Investing in Ecosystem Services: Opportunities and Challenges for Shivapuri National Park, Nepal

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Dedication

This work is dedicated to my mother, Indira Maskey and my mother-in law, Radhe Amatya.

Abstract

Protected areas around the world are increasingly being recognized for their potential to protect various ecosystem services. It is well established that they offer immense recreational and tourism services in the form of aesthetic beauty, wilderness, biodiversity, peaceful and clean environment and increasingly been recognized for their value of watershed protection. They protect important watersheds that supply clean drinking water for growing urban population. At the inception of this decade, ecologists started recognizing this value. A study on protected areas found that a third of world's largest cities depend on protected areas for drinking water supply and unfortunately a billion people who live in these cities live without access to clean and adequate water. Similarly is the case with Kathmandu valley population which receives 40% of its drinking water from Shivapuri National Park. The national park provides numerous ecosystem services among which drinking water supply and water purification occupy the highest value and that is US $112/ha/yr, which is significantly higher than global estimates. Valuations methods applied to calculate the value is by using current water price and avoided cost methods. A survey carried out among Kathmandu people showed that people give more importance to this service, feels responsible to protect and conserve these water sources and are willing to pay 1% of their average monthly income (US $300/month). Therefore, there are investment opportunities for watershed protection that lie within the national park and its surrounding areas. As, Nepal is a developing county with GDP per capita (purchasing power parity) of only $1,550 and GINI co-efficient as 0.47, showing unequal distribution of property and income, therefore, challenges lie ahead for institutionalizing these opportunities.

Key words: *ecosystem services, value, drinking water, willingness to pay, opportunities and challenges*

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ACRONYMS

ADB	Asian Development Bank
BZ	Buffer Zone
CBO	Community Based Organization
CLD	Causal Loop Diagram
CV	Contingent Valuation
DDC	District Development Committee
DWS	Drinking water supply
DNPWC	Department of National Park and Wildlife Conservation
FAO	Food and Agriculture Organization
IDRC	International Development and Research Center
IUCN	World Conservation Union
KV	Kathmandu valley
KVEO	Kathmandu Valley Environment Outlook
MEA	Millennium Ecosystem Assessment
MFSC	Ministry of Forest and Soil Conservation
MLD	Million liters per day
NP	National Park
NGO	Non-governmental Organization
NRs	Nepali rupees
NTNC	National Trust for Nature Conservation
NWSC	Nepal Water Supply Corporation
NWSSCL	Nepal Water Supply and Sanitation Corporation Ltd.
ShNP	Shivapuri National Park
$	United States Dollar
VDC	Village development committee
WTP	Willingness to pay

Unit of conversion

1$ = NRs 64

1 square kilometer (sq. km.) = 1,000 hectares (ha)

INTRODUCTION

Everyday, we use services from our surrounding environment in the form of air, water, food, fiber and many others. These are ecosystem services. The Millennium Ecosystem Assessment (MEA), 2005 defines 'ecosystem services' as the benefits people obtain from ecosystems. This includes providing services (food and water); regulating services (regulation of floods, drought, land degradation, and disease); supporting services (soil formation and nutrient cycling); cultural services (recreational, spiritual/religious) and other non-material benefits. The benefits depend on the flow of ecosystem services and are non-existent if these services cease to flow. Thus, the ultimate goal is to maximize these benefits by making sure that the ecosystem services are constantly available to support human well-being. But, changes are being made to these ecosystems that contributed to substantial net gains in human well-being and economic development. This gain have been achieved at the growing costs in the form of the degradation of ecosystem services and the intensification of poverty for some groups of people and substantially diminishing the benefits for future generations (ibid.). As ecosystems and its beneficial services are rapidly disappearing and becoming scarce, future economic development and human well-being are at risk (Barbier, 2007). Illustrative examples worldwide are scarcity of fossil fuels (non-renewable services), soaring food prices, shortage of fresh water supply and polluted air (renewable services of ecosystem). Therefore, this scarcity necessitates the action of protecting, preserving and restoring ecosystems which provide significant benefits to humans which definitely is anthropocentric (Pagiola, 2004).

Protected areas and national parks ensure a continuous flow of ecosystem services (benefits). These include provision of clean water and the protection of soil resources. They provide significant economic benefits to surrounding communities and contribute to spiritual, mental and physical well being and also help to fulfill an ethical responsibility to respect nature and provide opportunities to learn about nature and the environment (IUCN, 2000). Shivapuri National Park (ShNP) promises the same for the population living in and around the park and in the Kathmandu valley. Nevertheless, management of these conservation areas entails costs that include direct cost of implementing the conservation measures and opportunity cost of alternative uses (Pagiola, 2004). Therefore, the aim is to use 'economic or market-based instrument' along with regulatory or legal measures so as to seek reasonable investments opportunities to conserve an ecosystem that can support rural development.

Markets for ecosystem services can contribute to rural development and poverty reduction by providing financial benefits from the sale of ecosystem services, improving human capital and strengthening social capital (Jenkins et. al., 2004; MEA, 2005). Human capital means training and education, while social capital means the level of trust, cooperation and institutional coherence in society which increases economic output by decreasing transaction cost (Harries et. al., 2001). As, the degradation of ecosystem services is a significant barrier to achieving Millennium Development Goals (MDGs), especially for rural poor (MEA, 2005), protection of these services is urgent. Therefore, this study takes ShNP, as a single case to examine the value of ecosystem services that can enter the market and benefits reaped can be invested for its future management and rural development.

I) Aim and Research questions

Shivapuri National Park (ShNP) delivers numerous ecosystem services; provisioning (clean air and water), regulating (climate change through carbon sequestration, flood control, water purification) and cultural (recreational, aesthetic, spiritual and religious). Therefore, the main aim of this paper is to assess these ecosystem services which are prominent in the market then identify investment opportunities and challenges for its management and local development. Specific questions to fulfill the aim are;

1. What ecosystem services does ShNP offer and what are their existing market values?
2. How do beneficiaries (downstream) perceive ecosystem services? Are they willing to pay for the services?
3. What are the opportunities and challenges associated with the investment?
4. How can the opportunities be embedded and challenges overcome to conserve ecosystem and support local livelihoods?

Definitions of terms used in this paper: ‘upstream or locals’ refers to people living inside and outside the Shivapuri National Park while ‘downstream or beneficiaries’ refers to people who are living in the Kathmandu Valley and are using the benefits from national park. ‘Watershed’ refers to area with ShNP and its buffer zone[1]. ‘Investment’ means monetary investment and $ sign refers to US dollar. One $ is equal to 64 Nepali Rupees (NRs).

BACKGROUND

I) Study Area

a) Geographic location

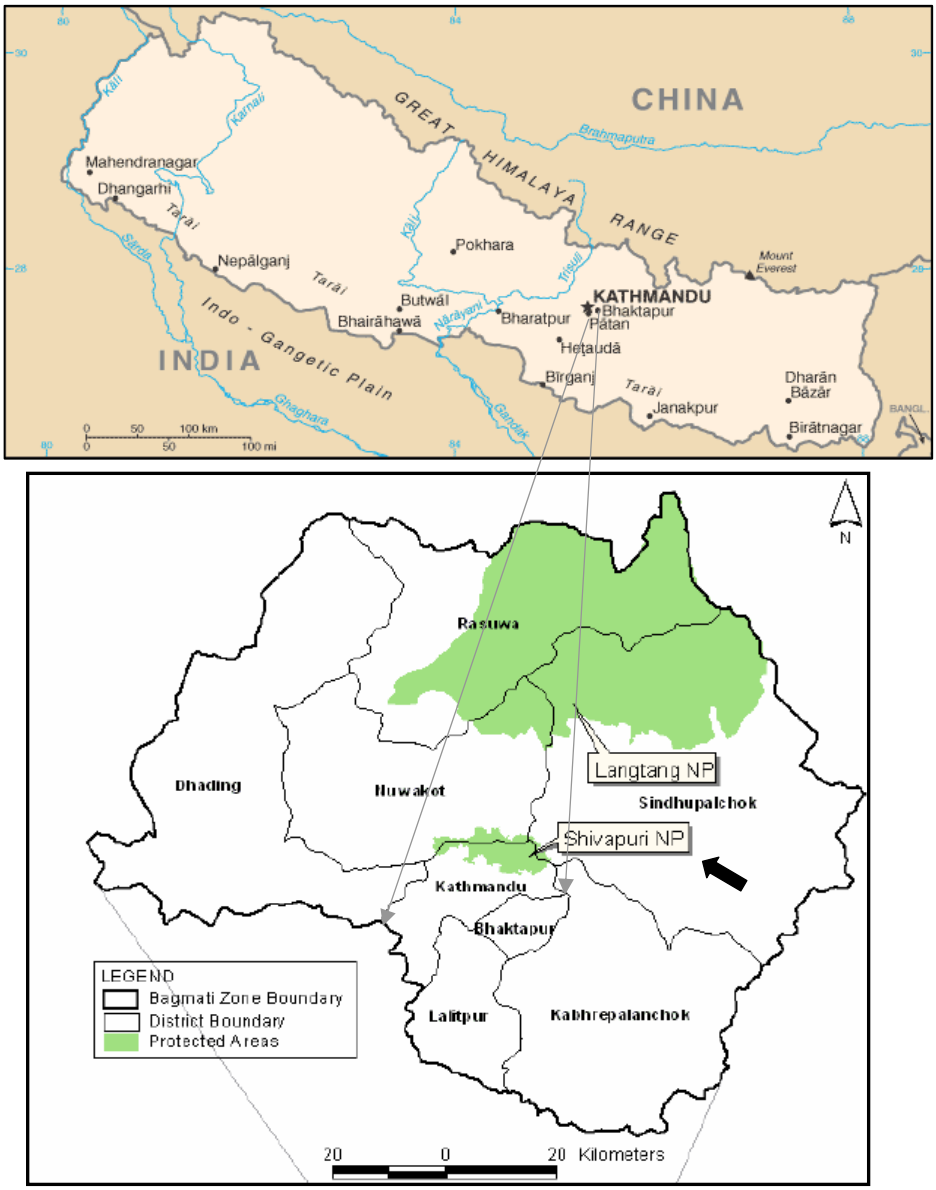


Figure 1: Map of Nepal and Shivapuri National Park

(Source: www.lirung.com)

Shivapuri National Park (ShNP) is located 12 km north of capital city, Kathmandu of Nepal. Nepal is a mountainous country with area of 147,181 sq. km situated between China and India, along the base of

Great Himalayan range (Figure 1). The national park lies in the Bagmati zone and the south of Langtang national park. The area has sub-tropical to temperate climate with 20°C (68°F) average annual temperature. The national park occupies an area of 144 sq. km of the total watershed area (221 sq. km). The watershed is categorized under sub-catchments (100-500 sq. km.) and is important for surface and ground water sources for Kathmandu valley. The valley comprises of four important cities; Kathmandu, the capital, Lalitpur also called Patan, Bhaktapur and Kirtipur.

