

# Participatory 3D Modelling for Sagarmatha National Park:

## Feasibility Report



HKKH Working Papers

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### **About the HKKH working papers**

In the framework of the HKKH Partnership Project several technical papers have been developed by the four Partners and the Technical Team. Before being finalized and published, these documents require further collaborative work and review by a wide range of resource persons and stakeholders. The **HKKH working papers** is a selection of draft documents printed and distributed in a limited number to share the wealth of knowledge developed so far and stimulate feedback and debate.

For additional information and any queries, please contact the PMU at [info@hkkhpartnership.org](mailto:info@hkkhpartnership.org).

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The presentation of material in this document and the geographical designations employed do not imply the expression of any opinion whatsoever on the part of any of the agencies involved, concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries.

## LIST OF ACRONYMS

CESVI	Cooperazione e Sviluppo
CKNP	Central Karakoram National Park in Pakistan
DEM	Digital Elevation Model
DGCS	Directorate General for Development Cooperation, Italian Ministry of Foreign Affairs
DNPWC	Department of National Parks and Wildlife Conservation
DSS	Decision Support System
Ev-K <sup>2</sup> -CNR	Ev-K <sup>2</sup> -CNR Committee
GIS	Geographic Information System
GPS	Global Positioning System
HKKH	Hindu Kush-Karakoram-Himalaya
ICIMOD	International Centre for Integrated Mountain Development
IUCN-ARO	IUCN Asia Regional Office
P3DM	Participatory 3-Dimensional Model
PGIS	Participatory Geographic Information Systems
QNP	Quomolongma Nature Preserve
RDBMS	Relational Data Base Management System
SNP	Sagarmatha National Park

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## **1 Executive summary**

The Participatory 3-Dimensional Modeling (P3DM) integrates participatory resource mapping, and spatial information to produce a stand-alone scaled relief model, which has proved to be a user-friendly and a relatively accurate research, planning and management tool. This model is constructed through the active participation of a given community with facilitation by mapping experts and hence derives its name, Participatory 3-Dimensional Model.

It is easier to understand 3-dimensional (3D) models as compared to other types of maps as it adds a third dimension which makes it easy for visualization and communication. With the application of Participatory 3-Dimensional Modeling (P3DM) communities can better plan the management of their resources because they will have more knowledge about resources available.

The participatory approach to community management in SNP is not a new concept. There are several activities in Sagarmatha region that involved the participation of the communities in the planning and development. Through these exercises, communities understand the major problems and provide them opportunity to find means to solve these problems. It is expected that, local communities will have deeper understanding of the geography of the region, improved communication skills and stronger cohesion and consensus among them. This activity has the stronger linkages with CESVI.

## **2 Objectives of this document**

The general objective of this document is to assess the feasibility of Participatory 3-Dimensional Modeling (P3DM) in Sagarmatha National park (SNP) and to answer the basic questions on how P3DM can be used in planning and management of the park. P3DM will be developed by the communities and would result in a physical 3D representation of an area of the park. This in turn would increase the understanding of the situation and qualities and strength of the decision-making process of the communities of the region. Also the model would be a useful means of information communications to the visitors.

