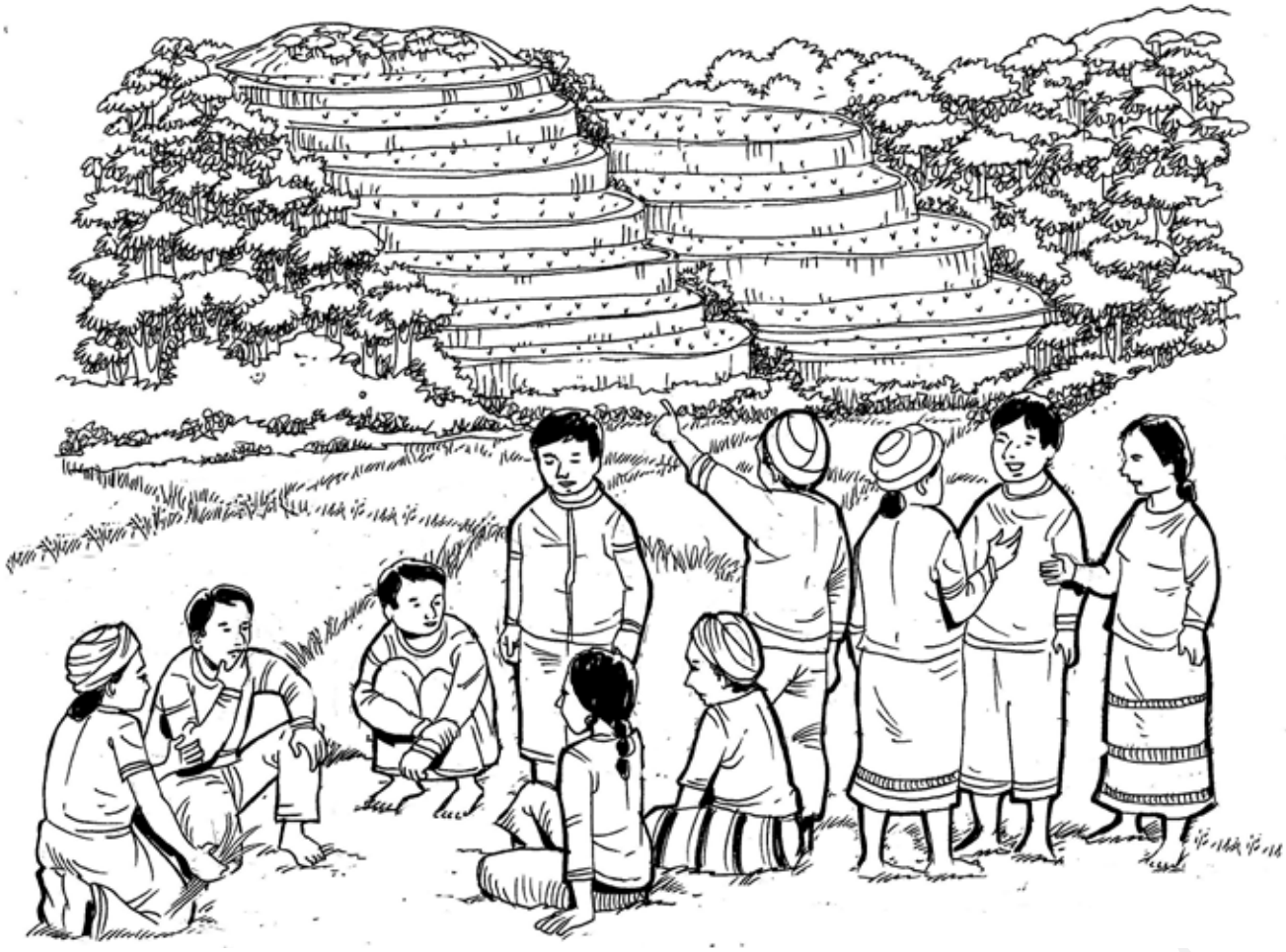
Methodologies for Characterizing Biophysical Resource Systems in Upland Lao PDR



The upland communities of Lao PDR are typically composed of marginalized people living in severe poverty and are food insecure (WB 1995, ADB 2001). They devote most of their economic and biophysical resources to growing rice, the country's staple crop (Pandey *et al.,* 2002). Paddy rice is grown on bunded terraces in the valleys, while upland rice and some cash crops are grown under shifting cultivation systems on the steeper slopes. Increasing population drives agricultural intensification in the upland communities resulting to the degradation of agricultural resources through soil erosion, loss of water supply, and reduction of primary forest cover, which in turn caused drastic reduction in fallow periods (Schoeneberger *et al.,* 1998, Graeme and Lefroy 1999). This vicious cycle continues, depleting resources and making the community poorer and more food insecure.

Poverty assessments for the uplands of Lao PDR identified strong correlations between rice

sufficiency and food security. This led the CGIAR Challenge Program on Water and Food (CPWF) Upper Catchment Rice Landscape Project partners to examine the productivity of the region's upland rice and wetland rice agroecosystems, as well as the productivity and availability of water on which these ecosystems depend. Significant spatio-temporal interactions between rice production, water, land use and other biophysical resources necessitate an approach that places agronomic alternatives in the context of the overall landscape and that enables linkages to socio-economic factors.

