National Geographic Information Infrastructure in Nepal for Strengthening Planning and Resource Management

R.R. Chhatkuli
National Geographic Information Infrastructure Programme
Survey Department, Kathmandu, Nepal
Phone: +977.1.4 482 903 Fax: +977.1.4 482 957 email: ngiip@ccsl.com.np

Abstract:

Nepal has a tremendous potentiality of water-resources ranking only second in the world and it has also a rich natural wealth like biodiversity, lofty Himalayas, scenic valleys and mountains among others. It has a hardworking and patriotic workforce. However, it is limited by heavily diverse topography and fragile geological conditions coupled with extensive poverty and abundant illiteracy. The thrust of the development problem in Nepal is "poor management". Simply said, management is a cycle of planning, implementation, monitoring/evaluation and re-planning. One of the weaknesses of the Nepalese management process is the lack of adequate geographic information in decision-making thus resulting in poor-management. To support this gap, His Majesty's Government of Nepal initiated National Geographic information Infrastructure Programme (NGIIP) since 2002. This programme is the extension of the digital mapping programme of Survey Department, which was initiated in 1996.

Nepal is a member of the Global Mapping community. The NGII programme will support in the development of a spatial data infrastructure and a geographic information system at the national level. NGII Programme has the overall objectives of strengthening planning and resource management in Nepal and its specific objectives are to develop a platform to facilitate data sharing among Survey Department, Central Bureau of Statistics and participating agencies. As part of its contribution to the NGIIP, Survey Department provides spatial data ranging from 1:25,000 to 1:1Million. To facilitate the success of the NGII initiatives several approaches have been undertaken. Some of them are: the identification of the key players and developing a stakeholders' institutional coordination mechanism, the situational analysis and needs assessment, developing an implementation strategy, and conceptualisation of a NGII centre of excellence for promoting sustainability. The programme has multiple facets like: fundamental- and meta- database production, technology installation and human resource development, and institution building components including standards and processes. The details are explained.

Least developed countries like Nepal are entangled with the vicious circle of lack of information, poor planning, poor performance, and subsequent lack of resources for additional funding for information. A strong will and commitment is necessary to make a breakthrough. This is a time in Nepal, when a breakthrough is underway with the launching of a NGII programme. The programme has a promising future; but it being on a very initial phase, its effectiveness cannot be evaluated as yet.

1. Background:

Nepal is a small mountainous landlocked country in South Asia located between latitudes 26°22'N to 30°27'N and longitudes 80°04'E to 88°12'E and lying between India and China. It has an area of 147,181 square kilometres and a population of 23.4 million inhabitants. It has a rich human culture and natural biodiversity with more than 61 ethnic groups and 70 spoken languages. Nepal- occupying only 0.1% of the earth- is home to 2% of all flowering plants in the world, 8% of all the world's population of birds (more than 848 species), 4% of mammals on earth, 11 of the world's 15 families of butterflies (more than 500 species), 600 indigenous plant families, and 319 species of exotic orchids. Nepal has a rich hydropower potential with about 83,000 MW among which 45,000 MW is economically exploitable. The Nepalese, sometimes also called Ghurkhas, are world famous as honest and hard-working workforce. However, economically the situation is not that encouraging. The per capita income in Nepal is a mere US$ 240. Additional development indicators at the end of Ninth Plan which completed in 2001 are: a total road network of 15308 km, 11 telephone sets per thousand population, literacy 52.7%, power generation 393 MW, and population with access to drinking water 69%. Worst of all, the single indicator showing the condition of people in Nepal is the number of population living under the poverty line, which is 38%.

The Tenth Plan, which started one year back, has set poverty reduction as the national goal. For this the following strategies have been outlined for the improvement of economic, human and social indicators:

- Mobilisation of resources through the coordination of government, local bodies, private sector and civil society;
- Expansion of economic and employment opportunities;
- Access of women, deprived classes, and inhabitants of remote areas to resources and economic benefits through empowerment, human development, security and prescribed programmes.

Despite a tremendous potentiality of water-resources ranking only second in the world, a rich natural wealth like biodiversity, lofty Himalayas, scenic valleys and mountains among others, and a hardworking and patriotic workforce Nepal is limited by heavily diverse topography and fragile geological conditions coupled with extensive poverty and abundant illiteracy. The thrust of the development problem in Nepal is "poor management". One of the weaknesses of the Nepalese management process is the lack of adequate geographic information in decision-making thus resulting in poor-management. To support this gap, His Majesty's Government of Nepal initiated National Geographic information Infrastructure Programme (NGIIP) since 2002. This programme is the extension of the digital mapping programme of Survey Department, which was initiated in 1996.