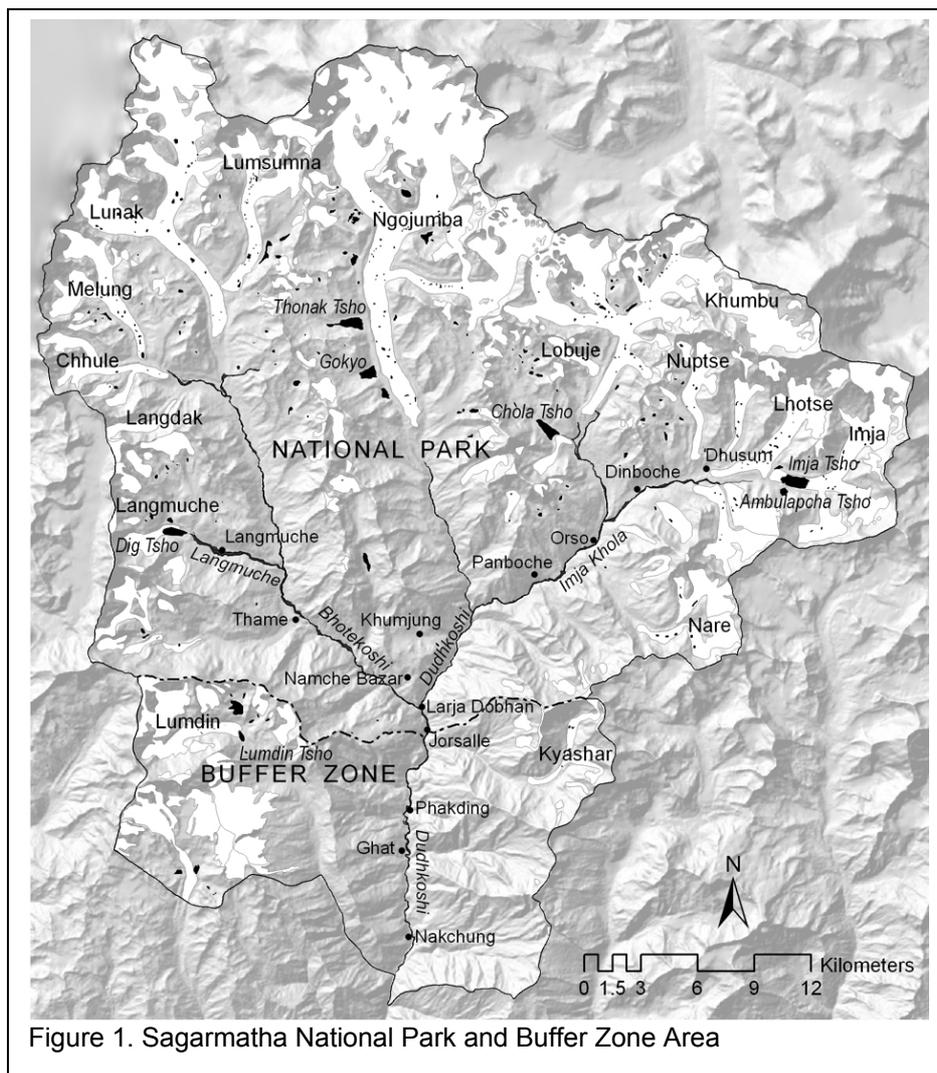
The specific objectives are to:

- Introduce P3DM model, P3DM methodology.
- P3DM as a method to bring about cohesion and consensus among communities
- To prepare cost estimate of the model

### 3 The Participatory Approach in SNP

#### 3.1 Background

The participatory approach to community management in SNP is not a new concept. The idea of community participation in this region for protection is well established. In general terms it can be seen that decentralization and empowerment of local organizations and people are the key strategies to achieve an effective participation on local people in natural resources management.



There are several activities in Sagarmatha region worth mentioning that involved the participation of the communities in the planning and development. An example of such a project is the one developed by The Mountain Institute (HDCG, 2004) in the upper Imja valley. This project had the objective to conserve and restore the alpine ecosystems. Youth clubs, hotel owners, tourist guide participated in the planning and later involved in the implementation of activities. Through these exercises clear understanding of the major problems faced by the

community could be understood and the means to solve the problems could be explored. Therefore, the people were then able to rank their expectations and to estimate a budget for the activities chosen.

Realizing the benefits of the participatory 3D modeling the HKKH partnership project under the second Detailed Operational Plan (DOP2) aims to carry out a feasibility of participatory activity under activity A.1.4.11. Based on the previous similar experiences conducted by ICIMOD a feasibility of developing a 3D model of SNP through a participatory workshop has been assessed. The exercise would result in a physical 3D representation of an area of the park developed by the communities that will then be a part of the SNP visitor center.

## **4 Participatory 3-Dimensional Modeling**

### **4.1 Introduction**

The participatory creation of maps, above and beyond their interpretation, started in the late 1980s. At that time, development practitioners were inclined to adopt Participatory Rural Appraisal (PRA) methods such as sketch mapping (Mascarenhas et al. 1991) rather than the more complex and time consuming scale mapping. In 1990s, with the diffusion of geographic information systems (GIS), remote sensing based image analysis and application of global positioning system (GPS) revolutionized the mapping technology. Later there were initiatives taken to integrate geo-spatial information technologies and systems into communities. The concept of Participatory Geographic Information Systems (PGIS) emerged where the geo-spatial technologies were used for the community development for the empowerment of less privileged communities. PGIS combines a range of geo-spatial information management tools and methods. Participatory 3-dimensional modeling (P3DM) is one such method which can be used to represent peoples' knowledge in the physical 3 dimensional models. This model can be used as an interactive vehicle for spatial learning, discussion, information exchange, decision making and advocacy.

