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Web Based Environmental Information System on Himalayan Ecology: A Scientific Review

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Abstract

The purpose of this research paper is to provide conceptualized information about the developmental process and need of web based Environmental Information System (ENVIS) on Himalayan Ecology for sustainable development and inclusive growth of Himalayan people. The methodology applied for the development of this information system is to collect the specific information from various resources like filed visit for primary data, secondary data through other departments and internet; collation of data in a systematic manner; electronically storage of data in online mode; development of mechanism for speedily retrieval of information and finally dissemination of information in electronic and print form to various stakeholders. As a result, a comprehensive database has been prepared on IHR which includes data on various aspects in six major categories viz: natural resources, forest data, demographic data, health profile, educational data and state and districts at a glance and in progression with upcoming updates. The synthesized information was subsequently linked electronically with the ENVIS system on Himalayan Ecology and information was further placed in various categories and sub categories for easy access where one can find the ready to use information related to Himalayan Ecology. As per the conclusion, this research paper describes how ENVIS system, internet and web technologies are utilized in development of the Indian Himalayan Region (IHR). This information system provides a single platform for policy-makers, academicians, scientists and researchers for deep research and development studies and to find out the solutions for various environmental problems faced in the entire IHR region.

Key words: Environment, Ecology, Natural Resource, Information System, Environmental Information System (ENVIS), Indian Himalayan Region (IHR).

Introduction

This research paper is focused on web based Environmental Information System (ENVIS) which covers Himalayan Ecology aspect of the Indian Himalayan Region (IHR). Environmental information system on Himalayan ecology plays a vital role not only in formulating environmental management policies but also in the decision making process aiming at environmental protection and improvement of environment of the IHR for sustaining good quality of life for the living beings. To manage natural environment responsibly, governments, industry and the community need comprehensive, trusted and timely environmental information. Good information is essential to make sound decisions, individually and collectively, about Himalayan ecology and issues affecting the environment. Hence, management of environmental information is a key component and thus plays an important role in effecting a balance between the demands and resources available for keeping the environmental quality at a satisfactory level by making ENVIS a web-enabled comprehensive information system.

Environmental Information System (ENVIS) on Himalayan ecology is a web based system for environmental information collection, collation, storage, retrieval and dissemination to policy planners, decision makers, scientists and environmentalists, researchers, academicians and other stakeholders. Environmental Information System on Himalayan ecology consisting the web enabled database on various aspects of Himalayan ecology as natural resources, demographic profile, forest cover, agriculture status, major educational and healthcare infrastructure of the all Indian Himalayan states. The information database has been collected, complied and synthesized at a single place to help various stakeholders to find solutions for various environmental and ecological problems faced in the IHR.

An overview of the Indian Himalayan Region

The Indian Himalayan Region (IHR) covers twelve states of Republic of India namely, Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Mizoram, Tripura, Assam (2 districts) and West Bengal (1 district). The Himalaya is quite unique and diverse in term of natural resources, biodiversity, socio-cultural aspects and

many more that separates the northern part of the Asian continent from South Asia (Singh, 2006). Geographically, Himalaya includes the parts of Trans, Northwest, West, Central and East Himalaya. The Indian Himalaya part is stretching from Jammu and Kashmir in the northwest to Arunachal Pradesh in the east and lies between $27^050'-37^06'$ N and $72^030'-97^025'$ E (Fig.1).
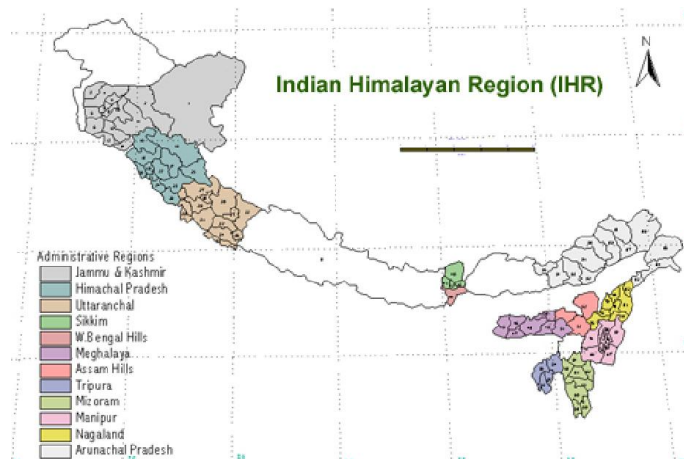
Fig.1. Geographical representation of the Indian Himalayan Region (IHR).

