

Geographic Information System

- A Tool for Bridging Digital Divide in Bhutan

Binu Thomas

Lecturer, Computer Science

And

Th. Shanta Kumar

Lecturer, Computer Science

Dept. of Mathematics and Computer Science

Sherubtse College, Kanglung Bhutan

Abstract

Digital Divide refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to their opportunities to access information and communication technologies (ICTs) vis-à-vis their ability to use digital information for a wide variety of activities. The success of any developing country in the modern world depends on its ability to use the potentials of ICT in the process of development.

Geographical Information System (GIS) is a potentially powerful device for integrating, manipulating and communicating information and it can be used as a powerful tool to bridge the Digital Divide by creating valuable reports and map representation for developing infrastructure and community development.

Bhutan finds ICT as a driving force for the promotion of a sustainable, dynamic and vibrant Information Society, contributing to poverty alleviation, robust economic growth and significant increase in GNP. But Bhutan's rugged geography and isolated, land-locked status makes digital divide a serious concern in its endeavor for development through ICT.

In the light of these, the paper attempts to provide an insight about the extent of Digital Divide in Bhutan and its effect on the country's pursuit of economic development and "Gross National Happiness" with the support of ICT. The paper also tries to emphasize on the role of GIS in bridging the Digital Divide in Bhutan by mapping the locations for infrastructure and community centre development.

Introduction

The ICT policy of Bhutan

The Royal Government of Bhutan finds Information and Communication Technology (ICT) as a driving force for sustainable development and poverty reduction since the establishment of the Ministry of Information & Communications (MoIC). Along with the global acceptance(10FYP) of ICT as a powerful tool for development, the tenth five year plan of Bhutan emphasizes in the importance of (ICT) for promotion of sustainable, dynamic and vibrant Information Society, and contributing to poverty alleviation, robust economic growth, significant increase in GNP, increased technological innovation and development(Technical Guidelines on ICT, 2006, Aug.). ICTs can help to achieve the poverty reduction target set for the 10FYP through its power to create and transfer knowledge, improve the efficiency and transparency of institutions and markets, and facilitate the participation and empowerment of the poor. Bhutan has many thrust areas where ICT can be an influential tool for further development. Few of these areas are identified and mentioned below.

Agriculture

Use of ICT by farmers to obtain timely market information to obtain better prices for their produce and it can also support farmers and herders in co-management of land resources through making local maps and GIS available in community information centers. Farmers can also use ICT to have more accurate information on the factors that are needed to increase crop yield.

Health

The difficulty in availing the service of qualified doctors in the remote Basic Health Units (BHU) is the main challenge faced by Bhutan. According to the present scenario one third of the district hospitals have only one doctor (Second

periodic report, 2007). In this situation, Bhutan will be highly benefited by the implementation of ICT technologies in the medical field such as remote diagnosis and telemedicine. ICT can also help in providing fast and accurate access to health information.

Education

Due to the geographical peculiarities and remoteness, many of the educational institutions in Bhutan face real problems in maintaining their infrastructure like libraries and labs with modern books and equipments. Proper use of latest developments in the field of Information Technology will be a great help to the country in accessing information from various sources to meet the requirements of educational institutions. Computer Simulation and virtual reality systems can be used as a better and affordable alternative for the present laboratories in various institutions. In the present scenario, The tertiary institutes of Bhutan have the facility to accommodate only 1342 students for Engineering, Bachelors, Bed., and diploma programs(Kuensel, 2007, March 28). In a situation where a country has only a few limited number of institutions in the field of higher education and a quite good number of school all around the nation, distance learning programs with the support of modern technologies like video conferencing and virtual learning will be the most effective solution to satisfy the educational needs of a vast community of students aspiring for higher education.

Environment

Bhutan is lucky to have one of the most vivid and attractive eco-systems in the world and it is one among the ten hot spots in the world in terms of biodiversity (Ms.Thinley Choden, 2007). With a vast coverage of forest area and comparatively less pollution, the country has a better environment than any of the developing nations. But at the same time Bhutan has a great responsibility of maintaining its highly fragile environment for its sustainable development and even for survival. In this situation ICT can play a major role to raise awareness

and disseminate information on environmental protection and sustainability. Geographical Information Systems (GIS) will be a great help in collecting information relating to sensitive and vulnerable forest and watershed areas, management of potential or actual calamities such as managing forest fires and landslides.

Gross National Happiness

Happiness and satisfaction are directly related with a community's ability to meet their basic needs and these are important factors in safeguarding their physical health (How to measure GNH, P.387).