2. Advent of National Geographic Information Infrastructure programme in Nepal

GIS activities were initiated in Nepal during Eighth Plan (1992-1997) period. Due to lack of a national perspective, sporadic creation of spatial databases and mushrooming of independent and isolated systems were witnessed. Most of the systems started from the digitisation of existing topographic maps and therefore lot of resources were duplicated in these efforts.

The Ninth Plan (1997-2002) states the importance of GIS in more than occasion. It states that "reliable information and data are necessary for programmes for agriculture and forest production, land-use, land-consolidation, the preparation of local and regional housing and physical plans, the preparation of environmental programmes to preserve, develop and use natural resources, and the preparation of poverty alleviation programme and sustainable development".

The base paper of Tenth Plan (2002-1007) is more pronounced on the importance of a "national" geographic information system. One of the key sectoral policies and strategies outlined in the Tenth Plan state that "development of a national geographic information system shall be pursued the easy access and dissemination of geographic information".

Many institutions and organization in Nepal have the legal obligation to prepare management plans and/ or maps and databases, which require the use of geographical information. As an example Forest Act, 1992 makes obligatory for the Forest Department to prepare a work plan for systematic forest management and submit it to the Forest and Land Conservation Ministry. Once approved, it makes obligatory for the District Forest Officer to implement the work plan. Local Self Governance Act, 1998 and the Local Self Governance Regulation, 1999 prescribes for the local bodies like the VDCs, municipalities and the DDCs to prepare local development plans and also prepare resources maps for that purpose. Such work plans/ development plans can only be made through the analysis of spatial and socio economic data. Collection and database creation of such data by individual organizations for individual applications can only be a duplication and wastage of resources.

During the period after 1996, for an approximately 7500 square kilometres densely populated urban areas and the approximately 25000 square kilometres semi-densely populated urban areas of Nepal orthophoto softcopy and maps at scales 1:5,000 and 1:10,000 respectively have been recently created. By the end of 2002, digitisation of all the new topographic base maps prepared between 1992 to 2001 at the scale of 1:25,000 (for the terai and middle mountains) and the scale of 1:50,000 (for the higher mountains and Himalayas) have been completed and a consistent topologically clean spatial database created. Further more, generalization of 1:25,00/ 1:50,000 database and compilation at the scales of 1:100,000 and 1:250,000 have been tested and are now under production. It is expected that the compilation will be completed within a few months. There is a further programme of compiling topographic database at the sales of 1:500,000 and 1:1 Million.

