Prospects and Problems of GIS in India

Ravi Gupta

Editor, GIS@development,
Director, Centre for Spatial Database Management and Solutions (CSDMS)
A - 13, Sector 22, NOIDA 201 301 India
Tel: +91-118-544410, Fax: +91-118-527044
Email: Ravi.Gupta@csdms.org

ABSTRACT India possesses considerable strength in software technologies and has many innovative research groups working in GIS arena besides some GIS vendors with novel approaches and ideas. Remote Sensing images as an inherent part of geographical databases work as an integral part of GIS to the advantage of India, especially with the advent of new satellites with high resolution in India. The combination of Remote Sensing with GIS and geographical infrastructure development puts India into a prominent spot. However, despite the strengths in remote sensing and software technologies, the state of the GIS market in India today is one of immaturity in which much good quality data already exists but is unknown to potential users. India is not able to take advantage of the richness of data it has compared to other parts of the world because of the lack of a clear legal and commercial framework is not in place. Valuable data sets are held, especially by government bodies, but are not currently available for many reasons. Moreover, the information available varies greatly in quality between organizations and existing datasets have been collected to different specifications so it is not easy to integrate data safely from multiple sources.

The major impediments to the widespread and successful use of geographic information in India are not technical, but political and organizational. The present paper discusses in detail about the genesis, history and impact of the problems of GIS industry and the recent initiatives taken by the various stakeholders including government of India in back ground of ongoing process of globalisation. The paper summarises the status of GIS in India and highlights the urgency of certain well-defined steps to be taken to ensure the growth of GIS in the country.

KEY WORDS India, Data dissemination policy, GIS, Remote Sensing, NSDI

1.Importance of Geographic Information

GIS technology promises greater efficiency in commerce, improvements in environment, health, safety, increased convenience for consumers, more citizen participation in governance and improved public and private decision making in general. But, legal regimes for protecting and managing compilations of digital spatial data are underdeveloped and unclear all over the world. The concepts of ownership of digital spatial data, protection of privacy, access rights to spatial data compiled and held by governments, and information liability are still evolving in the context of GIS and spatial data.

Geographic Information Systems may be defined as a tool that uses the location at which an object exists or an activity occurs as a unifying concept across which information in a variety of forms may be merged, referenced, sorted, and analysed. Reality is represented by a set of mapped space where every attribute or event of concern has either a direct or indirect locational element. GIS enable the planned systematic collection, maintenance, and management of location based information and the automated processing of that information. The computerised integration of information through spatial links has the ability to greatly enhance decision making across a wide range of applications (Onsrud, 1995).

Governments are spending billions of dollars on collection of geographic information knowingly or unknowingly. For example, US spends more than 4 billion dollars per year on geographic data acquisition (Tosta, 1997). In France, the public financing of geographic information projects represents 0.17% of public development aid (AFGEO, 1998). Other countries are also spending huge amount of money for data generation, acquisition, documentation and dissemination. Recent estimates show that the worldwide investment in GIS technologies by government and private sector ranges from US$ 3.3 billions (Dataquest, 1995) to more than $ 8 billion (Market Intelligence Corporation, 1992 & Lopez, 1995a) with annual growth rate reaching nearly thirty per cent.

And surely these investments are not without due considerations. A report by Economic Studies and Strategies Unit of PriceWaterhouse on the economic benefits arising from the acquisition and maintenance of the nation's land and geographic information has estimated that for the period 1989-94 approximately $ 1 billion has been spent in Australia on investment in geographic data. This investment produced benefits within the economy in

the order of $ 4.5 billion. The study also found that this investment has saved users approximately $ 5 billion. This implies that there is a saving of $ 5 on the investment of $ 1. The study concluded that the existing infrastructure for supplying data had provided information to users at low cost than alternative methods. If this infrastructure had not been in place, and users had been forced to meet their data requirements from other sources, their costs would have been 6 times higher; if the benefits are to continue, an additional investment of 30% of existing funding levels will be required to meet the growing demand for data usage (Commonwealth Position Paper). Thus it is clear that governments all over the world realise that geographic information is an important infrastructure for a nations development. The government is the biggest geographic data generator also happens to be the biggest consumer also. In India, for example, out of the US$ 3.27 million revenue of National Remote Sensing Agency (NRSA) from sale of remote sensing imagery, 83% revenue was from the government departments themselves (GIS@development, 1999).