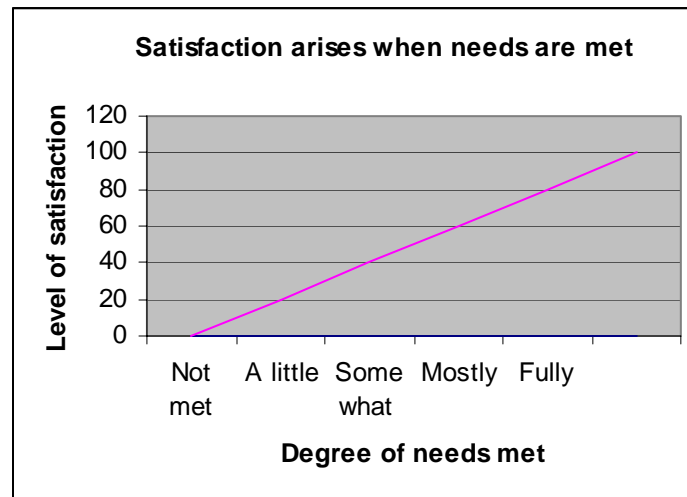


Figure 1. Satisfaction and happiness increases when needs are satisfied

Bhutan has adopted Gross National Happiness (GNH) as the development standard over GDP. The standard of living, health of the population, education, ecosystem vitality and diversity, cultural vitality and diversity, time use and balance, good governance, community vitality, and emotional well being are the nine provisional Gross National Happiness (GNH) indicators identified by the Centre for Bhutan Studies (Kuenselonline, 2006, Feb 4). With its positive impact on economy, environment, health, education and governance, ICT has a potential role to play in satisfying the needs of the society and there by improving GNH in Bhutan. ICT can enhance the efficiency of government through

improving internal business-processes, procurement and information sharing between different sectors of government.

Digital Divide - A barrier for ICT policy

Bhutan's Scenario

To find the extent of digital divide in Bhutan; we conducted a survey among the educated urban citizens of the country. The samples selected are considered as the most privileged community in Bhutan with the ability to access digital information and to enjoy the benefits of new developments in the telecommunication sector. While conducting the survey we took extra care to assure that the respondents truly represent random samples in terms of financial status, location, gender and age. The questions were selected carefully to find out the digital divide in terms of age, residential internet connections and the ability to use digital information among various age groups. Questions were included to find out the possible solutions to bridge the digital divide. The investigation was focused focussed on identifying the popular media, use of community centres to access digital information and the possibility of developing remote schools as community centres to disseminate digital information.

In order to assess the extent of digital divide the responses were compiled and the values are compared with the average standard of Bhutan. The information about overall scenario in Bhutan in terms of Internet connection, telephone penetration and number of mobile phone subscribers were collected from various government offices and from the official web sited of UNFP, ITU, UNISEF, and Druknet.

When we consider the number of citizens having access to Internet, like any other developing Asian countries, Bhutan also has marginal difference in comparison with the developed western countries. In 2006, 3% of Bhutan's

population (Internet world status, 2006) have access to internet while 82% of the population in western (OECD, 2001) developed countries has access to Internet.

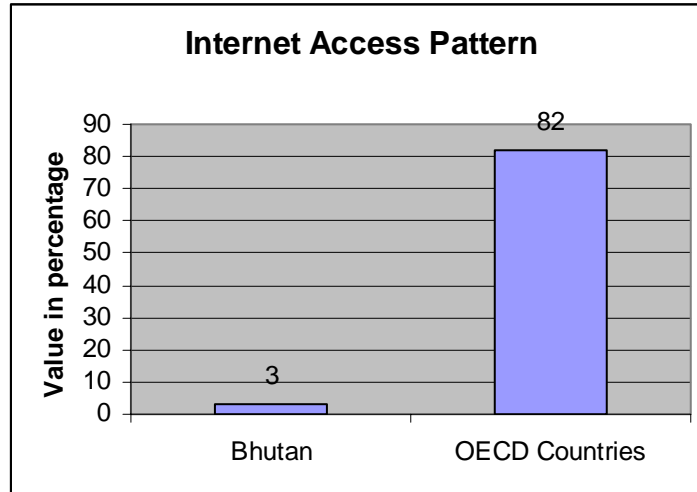


figure 2: Internet accessibility in Bhutan and western countries.

Within Bhutan, the country has an alarming situation in terms of digital divide and even with the awareness of the people about the ICT's 67.4% of the young educated respondents participated in survey from urban area feel that they have access to Internet, although 36.5% felt that the existing facilities available in Bhutan are not adequate for their access needs.