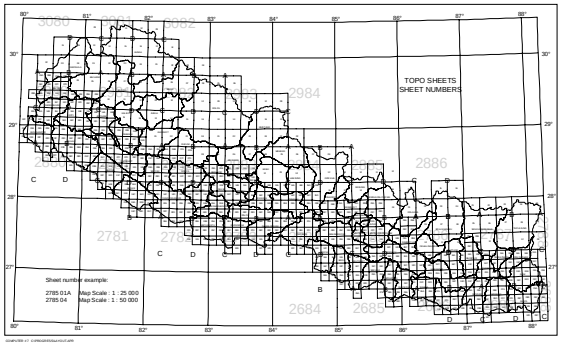

Fig 1: 1:25,000 and 1:50,000 database Index

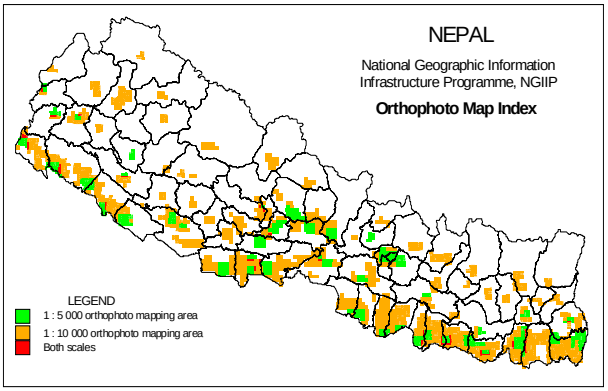

Fig 2: Orthophoto Map Index

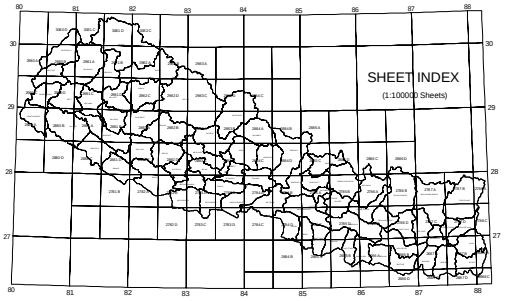

Fig 3: 1:100,000 database Index

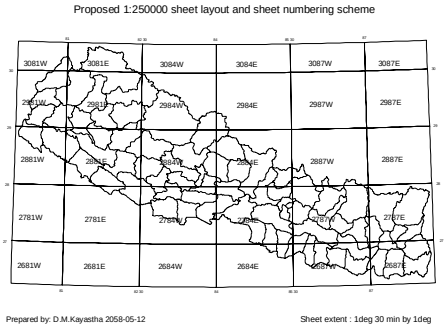

Fig 4: 1:250,000 database Index

With respect to socio-economic data, the Central Bureau of Statistics holds a national census of population and housing every ten years. The results of the past censuses are available in tabular forms, which can be translated into digital database with some efforts. The last census was held in 2001 and the data have been processed and a digital census database created.

The multi-resolution topographic database (NTDB) held at the Survey Department and the multi-temporal census data and the census database (NCDB) held at the Central Bureau of Statistics provides a sound basis for the development of national geographic information system (NGIS) in Nepal. It is against this context that the Survey Department of His Majesty's Government of Nepal launched a National Geographic Information Infrastructure Programme (NGIIP) in 2002 as an extension of its digital mapping programme initiated in 1996.

3. Spatial Data Users/ NGII Stakeholders

The Statistics Act, 1959 gives responsibility to the Central Bureau of Statistics to carryout all censuses and statistical surveys in Nepal, specifies procedures for operations, rules regarding confidentiality, and requirements for public to respond honestly to CBS enquiries. It restricts individual household data from being published and in the meantime authorises all aggregated data for public. The Land Survey and Measurement Act, 1963 and the Land Survey and Measurement Regulations 2001 make Survey Department responsible for all types of mapping and an authority for maps publication. While the permission of Survey Department is necessary for publishing all kinds of maps in Nepal, Survey Department makes its topographic base maps and digital topographic database available to all kinds of users without hindrance. A scrutiny on a section of about 70 key digital topographic database users of the Survey Department in the last two years shows the following categories of users:

Sl. No.	Type of User	Use of NTDB data	Remarks
1.	Watershed Management	Landuse mapping	
2.	Drinking Water project	Engineering scheme and design	
3.	Local infrastructure development	Project planning	
4.	B.Sc./M.Sc./ Ph.D. students	Student's research project	
5.	Environment Conservation	Training	

6.	Irrigation project	Engineering design	
7.	Geological Survey	Landslide inventory and hazard mapping, Environmental geological mapping	
8.	District Development Committee	District development planning	
9.	Hydrology	Water balance study	
10.	Researcher	Environmental change study	
11.	Consultant	Cable Car planning	
12.	Forestry	Forest management plan	
13.	Telecommunications	Access network planning	
14.	Red Cross	Disaster management planning	
15.	Water resources	Water resources study	
16.	Municipality and VDC	Urban planning, local planning	
17.	Education	School Mapping	
18.	Forestry	Site selection	
19.	Roads department	Road survey and design	
20.	Consultants	Small hydropower study	
21.	Power Company	Fishery monitoring	

The above shows that the digital spatial database users are diverse and their applications are equally diverse. The users range from individual students and researchers to organised sectors like power companies, roads and irrigation authorities, local bodies, government departments and ministries. It is therefore no doubt that a NGII is necessary to support these diverse users.

