punjab geographer

A JOURNAL OF THE ASSOCIATION OF PUNJAB GEOGRAPHERS, INDIA

VOLUME 1

OCTOBER 2005

PUNJAB GEOGRAPHER Volume 1 Number 1 Sept. – Oct. 2005

EVALUATION OF LAND AND WATER RESOURCES FOR INTEGRATED REGIONAL DEVELOPMENT

L.S.Bhat

Evaluation of land and water resources of India has to be attempted in a spatial and temporal framework because of the large size of the country, sharp regional contrasts in natural environment, physical and human resources and the patterns and processes of socio-economic development. Empirical studies of the spatial patterns of distribution and concentration of land and water resources reveal that the linguistic States are in most cases heteroqenous and it has been possible to identify sub-regions within the states having homogeneity in resource structure and geographical conditions. Often a distinct resource region comprises parts of the adjoining States as in the case of the forest and mineral resource region comprising Chhatisgarh, Jharkhand, western Orissa, small parts of Maharashtra and West Bengal. Agricultural regions too cut across the boundaries of different States. Likewise the river basins of major rivers cut across several States. Taking note of the spatial affinity of the natural resources a scheme of 11 major resource regions and 51 sub-regions have been identified and the boundaries of these regions have been adapted to those of the administrative units to facilitate quantification of the resources' and formulating development strategies appropriate to these regions and sub-regions. Since the data are used with District as the unit it becomes possible to identify the sub-regions within the States and to evaluate their development potentials and problems.

Recognising the relevance of regional approach to agricultural development the Planning Commission has adopted a scheme of 21 agro-ecological regions and within them 46 sub-regions having homogeneity in respect of natural environment and cropping pattern. This scheme of regions was based on the exercises carried out during early 1960s when the strategy for minimising regional imbalances was spelt out as a part of the long-term perspectives of development. Studies have also been carried out in measuring regional variations in levels of development using a large number of indicators of development with District as an areal unit in all India studies and tahsil for State level analysis. These indicators ranged from the physical characteristics of the land, intensity and diversification of cropping pattern, agricultural productivity and growth-rate, urbanization, industrialisation and occupational diversification. Techniques for working out composite index of development varied from adding rank scores of all the indicators for each District to the application of principal component analysis (Berry ,B.J.L. 1966, Bhat, L.S. 1972, Pal, M.N.1963, Dasgupta Bip lab., 1971, Kundu, A. 1982, Rao, Hemlata 1982, Mitra, A. 1964, Sunderam, K.V. 1983, Nair, K.R.G. 1963). Findings of these studies have brought out typologies of development and underdevelopment associated with historical and political factors on the one hand and the quality of the resources and socio-economic factors influencing the development process on the other. The regions identified are:

(i) The South-east resource region having important mineral resources (iron ore, coal, mica etc.) and forests is marked by extensive area of underdevelopment with 'islands' of economic development centred on Bokaro, Bhilai, Rourkela with very little impact on the surrounding region. The region's inherent limitations are its rugged terrain, low density of population - mainly tribal and dominance of small and scattered human settlements, low levels of social facilities and amenities. The hierarchy of nodal centres is weak and distorted.

(ii) Contiguous but limited areas around major metropolitan centres have emerged as axes of developed areas; and this pattern seems to be extending along major transport routes with little impact along the interstices of radial routes converging on them. There is dichotomy between major urban-industrial centres and small towns whose economic base is very weak. There are instances such as of the less developed Konkan area of Maharashtra where infrastructure development(e.g. construction of West Coast Highway) without complementary economic input has acted as counter to the growth of small towns which have come under easy access to Bombay and, Panaji-Marmagoa areas (Deshpande, C.D. et.al 1980).

(iii) Agriculturally developed areas in the Western U.P., Haryana and Panjab and the Delta areas of the Krishna-Godavari, and the Cauvery as well as the black soil plateau of diversified agriculture around Kolhapur in Maharashtra and the Madurai area in Tamilnadu are relatively developed. These areas have minimum variations in levels of development because of a more balanced development of a hierarchy of market towns and industrial centres.