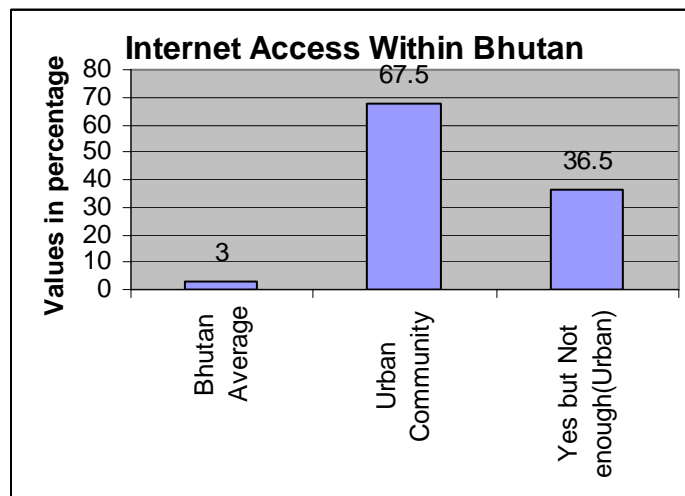


Figure 3: The extent of digital divide in internet access within Bhutan.

When we consider the geographic structure and environment of Bhutan, the country faces numerable challenges in terms of accessibility to remote villages due to the lack of motor able roads, steep mountains and hostile weather conditions. Even though power generation is the single largest source of income in Bhutan's revenue with a contribution of 45%, more than 70% of the village do not have electricity because of their remoteness and due to the unmanageable geographical conditions (Choden,2007).

In this unique situation which prevails in Bhutan it will be extremely difficult to bridge the digital divide by providing online digital information to the remote villages and the people. The situation in Bhutan can be handled only by promoting popular communication media like radio and TV for disseminating digital information. The community schools promoted by UNISEF in remote villages can be used efficiently to provide access to digital information for the common people (UNISEF, n.d.).

Bridging the Divide

Community schools

In the country, even with many constraints in infrastructure development, and geographical conditions, good number of remote villages has a school. In Bhutan remote rural areas are home to 80% of the primary schools (US Department of State,2006). UNISEF is coming up with the idea of promoting community schools in remote villages.

A preliminary study shows that 63.5% of the school teachers had exposure to ICT but many feel that they do not have the facility in the schools to practice their ICT knowledge.

By considering the fact that, most of the primary and upper primary schools are located in remote villages and fairly good number of staff has exposure to ICT, these schools located at remote areas can be promoted as community centres to offer internet for the communities. These community schools are expected to deliver the following:

- e-Government services
- Email services
- Domestic and international voice telephony
- Internet browsing and web hosting
- Internet and computer education etc.
- Financial services

These centres should not only provide access to Internet but it must also help and encourage the people to learn Internet browsing.

Off-line Internet

In some of the far remote villages, providing online internet may not be feasible or economically viable due the lack of cheap Internet connection, or of electric power or because of unfriendly geographical conditions. UNDP and ITU have proposed the implementation of off-line internet for Bhutan in remote places (Ercim news, 2003 July). In interior schools this off-line internet can be implemented to provide information about agriculture, farming, weather, health care and education with a local server containing downloaded information from internet. This servers have to be updated periodically either by connecting to the internet or by enhancing the information externally.

Radio and Television

Among the respondents of the survey 70.45% believe that radio is the most popular media among the common people. Television is also becoming a popular media after it was allowed in 1999(BBC News, 2004, June 17). 57% of

the respondents believe that common citizens can be informed through television. In the remote villages and schools of Bhutan Solar Electric Light Fund (self) is providing 750 watt solar power system for television sets and DTH systems(Self,n.d). Because of this facility, the penetration of television is also increasing marginally in the country. In this scenario these two popular media can be used effectively for providing information from Internet to the common citizens. If two or three hours of daily broadcasting services can be exclusively dedicated for airing information from internet according to the request from the users, it can help in bridging digital divide to a great extent. This request can be submitted to the radio or TV stations through a phone call or by ordinary mails or by submitting a request with the community schools. This will be an efficient way in disseminating digital information in rural communities in the areas like agriculture, health, farming, education, environment etc.

Importance of GIS

Introduction to GIS

Since time immemorial human beings have always resorted to geographical information in one way or the other in survival practices and decision making. Today systems have evolved that can use geo information in a myriad of applications such as management resources, facilities and infrastructure, analyzing population data, monitoring environment, health care and various location based activities.