2. Status of GIS and remote sensing in India

To analyse the prospects of geographic information, it is essential to understand the strengths and opportunities available in India

2.1. Good geographic information acquisition Infrastructure

India has a good institutional infrastructure for geographic data collection. There is a network of institutions collecting information on every conceivable socially and scientifically relevant subject. The Survey of India and the Indian Remote Sensing Satellites are the most important generators of geographical data.

2.1.1. Survey of India

India, with an area of 32,87,263 km^2 is covered by both topographical maps and geographical maps. The Survey of India (SOI), which was established in 1767, is responsible for all topographical and development surveys in the country. The topographical maps are on scales of 1:25,000, 1:50,000 and 1:250,000, which are ideally suited for the professional work of geologists, geographers, foresters, engineers, planners, tourists, trekkers, mountaineers and others.

India is covered by nearly 385 toposheets on 1:2,50,000 scale and these are also called as Degree Sheets. Each degree sheet has 16 toposheets of 1:50,000 scale and at present the whole of the country is covered by 1:50,000 rigorous metric surveys in more that 5000 toposheets. Each 1:50,000 scale sheet contains four 1:25,000 scale sheets. More that 35% of the country has also been covered on 1:25,000 scale (Srikantia, 1999). This is undoubtedly an impressive record for any country in the world.

2.1.2. Indian Remote Sensing Programme

The satellite based remote sensing was established in the country with the launch of the first operational Indian Remote Sensing Satellite, IRS-1A in 1988 which was followed, by the successful launch of IRS-1B in 1991. IRS-1A and 1B satellites provide imagery with spatial resolution of 72.5m and 36.25m respectively. These satellites have been providing data for monitoring and management of our natural resources and environment. An advanced and most sophisticated civilian satellite of the world today, IRS-1C and IRS-1D launched in 1995 and 1997 respectively incorporate enhanced capabilities in terms of spatial resolution, spectral bands, stereoscopic imaging, Wide Field Coverage and revisit capability. They provides 5.8m spatial resolution in panchromatic mode. India also launched Oceansat in 1999 with Ocean Colour Monitor (OCM) and a Multi-frequency Scanning Microwave Radiometer (MSMR) on its board. India plans to launch Cartosat with 2.5m panchromatic data resolution by the year 2000. This satellite will have a cutting-edge technology in terms of sensor systems and provide sate-of-the-art capabilities for digital terrain modeling, contour mapping (~5 m contour levels) and many specific needs of cartographic applications. The data provided by Cartosat will be useful for giving cadastral level information.

The Indian Remote Sensing programme has been a major factor for the growth of importance of geographic information in India. The National Natural Management System (NNRMS) programme by the Department of Space has played a key role in using the capabilities of the Indian Remote Sensing satellites for the benefit of the masses (GIS@development, 1997).

2.1.3. Other Institutions Involved

Many other programs of government like Natural Resource Data Management Systems (NRDMS) and National Atlas and Thematic Mapping Organisation (NATMO) under the Department of Science and Technology, National Informatics Centre under the Planning Commission, have played an important role in geographic data generation in the country. Hosts of other organisations under various central and state

governments are also involved in geographical data acquisition in the country. A summary of the main data producers under the central government is provided in Table 1. Moderate estimate of the total budget of the listed organisations in the Table 1 is more than US$ 457 million per year, which is comparable to spending done by Australia or US, if we assume that operating costs in these countries are nearly seven times that of India.

2.2. Growing Demand for GIS

The first system of geographic information appeared in India perhaps in the late 1980s. It started to catch up in the early nineties and by the late nineties the demand picked up appeared and the market for software, data and services came into existence.

The technological developments of computer hardware and software contributed greatly to the growth of GIS market in the country, with the market really taking off with the development of powerful desktop PCs. This evolution was favoured by political and administrative decisions like the Prime Minister's Task Force on Information Technology, e-governance and decentralisation initiatives by many states of the country, which had a significant effect on the GIS growth.