P3DM integrates indigenous spatial knowledge with data on elevation of the land and depth of sea to produce stand-alone, scaled and geo-referenced relief models (Rambaldi et al). P3DM main function is to generate spatially defined, geo-referenced and scaled information. P3DM integrates participatory resource mapping, and spatial information to produce a stand-alone scaled relief model, which has proved to be a user-friendly and a relatively accurate research, planning and management tool. This model is constructed through the active participation of a given community with facilitation by mapping experts and hence derives its name, Participatory 3-Dimensional Model. Based on the indigenous knowledge the informants use pushpins, yarns (thread or wool) and paints to depict land use and land cover and other features. Generally pushpins, yarns and paints are used to mark point feature, line feature and polygon features respectively.

## 4.2 *Why Participatory 3-Dimensional Modeling*

It is easier to understand 3-dimensional (3D) models as compared to other types of maps like GIS maps. A topographic map represents only two dimensions and is therefore not always easy to interpret if the map represents hilly and mountainous terrain. 3-Dimensional Modeling adds a third dimension which makes it easy for visualization. It is expected that local people would feel comfortable and happy using 3D models to communicate with one another and with others who do not know much about the area. Participatory 3-Dimensional Modeling (P3DM) can be useful tool to gather spatial information for variety of purposes. Communities can better plan the management of their resources because they will have more knowledge about resources available. They can monitor the implementation of development projects, and resolve resource conflicts within their own communities so they can respond better to problems. It empowers people to plan effectively for themselves based on their needs. Participatory mapping can force communities to confront the burning issues with regard to the management of natural resources. This will raise local awareness.

The P3DM approach allows the villagers to participate in the entire process of 3D model building though it is field intensive and requires much community time. P3DM acts as a visual language and is a powerful medium for easing communication and overcome the language barrier and creates common ground for discussion. This holds true particularly in regions like Sagarmatha National Park where there are a blend of visitors speaking sixty different languages. For them the model would be a source of visitor information system. Hence the practice of P3DM allows people to share information and concerns.

## 4.3 *Outcomes from Participatory 3-Dimensional Modeling*

It is expected that following changes within the communities would occur in the region after P3DM is applied.

- Deeper understanding of the geography of the region

Those who are not aware about the village geographical area would be able to get themselves familiar with the spatial information of the village. P3DM would allow the people to identify areas around the village and let them know the names of the creeks, rivers, forests, watershed areas, the altitude and areas of household settlements.

- Improved communication and planning capacity of the communities

P3DM would be a reference to interact among different institutions of the community. This would bring about different authorities to a common understanding towards better resource management. With a clear visualization of the land through the P3DM the community would know where exactly to construct terraces, roads/trails, areas for settlement, management of watershed, conservation of forests, protection of water source, and demarcation of village boundary.

- Stronger cohesion and consensus among the communities

Community will be brought together to work and to learn about protecting and preserving the area.

- A physical model of the area will be developed which will be an attraction of the SNP visitor centre. The model will serve as a base for visitor related information in addition to information on environment and natural resources.

## **5 ICIMOD's Experience in Participatory 3-Dimensional Modeling**

### *5.1 Introduction*

Participatory 3-dimensional Modeling (P3DM) models exercises have been conducted in the villages where ICIMOD works with IFAD in Nokrek, Meghalaya, India. P3-D models are effective tools for community-based natural resources' management and have been extensively used by the communities for land allocation in shifting cultivation, natural resource use, village planning, and for negotiating with government officials about services and the development of natural resources. An original model was up-scaled by the project and the communities, and is now available in twelve villages. The model has also been successfully applied in the villages surrounding ICIMOD's Demonstration and Training Centre in Godavari and in Mustang, Nepal for participatory natural resources' management in watersheds and rangelands.