GIS has been described as a computer, based technology consisting of data software, human ware, hardware that can capture, store, analyze and display information about the earth's surface and what is contained on or under it. Bhutan also identified the importance of GIS in maintaining its natural resources and in sustainable economic development through agriculture and hydroelectric projects. National agency for GIS coordination (NAGISC) was established in the

year 2000 for promoting the use of GIS in various government sectors (National GIS Coordination Committee, 2005, Aug).

We use GIS as a tool for decision making in a specific area by associating various information from the area to a digital map or aerial photograph. This information is usually called as data sets. Any GIS application will have fundamental data sets used for identifying the location and also for representing certain geographical parameters. The essential data are:

- Geo-reference system parameters
- GPS reference data
- Topographic database
- Digital elevation model
- Transportation network
- Cadastral data
- Hydrographs
- Settlements
- International/Administration boundaries
- Aerial photography
- Satellite imageries
- Land cover
- Communication
- Geology
- Demography

Other data sets can be promoted to the GIS application depending on needs and demands.

GIS for promoting community schools

The location for a community school must be chosen fairly so that it may be accessible to the people from different localities in a remote community. In the process of selecting a site for a community school for disseminating digital information, we have to address the various factors like geographic location, community and population, socio-economic profile of the region, literacy rate of the region and developmental factors.

Community mapping using a GIS system is considered as the best systems for promoting community schools and other services for the rural under privilege community. Community mapping involves the process of geographic enquiry using digital maps and by associating data items digital maps and by associating data items concerned with community in the GIS system. Some of the data items for community mapping can be identified as follows:

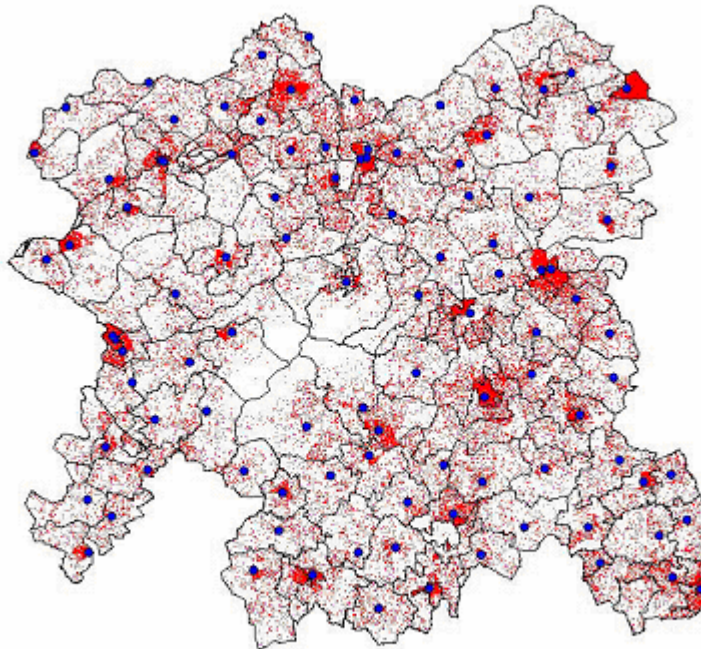
- Boundaries of the community
- Natural landscape
- Population
- Literacy rates
- Economic activities
- Roads and transportation facilities

In Bhutan, in addition to the above data items in a GIS based community mapping, some more attribute should be associated to the system to help in locating the sites for community schools. These data items are:

- Internet connectivity
- Phone connection
- Availability of televisions with DTH

- Electricity connection
- Ability to handle English in that region
- Number of school going children
- Number of people with computer awareness

Clusters of Residences and Schools, GIS Mapping



Schools are represented by blue dot. Each house is represented by a red dot

*Figure 1. Sample GIS implementation based on Location of Schools and of polling houses
(Steve Varner, 2002)*

In Such a system, all it takes is a click of the mouse to obtain the figures of the total population of a village, population of a community, Literacy rates, Internet connectivity and other details immediately and accurately. This system will be a potential tool for deciding the location for a community school (or for promoting a village school as a community school).

GIS for implementing Off-line Internet

Due to Bhutan's unique geographic and environmental situations prevailing in the country, many of the remote village community schools can afford to have only off-line Internet. The local servers of the offline community Internet centre must be stored with downloaded information which is relevant to that locality and community. These servers must be periodically updated with the latest information from the nearest point having Internet connection. GIS based community mapping systems can again help in this area of decision making especially in selecting a location after considering many factors and also in deciding the variety of information to be stored in the local server based on the needs of the society, region, geographical environment and economic activities. The GIS system can be further improved to support off-line community internet schools by associating some more data items about the rural community. They are:

- Availability of solar power
- Cultivation patterns of the area
- Health concerns of the area
- Nearest location with Internet connectivity
- Information needs of the locality