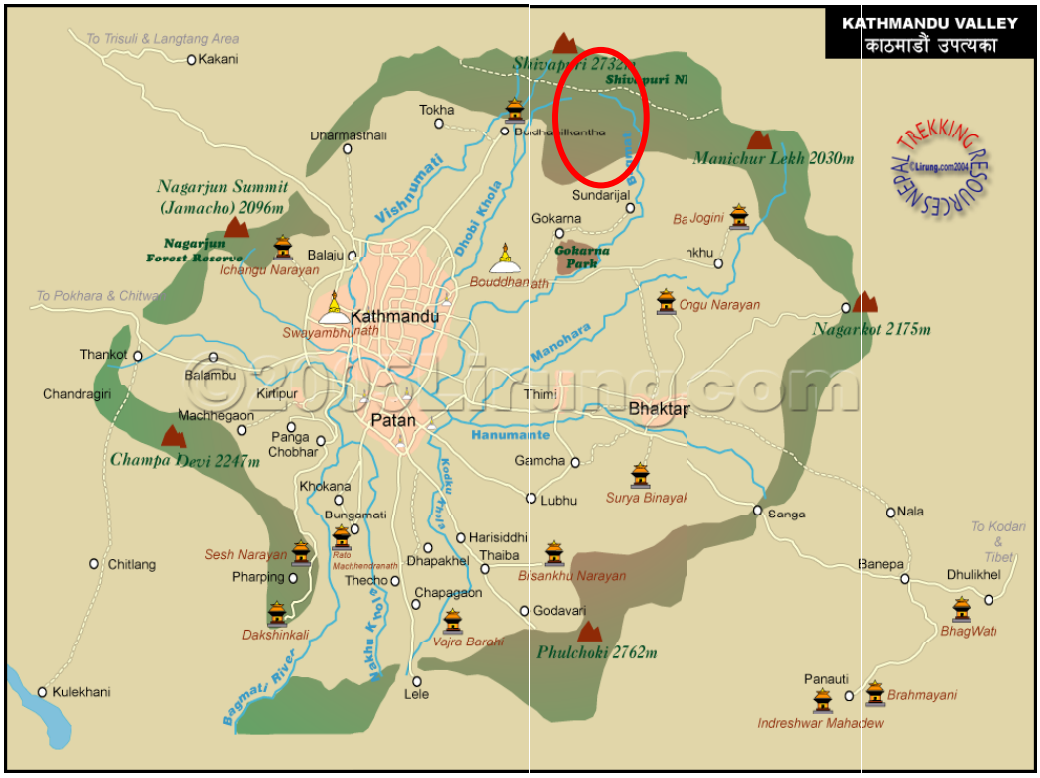


Figure 2: Map showing major rivers flowing inside Kathmandu valley

(Source: www.lirung.com)

ShNP was initially established as a watershed and later gazetted as a national park in 2002. Literatures show that before 2002 many watershed projects funded by FAO and many other funding agencies were implemented in this area. Realizing the watershed potentiality and high biodiversity led the government to protect this area. Figure 2 above shows a map with ShNP in the north (denoted by a circle) and drainages flowing into the valley.

ShNP is a protected area and define as a natural area of land designated to protect the ecological integrity of one or more ecosystems for present and future generations, which excludes exploitation or occupation destructive to the area; and provide foundation for spiritual, scientific, educational, recreational, opportunities which is environmentally and culturally sustainable. (IUCN, 1994). ShNP protects important water basin for two main rivers; Bagmati, and Vishnumati which contribute 40% of valley's drinking water supply (NTNC, 2004). Additionally, the park has high biodiversity and cultural and religious significance.

b) Altitude and Land-use types

The national park lies at the elevation of 1,360-2,720 meters above sea level (asl). The altitude is shown in Figure 3. Shivapuri peak also called Shipocho lies at the elevation of 2,720 meters asl (red area). This peak represents cultural and religious value as the sources of the rivers are located here.

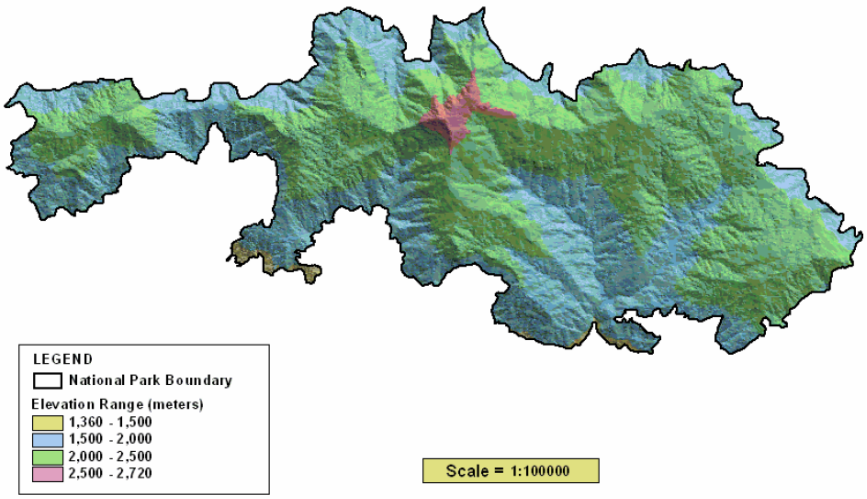


Figure 3: Map of Shivapuri national park showing altitude

(Source: NTNC, 2004: Shivapuri Draft Management Plan)

The Figure 4 below shows the land-use types of ShNP. Two communities called Okhreni and Moolkharka (yellow patches) lie inside the park which comprises of 2,600 people (500 Households). A total of 10,000 people live in and around the park and depend on the resources of the park (Emerton and Ali, 2004). The whole population, both inside and outside the park, depends largely on subsistence

farming and forest resources. Major areas of the park are covered by forest (41%) and farm (35%), remaining are grassland, shrubs, grassland with shrubs, rivers/ponds and other features as shown in Table 1 below.

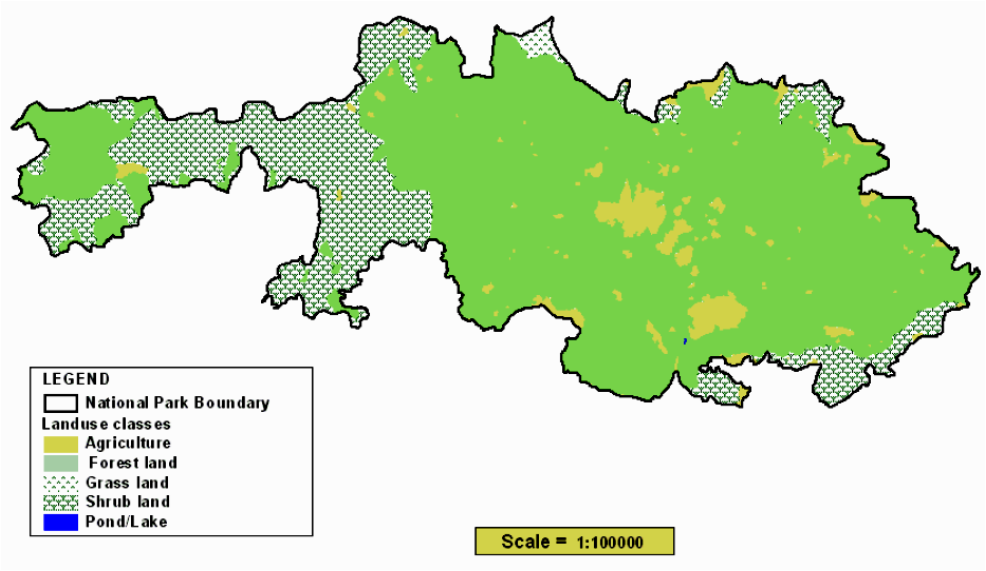


Figure 4: Map of land-use types

(Source: NTNC, 2004: Shivapuri Management Plan)

Table 1: Land use types in the watershed and national park

Land-use types	Area in ha (1993)[a]	Area in ha (2004)[b]	%
Forest	8,638.30	5,868.00	40.75
Agriculture land	7,477.00	5,090.40	35.35
Shrubs	3,148.20	2,131.20	14.80
Grassland	618.90	417.60	2.90
Grassland with Shrubs	555.60	374.40	2.60
Landslides	102.30	72.00	0.50
Riverine features	45.70	28.80	0.20
Settlements	187.60	129.60	0.90
Abandoned land	430.60	288.00	2.00
Total	**21,204.20**	**14,400.00**	**100.00**

[a]Tamrakar, 1993 represents total watershed area and land use type;

[b]Shivapuri draft management plan, 2004 represents area within ShNP and % of each land use types within the park.

II) Ecosystem services of Shivapuri National Park

a. Recreational and cultural heritage

Shivapuri peak (Shiphocho) is a religious site for many Hindus and Buddhists in the country. Many shrines, temples and gumbas are located on this mountain. This is the origin of two important rivers of the valley, namely, the Bagmati and Vishnumati. The sources are called Baghdwar and Vishnudwar. In the Nepali new year (April-mid) most of the people from the valley and other places go hiking and trekking in Shivapuri to pay homage. Many people also visit the temples and religious sites as picnic spot throughout the year. Since this is the nearest national park, this place is the closest recreational center for the valley people. Thus, this area has a high potential for domestic tourism. As this hill is the route for other famous trekking sites like Langtang, Nagarkot and Kakani, the place is also visited by many tourists from all over the world. The annual tourist flow is presented in Figure 5. The graph shows that the Nepali tourists visit this place more than the international tourists. The variation in the flow represents the political situation of country. The flow of tourists in 1997 decreased with the onset of Maoist conflicts in the country.

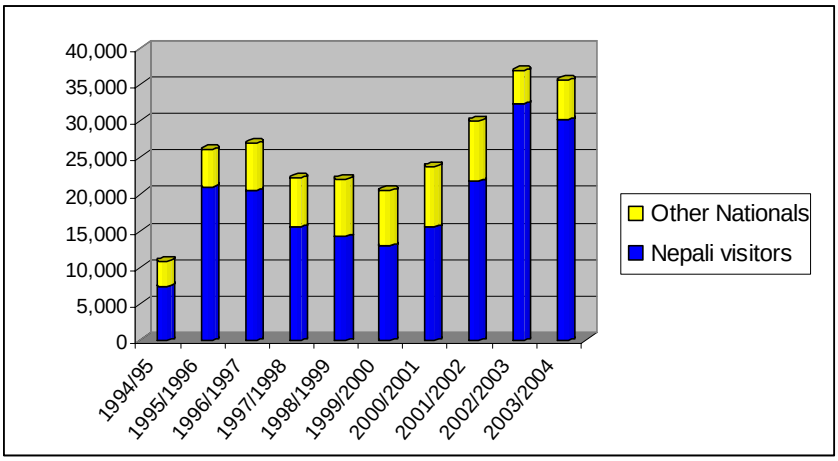


Figure 5: Annual tourist flow pattern for 10 years

(Source: NTNC, 2004: Shivapuri management plan)

b. Biodiversity

Amatya (1993) classified the Shivapuri watershed area into six forest types. As the protected area lies at the elevation of 1,360-2,720 meters above sea level, it occupies mainly four forest types (NTNC, 2004) shown in Table 2 below. The complexity of forest types without clear demarcation and degree of variations from sub-tropical to temperate species shows a high degree of diversity in the study area.

The draft plan identified 2,122 species of plants, 129 species of mushrooms, 177 species of birds, 102 species of butterflies, and 21 species of mammals in the study area. The country's largest national park, Chitwan National Park (93,200 ha) harbors around 919 species of flowering plants while this national park (14,400 ha) harbors around 2,122 species of plants (DNPWC, 2006). This represents the high floral diversity of the national park.

Table 2: Forest types in the study area

Forest types	Elevation (meters above sea level)	Dominating species
Lower slopes contain mixed hardwood forest (also called hygrophytic forest)	1,000-1,700	*Schima wallichii* (needle wood), *Castanopsis indica* (indian chestnut)
Coniferous forest	1,000-1,600	*Pinus roxburghii*
Oak forest	2,300- 2,700	*Quercus semicarpifolia*
Upper mixed hardwood forest	1,700-2,300	Oak-Laurel-Rhododendron

Source: NTNC, 2004

c. <u>Watershed and drinking water source</u>

Watersheds with a high proportion of land covered by intact forest and wetlands are effective at moderating runoffs and purifying water supplies (Postel and Thompson, 2005). It has been claimed that steadily improving vegetation cover in the Shivapuri watershed especially at Sundarijal sub-catchment has led to a more steady flow of water, as evidenced by stream discharge records showing a decreasing trend in potentially damaging peak flows and an increase in base flows (FAO, 1996). The total water supply for the valley is an average 84 million liters per day (MLD) and the estimated daily demand is 224 million liters (NWSC, 2004/2005). Shivapuri is one of the sources of drinking water for Kathmandu Valley. Everyday about 30 million liters of water is tapped from rivers such as the Bagmati and the Vishnumati as well as from several other smaller streams (DNPWC, 2006). This shows that more than 35% of the total water supply of the valley is supplied by the Shivapuri watershed. Mahankal and Bansbari water reservoirs have the capacity of providing 40% of the water supply of the valley (NWSC, 1997). Due to this potentiality, the park is protected and conserved.

d. <u>Carbon and air pollution sink</u>

A study conducted by IDRC, in the Kumaon region of Uttaranchal Pradesh of India, observed that the Chirpine (*Pinus roxburghii*) forest is the largest contributor to sequester carbon, and the temperate broad leaved forests, in which various Oaks dominate, account for the largest fraction of carbon

accumulation (Tiwari and Phartiyal, 2006). The biological diversity of the Shivapuri NP is mainly dominated by Pine and Oak, demonstrating high potential for being a carbon sink. The same study showed that the community forests of Nepal have the capacity of sequestering 2.1 t C/ha/yr and undisturbed Pine forests of Uttaranchal can sequester in the range of 4.0-5.6 t C/ha/year. Presumably, Shivapuri NP can sequester more carbon than community forest and lower than the forests in Uttaranchal. This is because though protected the park still shelters agriculture land and two settlements as you see in land use types in Figure 4. Preferably, vegetation in the park can sequester carbon in the range of 3–4.5 t C/ha/year.

e. Research and educational value

Several individual and institutional studies were carried out in and around the park, especially when the area was designated as watershed reserve during the 1980's. This was mostly during the inception of Shivapuri Integrated Watershed Development Project initiated by FAO (NTNC, 2004). Even after the establishment of the park, several studies are undertaken regarding socio-economic and natural resources. As the park is accessible to valley schools and colleges, it has high research and educational value. Currently, an NGO called National Trust for Nature Conservation (NTNC) is conducting carbon sequestration potentiality study in this area. This NGO was involved in preparing Shivapuri draft management plan in 2004. The plan acknowledges the educational value of the park.

