


Setting
Introduction
Cultural setting
Biophysical setting
Systems dynamics
Landuse & production systems
Gender & socio-economics
Soil & water
Impacts & options
Degradation
Prevention
Rehabilitation
Interactions & implications

Existing Land Use Map



Forestry

As forest resources near settlement areas become scarce and exhausted, access to villages becomes more and more difficult. Farmers must travel long distances to obtain forest materials.

Horticulture

To demonstrate the possibility of producing vegetables all year round and to improve family nutrition, model kitchen gardens were established with interested farmers.

In addition, farmers were introduced to improved technologies such as portable plastic greenhouses for growing out of season vegetables and fruits throughout the year. Construction techniques were also demonstrated.

Agriculture

Rice is the main staple crop with many different varieties and purposes. Local varieties are tall and low yielding leading to an introduction of medium tall, high yielding, varieties.

Livestock

Winter fodder shortage is one of the primary constraints for livestock rearing communities. Farmers established a community pasture plot of grass- legume mixture to feed their cattle during the dry periods.

Nurseries

Community nurseries were established in order to rehabilitate degraded areas and eventually generate income through the sale of seedlings (forestry/fruit trees).
The members of the Community Forestry Management Group are actively involved in planting tree seedlings in degraded areas.

Replanting

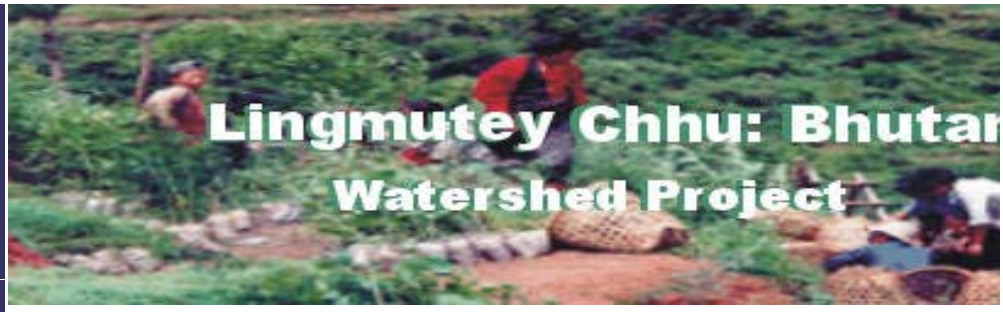
Heavy grazing pressure from livestock often results in bare areas prone to erosion and gulley formation. Seedling plantation has proven effective in such areas.

The succession of seedling growth over a three year period displays increased ground cover

Gully Stabilization

Vegetative stabilization of gullies, formed by distributory irrigation channels running down slopes, is carried out using a locally available tree species, such as *Erythrina indica*. Check dams are built across gullies and grasses are planted on gully slopes to stabilize the beds.

Where soil is highly prone to erosion and stabilization and natural recovery of vegetation is not possible, pipes are placed at the bottom of the gully and covered with soil. A series of vegetative check dams are also built.



Soil Resource Management

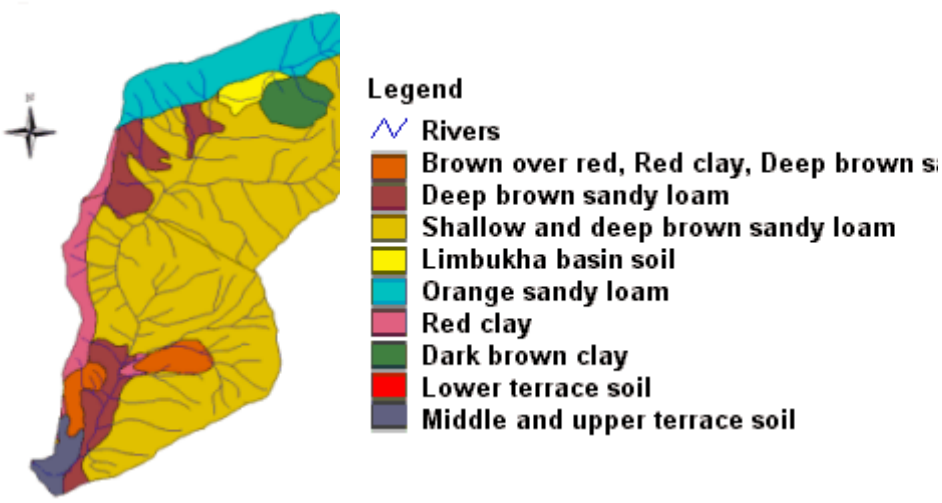
Soil fertility is a fundamental resource for farming households and a central component of the farming system. It determines the amount of crops that can be grown and the amount of work required to produce enough crops to derive a livelihood from agricultural production.The sustainability of soil fertility management depends on the profitability of the household which in turn determines the additional soil fertility input.
Many rice fields in the watershed suffer from nutrient deficiency. Farmyard manure (FYM) is the preferred natural fertilizer but is often in shortage. Artificial fertilizers are used to increase or maintain crop yield. There is a serious imbalance in supply of soil nutrients through the use of fertilizers. Balance fertilizer trials were conducted and results were encouraging. A modified Farmer Fields School was established with major emphasis on balance fertilizer use on crops with the aim to add sustainability on a village, rather than an individual, level.

