

# Valuation of Ecosystem services in Himalayas

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# Background

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- HKH region is rich in biodiversity but is **vulnerable** to anthropogenic pressures,
- **Population** growth in HKH countries have seen **massive increase since 1950**, and likely to continue growing beyond 2050 (Sandhu & Sandhu 2015),
- In the region, there are a **growing number of rural poor** who are dependent on forest and ecosystem services for their livelihood (Chaudhary and Bawa 2011).
- Indicates resource curse – as extreme poverty and biodiversity hotspots are generally **co-located** (Sachs et al. 2009)

# Background...

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- Poverty often occurs when links between ecosystem services and human well-being have been **damaged or broken**.
- The ES contributes between 50%-90% of the so-called '**GDP of the poor**' (TEEB 2010).
- Therefore, any intervention related to poverty reduction and reversing biodiversity loss requires **understanding of the dynamics** of ecosystem services and livelihood of local communities (Adams et al. 2004; DeClerck et al. 2006; Barrett et al. 2011).

# Issues

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Two key factors that affect equitable and sustainable development:

- i. failure to simultaneously address economic and environmental problems in the developing world (Adams et al. [2004](#)), and
- ii. lack of an ecosystem services approach and a network that can provide strategic directions to address poverty and environmental degradation (Perrings et al. [2011](#))

# Addressing the issues

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- Good governance may contribute to address the problems associated with environment and development,
- Participation of local community and market actors may lead to effective governance (Agrawal et al. 2008),
- Valuation of ecosystem services could be a tool for promoting good ecosystem governance through the supply of information about the [values, incentives and options of management](#) (King 2007)

# Ecosystem valuation

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- Stated preference (SP) is suitable —allows respondents to put price on a wide range of hypothetical scenarios (Garcia-Llorente et al., 2011)
- Usually, WTP for ecosystem services increases with respondent's income (e.g. Lehotnet al. 2003, Do & Bennett 2008)
- A large portion of rural population reject in cash contribution - **Luxurious goods??** (Alam, 2006; Hung et al., 2007, Rai & Scarborough 2013).
- Hence, SP may overlook the concern of income poor as WTP is determined in **dollar value**,
- Therefore, policy often ignores environmental issues in developing countries,

# Determining WTP in non-monetary numeraire

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- SP studies in developing countries have occasionally used non-monetary numéraires to elicit WTP such as [Cereals & Labor](#) (Shyamsundar and Kramer, 1996; Alam, 2006; Birol et al., 2006; Hung et al., 2007; Asquith et al., 2008; Saxena et al., 2008)
- Farm households [allocate labour](#) for different purposes and well know about availability of time (Jacoby, 1993; Abdulai and Delgado, 1999; Alam, 2006),
- A theoretical complexity arises while placing monetary values on the number of labour days declared—the opportunity cost of time varies across individuals.

# 3 Cases: Using Labor as a Payment Numéraire

| Case   | Approach  | Reference                                       |
|--|---|---|
| Case 1 : Estimating benefits of invasive species management in Chitwan National Park | Allowing respondents to select the payment numeraire before choice  | <i>Rai and Scarborough (2014)</i> - AJARE       |
| Case 2: Estimating benefits of invasive species management in Chitwan National Park  | Using Labor and Cash in the same experiment / asked to choose preferred payment numeraire after the choice made | <i>Rai and Scarborough (2013)</i> - EDE         |
| Case 3: Estimating demand for watershed services in Koshi Basin                      | Sub-sampling population and presenting different numeraire  | <i>Rai et al. (2015)</i> – Ecological Economics |



# CE- Theoretical background

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- Respondents are given multiple choice cards containing policy alternatives,
- **Alternatives**
  - hypothetical outcomes of programs ,
  - comprised of attributes/ecosystem services ,
  - distinguished by the levels of these attributes.
- Lancaster's characteristics theory of value (1966);
- Random utility theory (McFadden 1974)

$$U_{ijt} = V(x_{ijt}) + \varepsilon_{ijt} \quad (i)$$

- Probability

$$P \{ \text{choose } j \} = P \{ (U_{ij} > U_{ig}, \text{ s.t. } \forall g \in R, \text{ and } j \neq g) \} \quad (ii)$$

# Determinants of the payment numerarire

- Binary Logistic Model
- Dependent variable :  
Cash – 1, Labor= 0

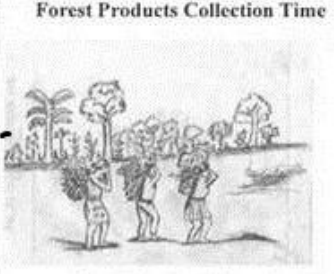
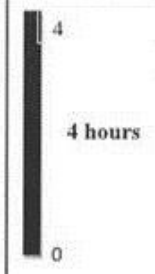