Despite its richness the region is under developed with the increasing preponderance of poverty and marginality especially among the famers and rural communities. The people are heavily dependent on natural resources and derived their livelihood needs from primary sectors like agriculture, forestry, livestock, etc. Meanwhile, with increasing demand and expansion of human population, the resources are under tremendous pressure and adversely impacted due to unsustainable use/over exploitation and lack of viable policy tools & technologies that could optimize the resource utilization and subsequently address the development needs and mitigate the drudgeries of the people. Developmental interventions often neglect the imperatives of mountain specificities due to unavailability of reliable scientific datasets/information (the region has been termed as data deficient) that invariably impact the resources and aggravate hardships of people.

Purpose and objectives of ENVIS
Realizing the importance of user-friendly scientific information in addressing the various needs of stakeholders like policy makers, academicians, scientists and researchers in designing various strategies and plans, Ministry of Environment & Forests, Government of India, in December 1982, established an Environment Information System (ENVIS) network as a plan programme. This was aimed to integrate the scattered information in one place and make it available in the simplest and easily accessible form to meet the varying demands of the end users. Environmental Information System on Himalayan Ecology at G.B. Pant Institute of Himalayan Environment and Development (GBPIHED) was established in 1992-93 with the financial support from the Ministry of Environment & Forests, Government of India, as an extension of the above said plan with the mandate of collecting, collating, compiling and building quantitative and qualitative databases of information related to various aspects of Himalayan Ecology and its subsequent dissemination for the wider acceptability and outreach.

The broad objectives of the ENVIS on Himalayan Ecology are as follows:

- *To address the need of various stakeholders by providing information on different aspects of Himalayan ecology.*
- *To develop qualitative and quantitative databases of information in the areas related to Himalayan Ecology.*
- *To provide and disseminate the information in use-friendly interface.*

ENVIS Objectives at the level of Ministry of Environment & Forests, Government of India:

Long-Term Objectives
- *To build up a repository and dissemination centre in Environmental Science and Engineering.*
- *To gear up state-of-the-art technologies of information acquisition, processing, storage, retrieval and dissemination of information of environmental nature.*
- *To support and promote research, development and innovation in environmental information technology.*

Short-Term Objectives
- *To provide national environmental information service relevant to present needs and capable of development to meet the future needs of the users, originators, processors and disseminators of information.*

- ▪ *To build up storage, retrieval and dissemination capabilities with the ultimate objectives of disseminating information speedily to the users.*
- ▪ *To promote, national and international cooperation and liaison for exchange of environment related information.*
- ▪ *To promote, support and assist education and personnel training programmes designed to enhance environmental information processing and utilisation capabilities.*
- ▪ *To promote exchange of information amongst developing countries.*