The potential stakeholders in the NGII in Nepal are all producers and users of spatial data. Simply said, the same agencies who have been the major users of paper maps in the past are the major stakeholders in the NGII in the new set-up. Some of the important agencies are:

- Survey Department,
- Central Bureau of Statistics,
- Department of Forests,
- Department of Hydrology and Meteorology,
- Department of Mines and Geology,
- Department of Roads,
- Department of Irrigation,
- Department of Urban Development,
- Water and Energy Commission,
- Municipalities/ VDCs,
- District Development Committees,
- Consultants,
- Planners and developers.
- Ministry of Land Reform and Management,
- Ministry of Population and Environment,
- Ministry of Agriculture and Cooperatives,
- Ministry of Health,
- Ministry of Education,
- Ministry of Local Development,

The stakeholders in the NGII will be of two types, *Stakeholder x* who contributes as well as uses data through the NGII, and *Stakeholder y*, which has nothing to contribute but uses data through NGII. Both types of stakeholders are welcome in the Nepalese NGII. Participating in such a NGII platform is an expensive and high-tech affair. So stakeholders can be attracted to the system very slowly. In the beginning it is expected that a NGII nucleus will be formed through the partnership of six agencies, namely, the Survey Department, the Central Bureau of Statistics,

the Ministry of Local development, the Ministry of Population and Environment, the Ministry of Agriculture and Cooperatives, and the Ministry of Health/ Department of Health Services. It is proposed that other agencies will slowly participate in the NGII system.

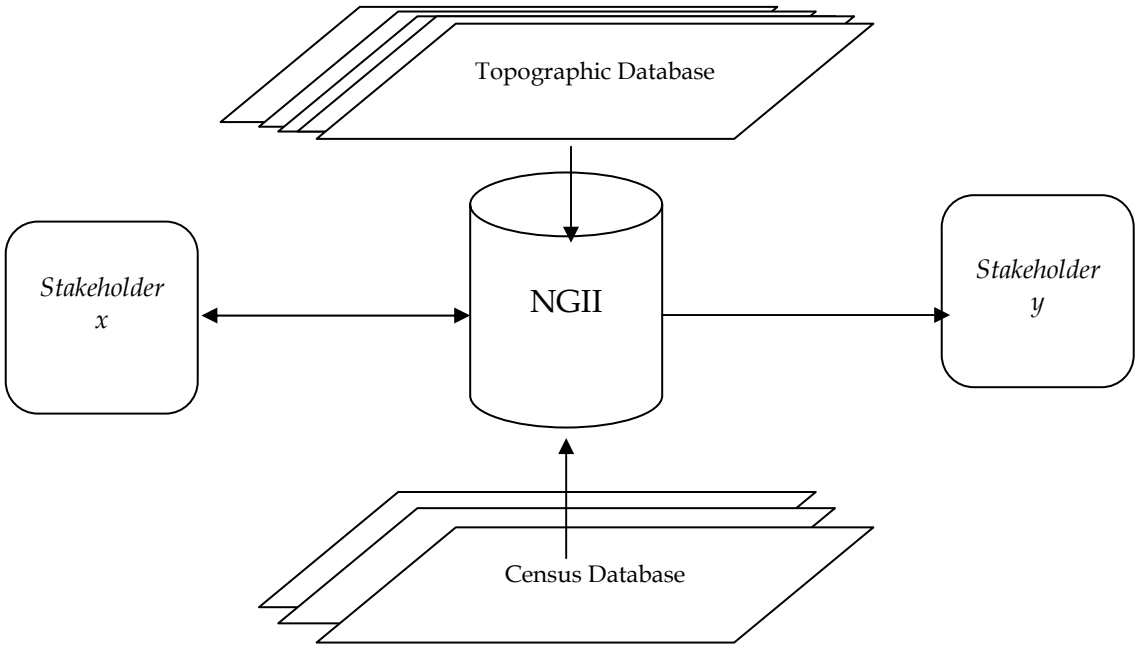

Fig 5: Types of Stakeholders in NGII

4. NGII Implementation Strategy

There have been NSDI/ NGII initiatives in many countries. It is our contention that NSDI/ NGII should be considered in the context of the national environment. The NGII in Nepal is evolving through a user-driven process with bottom-up approach. However the following common features of a NSDI also holds for the Nepalese NGII:

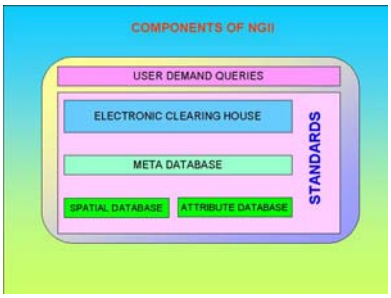

Fig 6: Components of NGII

The NGII implementation strategy has been evolved through the following processes:

1) Stakeholders inter-agency consultation through the following steps:
    a. Stakeholders Workshop,
    b. Secretaries' meeting,

c. Joint Log frame planning,
d. Technical Needs Assessment for each partner agency,
e. Establishment of inter-agency work groups,
f. Sharing Agreements.