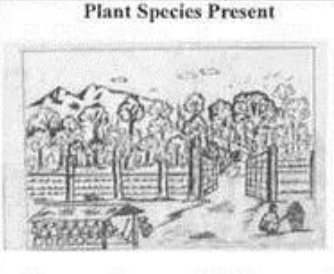
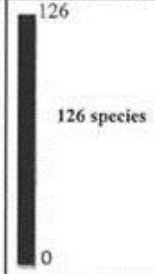

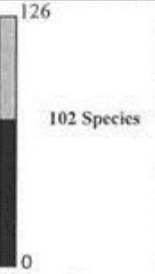

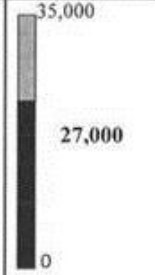
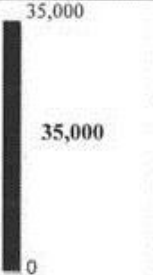

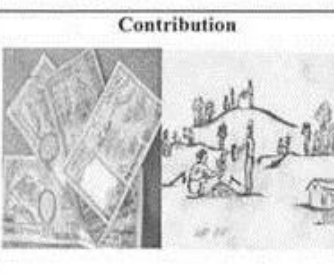
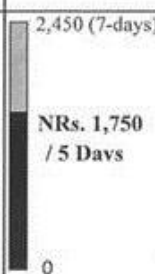
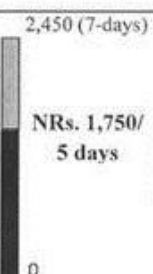
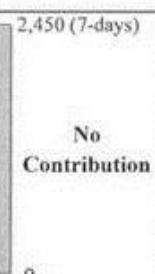
| Variables                        | Coefficient      |
|----------------------------------|------------------|
| Constant                         | -1.039 (0.666)   |
| Male                             | 0.680 (0.247)**  |
| Education                        | 0.082 (0.031)*** |
| Landholding size                 | 0.091 (0.012)*** |
| Family size                      | -0.120 (.048)**  |
| Distance from forest             | -0.012 (.005)**  |
| Forest entry                     | -0.448(0.230)**  |
| Native to the area               | 0.463(0.245)*    |
| Agriculture only (income source) | -0.914 (0.262)   |
| Age                              | 0.001 (.011)     |

# Attributes and their levels

| Attributes                           | Description  |
|--------------------------------------|--|
| Forest products (FP) collection time | Time required for each trip in hours for a day requirement excluding travel time between house and community forest. There are four levels: 4*, 2, and 1 hour(s).                                  |
| Plant species present                | Number of plant species in the community forests. There are three levels: 102*, 115, and 126.  |
| Visitors to forest                   | The number of tourists visiting community forests annually. There are three levels : 20,000*, 27,000, and 35,000   |
| Contribution                         | <p>Annual contribution for five years. There are four levels:</p> <p>In cash- An annual membership fee. NPR# 0*, 1,050, 1,750, and 2,450 or</p> <p>In labour - 0*, 3, 5, and 7 labour-day (s).</p> |








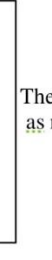








# Case 1: An example of a choice card

- 20 types of choice cards
- Each households received 4 choice cards
- Have to select one alternative in each card

|   | Alternative 1  | Alternative 2  | Current Situation  |
|---|--|--|--|
| <b>Forest Products Collection Time</b><br>          | <br>4<br>4 hours<br>0                            | <br>4<br>1 hour<br>0                             | <br>4<br>4 hours<br>0                        |
| <b>Plant Species Present</b><br>                   | <br>126<br>126 species<br>0                     | <br>126<br>115 Species<br>0                     | <br>126<br>102 Species<br>0                 |
| <b>Number of Visitors in Community Forests</b><br> | <br>35,000<br>27,000<br>0                       | <br>35,000<br>35,000<br>0                       | <br>35,000<br>20,000<br>0                   |
| <b>Contribution</b><br>                           | <br>2,450 (7-days)<br>NRs. 1,750 / 5 Days<br>0 | <br>2,450 (7-days)<br>NRs. 1,750 / 5 days<br>0 | <br>2,450 (7-days)<br>No Contribution<br>0 |
| <b>My Choice</b><br>(Please ✓ in one box)   |  |  |  |