Adopted Methodology for ENVIS system

Environmental Information System essentially helps in handling of huge and varied information relevant to environmental management and development. The knowledge products were placed in various database categories and subsequently published and linked electronically through the web portal for speeding up the information flows, so that it becomes readily available and accessible in the most understandable way. As the information on Himalayan ecology and its various aspects are extensively scattered and distributed, it is likely to have an information flood. It became quite imperative to scrutinize the material & its source before making it available. To meet out the challenge and to provide scientifically tested information in user friendly knowledge products for stakeholders of multiple disciplines, the steps showing in Fig.2 were integrated systematically for handling of data and subsequent dissemination. The methodology adopted for the development of this information system is to collect the mountain specific information in respect of Himalayan ecology from various primary and secondary resources like filed visit, internet, etc.; collation of information in a systematic manner for specific categories and sub-categories; electronically storage of compiled information in online database; development of mechanism for speedily retrieval of information; and dissemination of information in electronic and print form to various stakeholders.
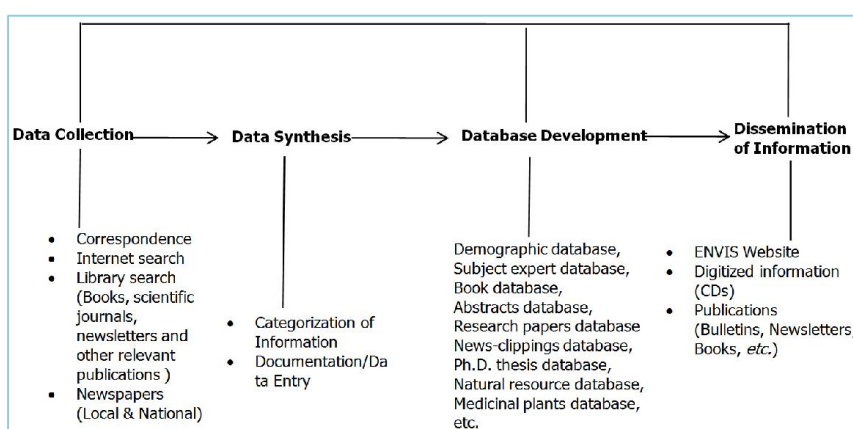
Fig.2. Graphical view of applied methodology for ENVIS system

Networked information for sharing knowledge and dissemination has been emerged a major tool for effective outreach, recognition and acceptability. The synthesized information was subsequently linked electronically with the development of a web portal in dynamic mode following the latest web technologies (Microsoft Visual Studio 2008, Microsoft SQL Server 2008, JavaScript, JQuery, HTML, etc.). The information was further placed in various categories and sub categories for easy access where one can find the ready to use information (Fig.3). The URL for the Environmental Information System on Himalayan Ecology is *http://gbpihedenvis.nic.in*.
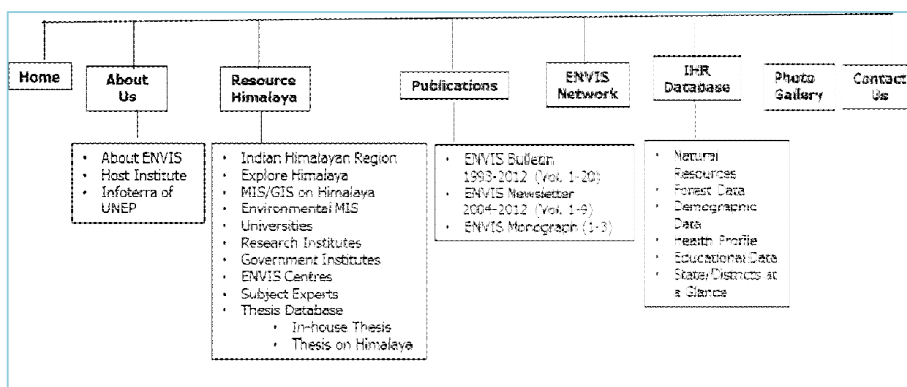
Fig.3. Categories of major networked information with web based ENVIS system.

Database design and development

The main aim of design process is to produce a model or representation of the system, which can be used later to bind the system. The produced model is called design of the system. A system design is a top down approach to minimize complexity and make a problem manageable by subdivided it into smaller segments. The most changing phase of the system development of life cycle is system design. It refers to the technical specification that will be applied in implementing the candidate system. The design phase is a translation from user oriented document to document oriented to programmers. The potential objects are thoroughly analyzed. Class hierarchies are to check whether the system is behaving the way it has to. There after the classes are individually tested and subsequently they are integrated from the overall system. This level focuses on deciding which modules are needed for system the specifications for those modules and how these modules are that interconnected.