There are hardly any figures available on the number of decisions to invest in geographic information systems in the country. According to IDC, the GIS market is expected to grow from US$ 6.63 million in 1996-97 to US$ 18.05 million in 1999-2000. The relative share of the GIS market in the design software market is expected to increase moderately from 16.1% in 1996-97 to 19.1% in 1999-2000. According to NRSA, the sale grew of its remote sensing data products grew from US$ 1.33 million in 94-95 to US$ 3.27 million in 1998-99. Industry heads are bullish about the market and project the GIS industry growth at 35-40% for the next few years (Verma, 1999).

The development of the geographic information market has contributed to the creation of a whole group of companies dealing in software, value-added data and services. The initiatives by NRSA and Space Application Centre (SAC) in vendor development have been creditable. More than 100 companies, mainly in Hyderabad, Bangalore and Delhi are into this business. The GIS service industry in the country is expanding at 10-15% per annum (Lavakare, 1999).

India is also fast emerging the global data conversion centre for GIS. The GIS companies from USA, Europe, Japan, Australia have either started operating directly or are subletting work to Indian companies. This has created enormous employment opportunities in the sector, which is leading to proliferation of this technology.

3.Problems

3.1. Data Access to the Public is Not Easy

Most of the organisations in the country are plagued with severe vision crunch in terms of the importance of their data for the people outside their organisation. It is extremely difficult to access any government-generated data. Moreover, existing datasets have been collected to different specification making it difficult to integrate the data collected from different sources. Very often, the agencies collect and utilise their own data as part of their institutional mandate and therefore are less concerned with the problem of access to public domain data and it is unlikely they provide data to other major players. Most of data generating agencies do not have the mandate for data dissemination. This results in ad hoc arrangements that benefit neither the government sector as a whole nor the private sector, which functions in a climate of extreme uncertainty. As mentioned in Table 1, very few data generating agencies have websites and even fewer of them put any worthwhile information on their sites. This reflects the poor understanding of these organisations about the importance of information dissemination.

3.2. The Geographic Data

Coming specifically to the status of geographic data, the situation is worse. Maps of restricted areas are not easily accessible. Aerial photography in whole of the country is considered secret or top secret by the government. Private sector is virtually debarred from entering into this sector. Digitisation of Survey of India toposheets can be done by only a few government agencies. Digital data is not available with most of the data producing agencies and at times even analogue data is not accessible.

The situation appears to be grim if we compare ourselves with most of the developed countries (Table 2). A survey of national and regional spatial data infrastructure activities around the globe documented the strength and weakness of Indian geographic information situation (Onsrud, 1998). An analysis of the responses on the parameters set by this survey reveals the following:

Mechanics of Data Access: It refers to the technical and organisational mechanisms through which spatial data is being made available to the citizens. In most of the developed countries, there is a system, which is, either well placed or taking

Table 1: Data policy/practice indicators in data and data generating agencies in India

S. No.	Data Type	Name of Agency (ies) involved	Name of Ministry involved	Paper Data Availability	Digital Data Availability	Does the concerned agency have a web site?	Use of web site for data dissemination
1	Meteorological data	Indian Meteorological Division	Science and Technology	Y	N	N	N
2	Environmental data	Central Pollution Control Board (CPCB)/ National Environmental Engineering Institute (NEERI)/WWF /Forestry Survey of India	Environment and Forests	Y	N	N	N
3	Mapping data	Survey of India	Science and Technology	Y	N	N	N
4	Remote Sensing data	National Remote Sensing Agency	Space	Y	Y	Y	Y
5	Information on buildings (at national or local level)	Local Government	Rural Areas and Employment /Urban Affairs	N	N	N	N
6	Cadastral Registers	State Government	Rural Areas and Employment /Urban Affairs	N	N	N	N
7	Geological data	Geological Survey of India (GSI)	Mines	Y	N	N	N
8	Botanical data	Botanical Survey of India	Agriculture	Y	N	N	N
9	Agricultural data	NBSS, AISLUS	Agriculture	Y	N	N	N
10	Thematic Mapping	National Atlas and Thematic Mapping Agency	Science and Technology	Y	N	N	N
11	Census data	Census of India	Home	Y	N	Y	Y
12	Watershed data		Agriculture	N	N	N	N
13	Data on River Basins	Central Water Commission	Water Resources	Y	N	N	N
14	Oceanographic data	National institute of Oceanography	Ocean Development	N	N	Y	N
15	Geographic Information Laws	Defence	Defence	N	N	N	N
16	Ground Water data	Central Ground Water Board	Water Resources	N	N	N	N
	Statistical data	CSO (Central Statistics Organsation)	Planning and Implementation	Y	Y	Y	Y
17	Information Systems	National Informatics Centre	Planning Commission	N	N	Y	Y

place for data accessibility. Unfortunately, the sale of unrestricted maps trough the Survey of India (SOI) maps sales offices are the only source of topographical data in India. Most of the other theme specific paper maps are supplied by various departments on specific requests.