GIS for Internet radio and TV services

The success of Internet radio and Television depends on the ability to broadcast the downloaded information to the region from where the request has come. GIS based community mapping systems are highly successful in locating the source of a request or a telephone call from the geographical area. Such a GIS based system can be further improved by adding some more data items to handle the situation in Bhutan. These data item can be listed as:

- Television set with DTH or cable connection
- Coverage of radio broadcasting
- Location of the radio station
- Location of the cable TV operator

In an internet radio service, it is possible to broadcast the information only to a specific region after locating the geographical source of the request and by locating the radio station which covers that area with the assistance of a community mapping GIS system. Based on the type of the request and situation, it is also possible to air the information through the television broadcasting network or through a cable television network from that region.

Conclusion

Even though the extent of gap in Internet access facilities between rural and urban communities is alarming, Bhutan has all the potentials to bridge this gap through community services with the support of an efficient GIS system. Many international organizations like UNFP, UNISEF and UNDP are providing assistance in developing community schools in rural areas. From the ongoing export based hydroelectric power projects Bhutan will also have sufficient resources for infrastructures development (Bhutan News Online, 2005, May 5).

The popularity of English and fairly good number of employees with exposure to IT are two important factors which have the capability to bridge digital divide. After the extensive census exercise of 2005, the government has adequate information about the citizens, economic and agriculture pattern, infrastructure and penetration of television, radio and Internet etc. Various

government bodies have also realized the importance of GIS in the process of development and they have started using GIS for solving wide variety of issues. If the Government can coordinate and mobilize the resources with the assistance of a proper community mapping GIS system, the digital divide in Bhutan is manageable and it can be easily bridged.

Reference:

- 1 Royal Government of Bhutan,(2006,Aug.)
Technical Guidelines on Information and Communications Technology (ICT) for Preparation of the Tenth Five Year Plan (2008-2013).
Ministry of Information & Communications.

- 2 Second Periodic Report of the Kingdom of Bhutan to the Committee on the Rights of the Child.(2007).

- 3 Samten Wangchuk.(2007,March 28)
Tertiary education : Limited seats.
Kuensel Vol XXII No. 23

- 4 Thinley Choden.(2007)
Bhutan: Balancing Growth and Environment Conservation through Hydro Power
<http://www.adb.org/AnnualMeeting/2007/Essay-Competition/winning-entries/Thinley-Choden.pdf>.

- 5 Suellen Donnelly.(P.387).
How Bhutan can Measure and Develop GNH.
www.bhutanstudies.org.bt/seminar/0402-gnh/GHN-papers-1st_18-20.pdf.

- 6 *The term Gross National Happiness.*
Development based on non-material values.
<http://www.grossinternationalhappiness.org/gnh.html>.

- 7 Diego Puppini(2003, July).
Internet and Isolated Villages: An Opportunity for Development.
<http://ercim-news.ercim.org/>

- 8 Bhutan.(2006,March 8).
Country Reports on Human Rights Practices.

Released by the Bureau of Democracy, Human Rights, and Labour.

<http://www.state.gov/g/drl/rls/hrrpt/2005/61706.htm>

9 UNISEF(n.d)

Education-Shortening the long trek to school.

<http://www.unicef.org/bhutan/commsch.htm>.

10 BBC News(2004, June 17)

Has TV changed Bhutan?

http://news.bbc.co.uk/1/hi/entertainment/tv_and_radio/3812275.stm.

11 National GIS Coordination Committee. (2005, Aug).

National Framework For GIS Implementation in Bhutan.

Center for GIS Coordination Department of Survey & Land Records.

Ministry of Agriculture

12 Steve Varner.(2002).

The Effectiveness of GIS in High School Education.

<http://gis2.esri.com/library>.

13 Solar Electric Light Fund. (n.d).

Powering "gross national happiness".

<http://www.self.org/bhutan.asp>.

14 Bhutan News Online(2005, May 5).

Hydro-Electric Power Projects of Bhutan.

<http://www.bhutannewsonline.com>.

Abbreviations:

1. ICT : Internet and Communication Technology
2. MoIC : Ministry of Information & Communication
3. GNP : Gross National Product
4. FYP : Five Year Plan
5. BHU : Basic Health Unit
6. UNFPA : United Nations Population Fund
7. ITU : International Telecommunication Union
8. UNISEF : United Nations Children's Fund
9. UNDP : United Nations Development Program
10. DTH : Design Tech Homes
11. NAGISC : National agency for GIS coordination
12. GIS : Geographic Information System
13. GPS : Global Positioning System
14. OECD : Organisation for Economic Co-operation and Development