A comprehensive database has been prepared and in progression with upcoming updates. Till date, the database on IHR includes data on various aspects in six major categories viz: natural resources, forest data, demographic data, health profile, educational data and state and districts at a glance (Fig.4). Each major category was further sub categorized to have systematic data sets and statistics on the respective sub categories.
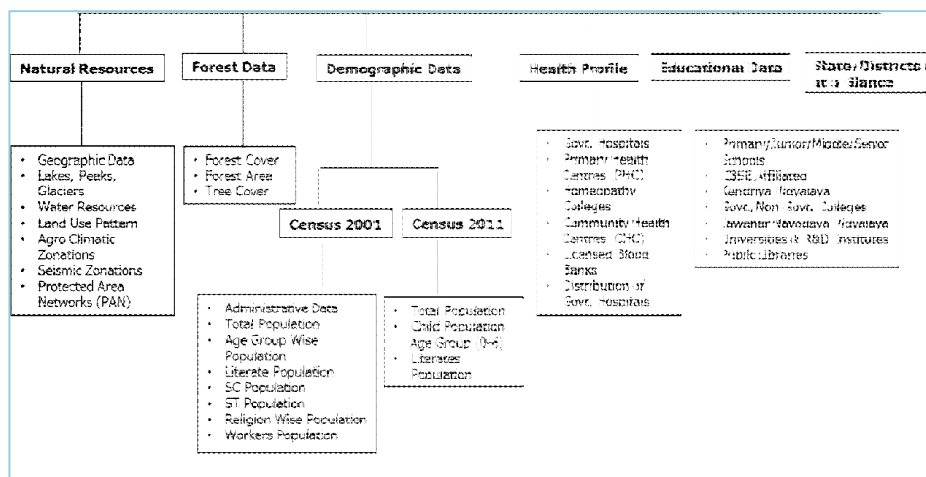

Fig.4. Category wise database design & development on various aspects of Himalayan Ecology.

Database on natural resource

The category includes database on seven different aspects of IHR, having detail information in various attributes. The database categorically covers state-wise as well as district wise information up to the most possible level. Geographically the IHR has an area of 533604 sq. km., which is 16.2 % of the total geographic area (3287240 sq. km.) of the nation. The region occupies the strategic position of entire northern boundary from North-West state J& K (32^0 17' - 37^0 5' N 72^0 40' - 80^0 30' E) to North-East state Mizoram (21^0 58' - 24^0 35' N 92^0 15' - 93^0 29' E) of the nation and touches almost all the international borders (7 countries) with India. The highest contributing state is Jammu and Kashmir with 222236 km^2 (41.65%), whereas West Bengal hills contribute the least with 3149 km^2 (0.59%).

The area is quite rich in terms of natural resources covered by snow-clad peaks, glaciers of higher Himalaya, high altitude lakes. The IHR has 14 high altitude lakes above 3000 m, in four states J&K (3), Himachal (5), Uttarakhand (5) and Sikkim (1). Among the fourteen lakes Suraj tal (4950 m) in Himachal Pradesh is located at the highest altitude and Deoria tal (3255 m) in Uttarakhand at the lowest extremity. There are 13 peaks in IHR above 7000 m and Uttrakhnad has maximum of them (08) followed by J&K (04) and Sikkim (01). The highest peak in IHR is Kangchendzonga (8586 m) in Sikkim and peak and peak with lowest elevation is Dunagiri (7066 m) in Uttarakhand. There are 19 main glacial-fed river systems across the IHR, of which river Indus has the maximum glacier area (7890 km2) and mountain area (268842 km2) and river Dibang has the minimum glacier area (90km2) and mountain area 12950 (km2). The water resources of IHR include 49.53 thousand km length of rivers/canals, 2.42 lakh hectare Water bodies and 11311.22 mcm/yr of total replenishable ground water.