Role of Private Sector It refers to involvement of private sector in data generation, and dissemination. In general, throughout the world, private sector participation has been envisaged for the growth of GIS industry. In US, even small vendors get ample opportunity to flourish in US market by getting at low or no price the government data and claiming their copyright after doing value addition (Tosta 1997). In Canada, private sector works in partnership with government in data dissemination process. In UK, private sector can access the data, after paying for it (Lopez, 1995b). In India government generated data is not accessible to private sector and surely not for commercial purposes.

To illustrate the difference between the opportunities for private sector in India and abroad, we take the case of US. Unlike SOI, the United States Geological Survey (USGS) 1:24,000 scale topographic maps are the basic scale maps for the USA and are not protected by copyright. They comprise some 57,000 sheets. Projections for integrating and updating them into coherent digital topographic database do not foresee completion until the early 21st century. It is technically and legally feasible for a low-labour cost developing nation to purchase the maps and digital files at minimal cost, update them from commercially

available remotely-sensed imagery according to market priorities (there would be no need for them to deal with remote and sparsely populated areas unless it was profitable), and resell the USA's own maps back into the internal market, this time claiming commercial copyright. In India, such a situation is unimaginable. We have enough rules and regulations for discouraging market forces to dominate, which is not good at all the times.

Digital data availability: It is important to have the data in digital form as it can be circulated and exchanged at high speed. It can be duplicated without deteriorating and combined with other information to create new information, etc. Most of the developed nations are introducing amendments to their existing legislation to incorporate the provision of the supply of digital data. In India, digitisation of maps can be done only by some of the government agencies and NGOs working with them. No policy framework for digital data exchange or sale has been evolved till data in the country.

Public domain data sets: It refers to those digital spatial data sets for jurisdictions within the nation that are available to anyone without licensing or intellectual property restrictions imposed on the data sets and the data sets are available at no cost (Cardinal, 1996). In India, it is understood that SOI is planning to evolve a centralised digital geographic information infrastructure. Given the enormity of the work involved, probably it should involve other players in developing geographic information infrastructure as it may not be possible for SOI to complete the task in near future.

Metadata: It refers to information about what kind of data is available, where it is available and with whom it is available. In US already data clearinghouse, a system from where various kind of (spatial) data is disseminated, is operational (Rhind, 1997). Most of the countries are striving to develop the metadata of their datasets. In India, there is no such effort so far.

Core data accessibility: There are some basic data which government provides either free or at cost. There exists at least a strategy in several countries to make these data available. In India, even if these data is available, people are not aware of them and at times the custodians of these data themselves are unaware about its existence.

Access to government information: In US, government information is available at or less the cost of dissemination, free of cost or at the cost of dissemination. In UK, government information is available at a price (Lopez 1995b). Situation in other countries somewhere lies in between UK and US. In India, government practices data secrecy policy. In fact, the fundamental issue that needs to or little cost. Anyone can take this data and use it and even customise it as per the requirement. In US, most of the government-generated data are in public domain and these data are available either free or at the cost of dissemination. To the contrary, in UK, government generated data come to public domain only after the expiry of copyright. In India, huge amount of valuable data sets have the potential to go to public domain (Gupta, 1999). But at present, only few data is available in public domain. Some of the data may be available at price but in general most of the data is not available in public domain.

A strategy for National Geographic Information Infrastructure: Several countries have been evolving a system for their spatial data at their central/ national level. These systems envisage proper data collection, documentation and dissemination. For example, the uniqueness of the NSDI (in US) is based on the idea that it is impossible for a federal committee to muster the resources necessary to build a national data infrastructure by itself, and that it is necessary to bring together the appropriate organisations and the individuals who generate, or use geographic information in order to expedite this onerous task be addressed to deal with the issues related to data accessibility is freedom of information. It is important in democratic set ups that fundamental right is given to citizens to live up the democracy to its true spirit. Norwegians enjoy this right since long (Bing). In India, such a proposal has been in political pipeline since long. However, some of the state governments such as Goa and Rajasthan are in the process of implementing some form of right to information.