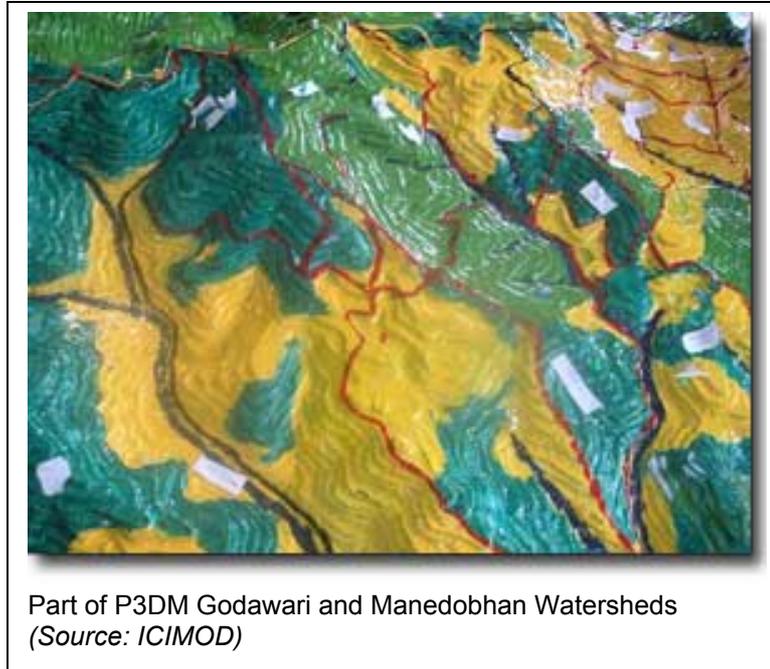
### *5.2 Participatory 3-Dimensional Modeling in Godawari*

A P3DM modeling exercise was conducted in relation to the Participatory GIS (PGIS) including P3DM and GIS. The model was manufactured in the context of training on PGIS organized by ICIMOD from 23 to 30 September 2003 at the ICIMOD Training Centre in Godavari, Nepal. The purpose of this exercise was to train facilitators and staff in Participatory Three Dimensional Modeling (P3DM). There were altogether 24 representatives from different village community groups and 22 from national and international organizations. The 3D Model has been helpful to communicate with communities having limited knowledge about maps and geographic information systems. Tamang community used the 3D model to update ICIMOD spatial data on land-uses and forest management systems.



Participants engaged in P3DM exercise  
(Source: ICIMOD)

The model was developed at a scale of 1:2,500 and covered an area of 26 sq. km. The area included Godawari and Manedobhan Watersheds (including Phulchoki Peak) in Godawari and Tripeni. Nepal covering an elevation ranges from 1,455 m a.s.l. to 2,765 m. a.s.l. The size of the model came out to be 6' x 8'.



## **6 Methodology for Participatory 3-Dimensional Modeling**

### **6.1 Preparatory Work**

#### **6.1.1 Area Selection**

The selection of the area is done based on different factors which includes physical, administrative, environmental, cultural, socio-economic and issues of disputes, conflicts in the region. Based on the above mentioned criteria and in consultation with the stakeholders area is identified on the topographic and administrative maps.

The area selected for the P3DM is Sagarmatha National Park and Buffer zone (Figure1). It covers an area of 1400 sq. km with elevation range from 1700 m to 8848m.

#### **6.1.2 Understanding Social Dynamics**

One needs to have a thorough understanding of the social dynamics in the area. A stakeholder analysis helps to give an idea of different interest groups, conflicts in the area. Such assessment will guide us to define the composition of the groups.

### **6.1.3 *Groundwork at Community Level***

This step in the preparatory work will introduce the concept of participatory 3-dimensional modeling to the various stakeholders.

### **6.1.4 *Planning for the Logistics***

A venue sufficiently large enough to accommodate the community to prepare the model should be located in the area. Transportation, accommodation and catering should also be organized.

### **6.1.5 *Participants Selection***

It is preferred that the first category of participants be students from locally based institutions. The second category of participants may be included from those identified by stakeholders having vested interest in the area. These participants may be representatives from indigenous groups, economic sectors, government and non-governmental organizations.

### **6.1.6 *Gathering Secondary Information***

A pre-requisite for P3DM is contour lines. It is cost effective if contour lines are available in digital formats. If not the contour lines will have to be digitized which will relatively increase the cost of the model. An alternative solution will be to enlarge the topographic maps using the digital photo copiers and to trace the contour lines. This will relatively deteriorate the quality of the model in terms of accuracy.

Apart from contour lines, additional information needs to be gathered which includes demography, land use, vegetation cover, infrastructure and whatever information that may be relevant to the facilitators to understand the physical, social and economic characteristic of the area.