Major land use distribution pattern in the IHR indicated three major categories viz. agriculture land, wastelands and forest cover. The database included state-wise proportional contribution. Among all the IHR states highest proportional agricultural land was recorded in Meghalaya (48.2%) and lowest was recorded in Arunachal Pradesh (3.5%). The IHR has 30.5 % of its area in waste land. The highest proportional waste land was recorded in J&K (64.6%) and lowest was recorded in West Bengal Hills (2.2%). The IHR has divided into two agro climatic zones viz. Zone I (humid to cold arid & per humid to sub-humid) and Zone II (per humid to humid). The Zone I includes the states of Jammu & Kashmir, Himachal Pradesh and Uttaranchal with annual rainfall <1200 to 1200-1800. The Zone II includes Nagaland, Mizoram, Manipur and Tripura, Sub Himalayan West Bengal, Sikkim, Assam and Meghalaya and Arunachal Pradesh with annual rainfall 1800 to >2800.

The entire IHR has been divided into two seismic zones Zone V and Zone VI. The states which fall in Zone V are Meghalaya, Assam, Tripura, Mizoram, Manipur, Nagaland, Arunachal Pradesh and Uttarakhand on Modified Mercalli Scale (MSK) of IX or more. Sikkim and West Bengal Hills fall in Zone IV on MSK VIII, whereas J& K and Himachal fall in both Zones IV and V with MSK VIII to IX or more. The Protected Area Networks (PAN) in IHR includes National Parks (27) Conservation Reserves (36) and Wildlife sanctuaries (90) that spread across in area of 48218.12 sq km (9% of the total geographic area of IHR). As far as other conservation reserves are concerned it has Biosphere Reserves (5), Tiger Reserves (5), Elephant Reserve (5) and RAMSAR sites (9) that spread over 47219.99 sq km sharing 8.85 % of the IHR area.

Database on forest

Forest data (state-wise) include forest cover assessment (very dense, moderate dense, open forest, *etc.*), recorded forest area (reserved, protected, unclassed, *etc.*) and tree cover estimates (geographical as well as tree cover areas) over different time scale from 2001 to 2011. Data on forest area assessment over a period of ten years from 2001 to 2011 has been showing an increasing trend. The forest area in 2001 was recorded 202741sq km whereas in 2011 it was recorded 221738 sq km with overall increment of 18997 sq km. The recorded forest area in IHR also varied over the timescale of ten years and proportional increment has been observed in total. It was 38.79 % of the total geographic area in 2001 and which increased to 39.06 % in 2001. Similarly, data on tree estimates revealed an increasing trend, tree cover estimates in 2001 was 0.75 % of the total geographic area, which increased to 1.85 % in 2011.

Census data

Census data cover extensive demographic details of the region. It includes information on total population, SC/ST population, religion/ethnicity profile, literacy rate as well as population. Administratively, the IHR region has four units with highest number of districts (22) in J&K. The IHR has a total of 63818 villages, of which in 58801 were inhabited and 5017 were uninhabited. Population trend in IHR has shown increasing trend over the last two decades, the population was 39523752 in 2001 whereas in 2011 it was recorded 46,961,740. The sex ratio has also improved during the last decade; in 2001 it was recorded 930 whereas, in 2011 it was recorded 949. As far as literacy rate is concerned it has decreased across all states in the IHR. In 2001 there was 79.35 % of literate population as compared to 68.57 % literate population in year 2011.

Health profile

As per the availability of data, the health profile on IHR includes, Govt. Hospitals (109), Primary Health Centres with ayush facility (980), homeopathy Colleges (07), Community Health Centres (334), licensed Blood Banks (109), and distribution of Govt. Hospitals (no of hospital 18, number of beds 475 and number of dispensaries 468). The data is quite deficient as the data is not available on most of the states, for more detail visit the ENVIS portal (http://gbpihedenvis.nic.in).