Data pricing policy: Whether data should be priced at all and if yes, which document should be available at what price. All these issues should be addresses in a well-defined manner to formulate the data pricing policy. This pricing structure is essential for the commercialisation of geographic data and that is why most of the countries encourage sale of their geographic data through government or the private sector. In India, there is no well-defined policy in this regard.

Driving force for SDI: It refers to the dynamics of forces, which give the shape to spatial data infrastructure. These forces may be the government, private sector, international pressures, etc. India is also, after much liberalisation in economic policy feeling the pressure. In India, Indian Remote Sensing Programme and IT Task Force have played a positive role in creating a conducive atmosphere for SDI.

As in many other developing nations, the major impediments to the widespread and successful use of geographic information in India are not technical, but political and organisational. There is a lack of concerted action and political critical mass at both state and national level. There is no national mandate on geographic information, which retards development of information strategies and causing unnecessary costs and also discouraging new services based on geographic information. Worse, there is significant lack of awareness among the decision-makers at all levels. Attempts to develop a coherent information policy are likely to fraught by diverse policies advocating conflicting goals. As described in Table 3, geographic information arena as a whole is still immature in the country with broad set of issues yet to be resolved. To make the matters worse, there is no cohesive geographic information community, which can take up these problems at the top echelons of the government.

India can earn billions and make savings in the same amount with a visionary policy on geographic information. Let us look at the available and emerging opportunities for India.

4.Prospects

4.1. India improves the quality of life of citizens through GIS

India has a well-developed software industry and skilled and well trained software engineers. This industry can be used to reduce the of cost of public service and increase its efficiency through GIS usage for better governance.

4.2. Employment Generation

The development of uses and the emergence of new GIS applications and services will create new jobs, on condition that there is a consistent policy which takes all aspects - research, training, production and distribution, exportation, services - into account. Such a policy requires the involvement of players in the field and also clear guidelines from the State and its offshoot organisations. The essential issue lies very much in increasing economic activity in a sector related to the new technologies and in the stable jobs that such development can generate.

4.3. Employment Generation

The development of uses and the emergence of new GIS applications and services will create new jobs, on condition that there is a consistent policy which takes all aspects - research, training, production and distribution, exportation, services - into account. Such a policy requires the involvement of players in the field and also clear guidelines from the State and its offshoot organisations. The essential issue lies very much in increasing economic activity in a sector related

Table 2: A Comparison between India and International Scenario

Parameters	India	International*
Mechanics of Data Access	Paper data sale through SOI offices.	Clearinghouse nodes, websites, E-commerce etc.
Private Sector involvement in Data generation, dissemination	Nil	In most of the countries
Digital geographic data availability	No	Yes. Now vector data being also provided in addition to the raster data
Public domain datasets (available for free)	Nil	Few in most of the countries. US is an exception.
A strategy for National Spatial Data Infrastructure	No	Yes
Metadata	No	Process going on in most of the countries.
Data Clearinghouse	No	Yes in many of the countries
Data standards	No	Yes
Core data accessibility	No	Yes
Access to govt. information	No	Yes
Data dissemination policy	No	Yes
Data pricing policy	No	In some of the countries
Driving force for Spatial Data Infrastructure	No focussed program. One of the agendas of Indian Remote Sensing Program / IT Task Force	Focussed initiatives for geographic information
Information economy	Poor	Rich
Freedom of Information	No	In some of the countries

***International:** Here it refers to the trends in countries like US, major European countries, Canada, Australia, Japan, Korea, Qatar, Indonesia, Malaysia.*

Table 3: Micro-level issues in geographic information scenario in India – an analysis