(iv) Areas of poor agricultural productivity due to inherent topographical, soil and semi-arid conditions as in most parts of dry-farming areas of the Peninsular Plateau, are uniformly low in levels of development (e.g. Telangana in Andhra Pradesh and Marathwada in Maharashtra). These areas are again conspicuous by the occurrence of small pockets of urban - industrial centres without having their impact on the surrounding areas.

These findings are not exhaustive to cover all the typologies. Yet the interpretation of the observed patterns of regional disparities in development illustrate the distortions in spatial organisation of the economy and lack of integrated development of natural and human resources at the regional level. Centrifugal tendencies of spatial organisation centred on major metropolitan centres have rendered resource rich peripheral regions. Some agriculturally developed regions are weak in functional economic organization centred on a hierarchic system of nodal centres. The strategy for optimal utilisation of recources has to correct the imbalances in regional development.

Resource Evaluation at Different Scales of Areas

Strategy for utilisation of resources needs to be formulated at different scales of areas because of their relative importance at the national, regional and local levels. In the context of multi-level planning in India the following are the scales of areas at which the development plans have to be formulated and implemented. Such an approach is holistic and incorporates the hierarhic systems approach in planning. Scale of mapping would also vary according to the objectives of the study.

Area scale	Administrative Quantification of Data	Scale of mapping
Nation (Macro)	District	1:1000000 1:200000
State (Meso)	Tahsil/ Development Block	1:200000 1:50000
District (Micro) village clusters etc.	Village	1:50000 1:25000

Preparation of up-to-date resource inventory in the form of maps and their interpretation at different scales of areas is a pre-requisite for building up spatial profiles of present use and development potentials. Remote sensing and its application needs critical evaluation keeping in view the prospects for their use for specific problems as well as in the preparation of comprehensive regional landuse plans for homogenous sub-regions within the States and in turn at the micro regional levels (district, water-shed in hilly areas, village clusters etc.). The framework of agro-climatic regions adopted at the national level could be the guideline in integrating the approach to resource evaluation from the national angle and in the preparation of area specific land use plans from the micro regional levels.

Land Systems Approach to Land-use Planning

The concept of land system is based on the assumption that various parameters involved in the formation of land units do not occur randomly on the surface of the earth. Land units therefore show recurrence in the distributional pattern under similar geomorphological processes. For example, geomorphological process in arid regions shows the impact of aridity and wind erosions on rock types; granitic landscape in semi-arid Telangana is typical of boulders and tors topography. Deccan Lava landscape is marked by recurrence of flat-topped ridges, structural benches, concave slopes, messas and pediments. These land units have distinct characteristics which influence land cover, cropping pattern and land productivity.

Till recently, identification of land systems has been largely an academic exercise by geomorphologists using large scale topographical maps and field observations by reconnaissance surveys. It is only in 1950's that the work of land evaluation using land systems approach has been taken-up by specialists from different sub-fields of earth sciences geology, geography, botany, pedology, climatology and related disciplines such as geo-engineering.

Council of Scientific and Industrial Research Organization (CSIRO) of Australia *through the work of Christian (1958)* is the first to initiate classification of land for land evaluation. Three different but related approaches have been in use. The "*landscape approach*" is by and large qualitative and subjective, yet for District and intra-State sub-regional planning the approach is valuable wherever large scale maps, satellite imageries and aerial photographs are available. Techniques of map superimposition and quantification of qualitative data (e.g. slope, areas under different uses, degraded lands) do provide insight into ground reality. The approach attempts to classify the terrain into 'Land Systems and Units' with their characteristics tabulated as information systems for different land uses. Land systems 'approach has been extensively used for military engineering purposes in USSR, USA, parts of Africa and also in integrated land use survey of forests in Canada and plantation areas in South East Asia.