2) Overall Objectives of NGII established as following:
" To strengthen planning and resource management through the availability of geographical information necessary for decision making."

3) Specific Purpose established as following:
   a. To develop an NGII platform to facilitate data sharing among CBS, SD and participating agencies,
   b. To disseminate Population and Housing Census 2001 results via an NGII platform

4) Programme launched to achieve the following results:
   a. Result1: NGII platform developed.
   b. Result2: Recommendations drafted to update legal framework for data sharing.
   c. Result 3: Seamless national topographic database established.
   d. Result 4: Population and Housing Census 2002 results disseminated via NGII platform.
   e. Result 5: Co-ordination mechanism established for collection, management, and access of data contributed.

5 Proposed System Architecture of NGII

5.1 Conceptual System Architecture for Metadata System

NGII will provide two basic services namely **"Metadata Services"** and **"Clearinghouse Services".** Metadata service will provide the description of data to the users. The clearinghouse service will help the users to access and retrieve data of their interest. It will facilitate the users to query, download and integrate the data from different sources connected to each other by communication network.

Minimally, all the participating agencies will participate in Metadata System. Metadata system will provide the metadata of all the participating agencies. A central metadata system will be implemented in the NGII Centre. The database server will store and manage the metadata from all the participating agencies.

- An application server/web server will be running in the NGII Centre. This application server will be connected to the database server.
- The application server will provide the following two types of applications:
  - Application for browsing the metadata such that each individual user can log on to the metadata server and then view different agency's metadata.
  - Application for metadata update, which will have restricted access to the participating agencies.

5.2 Conceptual System Architecture for Clearinghouse System

- A central database system will be implemented in the NGII Centre.
- In the first phase, the Census and Topographic data will be integrated in the database, to be slowly enriched with other databases; until the agencies develop their capacity to manage and keep the respective systems up.
- A clearinghouse application will be running on the NGII server.
- A number of predefined queries will be available to the users based on the user's access level.

Some of the technical requirements and Issues are:

- One of the technical requirements for storing the data from any agency at NGII Centre is that the data standard be first developed for agency's data and the database be designed following the developed standard.
- NGII Centre will be responsible for managing the data and ensuring its availability to the users. The data however need to be updated by the respective agency.
  - Different data access level needs to be defined.
  - For payable data, the users have to register themselves in NGII Centre or concerned agency. A registration and pricing policy needs to be developed.
  - Since the data for all the agencies will be stored in the central database at NGII Centre, data access will be faster.
  - NGII database management need only be done at the NGII Centre site.