Problem	Possible Solution Approach	Possible Problems foreseen by the government	The escape routes in vogue	Implications of government not accepting the solutions
Digitisation of SOI topomaps not allowed	Digitisation may be allowed at least for non-restricted areas. A fee may be charged for commercial applications	Loss of control of data.	People forced to digitise SOI maps 'illegally'. They don't acknowledge SOI name. Instead they acknowledge NRSA data / NATMO maps as the data source.	SOI loses its moral right to be known as producer of the data.
No clear-cut policy on import of Indian maps from outside India.	A clear-cut policy on import can make life easier for map users.	Assumes that no maps are available abroad.	Users are getting the required maps secretly from abroad, which may not be accurate	People lose faith in the system.
Restrictions on export of maps	Remove the restrictions	Government feels that maps exported will lead to increased security risks.	Digitisation and export of maps through Internet going on.	Private agencies are making profits at government's expense.
Maps of Restricted Areas	Ease restriction	Access to restricted maps will increase security risk	Restricted maps being imported from abroad	Indian scientists and private companies suffer because of restrictions.
Geodetic Data Restricted	Soften the restrictions keeping in mind the data already available with foreigners.	Access to geodetic data will increase security risk	Scientists forced to get data from abroad	Hamper the S & T growth in India
No Right to Information	Implement it	No political motivation to implement	Beg, borrow or steal principle for data access being used	Government loses the revenue it would have generated by selling data. Public loses a chance to benefit from the information collected by its money.
In all data dissemination activities only government considered as a consumer of data	Public should be the main consumer	Government runs the country. Not the NGOs or private sector. So no question of giving them the access	Beg, borrow or steal principle for data access being used	Lack of public participation in government decision making
Mandate for data dissemination	There should be mandate.	Too busy in data generation to think of dissemination	Selective data leakage done by the government depending on its comfort	Duplication, of costly data generation efforts.

4.4. External Markets

According to NASSCOM (National Association of Software and Service Companies), IT-enabled services has emerged as the new "big" opportunity for India after the Y2K services. These services are expected to generate over 1,000,000 new jobs and export revenue of US $ 18 billions over the next 10 years. GIS is considered as one of the high "value add" IT-enabled services. But, it has also to be realised that unless India moves up the value chain quickly enough, we may lose out this opportunity to other low-cost service nations. According to an estimate, the total export market size of Indian geographic information is around US$ 40-50 million, and it is growing at a rate of over 40% (Lavakare, 1999). Similarly, the opening up of the South Asian countries (Nepal, Bangladesh, Sri Lanka, Bhutan, Pakistan) to a market economy is giving rise to a high demand for geographic information. These countries are spending millions of dollars in programmes financed by the big international funding agencies every year. These markets represent essential political (extends the Indian presence in various countries and helps in improvement of relationships) and economic stakes.

The possibility for Indian companies and experts to participate in these important programmes very much depends upon the exemplarity of the national model and the capacity of companies to promote and sell it. Due to the small domestic market for GIS, there's no training ground for companies to experiment, learn from failures, take risks and innovate. Thus Indian companies are caught unprepared to take on international competition. The restrictive and unclear government regulations inhibit the growth of the domestic market, which in turn prevents Indian companies from showcasing their skills in the international arena. Inexperience of Indian companies also dissuades foreign tie-ups in the domestic market, which discourages import of new technology (Lavakare, 1999).

4.5. Self Reliance of Data Generating Agencies

The emerging market of geographic information opens up ample opportunities for the geographic information generating agencies such as Survey of

India (SOI), National Atlas and Thematic Mapping Organisation (NATMO) and Indian Meteorological Division (IMD) to exploit the market potential and earn revenue for their respective departments. They can become self reliant by selling the data after doing the value addition and making their data more user-oriented. The UK experience shows that government can earn its keeps for data generation. This model, if adopted in India, may atleast motivate the data acquisition agencies for development of more user targeted strategies of data sale.

5. The Need of the Hour

5.1. If We Don't Do It, Someone Else Will

There is an urgency to act for the simple reason if we don't start providing services to our countrymen, someone else will. For example, Microsoft has launched MapPoint, a desktop map visualisation and analysis software at the cost of $ 109. And this includes four years of demographic data for USA. By 2000 MapPoint for UK and by 2002 MapPoint for Europe are expected to hit the market. If the pace remains same, no doubt by 2005-MapPoint for Asia (including India) may be in the market, provided the government does not come in the way. The revenue which SOI or any other agency may have earned, will then be earned by someone else.