### **6.1.7 *Preparing Base Map***

#### **Scale and size of the map**

Fewer details can be shown on the model with small scale as compared to model prepared on larger scale. Larger scale 3-dimensional is more comprehensive and of more use to the planning process. Considering that Participatory 3-D Modeling aims at providing a visual aid capturing the details of the terrain, the larger the scale the better. Larger the scale of the model larger would be its size. Therefore when making the choice of the scale, size of the model should be taken into account for enough space in which to physically construct and store the model and the need for the accuracy. The ideal scale for 3-D modeling is 1:10,000 or larger. So in an ideal case if the reference map is at 1:50,000-scale, it needs to be re-scaled to 1:10,000 to make it suitable for the activity. At 1:10,000, one centimeter on the model corresponds to 100 meters on the ground - a pretty comfortable scale for people to pinpoint salient features.

Taking into consideration the size of the area and the location where the model is going to be stored it is proposed that the P3DM model be constructed at a scale of 1:25,000. The size of the model will come out to be about 6 'X 8'. The vertical scale may be the same as the horizontal scale. But for exaggeration purposes vertical scale may differ from horizontal scale. To enhance the visual perception of the ruggedness of the landscape or to highlight erosion hazards or accessibility, the vertical scale could be exaggerated by nearly double the horizontal scale, say 1:10,000.

#### Contour Interval

Generally, 1:50,000-scale reference maps feature 20-m contours, which conveniently may be applied to a 1:25,000 model.

#### Preparing customized base map

Once scale, size and contour interval is fixed then a base map is generated. It is wise to plot the sequence of contour lines in different color. Elevation labels should be placed close to the contour lines.

### **6.1.8 Procurement of Materials**

One of the most critical tasks in building the 3-dimensional model is to assemble the materials required for it. Various map symbols with a range of coding items should be available in sufficient quantity to mark the many variables that people may want to record in the model. Procurement is done after the first assessment of the features that may be encountered in the area.

Map symbols should be chosen understanding the existence of different types of point, line and polygon features. Some guidelines to code and display the features are given in table 1.

Table 1: Means to display the features on the model

	Features	Means of display
Points	Water bodies (springs and waterfalls); mountain peaks; social infrastructures (municipal/district halls, administrative centres, day-care centres, schools, rural health centres, hospitals, bus stops); cultural places (churches, burial caves, cemeteries, sacred areas, etc); tourist establishments; human settlements (households); scenic spots, turtle nesting sites; diving spots; docking sites, and others.	Map and push pins of diverse colours, shapes and sizes.
Lines	Watercourses; communication ways (roads, bridges, trails); social infrastructures (rural water supplies), classifications (e.g. watershed classifications), boundaries (administrative units, protected area, ancestral domains,	Yarns of different colours.

	land status, areas where destructive methods are employed, fish breeding and spawning areas; feeding grounds of endangered species; fishing grounds; features of the seabed like coral reefs differentiated into “intact” and “damaged”, seaweed areas, etc); borders, coordinates (grid).	
Polygons	Water bodies (rivers, creeks, lakes, springs and waterfalls); cultural places (cemeteries, sacred areas, etc); tourist establishments; land uses (rice fields, vegetable gardens, sugarcane and coconut plantations, orchards, reforestation sites, residential areas, resettlement areas, etc.); land covers (different types of forest cover, grassland, brushland, mangrove, etc.); landslides and bare land; and others.	Acrylic paint – different colours.
Attributes	Names, annotations	Text on labels

## 6.2 *Assembling the Model*

### 6.2.1 *Orienting Participants*

Participants should be oriented on the mechanics of model construction. They should be introduced with the rudiments of map reading. It would be an added advantage if they know in advance what sort of material is being used, the scale of the model and the contour interval.

### 6.2.2 *Organizing Work*

Participants should be divided into groups to do specific tasks.

### 6.2.3 *The Base Table*

It is recommended to have a wooden base table to rest the model. The table should be of the size to match the base map and strong enough to support the weight of the model. One side of the base table should be narrow enough to permit easy access to all sections of the model.

### 6.2.4 *Tracing, Cutting and Pasting*

The contour lines are traced, cut and pasted on top of the previous one maintaining proper geo-references. The outcome is a scale relief model with base contours of the landscape.