Application of Land Systems Approach to building up a Resource Inventory

The literature on this subject is vast and there are few applications of direct relevance to regional planning. The Hunter Valley Research Foundation in Australia attempted land evaluation for regional planning. As an extension of this method, there have been few applications in terrain classification for military engineering in India. Christian extended the approach to land classification to arid and semi-arid region of Rajasthan. Central Arid Zone Research Institute at Jodhpur has carried out a number of studies and brought out composite maps differentiating land units on the basis of their overall characteristics (+ve and -ve features related to one or more land uses). Noteworthy contributions to land systems analysis have been made-by geomorphologists in selected areas of the country. The main feature of these studies is either in the demarcation of land systems and units using large scale maps and aerial photographs and providing a description of their capabilities, limitations and present and potential uses.

Using the available literature and applications in different countries FAO has attempted in 1976 a *framework for land evaluation* for use by different countries. It is however necessary to modify the approach to Land Systems for a country like India in which different ecological regions co-exist and are spatially interrelated. Agro-Ecological regions could be the framework of reference for land systems analysis at the sub-regional and District Level.

From Land Systems to Land Capability Classification

The following stages of work are recommended:

(1) Identification and characterisation of land units in a hierarchic scheme of land systems listing the important attributes at each area level.
(2) Mapping existing land cover (forests, grassland, cultivated area, wasteland due to gully erosions, salinity, water-logging etc.)
(3) Pattern of association between geomorphological features of the land units and existing land use.
(4) Land productivity index to be worked out. This is possible in the case of cultivated area under different crops using standard statistical techniques.
(5) Assessment of land productivity potential.
(6) Preparation of a map of land capability showing the gaps between existing productivity and potential.

Findings of this exercise have to be adopted to cadestral maps on the same scale so that groups of villages having similar problems and potentialities can be identified to facilitate the preparation of shelf of development schemes which are location and area specific. Such an approach provides for inbuilt continuity in the choice of development schemes on a spatio-temporal basis.

Approach to Identification of Scientific and Technological Inputs for Resource utilization

Against the background of the problems related to resource development in India discussed above, the approach to developing relevant scientific and technological inputs for resource development should be innovative and not stereotype diagnosis of the problem from the national angle. The challenge before us is one of gradual delinking of the process of urban dominated technology and its role in providing most of the goods and know how required for resource development in the vast rural area. Gandhiji's advise that what can be produced in the rural area for its needs should not be produced in urban centres in its extended form would be that the rural areas should process the goods which are for use by both the rural and the urban population. This is particularly true of agricultural produce and its different stages of processing by setting up agro-based industries widely dispersed in the rural areas. The following approach is suggested.

1. Profiles of regional development have to be built up on the basis of identification of relatively homogeneous regions in respect of environment, resources and the emerging patterns of development from within. A good deal of studies exist in this respect, but these need to be integrated for giving new focus to the problem of development. Access to remote sensing and computer application is only a beginning and it needs critical assessment of priorities keeping in view the multi-level process of planning as mentioned above.
2. Within these regions quantitative and qualitative evaluation of the physical resources should be carried out and a complex of activities based on the utilization of these resources should be identified. This step is similar to building up industrial complexes around say, the steel plants, petro-chemicals etc.; but the approach needs to be extending to agro-industrial complexes in different agro-climatic regions adopted in national agricultural development strategy in the Eighth Five Year Plan.
3. The resources and economic activities should be differentiated according to their local, regional and national importance to facilitate the applicability of the national level technological advances to meet the requirements of different regions' development strategies.
4. Simultaneously regional development strategy for each of the region delineated as above should be formulated. This would provide a basis to spell out the technological requirements appropriate to different regions in keeping with their environment and resources for development.
5. Peoples perception of development and their responses to technological innovations vary within and between regions. Hence, an understanding of the quality of, human resources in respect of their demographic, cultural and socio economic indicators is a pre-requisite to evaluate capacity of the people for adopting the new technology in their activities.
6. Development models true to reality of the ground/regional conditions should be constructed in different regions using a village, or village clusters or catchment areas of well defined tributary streams. Resource evaluation at the micro level should be based on land quality assessment. Land systems approach, classification of land according to use capabilities need to be tested under different ecological conditions. The NRDMS projects in progress in selected Districts should provide the guidelines and training facilities for building up resource inventory using land systems approach.
7. Vertical and horizontal linkages among major industries and in turn the intra and inter-regional flows of commodities have to be analysed to identify the nature of the existing relationship between technology and development and to suggest modifications.
8. Exercise in land-use planning should not be divorced from ground reality based on socio-economic conditions of the people living in the area. The strategy for land-use planning has thus long-term and short-term implications. The long term strategy would be normative within which the sub-optimal patterns of resource use at short-term intervals need to be corrected to the extent possible using scientific and technology inputs.
9. These exercises are of interdisciplinary nature within different sub fields of natural sciences (geology, geomorphology, physical geography, climatology, hydrology etc.) as well as those in social sciences (human geography, sociology,