The project contributed to a platform of spatial modeling tools by linking spatial and watershed hydrology software into a coherent framework, satisfying the need for a system-level approach. The platform has the collective capability to simulate and analyze key upland biophysical processes on a sub-catchment scale. It enables analysis of impacts on water availability, rice production and economic flows under various land use scenarios, including upland sloping land-use mosaics and increased paddy area.

Methods

System descriptions and input data are basic requirements for model development and deployment. Hence, initial researh focused on characterization of the biophysical resource systems of the target villages. The objectives of biophysical characterization were to (1) gain an understanding of spatio-temporal resource flows, processes and linkages for model development and preliminary analysis; and (2) build an input data set for model application. The scale of analysis was at the community level to look into interactions between water availability, rice production and poverty.

Luang Prabang province typifies the upland environment, agroecosystem and socioeconomic characteristics found throughout northern Lao PDR. Two villages within 60 km of the town of Luang Prabang—Ban Fay and Ban Silalek—were selected as project target sites. These villages share many commonalities but nevertheless represent differing ethnic composition, land area, demographics, resource endowments and histories.

Resource linkage appraisal

Upland communities manage their resources according to perceived realities. The resource linkage appraisal (RLA) track fulfilled the dual purpose of enhancing system understanding and informing subsequent recommendation domains amendable to the community. The three objectives of RLA were designed to integrate researchers' and the community' perceptions of resource availability, use, and interactions by (1) gaining a comprehensive qualitative description of the biophysical resource domain of the two target sites, focusing on land and water resources; (2) identifying perceived interactions between land use and water availability; and (3) estimating changes in land and water resource availability over time. Land and water resources were the primary drivers for other biophysical processes that are affecting the livelihoods of the communities.

The RLA was carried out using a two-pronged approach. First was a field survey of land and water resources to characterize their availability and quality in spatial terms. The field survey also provided the context for framing more effective participatory assessments. Second was a participatory assessment to gather the communities' perceptions of their land and water resources was conducted. The latter was done using informal interviews during field observation trips and focus group discussions (FGD). Various

participatory tools such as resource maps, a seasonal calendar, and a resource flow matrix were integrated into the FGDs.

Land/water resource characterization (LWRC)

For the LWRC, detailed topographic, land use and hydrologic data for 2 years were collected from the Houay Hom watershed in Ban Fay. The Hom watershed covers approximately 3.8 km^2 and is entirely contained within the political boundary of Ban Fay. The watershed has key agricultural and water-use systems prevalent in the Lao uplands.

Field monitoring visits documented management decisions, seasonality and discharge characteristics of water flows and land-use regimes. These provided qualitative understanding that augmented quantitative data collection—detailed field surveys and land-phase field hydrology. The primary LWRC field methods carried out in the project are listed in Table 1.

In the field mapping survey, paddy areas, stream and conveyance networks and structures, dry-season springs and easily accessible areas were delineated and mapped. Since much of the watershed was not readily accessible and detailed land-use characterization on a watershed scale using global positioning system (GPS) units was not feasible, an alternative method was needed. Remote field mapping survey (RFMS), a ground-based method for simultaneous and rapid collection of spatial land-use and topography data over several square kilometers, was applied. Survey base points, along with key land uses and topographic formations with easy access, were mapped using a GPS unit. A laser rangefinder and

Table 1. LWRC field methods

Method	*Data type*	*Key methodological elements*
Remote field mapping survey (RFMS)	Topography; land use	Augmented RLA data in Ban Fay. Utilized a Garmin 76 global positioning system (GPS) unit, an altimeter, a compass and a Laser Technology TruPulse 200 laser rangefinder/hypsometer.
Climate monitoring (three locations)	Evapotranspiration (potential); rainfall	Automated weather station (one location); supplemental weather stations (two locations); ETgage (three locations) (www.etgage.com) Distributed across watershed to capture rainfall spatial and elevation effects. Manual and automated readings.
Streamflow monitoring (four locations)	Streamflows	High-resolution (10-min) depth measurement at the watershed outlet during dry season; daily depth measurements in dry season. Utilized velocity-area method, volumetric measurement, S-M flume (Samani and Magallenez, 2000) and rectangular culvert depth monitoring.
Paddy water level monitoring	Paddy water management	Daily manual depth measurements in two adjacent rice paddy areas at multiple levels on the toposequence.

Source: Pandey, S., et.al., 2010. CPWF Project Report: PN11

electronic compass collected height, distance and bearing data relative to the base points for land uses and terrain extrema in less accessible areas of the watershed. Base points and remote points were then translated into detailed land-use and high-resolution contour maps.

Lessons learned

- Food security and poverty issues underpin research site selection. A clear potential exists for improving rice productivity and reducing poverty, which are therefore important selection criteria when identifying study areas.

- Participatory methods increase the qualitative understanding of biophysical resource endowments and linkages. System characterization and model development should be viewed as conjoint and concurrent activities to maximize the efficiency of characterization efforts.

- It is important to build on the indigenous knowledge of traditional farming systems and thereby understand the interface between biophysical and socio-economic circumstances of communities for effective development and dissemination of technologies.

- Several technologies (e.g., ETgage for getting reference evapotranspiration and RFMS for getting land-use and topography data, especially in inaccessible areas) are useful for field hydrology and land data collection in the upland Lao context.

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Tags: PN11: Upper Catchment Rice Landscape

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