The Table 3 below lists of ecosystem services of ShNP ranking their market status and identifies potential users/beneficiaries of these services.

Table 3: Market status ranking and beneficiaries of ecosystem services of ShNP

Ecosystem Services	Market status	Beneficiaries
Recreational and cultural (tourism)	**1**	National and international tourists/pilgrims
Drinking water supply	**1**	Kathmandu population and locals
Water purification	**2**	Kathmandu population and locals
Carbon sequestration	**2**	Global population
Water flow regulation	**3**	Kathmandu population and locals
Biodiversity	**3**	Global population
Pollution control	**3**	Kathmandu population and locals
Research and educational	**3**	National and international students/researchers

1 = Market value exist, **2** = Market value do not exist but can be included after valuation, **3** = Market value does not exist at all

RESEARCH STRATEGY

I) Case study

Shivapuri National Park (ShNP) is selected as a single case for examination in this research. The rationale behind an embedded single-case design follows five reasoning (Yin, 2003; Bryman, 2005);

- The case is critical to prove the relationships between ecosystem services and investment in the preservation of ecosystem,
- The case represents the upstream and downstream concept of watershed management,
- It is unique as it is the nearest national park to the capital city and with high biodiversity.
- It reveals the urban-rural relationships, and
- It carries the history of transformation from 'Watershed-reserve to National Park'.

II) Literature review and analytical framework

The complete understanding of a case of ShNP is established by applying methodological triangulation (Yin, 2003). National parks definitely promise environmental sustainability through legal measures (Pagiola, 2004) but equally important are socio-economic and institutional sustainability. Therefore, this study applies a trans-disciplinary approach to realize a system that can sustain present and future generations. The preliminary information regarding the study area was acquired through intensive review of scientific literature, documents, reports which facilitated the identification of the key areas of inspection and aided in the formulation of analytical framework for this research.

The economy is a subsystem of the natural system (Harris et. al, 2001), this means that the economy depend on the ecosystem, therefore it is essential to understand the relationships between these systems as a basis for effective policies for sustainability (Costanza et. al., 1994). Equally important is to maintain minimum level of ecosystem 'infrastructure' necessary to allow the production of the range of services essential for human welfare (Turner et. al, 1994; Costanza, 1997). Though it is difficult to measure the minimum level of ecosystem services and assess the monetary value of these services which is complicated and controversial (de Groot, 1994), they are essential to sustain the economy. It is of little use if valuation does not lead to real investments in conserving the ecosystems that provide the necessary services (Pagiola, 2004). Again, the social (human) system lies within the natural system. Thus, socio-economic sustainability depends on the ecosystem. A minimum necessary condition for

sustainability is the maintenance of the total natural capital stock at or above the current level, while a lower stock of natural capital may be sustainable, unless society can allow no further decline (Costanza and Daly, 1992). In order for the society to limit damaging existing ecosystem, the society must understand the benefits of ecosystem services. In developing countries, most of the vulnerable segments of society depend on these services directly or indirectly for their livelihoods (de Groot, 1994) and the missing market for these services can generate inefficient and infeasible policies (Kumar, 2005). This means valuation must lead to investments for conserving these services and supporting vulnerable society who depend on them.

Ecosystem services of ShNP like drinking water supply and recreation/tourism (Table 3: ranked as 1) exist in the present market and are categorized as direct use values in Figure 6 below. These values exist in the market and are paid for in the form of 'water tariffs' and 'park entry fees'. Water purification and carbon sequestration services (Table 3: ranked as 2) are indirect use values and these values have the possibility of entering the market in the future with valuation.

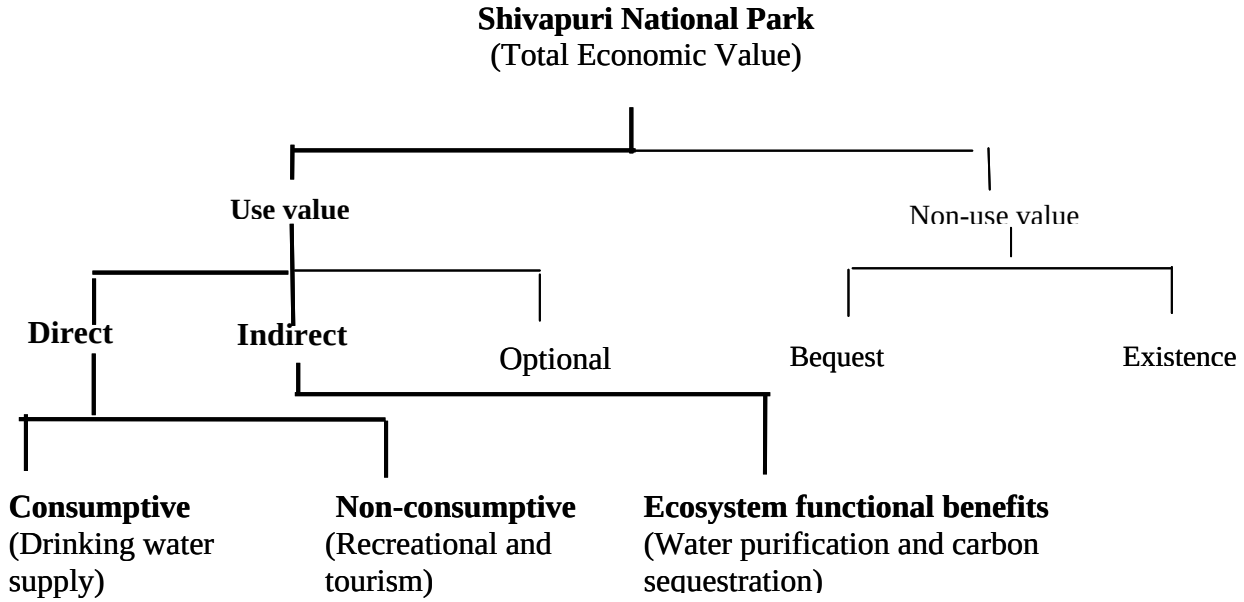


Figure 6: Chart of Total Economic Value of ShNP
(Adopted from Pagiola, 2004)
(Bold lines showing direct and indirect use values evaluated in this paper)

The sum of 'use value' and 'non-use value' leads to "total economic value" of ShNP. There are other values like optional, bequest and existence which are not evaluated in this paper but are left for future

study. However, the evaluation of direct and indirect use of ShNP is to initiate the valuation method that can continue for future research. And, there are multiple ways and means to assess valuations.

MATERIALS AND METHODS

Ecosystem services are so diverse and methods to measure one service may not be appropriate to measure another (de Groot, 1994). Therefore, this study takes into account multiple of methods to calculate market and socio-economic values of the ecosystem services. Primary and secondary data were collected for both quantitative and qualitative analysis. And, this research is intended to analyze the problem through four pillars of sustainability; the methods applied are categorized below;

I) Ecosystem services valuations

This paper attempts to assess the value of ecosystem services of ShNP by applying various methods so as to gain knowledge of its existing values. As identified in Table 3, drinking water supply, water purification, recreational/cultural and carbon sequestration are the services of ShNP which exist in the market and value is calculated by using market prices. The methods are listed in Table 4 to evaluate these ecosystem services using various sources of data;

Table 4: Methods to value ecosystem services of ShNP

Ecosystem services	Methods	Data type	Source
Drinking water supply	Water tariffs	Primary	Nepal Water Supply Corporation (NWSC)
Recreational and culture	Direct calculation of revenues	Secondary	ShNP draft management plan, 2004
Water purification	Avoided cost method[3]	Primary	personal communication with technicians
Carbon sequestration	Literature reviews	Secondary	Scientific papers

[3]The method adopted by Florence Bernard (2005)

Price or tariff provided an important source of information to calculate water supply benefits of downstream beneficiaries, recreational and cultural benefits of tourists. The benefits of upstream populations are excluded in these calculations as they access this resource ‘free’. Water purification is calculated by using ‘avoided cost’ method. This method is used by Florence Bernard to calculate avoided cost of Tipanti National park of Costa Rica. This method estimates values of ecosystem services based on the costs of avoiding damages due to lost services. The carbon sequestration potentiality is examined based on the available literatures from the region.

II) Socio-economic survey

A two-fold survey was conducted; one in the form of informal for the local people who directly depend on ecosystem services of ShNP for their livelihood and another questionnaire survey for the beneficiaries who directly benefit by using the services in the form of drinking water. The methods for socio-economic survey are listed in Table 5.

Table 5: Methods for socio-economic survey

Target groups	Methods	Data type	Source
Park residents (inside national park)	Informal talk and Field Observation	Primary and Secondary	Informal interview, Observation notes and ShNP draft management plan, 2004
Kathmandu residents	Willingness to Pay[4]	Primary	Questionnaire Survey (Annex)

[4]The methods applied by Hadker et al. (1997)

An informal interview with open-ended questions was designed as a guideline to carry out in the form of narratives (Yin, 2003) among the locals who are directly impacted by the national park. This was done to integrate available evidence and to converge on the facts of matter for interpretation and the main purpose of open-ended answer is to document specific piece of evidence to various issues of the case study (ibid.). The evidence gathered was compared with ShNP draft management plan for data triangulation (ibid.). The narrative was conducted among the locals of ShNP. Ten people from two settlements, namely Moolkharka (4) and Okhreni (6), were randomly selected and informally interviewed. This was done to learn the local people's perception towards ShNP and their perception towards future management of the park. Also, a close field observation was made and details were noted during the frequent visits between January 20 and February 10, 2008.

For the Kathmandu people, a semi-structured questionnaire survey (Bryman, 2004) was constructed to understand their perception of ecosystem services provided by ShNP and their willingness to pay (see Annex). The method adopted by Hadker et.al. (1997) is applied in the survey as this method tried to minimize the biases of CV methods like hypothetical bias, starting point bias, embedding effects and part-whole biases. The method was used for calculating WTP of the Bombay residents for preserving Borivil National Park. The survey was administered among 24 respondents of Kathmandu valley. The sample size was small to represent the whole population but the results were cross-checked with other researches and validated.

The people from different occupation and locations of the valley were randomly selected and interviewed. The people from different occupation were selected to weigh the results against their different income levels and location to identify users of the water from ShNP sources. Students, teachers, business people, government service holders, people working for international organizations, housewives and office helpers were interviewed to ascertain their perception of ShNP and to calculate their 'willingness to pay' for drinking water service of the national park. The sample of the questionnaire is provided in the Annex. One third of the total sample was women and all the respondents were above 20 years of age capable of decision making. Two respondents were students without earnings while rests had regular income in the range of $24 to $938 per month.