# Case 2: An example of a Choice Card

- Allows trade-offs between monetary and non-monetary payments too,
- Allow to estimate opportunity cost of time,

| Choice Situation 1.1   | Alternative 1   | Alternative 2  | Current Situation   |
|--|---|--|---|
| <b>Forest Products Availability</b><br> |  <p>1 hour</p>                 |  <p>4 hours</p>                       |  <p>4 hours</p>                |
| <b>Visitors to Forests</b><br>          |  <p>The same number as now</p> |  <p>Twice as many tourists as now</p> |  <p>The same number as now</p> |
| <b>Labor Contribution</b><br>           |  <p>3 days</p>                 |  <p>3 days</p>                        |  <p>0</p>                      |
| <b>Annual Membership</b><br>           |  <p>NRs. 1,050</p>            |  <p>NRs. 2,450</p>                   |  <p>0</p>                     |
| Select one (✓)   |   |  |   |

## Case 3: Results of RPL model

| Variables                         | Mode of payment          |                         |
|-----------------------------------|--------------------------|-------------------------|
|                                   | Cash                     | Labor Time              |
| Drinking water                    | 8.45e-3***<br>(1.08e-3)  | 1.63e-2***<br>(3.30e-3) |
| Irrigation water                  | 0.552***<br>(6.41e-2)    | 0.831***<br>(0.160)     |
| Leaf litter                       | 0.460***<br>(9.56e-2)    | 0.524***<br>(0.204)     |
| Fuelwood                          | 3.49e-2***<br>(8.78e-3)  | 5.08e-2**<br>(1.74e-2)  |
| Fee/Labor                         | -3.74e-4***<br>(8.55e-5) | -0.131***<br>(5.11e-2)  |
| Age × ASC                         | -1.38e-2*<br>(7.35e-2)   | -6.02e-2**<br>(2.85e-2) |
| Education × ASC                   | 7.34e-2<br>(6.57e-2)     | 0.229<br>(0.229)        |
| Family size × ASC                 | 5.09e-2*<br>(2.82e-2)    | 0.416*<br>(0.214)       |
| Irrigated land × ASC              | -8.61e-2<br>(9.14e-2)    | -0.456**<br>(0.186)     |
| Traditional house × ASC           | -0.853*<br>(0.455)       | 4.40***<br>(1.48)       |
| Irrigated land × fee/labor        | 2.34e-5**<br>(1.15e-5)   | -1.73e-2**<br>(8.64e-3) |
| Irrigated land × irrigation water | 2.05e-2***<br>(7.60e-3)  | 3.88e-2**<br>(1.85e-2)  |
| Female × leaf litter              | 7.35e-2<br>(8.38e-2)     | 0.329*<br>(0.174)       |
| ASC                               | -6.30e-2<br>(8.65e-2)    | -0.323<br>(0.201)       |
| <b>Standard deviation</b>         |                          |                         |
| Drinking water (Ns)               | 7.30e-3***<br>(2.58e-3)  | 2.69e-2***<br>(6.55e-3) |
| Fee/Labor (Ts)                    | 1.87e-4***<br>(4.27e-5)  | 6.59e-2***<br>(2.55e-2) |

# Implicit price of attributes (NPR)

| Attributes  | Implicit price<br>(Confidence intervals) |
|---|--|
| Forest products collection time (decrease by an hour) | 531.44<br>(334.27-748.60)                |
| Visitors to CF (increase by one)                      | 0.24<br>(0.18-0.29)                      |
| Labor contribution (Increase by a day)                | 165.72<br>(114.51-216.91)                |

Estimated opportunity cost of labor NPR 165.72 is 47% of the market wage rate (NPR 350/day)

# Findings

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- 35% elected monetary numeraire and 65% labor (Case 1)
- Asking respondents to select the payment numeraire after choice – 64% in labor (Case 2)
- 50% in monetary , and 72% in labor (Case 3)
- Social benefits from environmental services are 1.4 to 2.2 times higher in labor hours relative to benefits estimated in monetary terms (Case 3)
- However, respondents electing to contribute in monetary terms consistently have a higher WTP than their neighbors who prefer to contribute in labor term (Case 1)



# Conclusions

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- Determining WTP in dollar values is a contributing factor for the relatively low use of stated preference studies in low-income economies,
- It substantially excludes the concerns and contribution of primary users of ecosystem services
- However, the expression of WTC in labour may not be suitable for all programs so required to select other in-kind numeraire,
- Education program may help to increase benefits from ecosystem,
- In the long run, the determination of WTP in monetary terms would be appropriate with economic development, because average WTP of monetary group is consistently higher than non-monetary group

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Thank You