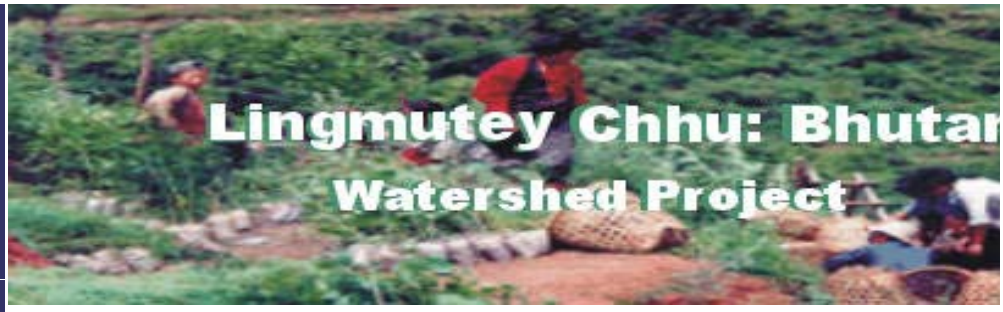
Erosion Control

Pressure on forest resources by users and cattle caused the erosion of topsoil, which led to the formation large gullies.

Success stories about maize trash-line in reducing surface soil erosion were discussed with farmers. Farmers welcomed the idea and took initiatives. Height of the bund riser behind the maize trash-line was 0.5m after two maize harvest seasons. Maize trash-line along the contour lines was observed to not be very stable/strong. Planting of hedgerow legume shrubs along trash-lines in slopping upland fields to reduce erosion of topsoil has proven effective.

Watershed Soil Map





Geographical Boundary

The catchment area of the Lingmutey Chhu Watershed is 34 square km . The watershed line at the top of the region is defined by the Antakarchung and Darchula ranges. The Lingmutey Chhu or Limtichhu is the stream which drains the Lingmutey Chhu Watershed. It originates at about 2400 m below the Antakarchung range as a spring out of a rock face. It is joined by the Shenzarongchhu downstream which originates in the Darchula range.

Hydrology

The stream flows in a south-west direction and drains into the Puna Tsangchhu. It drops from 2400 m to 1200 m over a length of 11 km giving an average gradient of about 1:10. It is not fed by a perennial snowfield and therefore depends on rainfall for its flow. The base flow is

at a minimum during the months of April and May and increases during the rainy season. Though there is a steady base flow of about 30-40 l/s, the peak flow after a widespread rainfall can be as high as 10001/s making the stream ephemeral. Due to the steep gradient of the watershed, rainfall-runoff response is quick. The sediment load is quite high, especially for flow generated after a heavy pre monsoon rain. The erosion regions in the watershed are concentrated in degraded red soil areas. This is evident from the spectacular red tinge given to the water as the stream joins the Puna Tsangchhu.

Water Usage and Agricultural Setting

Farmers use water primarily for growing paddy, the most important crop. Paddy is transplanted in June-July and harvested by the end of October. The winter crops grown in the watershed are wheat, mustard, buck wheat, potato and leafy vegetables. Irrigation of these watershed crops are limited to pre-sowing flooding, to ensure good germination, and a couple of times at various stages of the crops. Water shortage for winter irrigation is not a concern at present as winter crops are not grown on paddy land and do not require as much water as paddy.