## 6.3 *Transposing Information*

### 6.3.1 *Composing People’s Knowledge*

It is very important that the participants are well aware of the legends they are going to use before they mark the features on the model. Participants are then invited in groups to locate the water courses, mountain peaks, islets, roads, trails, social infrastructures and other landmarks they use to orient themselves when moving around within their domains. Pins, yarns and colour paints are used to mark point, line and polygons features respectively.

### 6.3.2 *Secondary Information*

After the informants have completed the transference of mental maps and cross checking, other secondary information can be added to the model. Some secondary information are administrative boundaries, park boundaries, placing the grid.

### 6.4 *Handing Over of the Model*

After the completion of the model the ownership of the model has to be formally transferred to the community. The model is never complete and it needs to be regularly updated with the latest information. The model has to be entrusted to an entity having the means and the commitment to safeguard and maintain it, and to make it accessible to those who would like to, use it, update it with the latest information and correct previously entered information.

In the case of SNP, the model will be handed over to the visitor information centre which will be maintained by Park Office in collaboration with the local community.

## 7 Cost Estimate

The cost estimate presented is indicative and is subjected to change as per the location, size of the model and the number of participants attending the workshop.

### 7.1 Abstract of Cost of Materials

S No.	Material Specification	Quantity	Unit	Rate (NRS)	Amount (NRS)
1	Trekking mat (2' x 6' 7mm)	550	Sheet	375.00	206,250.00
2	Carbon paper	5	Packet	200.00	1,000.00
3	Glue (Dendroid)	15	Liters	265.00	3,975.00
4	Scissors 8 inches SDI	4	Piece	160.00	640.00
5	Cutter knife SDI big metal body	4	Piece	175.00	700.00
6	Cutter knife SDI blade	4	Packet	110.00	440.00
7	Plastic bucket 5 liter	5	Piece	100.00	500.00
8	Artist brush fine art no. 1 and 2	10	Piece	20.00	200.00
9	Artist brush fine art no. 9 and 12	10	Piece	35.00	350.00
10	Acrylic color camel India series 1	25	500 ml bottle	620.00	15,500.00
11	Acrylic color camel India series 2	25	500 ml bottle	750.00	18,750.00
12	Map pins different color (big head)	15	Packet	105.00	1,575.00
13	Map pins different color (small head)	15	Ring	30.00	450.00
14	Simple Alpin	6	Box	15.00	90.00
15	Pushpins different color	10	Box	45.00	450.00
16	Hand knitting woolen thread	8	Lacchi	55.00	440.00
17	Stapler m/c 10	3	Set	85.00	255.00
18	Stapler m/c 3	3	Set	300.00	900.00
19	Cotton thread 30 colors	60	110g/roll	70.00	4,200.00
20	Pencil	4	1 doz	40.00	160.00
21	Marker pen	6	Set	200.00	1,200.00
22	Pencil sharpener	6	Piece	10.00	60.00
23	3 inches iron nails	6	Kg	85.00	510.00
24	Clip board with corner file type	3	Piece	100.00	300.00
25	Name tag	40	Set	20.00	800.00
26	Plastic scale	6	Piece	45.00	270.00
27	Measuring scale	4	Piece	70.00	280.00
28	White cement	10	Kg	35.00	350.00
29	Plaster of paris	6	Pkt	15.00	90.00

30	Ramtilak	6	Pkt	20.00	120.00
31	Chalk powder	3	Pkt	10.00	30.00
32	Mobicol	6	Kg	140.00	840.00
33	Laminated plate	5	Roll	100.00	500.00
34	Base maps	2.00	Set	5,500.00	11,000.00
35	Base table	1.00	Piece	16,500.00	16,500.00
36	Film	6.00	Roll	300.00	1,800.00
37	Compass	2.00	Piece	2,200.00	4,400.00
				<b>Sub-total</b>	<b>295,875.00</b>
				<b>Transportation</b>	<b>50,000.00</b>
				<b>Sub-total 1</b>	<b>345,875.00</b>

## 7.2 Cost of the Workshop

Description	Unit	Amount
Number of participants	Nos.	24
Number of resource persons	Nos.	5
Number of days	Days	15
Logistics	NRs.	50,000
Accommodation / Food (29 persons @ 1500/ day for 15 days)	NRs.	652,500
Sub-total 2	NRs.	702,500
Total = Sub-total 1 + Sub-total 2	NRs.	1,048,375
Miscellaneous institutional cost (15% of Total)	NRs.	157,300
<b>Grand Total</b>	NRs.	<b>1,205,675</b>

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