Educational data

Education data on IHR includes statistics on Primary/Junior/(80261), Middle/Senior Schools (33584), CBSE Affiliated (1017) Kendriya Vidyalaya (139 of 77 functioning their own buildings), Govt./Non Govt. Colleges (973), Jawahar Navodaya Vidyalaya (152) , Central Tibetan School Administration (03), Universities , R&D Institutes, colleges & others (772) and Public Libraries (821). The data sets were not available on various states and in the process of up gradation.

States and district at a glance

The state and district at a glance shows state-wise and district wise information in an intensive manner as well as in nut shell covering all the above mentioned aspects. The database also depicts important and relevant web links.

Beside all above database, the ENVIS system also includes information on Aromatic and Medicinal Plants (AMPs), RET species, research abstracts, research papers, subject experts, Ph.D. thesis, and environment-based R&D literature/books/journals rerating to various aspects of IHR.

Information dissemination and distribution

ENVIS on Himalayan Ecology has been publishing its Annual and Occasional publications in volumes and issues of ENVIS Bulletins, Newsletters, Monographs, Books, etc. focused on Himalayan Ecology, environmental development and other important issues of the IHR. ENVIS on Himalayan Ecology has published 20 Bulletin, 09 Newsletter and 03 Monographs on the following topics:

- *Natural resource management and development in Himalaya: A recourse to issues and strategies (1997).*
- *Indian Himalaya: A demographic database (2000).*
- *(iii) Resource Information Database of the Indian Himalaya (2006).*

Online presence of all the published materials of ENVIS has also been linked with the portal for quick information flow and access. For effective dissemination and wider outreach the publication has been periodically delivered to the stakeholders as Regional Offices (6, Autonomous Bodies (16) of the MoEF, ENVIS Centres (66) with the MoEF, Major Libraries/Information Centres (30), District Information Centres in all 12 Himalayan states, Universities/ University Campuses (20), Research Centers / Govt. Institutions (40), Engineering Colleges (8) and NGOs working on IHR (75).

Results and discussion

Literature on various aspects on Himalayan ecology was extensively scattered in various form of media. The data was collected in hard as well as soft forms as possible and subsequently scrutinized & filtered to extract IHR related information. The data was further simplified and systematically arranged in a user-friendly interface. For the purpose of developing approaches, comprehensive database has been developed covering various aspects of Indian Himalayan region. It is envisaged that the database not only fulfill the requirements of diverse end users but also assist policy makers to find authenticated datasets to develop hill specific roadmaps and policies for inclusive growth & sustainable development of the Himalayan people.

A comprehensive Environmental Information System on Himalayan Ecology has been developed with the uses of information and communication technology. A compiled distributed database has been developed which is available through the ENVIS system and includes data on various aspects in six major categories like natural resources, forest data, demographic data, health profile, educational data and state and districts at a glance and in progression with upcoming updates. The synthesized information was subsequently linked electronically with the ENVIS system on Himalayan Ecology and information was further placed in various categories and sub categories for easy access where one can find the ready to use information related to Himalayan Ecology. This information system provides a single platform for policy-makers, academicians, scientists and researchers for deep research and development studies on Himalayan ecology and to find out the solutions for various environmental and ecological problems faced in the entire Indian Himalayan Region.

Conclusion

Web portal of ENVIS is expanding rapidly with increasing databases on various aspects of Himalayan ecology and also new avenues are being opened for studies and research with special reference to Indian Himalayan Region. In this research paper, it has been described, how ENVIS and internet/web technologies are utilized in development of the IHR. Web portal can be accessed at anytime from anywhere to get the updated database information on natural resources, demographic profile, forest cover, and agriculture status, major educational and healthcare infrastructure of all the Indian Himalayan states. Environmental Information System (ENVIS) web portal provides a single platform for policy-makers, academicians, scientists and researchers for deep research and development studies and to find out the solutions for various environmental problems faced in the entire IHR region. ENVIS web portal provides very interactive and online database facility related to Himalayan ecology to all scientific communities, common people and various stake holders, etc.

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