5.3 Proposed System Network Architecture:

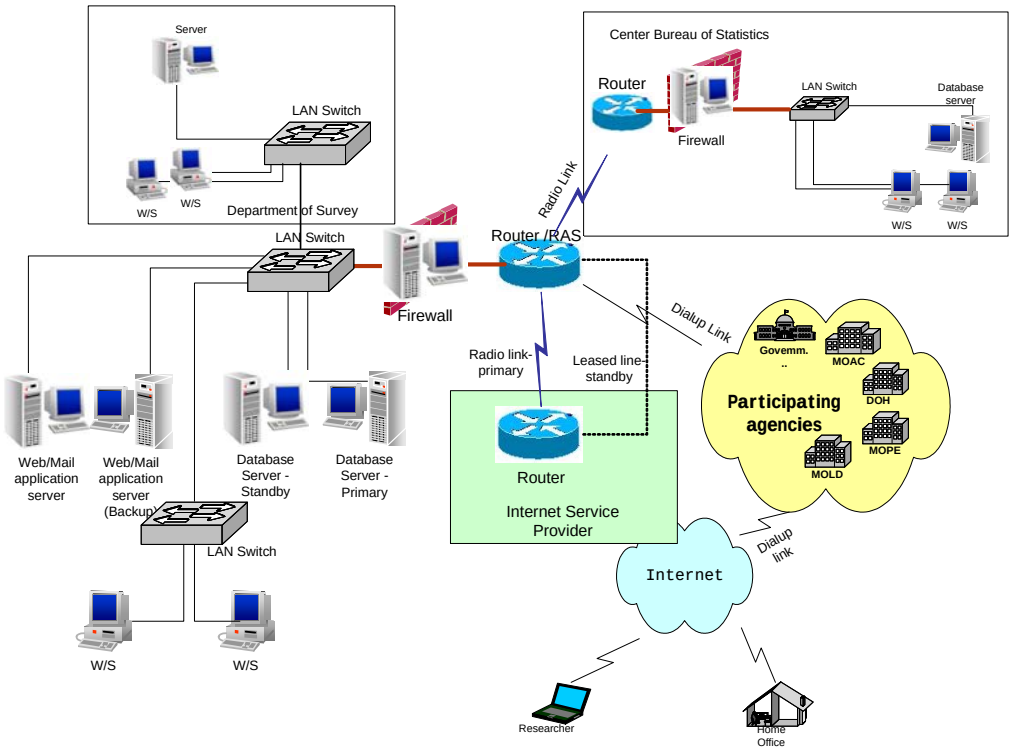

Fig 7: Network Diagram for metadata and clearinghouse service

6. Conclusion

Nepal has been a member of global mapping community since 1998. It was already felt late that a NSDI initiative was lacking in Nepal. With the advent of NGII programme in Nepal a systematic and structured NSDI initiative has been launched. While it is envisaged that the NGII has evolved through a bottom-up approach, due to the local situation it has evolved through a more concentrated efforts of the Survey Department. Though the Survey Department is taking a lead role other stakeholders are involved at the very beginning through out the programme right from the planning process. As the overall objective clearly defines the NGII shall strengthen planning and resource management through the availability of geographical information necessary for decision making at all levels. The availability and easy access of spatial and socio economic data through a NGII shall create an environment for objectively planning, implementation and monitoring of development projects by providing necessary information for effective decision-making. Due to lack of such a system, decisions were made on an ad hoc basis mostly through voice and interests of pressure groups. A more stronger have even more stronger voices and the deprived are sometimes forgotten when a systematic acquisition, analysis and application of information for decision making is not adopted. One of the major reasons of "management problems" in Nepal is the lack of a system of information processing for decision-making. The NGII is expected to cover this gap.
A NGII is a technically high-tech, financially expensive and institutionally complicated proposition. However, the costs with respect to the benefits are better justified. The geoinformation community in Nepal has high enthusiasm for the programme and several work groups are working at the moment to make it successful.

Least developed countries like Nepal are entangled with the vicious circle of lack of information, poor planning, poor performance, and subsequent lack of resources for additional funding for information. A strong will and commitment is necessary to make a breakthrough. This is a time in Nepal, when a breakthrough is underway with the launching of a NGII programme. The programme has a promising future; but it being on a very initial phase, its effectiveness cannot be evaluated as yet. It is said that the taste of pudding is in eating: we have to wait a couple of years before that taste can be effectively made.

References:

Chhatkuli, R.R. (1996); Geoinformatics: A New Challenge to Surveying and Mapping Professionals in Nepal, Nepal Surveyor, Volume 1996.

_____ (2002); Concepts and Challenges of National Geographic Information infrastructure Programme in Nepal, Valedictory Lecture, 5th ESRI India Users Conference, New Delhi, 23 January 2002.

Harvey, Francis (2001); US National Spatial Data Infrastructure (NSDI), GIM Volume 3, March 2001

Kayastha,D.M., Budhathoki,N.R., Pant,N., Hamal,S. (2002); Building National Geographic Information Infrastructure (NGII) in Nepal, Unpublished technical needs assessment Report, NGII, Kathmandu, Nepal.

Maser, Ian (2001); The Indian National Geospatial Data Infrastructure, GIM Volume 15, August 2001

National Planning Commission Secretariat (1997); Ninth Plan, plan document published by the Commission.

_____ (2002); Tenth Plan Base paper, base paper document published by the Commission in Nepali.

Nepal Law Books Management Committee ( ); Sited law books published by the Committee on several dates.

Nepal Tourism Board (2002); Nepal Guidebook, Kathmandu, Nepal

Roy, Aniruddha (2003); NSDI Initiatives in India, GIM Volume 17, March 2003.