5.2. Reduced International and Global Competitiveness

India does lose its global competitiveness by not making available core set of data to public. Like electricity, water, clean air, good human resource, information is also a vital factor for attracting investments, increasing tourism, boosting trade and improving quality of life of the masses. So instead of agencies finding n number of reasons to hide data, we should try to look for n+1 reasons to share data.

5.3. Continuation of Adopting Costly ad Hoc Solutions

In spite of the relative spending of India on geographic data acquisition being comparable to any other developed nation, the benefits have been relatively low in comparison. This will continue unless we develop synergy between various stakeholders.

5.4. Lack of Control of Information on One's Own Territory

Although the Indian citizens are denied access to border area maps, its available freely outside India. Is the same going to happen to updated large scale maps of whole of the country? With the spy satellites hovering upon us and monitoring each and every minute activity of the country, there is little left to hide. SPIN 2, the Russian satellite is already selling its 2m resolution data on the web. Commercial satellite IKONOS with 1m spatial resolution is already in the offing. Thus it is very difficult for countries to hide geographic information, and instead of being reactionary mode, we will have to adopt a pro-active approach regarding geographic data availability. The control of information describing one's own territory and the autonomy of decision models using this information are a major part of independent political decision making. India must endow herself with the means to surpass and be more dynamic than the global trends. Accelerating the process of quality digital data coverage of the territory and India's control of earth observation satellite technology are the primary means to guarantee autonomy in her choices.

5.5. Will the Patent Experience Be Repeated in Case of Maps?

Important projects exist today, which aim to build up data bases of geographic information on South Asia, and also on the whole world, such as Regional Geographic Information Infrastructure (RGII) project of UN, Earthmap projects of American institutional stakeholders or Global Mapping in Japan. In spite of the Indian technological leadership in Remote Sensing and software technology, Indian organisations have been taking an increasingly limited part in international bodies. Whether it be the UN's specialised commissions, international standardisation organisations like ISO, India's seat is empty or only symbolically occupied. However, an active presence within these bodies means preventing them from taking options which are prejudicial to the interests of national companies and gaining recognition of expertise, which is a first step towards intervention in the definition of the major international projects. Indeed, the limited presence of national experts' in the upstream phases of projects would appear to be one of the causes of the limited performances of national companies in terms of turnover. All the players must mobilise to ensure this presence and an organisation, for instance the SOI and Indian Space Research Organisation (ISRO) initially, must be in charge of making sure that India is present effectively in all these bodies.

Our limited or no presence in international bodies can be illustrated by following examples. The international body ISO/TC 211 is working in the field of standardisation of digital geographic

information. In this organisation the presence of India is as an Observing member along with Bahrain, Brunei Darussalam, Columbia, Cuba, Estonia, Hong Kong, Iceland, India, Mauritius, Oman, Pakistan, Poland, Slovakia, Slovenia, Turkey and Ukraine. The point to be noted is that India is not a participating member of the organisation where countries not only Australia, Canada, UK, US are the participating members but countries such as Iran, Jamaica, Malaysia, Saudi Arabia, South Africa, Tanzania and Thailand are also the participating members (ISO/TC 211 Scope, 1999). Do we need to be satisfied with the status of observer or we need to play more active role in these organisations?

To quote a related example, Surveyor General of India is a board member of permanent Committee on Geographic Information for Asia Pacific. It is good but again the role is peripheral in this international organisation which could have been central one and more active had India be a member of GSDI Steering Committee or Technical Working Group.

In the background of these several international initiatives, India can not afford to be an isolated entity. It is not only important for the better management of the country's resources for the development of the country but also it is important to involve in global mapping projects to influence the entire procedure. For this, it is essential to speak a global language if we want to participate properly in these projects. Otherwise, the any of the formulations of GSDI, RGII or ISO, which will evolve in due course will be more friendly to those countries who are involved in its development and may be far related to the ground realities of our country. Sooner or later, the developed nations will link it up with development aid and may force other countries to accept the standards developed by them. These kinds of instances are not unknown to international community. In fact, we should not forget how the patents of basmati, neem, turmeric, etc. by foreigners have caught us unaware. Although a wild thought, but imagine, what if someone patents or copyrights our maps?