III) Limitations of methods

The methods used in this paper to estimate the value of ecosystem services of ShNP is partial and may lie way below the real value. As there has never been "a rule of thumb" to value the services of nature, the paper has to triangulate methodologies from various researches. In doing so, the paper has embraced all the assumptions made in previous studies. However, the methodology used is for getting rough figures around which investment opportunities for conservation (Pagiola, 2004) can be estimated and understanding this valuation can contribute to conservation strategies which lead to better support and understanding from from the society (Swart *et. al.*, 2001).

Also, the methods are simplified since this research has to look into various aspects and to give a holistic picture to the problem, for examples; calculating direct revenues for tourism and cultural values, depending on literature for carbon sequestration values and conducting narrative for 10 respondents from upstream and willingness to pay (WTP) surveys for 24 respondents from downstream. This was due to time and resource constraints. This may bias the outcome of this study. Nevertheless, the contingent valuation (CV) method itself suffers criticisms as 'embedding effect and purchasing of moral satisfaction' (Kahneman and Knetsch, 1992), and many biases (Turner et. al., 1994). But, application of these methods can provide a ball parking figure for ecosystem services values and finding possible investment opportunities.

RESULTS

I) Ecosystem services valuations

a) Direct use values

1. Drinking water supply: This is a consumptive use value of the ShNP watershed. According to DNPWC, everyday 30 million liters of drinking water is tapped and supplied to the valley people from this area. As people are charged monthly for the water supply services by NWSC, we can determine the value of this service of NP in the market. The market valuation of this service is provided in Table 6. From the calculation, **ShNP is providing drinking water value of $1.3 million per year or $93.75 per ha per year.**

Table 6: Market value of drinking water supply

Total volume in MLD	Total water supply in m^3/month	Market Price in $/$m^3$	Total price in $ per month	Total price in $ per year
30	900,000	0.125	112, 500	1,350,000

2. Recreational and tourism:

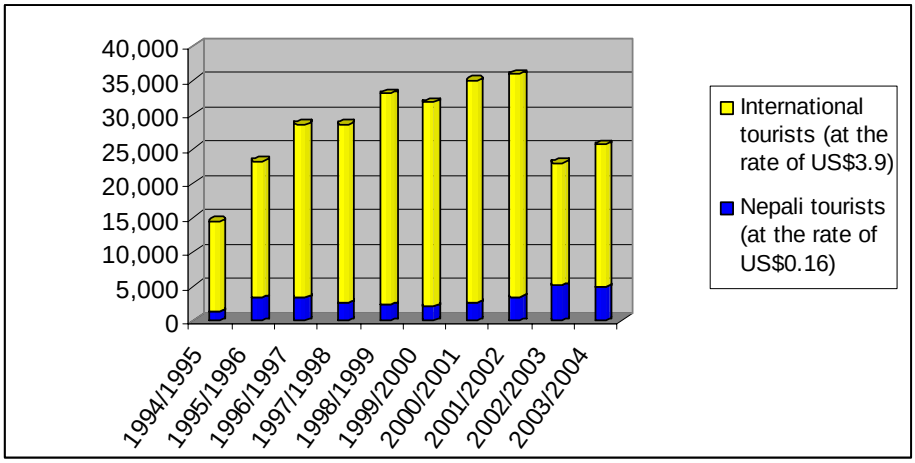


Figure 7: Revenues from tourists

This is the non-consumptive use value of ShNP. The nationals and international tourists, trekkers, pilgrims and picnickers are the main users of this service. As this park is accessible and within close proximity, the night stays are not common for tourists. Also, for international tourists this is only en route to trekking destinations like Nagarkot, Langtang and Helambu. Thus, hotels and lodges are not easily available according to the field observation. For this reason, the income of hotels, lodges and

restaurants are assumed to be negligible and not accounted for in this valuation. However, the park entry fee of $0.16 for nepali tourists and $3.9 for international tourists are allocated to value recreational and cultural values of the park. Depending on tourists flow, the revenue generated is calculated and presented in Figure 7 above. The average **annual recreational and cultural values of ShNP is $ 28,000 or $1.94 per ha per year.**

b) <u>Indirect use values</u>

3. <u>Water purification:</u> This ecosystem service is calculated by using the avoided cost method (Bernard, 2005). In this method coagulation and flocculation process in water treatment is used as a unit of measurement to determine avoided costs of the government. In this process aluminium sulphate (Al_3SO_4) commonly called 'alum' is used for removing sediments. There are various chemicals used to purify water like lime, hypochlorite or bleaching powder, calcium bicarbonate but alum is the most commonly used chemical in almost all the water treatment plants (field observation). Therefore, this chemical is chosen to calculate the avoided cost. In total there are eight treatment plants for processing drinking water. Out of the eight, water treatment plants Bansbari, Mahankalchaur and Sundarighat were chosen for this method because the first two have water source origins from ShNP (north of valley) while the last one has water sources different from ShNP (south-west of valley). Alum dosage (mg/l) used at these plants are respectively are 30mg/l, 40mg/l and 65mg/l respectively (personal communication with site technicians). These dosages are for dry seasons. During the monsoon, the sediments level increases in the water due to torrential rainfall and so does the turbidity, thus the dosages need to be increased accordingly (ibid.). Hence, the difference of dosage used between Bansbari/Mahankalchaur and Sundarighat are used to calculate the avoided cost. Dosage differences are 35mg/l and 25mg/l for Bansbari and Mahankalchaur respectively. The market price of 'alum' is established as $0.78 per kilograms (personal communication with retailers and shopkeepers). The avoided cost calculation is presented in Table 7.

Table 7: Avoided cost

Water treatment plants	Water treated daily in million liters	Alum dosage differences from Sundarighat (kg/l)	Avoided cost in $ per day	Avoided cost in $ per year
Bansbari	15	$35X10^{-6}$	409.50	149,468
Mahankalchaur	15	$25x10^{-6}$	292.50	106,763
Total	**30**	**-**	**-**	**256, 231**

From calculation we can conclude that the **water purification value of ShNP is $ 256,231 per year or $ 17.8 per ha per year**.

4. Carbon sequestration: This is also the indirect use value of ShNP ecosystem services. By reviewing various papers written for carbon sequestration rates of the forests of Nepal, this study establishes the rate in the range of 3-4.5tC/ha/year for protected areas. ShNP occupies a total of 14,400ha of land, thus ShNP can sequester in the range of 43,200-64,800tC per year. The market value for carbon sequestration is $13/tC (ANSAB, 2006). Therefore, **the carbon sequestration value for ShNP is $ 561,600 per year** (by taking conservative figure) **or $ 39 per ha per year.**

Therefore, ShNP has direct values of $96/ha/year and indirect values of $57/ha/year. **The total calculated value is $153/ha/year** for drinking water supply, water purification, recreational/tourism and carbon sequestration. **Drinking water and water purification together has value of $ 112/ha/yr.** This estimate is higher than global estimates which is $90/ha/year (Constanza, 1997).

II) Downstream perception and Willingness to Pay (WTP)

a) Perception, knowledge and responsibility

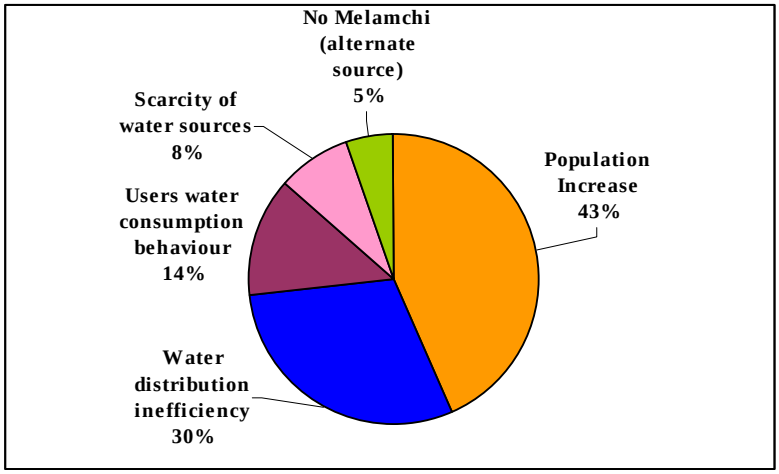


Figure 8: Perception of water supply problem

The people surveyed identified the population increase due to in-migration from villages and the inefficient water distribution system of NWSSCL as the main causes for drinking water problems in the Kathmandu valley which is presented in Figure 8.

A number of questions were asked to the respondents to determine their knowledge regarding the water sources of the valley like questions 15-20 (see Annex). The people who responded to all of these questions were regarded as people with complete knowledge and people who could not answer mainly 15 and 16 were considered to have partial knowledge. In Figure 9, 46% shows complete knowledge and could link drinking water supply to conservation of national park while 54% know the source but cannot make the linkage. The results show that people are knowledgeable about the cause of the problem and more than half of them do not have knowledge regarding origin of water sources, showing a need of awareness creation and education for the people to protect and conserve water sources.

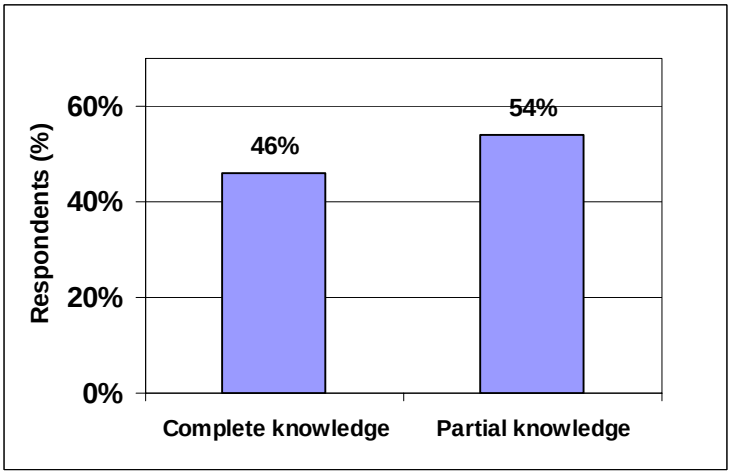


Figure 9: Knowledge of water sources

The response to the question regarding the responsibility to conserve ShNP, were much more divided among valley residents (35%), state (30%), NWSSCL (19%) and locals (12%) as presented in Figure 10. This result help identify important stakeholders of the water shortage problem in the valley.

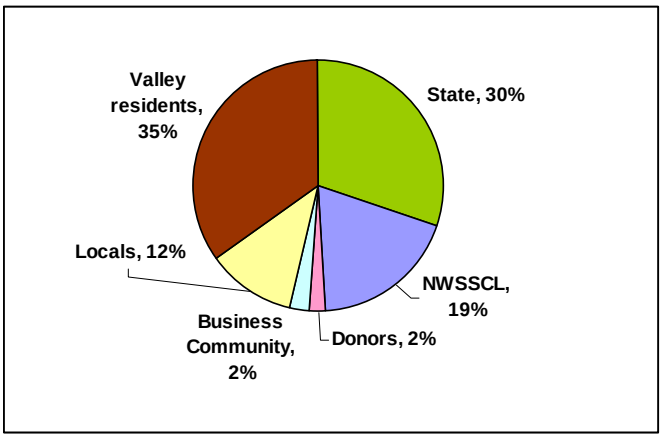


Figure 10: Who is responsible?

b) Ranking of ecosystem services

All the respondents were given the choice to rank the importance of ShNP before and after receiving information about the national park. People ranked the categories drinking water supply, a peaceful and clean environment, source of important rivers, biodiversity, cultural and tourism. The ranking remained the same after providing the important factors of the park. Later, more people chose drinking water services as their first priority when information was provided as shown in Figure 11. This result shows that by providing information and raising awareness, people's choice of services can be differed. This also helped to orient and focus the respondents' attention towards their willingness to pay.