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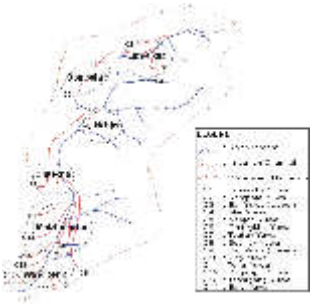
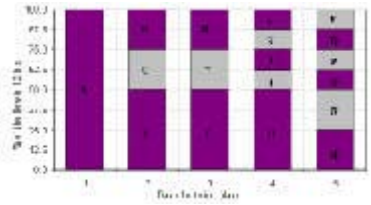
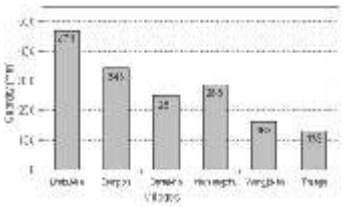


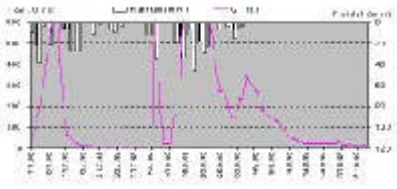
Watershed Map



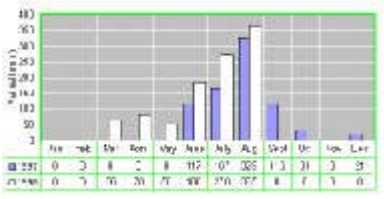
Water Sharing



Water Use



Baseflow Rate of Lingmutey Chhu River



Rainfall at Dompola

Gender and Social Economics

Major Factors

The major factors that shape current agricultural change in Bhutan are labour scarcity, advances in technology and increased urbanization and integration in local and regional markets.

Status of Women

Women are directly involved in managerial decision-making and provision of labour for Bhutan's rice farming systems. Women are, by tradition, the heads of the households, with the exception of those in Southern Bhutan. As such, women have a major role in household decision-making related to farming practices, although little has been documented on this subject.

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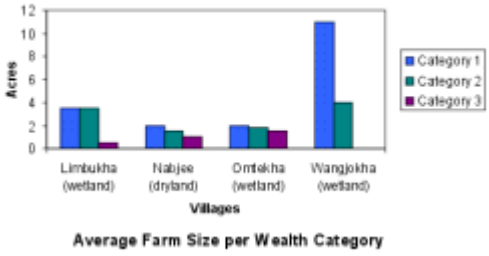
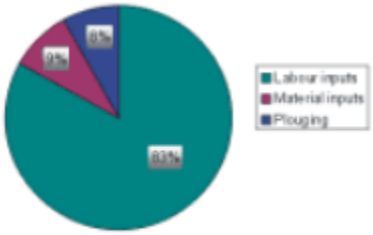
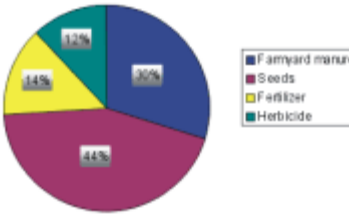


Land Distribution



Proportion of total rice production costs Dompola-Wanjokha,1998

Economics of Rice

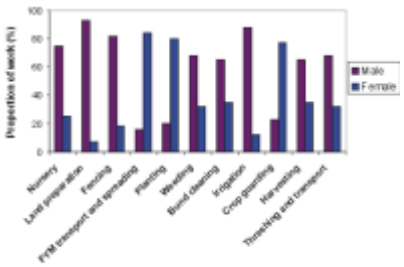


Proportion of total material inputs required for rice production Dompola-Wangjokha, 1998

Material Inputs

Proportion of total labour input for rice production Dompola-Wangjokha, 1998

Labour Inputs



Proportion of labour activities for rice production Dompola-Wangjokha,1998

Labour Activities by Gender

Contacts

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Sponsors

IDRC: International Development Research Centre

SDC: Swiss Agency for Development and Cooperation, Bern, Switzerland

Collaborators:

IRRI: International Rice Research Institute, Philippines

IRE: Institute for Resources and Environment, University of British Columbia, Canada