5.6. Increased Dependency on Technology from Outside India

We have all been moaning about the fact that India is just doing a roadside mechanic job in terms of Information technology. We haven't really moved up the value-chain in software development. By restricting data, we make the entry of new players in the market difficult and decrease the chances of innovation. So we ensure that we will never be able to grow the companies like ESRI, Intergrpah or MapInfo in India, and remain dependant on other nations for new GIS tools. The dependence or the need to rely on organisations in other countries for the provision of data and other services may not be considered good.

6.Conclusion

There are problems. But these are the problems which probably every country has faced or facing in one way or the other in different period of times. Equally true is that there is a huge potential for the growth of GIS industry given the strength of India in the field of space sciences and computer sciences. There is increasing awareness about the potential of mapping technologies not only in industry and academia but also in the government. Initiatives such as GIS@development have played crucial role in awareness generation and taking up critical issues concerned with GIS industry in particular and GIS users in general. Liberal economy, the process initiated around a decade before is now changing the culture of government offices. Some of the offices are now more open to private sector. There have been initiatives on the part of the central and some of the state governments in data sharing. The future of GIS in India is quite promising provided the pace of information policy reforms is further accelerated.

References

AFGEO,1998, French Geographic Information in the Information Society, Present Situation and Proposals for Actions, version 3.0, May 1998. www.cnig.fr/lblangl.htm

Bing, J., Commercialisation of Geographic Information in Europe.www.eurogi.org/legal/commerce.html

Cardinal, M. et al, Barriers to the Use of Geomatics Data, Inter-agency Committee on Geomatics, Working Group on Coordination and Cooperation, January, 1996.

Commonwealth Position Paper on the ASDI. www.auslig.gov.au

Dataquest, 1995, Market Figures for GIS Industry as reported in Business Geographics. 4:1 (January 1995) GIS World: Fort Collins p.p. 12.

GIS@development, 1997, IRS-1D: Another Milestone in Indian Remote Sensing Programme. Nov-Dec 1997. p.p. 11-18.

GIS@development, 1999, News Remote Sensing, March-April 1999, Vol 3.2, pp.10.

Gupta, R., 1999. Is there a way out? GIS@development, July-August, 1999, p.p. 42-45.

ISO/TC 211 Scope, 1999. www.statkart.no/isotc211/scope.htm

Lavakare, A. 1999, Geo-spatial Information Services in Software Exports. Map India'99, August 24-26, 1999, New Delhi.

Lopez, X. 1995a, From Gravel to Diamonds: The National Spatial Data Infrastructure at a Crossroads, Proceedings 1995 Urban and Regional Information Systems Association (URISA) Conference, July 17-20, 1995, San Antonio, TX, URISA, Washington DC. www.spatial.maine.edu/1-16/papers

Lopez, X. 1995b, The Impact of Scientific and Technical Information Policy on the Diffusion of Spatial Databases. 1995 Proceedings of Joint European Conference and Exhibition on Geographical Information, March 26-31, 1995, The Hague, the Netherlands. AKM Congress Service. www.spatial.maine.edu/1-16/papers

Market Intelligence Corp, 1992, Total GIS Software and Services Market: Revenue Forecast (World), 1991-1996, Computing Canada, January 1992, pp 23.

Onsrud H. J. & Robert I Reis, 1995, Law and Information Policy for Spatial Database: A Reseach Agenda, NCGIA Initiative 16: Law, Information Policy and Spatial Database, 35 Jurimetrics. 377-393, 1995. www.spatial.maine.edu/1-16/papers

Onsrud, H. J., 1998, Survey of National and Regional Spatial Data Infrastructure activities around the Globe, Global Spatial Data Infrastructure Conference, Canberra, 1998: www.umesve.maine.edu/harlan/gsdi/india.html

Rhind D., 1997, The relationship between national and international GII, Geographic Information research at Millennium GISDATA Final Conference, Le Bischenberg, France, 13-17 September, 1997.

Srikantia S. V.,1999, Restriction on Maps in India: An Anachronism that needs Removal. GIS@development, March-April, Vol 3.2, p.p. 25-34.

Tosta N., 1997. The US National Spatial Data Infrastructure Experience, Geographic Information Research at the Millennium GISDATA Final Conference, Le Bischenberg, France, www.shef.ac.uk/uni/academic/D-H/gis/tosta/html

Verma S., 1999. The Geographic Edge, Dataquest, Vol XVII No. 16, p.p. 86-90.