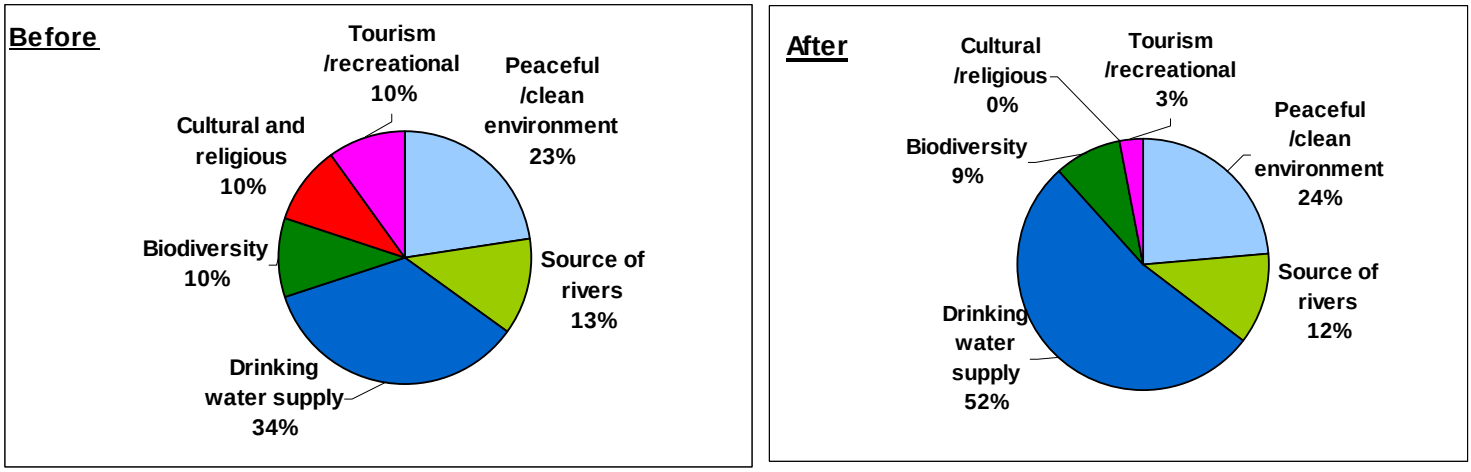
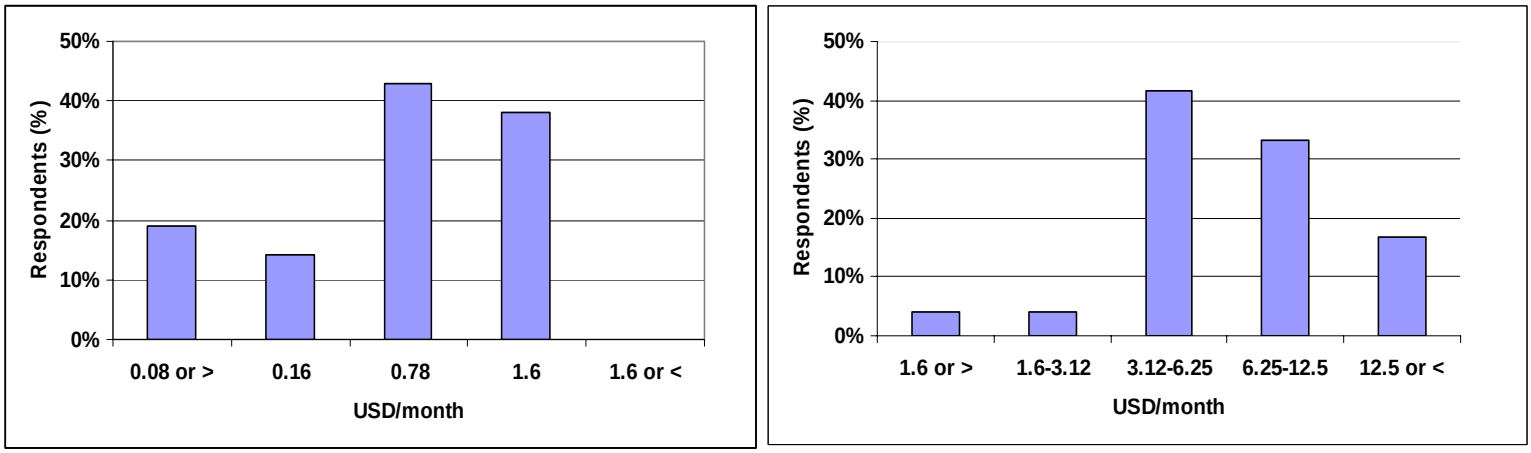


Figure 11: Ranking of importance of ecosystem services before and after informing

c) Willingness to pay

After the respondents were familiarized with the importance of ShNP for drinking water supply, the questions regarding what amount they were willing to pay were put forward; first to conserve ShNP and second to access regular clean drinking water. The respondents were given a range of values to chose. The result is presented in Figure 12 (a) and (b) below which shows 81% of respondents were willing to pay in the range of $ 0.78-1.6 per month (average of $ 1.19 per month) to conserve ShNP. And, 75% of the respondents were willing to pay in the range of $1.6 to 6.25 per month (average of $ 3.93 per month) if water supply is regular, dependable, clean and safe. Currently, they are paying $ 1.25 per month. WTP value among men and women respondents showed that the value is slightly higher for women with a difference of $ 0.22/month for conservation. And 75% of women chose $ 3.12-6.25/month for regular and clean water supply, while 56% of men chose in the range of $ 1.6-

3.12/month. This result shows women value this service more than men, but this could not be established simply based on this result and is behind the scope of this paper, but can be considered for future research. The data analysis of WTP with respect to income level, age and education level did not show much variation. This can be due to small sample size chosen for the survey. The result **shows WTP to conserve ShNP is 0.4% and for regular clean supply of drinking water is 1% of their mean monthly income ($300).**



a) For conservation of ShNP **b) For regular supply of clean drinking water**

Figure 12: People's Willingness to pay

d) <u>Institution</u>

Figure 13 shows most of the people were willing to contribute either in the form of tax (46%) or volunteering (42%). The choice of institutions is NWSSCL (46%), local clubs and NGOs (25%), ShNP (17%) and the municipality (13%) for their payment contribution.

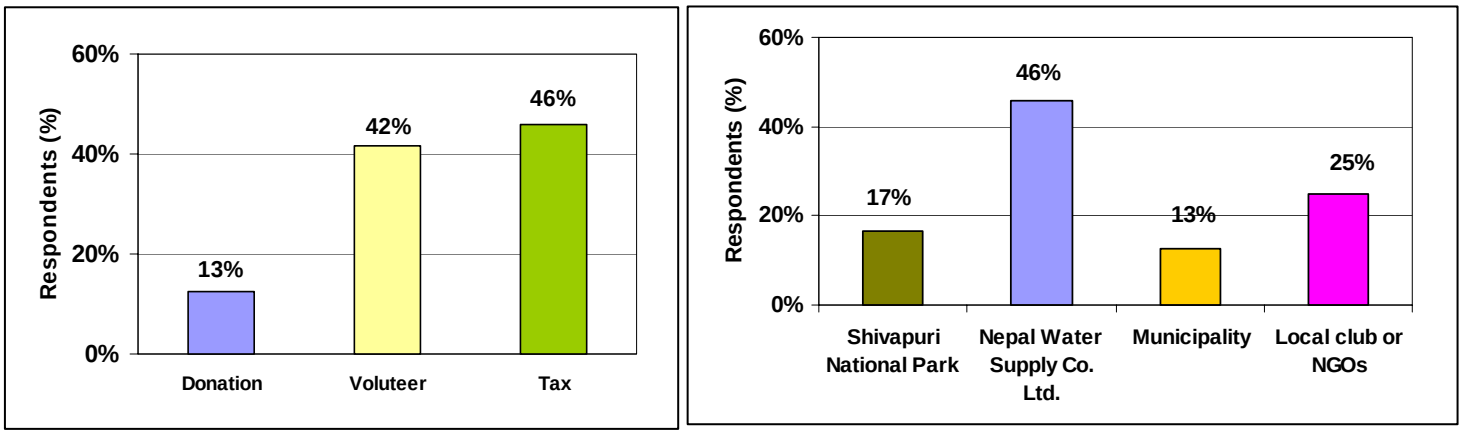


Figure 13: People's choice of institutions and mode of payment

In summary, the survey showed population increase as one of the reasons for water shortage problem in the valley. People have little knowledge regarding water sources and most of them ranked drinking water service of as an important ecosystem service of ShNP once information is provided. Beneficiaries felt the responsibility of protecting the water sources. Their WTP for ShNP conservation is 0.4% and for clean regular supply of drinking water is 1% of their mean monthly income.

III) Upstream perception and livelihoods

a) Local perception and Shivapuri National Park

A question regarding how the presence of national park impacts their lives was directed to ten local people living inside the national park. All the locals were negatively impacted due to wildlife depredation on their agricultural products. But, half of the respondents disagreed with the park restriction to use fuel-wood and fodder, as this is the mainstay of their energy source. The other half were positive and feel the park can bring other opportunities like tourism. The field observation revealed that people have strongly co-existed within the national park and their relocation from the park is highly improbable. The better option would be to embrace them within the park management and the benefits from the national park would be shared with the park residents to encourage them to conserve.

b) Buffer-zone and perception

An interview with the park warden Mr. Puran Bhakta Shrestha disclosed that the park will soon introduce a buffer-zone management plan and the office was currently demarcating the buffer-zone[5] area. This process has been successful in other national parks and especially in the Chitwan National Park. The locals, when asked, were not to be aware of the buffer zone concept. The buffer-zone is intended to involve the locals who were negatively impacted by wildlife and share 30-50% of the park benefits to encourage locals to conserve. After this explanation, most of the respondents showed a positive attitude towards the concept, while few were still skeptical and indifferent.

c) <u>Livelihood opportunities</u>

The field observation and informal talk showed that most of the park residents depend on agriculture (Figure 14 below), livestock rearing and small-scale business like tea and grocery shops. Domestic tourism is significantly impact on their livelihoods more than international tourism. Most of the people are involved in the alcohol fermentation business and the Kathmandu valley is the main importer of this product. Some of the people migrated into the ShNP to live near the city. The employment and education opportunities for children are the main reasons for their migration.

Therefore, upstream communities seem to co-exist with ShNP and hopes tourism can bring benefits in future. Most do not have knowledge what buffer-zone is and are happy to know that it will share 30-50% of ShNP revenue for local development. Locals depend on subsistent farming, livestock rearing and small scale business for livelihoods.

Figure 14: Agriculture terraces in ShNP

ANALYSIS

I) Problem

Interaction between human system and ecosystem is complex which varies across time and space (Liu et. al., 2007; Sendzimir et. al., 2007). But, understanding this complex system is important to identify underlying causes and effects of a problem (Haraldsson and Olafsdottir, 2003) and application of causal loop diagram[4] (CLD) is a useful tool (Pidd, 2003; Haraldsson and Olafsdottir, 2003). A study on protected areas found that a third of world's largest cities (33 out of 105) depend on protected areas for drinking water supply and unfortunately a billion people who live in these cities live without access to clean and adequate water (CBD, 2008). Recently, the watershed value of protected areas is recognized. Therefore, based on CLD analysis, this paper will attempt to identify cause-effect of drinking water scarcity in the Kathmandu valley to link with ecosystem services of ShNP. ShNP is providing ecosystem services of value of $ 152.5/ha/year of which drinking water and water purification value is $ 112/ha/year, which is higher than the global estimates ($ 90/ha/year) (Costanza, 1997). Drinking water services of ShNP is important for the downstream population and is willing to pay more. This motivates water scarcity problem as a topic of further analysis in this paper. Some of the assumptions made for using the analysis are locals use water for free as they perceive it as a free goods of nature and downstream uses water only for domestic purposes. Industrial, agriculture and other water uses are kept behind the system boundary of this analysis and also the water distribution inefficiency of government are not considered within this analysis. And ground water sources are considered within private investments. This may partially affect the outcome and may dilute or simplify the complexity of a dynamic system.

The annual budget expenditure for the ShNP management for 2006/2007 was $ 410,710 (Personal communication, P.B. Shrestha), from which we can calculate the current management value as $28.5/ha/year. This is substantially low than its ecosystem services value i.e $112/ha/yr. Thus a question arises; are we investing enough? In fact, there is a huge drinking water supply deficit downstream. In 2000, Kathmandu valley experienced a water stress of approximately 60 million m^3 and a water scarcity of 40 million m^3 (OECD, 2003) which is 50 million m^3 in 2005 (NWSC, 2004/2005). Thus, the attempt here is to conceptualize this problem by using a causal loop diagram (CLD) to initiate system thinking as in Figure 15.

In the figure R reinforces (increases) while B balances (decreases) the water shortage problem in the valley. The R at the right most shows increasing supply-demand gap as the population of the city is increasing due to in-migration from villages. This is creating pressure on the water resources and decreasing the minimum daily water requirement. WHO has set minimum daily requirement as 70 liters per person (capita) per day (lpcd) for domestic use purposes for South Asia while the survey showed that the average daily use of valley people is 43 lpcd.

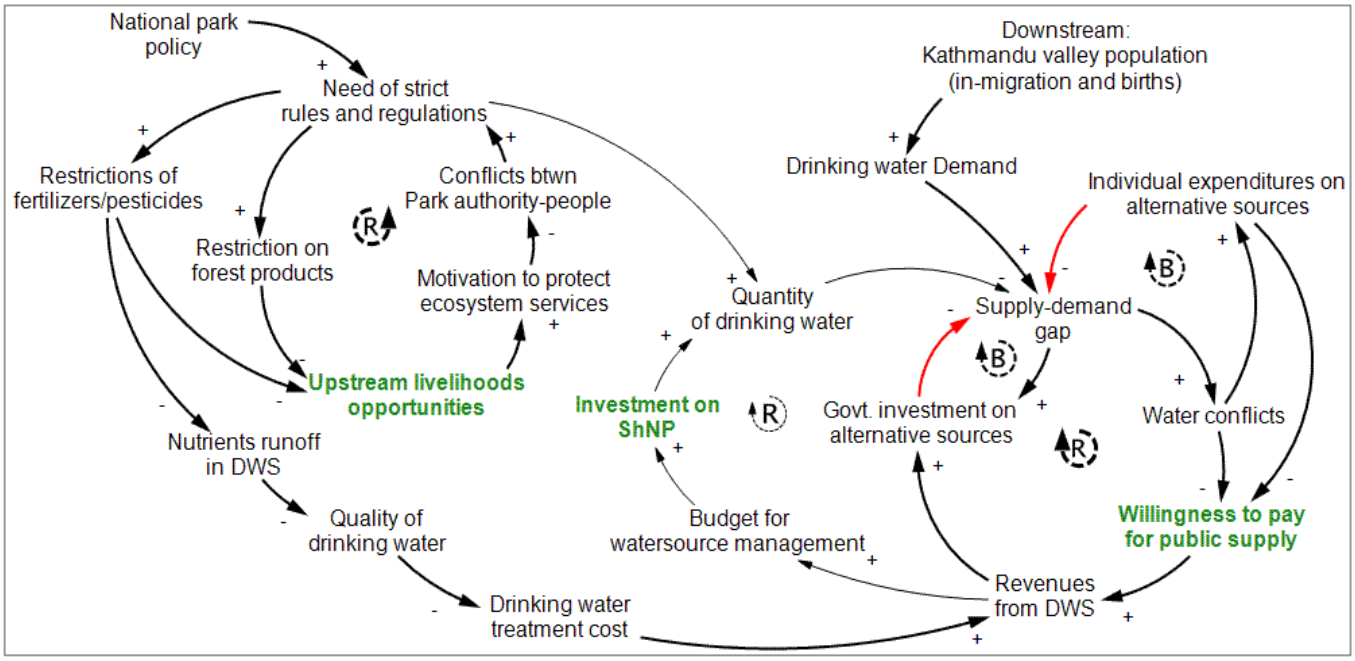


Figure 15: CLD of causes-effects of drinking water scarcity in Kathmandu valley.
(The bold arrows lead to dominating variables, red show delays, green texts are possible areas of intervention)

Consequently, the population is spending more on private sources like tube wells, bore wells, wells, tankers and even bottled mineral water to compensate for the deficit as coping strategies (Patnayak et. al., 2005). Thus, the people's 'willingness to pay' for the public supply is assumed to be decreasing, while the government's to investment on alternative sources, increasing efficiency in the distribution system is increasing and finally increasing administrative costs. But water production comes with a certain time delays of 5-10 years. This, therefore, reinforces the supply-demand gap in the valley. As government search for alternatives and techno solution of the problem follows the weak sustainability paradigm, where neo-liberal economists believe that natural capital is substitutable with investment into technology and new alternatives, which is refuted by ecological economists, who believe natural

capital is complementary rather than a substitute (Harris et al, 2001). This complementary nature of ecosystem triggers a need to protect and conserve it for human welfare.

The R at the left most shows presence of ShNP in the watershed of the drinking water supply for the protection of existing water sources. The park restricts locals from using pesticides/fertilizers on farms, forest products like fuel-wood, fodder, timber and non-timber forest products and encourages planting of endemic grass/tree species on farms (field observation). This decreases the nutrients (nitrogen and phosphorus) and sediment run-offs in the water supply, saving water treatment costs to the government. This saving comes at the cost of the water purification value of ShNP ($ 17.8/ha/year) which amounts to around $ 256,000 per year and total opportunity costs of locals to around $ 772,000/yr (IUCN, 2004). The national park policies are internationally implemented to protect and conserve the natural resources, the local conflicts increases the need to make them even stricter. This reinforces the problem at upstream without solving water shortages downstream. Thus, another question arises; by investing in the ecosystem services, can we solve the both the problems of downstream and upstream? For answering this question we need to go deeper and analyze the problem by identifying its driving forces, stakeholders and policies which can lead us to identify opportunities and challenges.

II) Driving forces

a. Population and urbanization

With the annual population growth rate of 6 per cent (Timilsina, 2007; WFP, 2005; ADB, 2001), the total population in the valley was 2 million in 2006 and projected to 2.5 million by 2016 (CBS, 2005). The growth rate includes rural to urban migration and natural births. Population increase in the valley (Figure 16) is a driving force behind the water shortage in the valley. This increase has affected the drinking water demand in the valley. The supply-demand gap was 95 MLD in 2000 and 140 MLD in 2005 (NWSC, 2004/2005), which can be predicted to increase to 190 MLD in 2010 and 290 MLD in 2020. Also, the KVEO report shows the forest area of the surrounding watersheds decreased by 40% from 1955-1996 due to increasing urban and rural built-up areas. Presumably, water recharge capacity of watershed has decreased, affecting both the quality and quantity of surface and groundwater sources. Increasing population triggers economic activities, affecting agricultural and infrastructural

development; hydropower generation and waste generation are the impact of urbanization. This has a direct and indirect impact on water quantity as well as quality, adversely affecting the water demand.

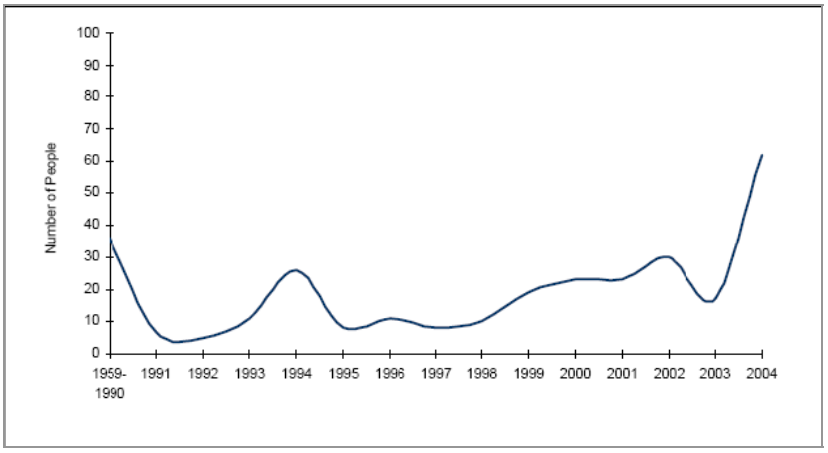


Figure 16: Population in-migration in Kathmandu valley (Some selected wards)
(Source: WFP, 2005:4 and Timilsina, 2007:18)

b. <u>National park policy</u>

This is a legal instrument which is driving and impacting the livelihood opportunities for upstream. The FAO review (2002) on watershed stated that many watershed management failed to achieve its objective because they focus more on natural resource conservation, pay little attention to local priorities and needs and neglect beneficiaries' participation in its management. The national parks protect the natural environment that ensure a reliable and high-quality supply of drinking water for downstream, minimize degradation of land by applying corrective measures, and improve the living standard of the resident and adjacent rural populations (CBD, 2008). Thus, this shows that ShNP not only has a responsibility to protect watershed but also has the responsibility to introduce appropriate land-use measures and improve living standards of communities living at proximity. Otherwise, it may give rise to park people conflict reinforcing the problem at upstream as in CLD of Figure 15.

III) Stakeholders

In context of this case study, five key stakeholder groups were identified through iterative process between literature reviews, field surveys and observation. They are a) downstream population, b)

government authorities (NWSSCL and ShNP), c) upstream communities, d) local authorities and organizations (DDC, NGOs/CBOs/Clubs) and e) Others (donors, tourists and private sectors). The Figure 17 ranks stakeholders with respect to the importance and influence in the context of water shortage. The stakeholders who are highly affected by the problem are given high importance and those who can influence or have power to change the problem are scaled as highly influential stakeholders. This is based on the matrix adopted by Grimble and Willard (1997).

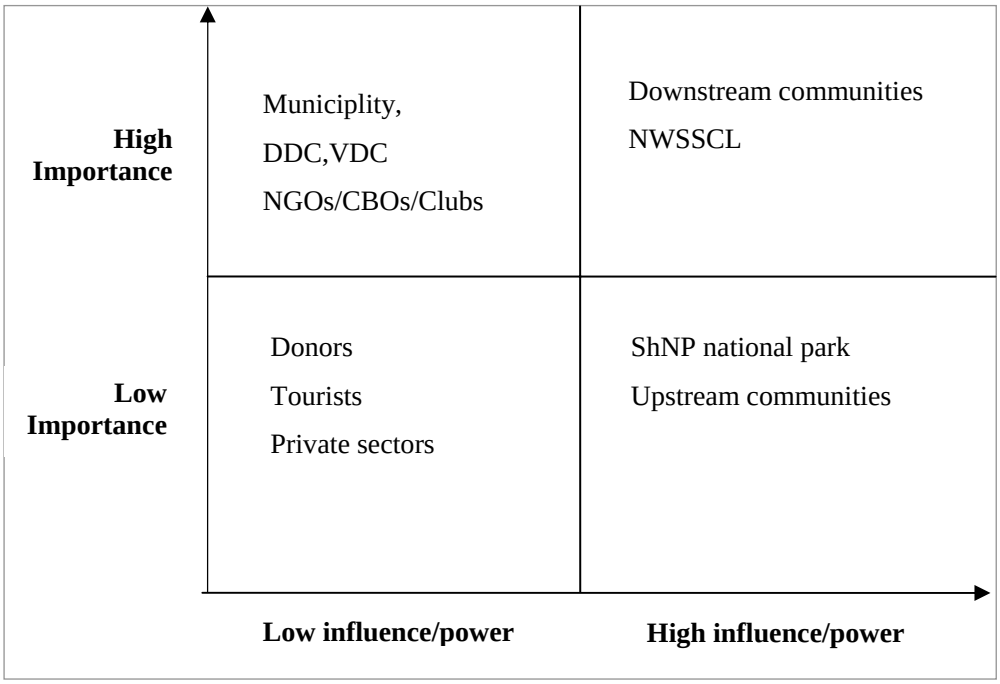


Figure 17: Stakeholders influence/ importance Matrix
(Adopted by Grimble and Wellard, 1997)

a. <u>Downstream communities</u>

Downstream is the most affected population from drinking water shortages. As stated, the water supply-demand gap is increasing and predicted to escalate in coming years and their minimum daily use is far below set by WHO. Thus, there is an urgent need to intervene in water supply management downstream. This shows that this stakeholder groups is critically affected by the problem. But can also be an agent of change for this problem by supporting in the conservation of ShNP and paying more for the drinking water supply. Based on the survey, the people of the Kathmandu are willing to pay total of

$4 per month per household. This can be a sustainable investment for conserving ShNP and managing water problem in the valley.

b. Government authorities

1. NWSSCL: This is the water supply authority which deals with water shortage problem in the valley. Complaints, leakages, pressure to search for alternative sources and budget constraints are its main problems. However, they have the most powerful role in solving these problems. This company has the capacity to implement the policy that embraces people's willingness to pay and manage services at an ecosystem level. Most of the interviewees selected NWSSCL as the institution to pay in the form of tax or volunteering to conserve ShNP for regular, dependable supply of drinking water shown in Figure 13.

2. ShNP: Shivapuri National Park plays an important role by protecting ecosystem services for the downstream population. And, ShNP has the high potentiality to influence the policy to manage ShNP at an ecosystem level, to fulfill ecological as well as human water needs. From the CLD in Figure 15 which recognizes the need of 'policies' that optimize both of the needs. For example, in South Africa, the National Water Act, 1998 recognizes the need to conserve ecological reserve for "in stream flow requirement" while the Water Service Act 1997, restricts non-native tree plantings and other land use activities to increase water supply (Sterner, 2003; Postel and Thompson, 2005). As, in this case study, ShNP located in the watershed area can play a balancing role that of conserving the ecological reserve as well as to increasing water quantity and quality by protecting new sources and optimizing land-use.

c. Upstream Communities

This represents around 2,000 households inside and outside the NP (IUCN, 2004), whose activities affect the ecosystem services of ShNP and vice-versa. The national park policies restricts the use of pesticides and fertilizers in the agriculture production, restricts the commercial use of timber, fuel-wood and fodder and even restricts any kinds of land-use activities that hamper the water quality and quantity downstream. This can create conflict between the park authorities and local people as this directly interferes with their livelihood opportunities. IUCN calculated this cost as $419 per year per household which include crop damage due to wildlife, loss of use of park resources due to restrictions on harvesting, loss of access to agricultural markets. Therefore, the total opportunity cost is $772,000

per year, which is a huge amount to be compensated. This requires a sustainable financial source of investment.

d. Local authorities and organizations

Municipality, district development committees (DDCs), NGOs, CBOs and local clubs are categorized in this group. These are strong actors for local development. These institutions can play an important role for developing an investment mechanism that captures people's willingness to pay to conserve ecosystem services. For example, in Brazil, the state government uses a public sector redistribution mechanism where the state provides additional funds to the municipalities that protect watersheds (Johnson et al, 2001). ShNP along with buffer zone occupies part of the Kathmandu, Nuwakot and Sindupalchowk districts. These districts have the responsibility to protect ShNP and they must be provided with additional fund to protect and conserve the national park.

e. Others

Donors, private sectors and tourists are categorized in this group. Donors can play an influential role in the problem. The water shortage in the valley induces donors to finance various water related projects and programs to support government to fulfill MDGs target. Besides, private sectors like hotels, industries, enterprises and water suppliers who use water intensively for profit can also play a crucial role in protecting the watershed. Likewise, both national and international tourists can contribute by paying additional costs for watershed management and protection. As this group of stakeholder is at lower stake in this problem, this group is not considered in further discussions.

IV) Policy

The stakeholder analysis shows a need of a mechanism that captures WTP value of downstream to conserve ShNP and support livelihoods upstream. This may necessitates a policy that links the two institutions; NWSSCL and ShNP at policy formulation level and a local institution at implementation level to compensate the locals who participate in water resource conservation and protection. But before that, it is important to analyze where and how the existing policies of water and forest resources and local development are dealt with.

Water resource is covered in seven pieces of legislation in Nepal: Soil and Watershed Conservation Act, 1982; Land Act, 1964; National Parks and Wildlife Conservation Act, 1973; Environmental Protection Act, 1996; Forest Act, 1993; Water Resource Act, 1992; and Local Governance Act, 1998. And, these legislative frameworks suffer overlapping responsibilities, unclear jurisdiction for implementation, 'lack of clear resource allocation for watershed management' and 'lack of emphasis on ground-level coordination' (Poudel, 2003). The National water plan formulated by Water and Energy Commission Secretariat (WECS), (2005) stressed on the need of water resource management through formation of a district water resources committee (DWRC) within the jurisdiction of the district development committee (DDC). This is against the provision of Local Governance Act (1998), which recognizes DDC as the planning agency at the district level (Pant et al, 2005). This means there is no local institution to implement water resource management at local level. The Forest Act (1993) has completely excluded water resources while defining "forest products" and the amendment of the Forest Act (1998) outlines that community will possess no rights over water resources within community forests (Pant et al, 2005), The forest policies mainly focus on the handing over of forests to community user groups at local level to meet their basic need while conserving the same. This shows water resource lies outside the jurisdiction of forest management.

Recently, Nepal's three year interim plan (2008–2010) recognizes the importance of forestry sector in poverty alleviation which says 'forest development fund' will be set up by collecting fixed percentage of amount from buyers while selling forest-related products and a fixed percentage from the revenue generated by the sale of these products will be used in the tree plantation and long-term forest management and poverty alleviation. As, water is not considered as forest products it is unclear whether the revenue collected by the sale of this product can be invested in forest management and poverty alleviation. Therefore, this shows a need of redefining water resource as a forest product which can bring revenue into the forest development fund to conserve ShNP and to compensate locals who participate in the conservation of water resources.

DISCUSSIONS

The analysis shows that there should be a mechanism that captures the WTP potential of downstream to invest in sustainable management of ShNP and support upstream to participate in this management. Also this mechanism must formulate a policy that redefines water as a forest product and benefits from selling this product can bring revenue for sustainable ShNP management. This policy must designate a local institution to implement the management. Investing in ShNP looks tempting due to following opportunities but it is also not far off from challenges.

I) Opportunities

a. New water sources and rural development

Investing in ecosystem services management can increase the service production potential of an ecosystem. An engineer (Badri Palanchowki) who is involved in feasibility study of water sources at ShNP observed that if the government would invest enough in the Shivapuri watershed management, it has the potential of producing 75MLD of additional drinking water fulfilling 50% of the present demand gap. According to the engineer there is more potential and it is more cost effective to invest in the existing sources than using resources and energy for alternative sources. Thus, the mechanism must realize this drinking water supply potential and water purification capacity of the ShNP.

A study conducted by IUCN (2004) established that the cost of relocating the local communities and compensating them is six times higher than allowing them to live in the park and participate in the watershed management. Similarly, the status quo or business as usual scenario is as expensive as the relocation scenario. Therefore, to accept people within the management and allow them to continue using their land in an efficient way is the most cost effective measure. This requires awareness among locals and their participation to change the current land use pattern and to provide compensation for the sustainable forest management of the park. The investment in sustainable forest management and compensation for local livelihoods can induce rural development (Postel and Thompson, 2005). Therefore, ShNP can induce rural development upstream.

b. Willingness to pay

The survey in this study showed that the people are willing to pay 1% of their income which is an opportunity for revenue generation. Another study carried out in Kathmandu also showed people are willing to pay more than what they are paying for coping strategies which they deducted to be 1% of average monthly income (Patnayak et. al., 2005). A similar study carried out in Bolivia demonstrated that it is possible to estimate the stakeholder WTP for a watershed restoration program for improved water supply and quality in a developing country (Shultz and Soliz, 2007). But capturing this revenue and integrating them in the management is a challenge. Water supplier, like NWSSCL, who benefits from ShNP management, must be willing to pay a portion of the revenue to upstream farmers (Postel and Thompson, 2005).

Besides, the park has several other services like recreational/cultural, biodiversity, educational and carbon sequestration. As said earlier, Shivapuri is an important religious place for Hindus and Buddhists and pilgrims from Kathmandu Valley and neighboring valleys visit Baghdwar and Vishnudwar where the sacred rivers Bagmati and Vishnumati originate. The survey of visitors "willingness to pay" can be another opportunity to harness revenues. As ShNP offers many ecosystem services it has huge potential for revenues. The aggregation of these benefits can be a huge investment fund for ShNP and local development.

c. Awareness and participation

Experience from the WTP survey and field visit showed the need of awareness creation among two levels; people who are using ecosystem services and people who are providing them. Most of the interviewees were not willing to participate until a detailed explanation and information of ShNP were provided. The information made people more responsive and encouraged them to choose values for the WTP questions. It has been observed that the survey itself can generate awareness. Same was the case in Bolivia, where WTP survey encouraged stakeholder understanding, support and participation in the watershed restoration program (Shultz and Soliz, 2007). Also, the field observation showed that most upstream communities are unaware of the buffer-zone concept where ShNP shares 30-50% of their benefits for local development. This means local NGOs, CBOs and clubs can play a bridging role for generating awareness among people to initiate their participation.

Nepal's community forest management through forest user groups is an illustrative example. It allows local people's participation for forest resource management. The Master Plan for Forestry Sector (MPFS) stressed that participation of local communities in decision-making and benefit sharing as essential for the conservation of forest management. This point is to emphasize that Nepal is fully aware of the people's power in resource management. And, the learning from community forestry is being diffused in soil conservation, watershed management and buffer zone management through community forest user groups (CFUGs), farmer groups and water users group (WUGs) (Kanel, 2007). Therefore, awareness creation and participation of both downstream and upstream is considered as an opportunity to initiate investment mechanism for protection and conservation of ecosystem services.

d. Institutional coordination and capacity building

The ShNP along with buffer-zone constitute watershed areas which occupy parts of the three districts, namely, Kathmandu, Nuwakot and Sindhupalchowk. These three districts must therefore be given responsibility and additional funds to protect watershed. Districts then pass on the funds to respective village development committees (VDCs) to compensate local institutions like farmer groups or community forest users groups or water users groups who are actively participated in the watershed protection. It is through DDCs and VDCs that the decision making process is decentralized and strengthening of these institutions is necessary to ensure participatory decision making, that is transparent and responsive to the development process (SAAPE, 2003). Fairness of resource allocation, good governance and monitoring of resource distribution are the possible challenges of this process. But, ShNP as a local institution can play a significant role by demarcating buffer zone, implementing land–use policies, linking farmers or community to access compensation funds and monitoring the process. This requires high coordination among NWSSCL for providing, ShNP for monitoring and co-ordinating and VDCs and local institutions for implementing the fund from the revenue.

A local expertise in water and land use management is a prerequisite for active and effective participation in the collaborative forum (Cronin and Otergren, 2007). Similarly, the capacity building to encourage participation and integrate local values fosters collaboration between locals and other

managers; the outcome is effective and it creates an environment that promotes discussion and solutions rather than litigation (ibid.). Therefore, training and education of locals to encourage their effective participation is another important step to foster investment. Rebecca Adamson, founder and president of the First Nations Development Institute, agrees on the need for capacity-building and technical assistance to these local, and insists that they do need community infrastructure and development but in their own terms that protects and sustain them (Alliance 2004). The capacity building of these locals must therefore first identify the local needs to complement them in the sustainable management of ShNP.

II) Challenges

a. Population increase and carrying capacity

Population increase and rapid urbanization is a driving force and a challenge for sustainable management of resources. This driving force is putting pressure on available resources in the valley like drinking water supply, consequently, increasing demand for the services. The Kathmandu population represents 13-14% of national population with an annual increment rate as 6 per cent. Rapid urbanization has been the major phenomenon of the 20th century, which will continue into the 21st and will lead to pressure on infrastructure and resources. Population is the denominator for many indicators, and is a measure of demand for services. (ADB, 2001).

Immigration in the valley started in mid 1990s and increased dramatically in mid 2000. This swelling up of conflict-induced migrants started with the onset of the armed struggle between the Government and Communist Party of Nepal (Maoist) in 1996 (WFP, 2005; Timilsina, 2007). Therefore, this will be a challenge for managing ecosystem services, as the ecosystem has its own 'carrying capacity'. Garrett Hardin (1977) defined carrying capacity as the maximum number of species/individuals that can be supported indefinitely by a particular habitat, allowing for seasonal and random changes, without degradation of the environment and without diminishing carrying capacity in the future. But there is no precise evidence of how many individuals an ecosystem can support. However, we can make roughly estimate that the Shivapuri watershed can support 1.5 million people downstream if its future potentials are included and by assuming water in the valley is used only for domestic purposes as shown in Table 8 below.

Table 8: Calculating carrying capacity of drinking water supply of ShNP

Existing supply: 30MLD
Future supply: 75 MLD
Total supply: 105 MLD
Assuming in valley, 2 million population use water only for domestic uses;
WHO minimum daily water requirement: 70 liter per capita per day,
Total demand for domestic uses: 140 MLD
With 105 MLD drinking water supply it can support 1.5 million populations

Moreover, Kathmandu is an economic hub of the country, many industries, hospitals, schools, hotels, and many more water intensive enterprises are located in the valley, there in constraining the available water resources. Thus, this necessitates an efficient population management and planning of available water resources for this population.

b. <u>Willingness to pay: a desire or capability?</u>

The WTP calculated in this paper may not truly reflect the beneficiaries' capability to pay. Capability means income, age, gender, education, location (Sen, 2000). For example, the survey for this paper shows that two interviewees whose income level is in the range of $ 93-125 per month are willing to pay the same as two interviewees earning in the range of $ 546-937 per month. Other examples are; students and housewives are more willing to volunteer than pay monetarily; men are willing to pay less than women are. Therefore, a question is whether the WTP really reflects capability or just a desire. One must be careful regarding embedding the WTP within a policy since it is largely affected by income level, initial bid amount, gender, age of beneficiaries (Ojaeda et. al., 2008). Nepal is one of the least developed countries in the world with GDP per capita (purchasing power parity) of only $1,550 and GINI co-efficient[3] as 0.47 (UNDP, 2005), showing unequal distribution of income.

Hence, the survey among 24 respondents may not be sufficient to reflect the WTP capabilities of the whole downstream population. A more detail survey is recommended to establish a valid WTP value before embedding it in a policy. Additionally, there are other ecosystem services like recreation/tourism, cultural, educational/research, carbon sequestration and biodiversity through which revenues can be pooled to protect and manage the watershed. The total value of such complementary

benefits besides hydrological services justify a greater degree of watershed protection and open up new financing opportunities (Postel and Thompson, 2005).

c. Sustainability of institutional mechanisms

Worldwide examples have shown that direct payments from beneficiaries of different ecosystem services of watershed are a sustainable source of investment. For example, in Quito, Ecuador the establishment of a trust fund, to compensate landowners for safeguarding water supply, faces financial constraints and equity issues. The fund came voluntarily from water suppliers, NGOs and electricity authority. Similarly, the Costa Rican government compensating landowners for watershed services through a forest conservation act also faced same issues as the source for compensation came from tax on fossil fuel, World Bank loan, GEF grant and from sale of carbon credits. Eventually, both of these cases revealed that the direct payments from user fees are a longer term solution than collecting fund through indirect sources (Postel and Thompson, 2005).

Therefore, in the case of the Shivapuri watershed to tap WTP beneficiaries is a sustainable investment source to compensate the people upstream. But there is a need of a mechanism that can capture this investment and identify an institution that can implement the same; the institutional mechanism that collects revenues for downstream and compensates locals upstream, who are willing to participate in land conservation for watershed purpose. But again it may encounter equity issues due to unequal distribution of property i.e. land in Nepal., as unequal distribution of land is a major cause of poverty in Nepal and must undergo "radical land reform" (SAAPE, 2003). Therefore, the mechanism to overcome equity issues must first experience radical land reform which is challenging and can cause delay in a system. Sustainability of an institution is also challenged by good governance, defined as fairness, transparent, responsive and a democratic process of decision making and implementation (SAAPE, 2003). This means; corruption, irregularities, lawlessness and absence of a local body are the challenges to overcome before implementing a sustainable finance mechanism for investment.

d. Future risks and uncertainties

Major uncertainties and risks involving the impact of climate change are flood and landslides for which Nepal is prone to. As ShNP lies in the mid- hills, its sustainability is challenged by these risks and uncertainties. The global circulation model (GCM) projected an annual increasing trend in

temperature and precipitation for Nepal in years 2030, 2050 and 2100 and the impact will be most vulnerable for the water resources through landslides, flood and sedimentation (OECD, 2003). This can further perpetuate water scarcity downstream as well as negatively impact agriculture and rural livelihoods upstream. Therefore, ShNP and its buffer-zone management must take into account these future uncertainty and risks so as to apply effective adaptation strategies that secure water supply downstream and livelihoods upstream.

CONCLUSIONS AND RECCOMENDATIONS

Watershed management is not a new paradigm and commonly being practiced worldwide to solve problems in an integrated approach. Realizing the watershed potentiality and high biodiversity of the Shivapuri watershed led the government to protect this area. It is interesting to note that though protected it cannot stand isolated from socio-economic system. It has its sustainability lying among human system, i.e. economy. Sustainable management of any system requires the integration with socio-economic system. Based on the findings of this research some recommendations are made for future management of ShNP, a way forward for government of Nepal and for future study. They are;

For ShNP management:

- Valuation of ecosystem services of ShNP shows drinking water as a potential service. The revenues from this service can be invested in the management and to compensate upstream communities. But there is a need of high level of co-ordination among institutions like ShNP, NWSSCL and local institutions to realize and materialize this potential. Also, it requires institutional efficiency to trickle down the benefits to the level where it is necessary.
- Beneficiaries are willing to pay to conserve ShNP and are willing to pay more for regular, dependable and clean water supply. This opportunity should be realized for increasing the investment for managing watershed upstream. But, there must be a reliable and sustainable mechanism to tap this opportunity which also takes into consideration factors like income and land distribution.
- This mechanism must formulate a policy that redefines water as a forest product and benefits from selling this product can bring revenue for sustainable management of ShNP.

- Awareness and education among the communities of upstream and downstream are important to institutionalize the concept of upstream and downstream in watershed management. Capacity building of upstream is important to protect and conserve the watershed but must consider their local needs. Also, there is a strong need to build capacities of institutions like NWSSCL and ShNP that formulate and local institutions like CFGUGs, farmers groups and water users groups to implement the policy of sustainable finance mechanism.

For Government of Nepal:

- As population increase is a driving force for water scarcity in the valley, there is a need of a policy that stabilizes in-migration in the valley to reduce water constraint. Since carrying capacity of the Kathmandu Valley with respect to drinking water supply has already crossed a limit, shows the need of a policy that encourages 'out-migration'. If development projects (like Melamchi project[2], outer ring road project) are centralized in the valley, supply-demand gap tends to increase. Therefore, "out-migration" of population from the valley is necessary for effective and sustainable management of natural resources like drinking water. The political system, the national plans and policies must therefore adopt decentralized policies that focus on creating economic opportunities in other urban and rural areas of the country. The sustainable management of ShNP and its buffer zone and decentralization of development projects must go side-by-side to manage population pressure on constraining resources.
- Kathmandu valley should therefore be responsible for managing and protecting ShNP and its surrounding area and must prepare a sustainable development plan that embraces all the opportunities by overcoming challenges. The plan must include a sustainable and reliable investment mechanism for ShNP management by setting short and long term goals, indicators, targets and activities to attain overall sustainability of the system. This type of plan will not only be an example document for replication in all the watersheds lying along inner Himalayan regions but also for other protected areas and watersheds around the globe.

For future study:

- There are many ecosystem services of ShNP which remain to be evaluated. For example; biodiversity, flood control, educational and research, existence value for future generations and

many more. But only valuations are not enough if it cannot draw investment for its protection and conservation. Therefore, it is important to identify beneficiaries of these ecosystem services who are willing to pay or contribute to preserve it.

- Valuation of an ecosystem services is complex and require multitude of methods to determine a value. As nature also possess intrinsic (own or non-market) value along with extrinsic (market or utility) value, valuation becomes an inadequate tool. More research, validation and critical analysis regarding the use of this tool are necessary.
- Sustainability requires us to integrate environmental, economical and social (political) systems. Integration requires complete knowledge of these systems which is challenging but can be acquired through continued dialogue and interactions among experts, practitioners and planners.

Notes:

[1]Buffer-zone of a national park is define as the area influenced by wildlife and people living in this area is compensated by sharing 30-50% of park revenues via local development programs.

[2]Melamchi Water Supply Project: This is ongoing project to bring extra 170 MLD of water supply to meet growing water demand in the Kathmandu valley. This is funded by ADB.

[3]The GINI coefficient is a number between zero and one that measures the degree of inequality in the distribution of income in a given society. The coefficient would register zero inequality for a society in which each member received exactly the same income and it would register a coefficient of one (maximum inequality) if one member got all the income and the rest got nothing (OECD, 2003).

[4]In a Causal loop diagram also called CLD, a plus sign designates identical direction; that is a decrease leads to a decrease or an increase leads to an increase (Haraldsson and Olafsdottir, 2003). A minus sign designates opposed direction; that is a decrease leads to an increase and vice versa. All arrows linking any two variables (the antecedent and consequent) in each of the four sub-systems indicate causality (Haraldsson and Olafsdottir, 2003). The arrows are valid only under 'ceteris paribus-all others being equal' (ibid.). R depicts a feedback that amplifies a condition while B depicts a feedback that dampens a condition (Haraldsson and Olafsdottir, 2003). The CLDs has its limitations. They are; first it is an abstract and may not reflect the complexity of a dynamic system and second, some of the variables are uncertain, qualitative and subjective.

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ANNEX

Kathmandu valley Drinking water management and Shivapuri National Park Conservation

Questionnaires

(The information provided will be treated as confidential and only be used for this research)

General information

1. Occupation:…… Education:…….. Age: ……Gender: ……..
2. Family size: ……
3. Monthly income (Average): …….
4. Years of residence and address in Kathmandu:…….

Drinking water Information

5. How many hours per day and how many days per week do you get drinking water from tap?.....
6. How many liters of water do you use per week?.....
7. Is the quantity enough for your household use? Yes or no. (If yes go to Q. 11)
8. If no, what are your other sources: i) private tanker, ii) well, iii) tube well, iv) others…….
9. How much did you spend to construct well or tube well and date of construction?.....
10. If you use water from private tankers, how much do you spend per month?.....
11. Is water from your source drinkable? Yes or No (If yes go to Q. 13)
12. If no, how do you treat drinking water?.....
13. How much per cent of your income do you spend for drinking water monthly?.....
14. According to you, what is the main cause of water scarcity problem in the valley? i) Population increase, ii) inefficient water distribution, iii) scarcity of water sources, iv) water consumption behavior of users, v) others……..
15. Do you know the source of your drinking water?.....
16. Do you think it is important to conserve and protect this source?.....
17. Do you think, if you invest the amount you spend in drinking water now you can protect and conserve your water sources?.....

Shivapuri National Park Information

18. Do you know about Shivapuri National Park? Yes or No (If No, go to Q. 20).

19. If yes, what do you know and how many times you have visited?.....

20. Have you been to Sundarijal? How many times? This lies in the national Park. ……..

21. a Why do you think ShNP is important? i) Peaceful and clean environment, ii) source for Bagmati and Vishnumati, iii) drinking water source, iv) biodiversity, v) location of important temples, vi) picnicking and tourist spot

(General information of ShNP is then provided by reading from brochures. How much expenditure the government requires in managing buffer zone area was briefly discussed to orient the respondents towards WTP).

21. b Do you want to change the choice for the importance of National Park? (ref. Q. 21)

22. Who do you think is most responsible to protect and conserve the national park? i) government, ii) NWSSCL, iii) donors, iv) business community, v) locals, vi) you yourself, vii) others……..

Willingness to Pay

23. In what way do you want to contribute for the conservation of the national park? i) donation, ii) volunteering, iii) as a special tax, or iv) others……

24. How much are you willing to pay NRs/month? i) 5 or less ii) 10 iii) 50 iv) 100 v) 100 or more?

25. Which institution will you choose for your payment? i) ShNP ii) NWSSCL, iii) DDC/VDC/Municipality, iv) local clubs/NGOs v) others……

26. Do you agree that by protecting ShNP we can get regular, dependable and clean drinking water? Yes or No or maybe

27. How do you feel about the tariff you are paying now? i) have to pay even we don't get water, ii) less water low tariff iii) If we get water regularly we are willing to pay more.

28) How much are you willing to pay if you get regular, dependable and clean supply of drinking water daily in NRs/month? i) 100 or less ii) 100-200 iii) 200-400, iv) 400-800 and v) 800 or more

(Thank you for your precious time in answering my questions!)