economics, political science).

10. Training requirements in a multi-level spatial framework vary depending on the regional level. This needs assessment of manpower availability. Because of the Sectoral or Departmental approach to planning even the existing personnel from natural and social sciences have hardly any opportunity to interact.

11. Planning machinery needs to be constituted at the State and District levels specifically to meet these requirements.

12. Involvement of the local community in planning can be best achieved by providing knowledge about the area's resources and development potentials in a holistic spatial perspective. This is possible only when the educated youth are given the necessary training by the planning machinery. Initially universities, colleges and other organizations could be the focal points for spread of such training.

Bibliography

Beek, K.J. et.al., (1972): *Land Evaluation for Agricultural Landuse Plannint - An Ecological Methodology*, Department of Soil Science and Geology Agric. University, Wageningen.

Bhalla, G.S. and Alagh, Y.K. (1979): *Performance of Indian Agriculture - A Districtwise Study* Sterling Publication, New Delhi.

Bhalla, G.S. and Tygi, D.S. (1989): *Patterns in Indian Agricultural Development - A District Level Study,* Institute for Studies in Industrial Development, New Delhi.

Bhat,L.S. with Learmonth, A.T.A. (1960): Mysore State - Vol.I: Atlas of resources and Vol. II*A Regional Synthesis*, Asia Publishing House, Bombay.

Bhat,L.S. et.al. (1967): *Regional Variations in Natural Environment and the Identification of Regional Physical Complexes for the Evaluation of Land Use Potential in India*, Indian Statistical Institute, New Delhi.

Bhat,L.S.(1972): *Regional Planning in India*, Statistical Publishing Society, Calcutta.

Champion, H.G. and Seth, S.K. (1968): *The Forest Type of India (Revised Survey)*, Government of India, New Delhi.

Christian, O.S. (1957): "The Concept of Land Units and Land System". *Proceedings of the Ninth Pacific Science Congress*, 20, 74-81.

F.A.O. (1974): *Approaches to Land Classification*, Soils Bulletin 22, Rome.

F.A.O. (1976): *A Framework for Land Evaluation*, Soil Bulletin 32, Rome.

Govt. of India, Planning Commission (1964): *Resource Development Regions and Divisions of India*, New Delhi.

Govt. of India, Planning Commission Agro-Climatic Regional Planning Unit (1989): *Agro-climatic Zones, Profiles and Issues*, Ahmedabad.

Graham, E.R. (1944): *Natural Principles of Landuse*, Oxford University Press, New York.

Hatt, Paul (1946): "The Concept of Natural Area", *American Sociological Review*, II, 423-427.

Jacks, Graham V. (1946): *Land Classification for Land Use Planning*, Imperial Bureau of Soil Science, Technical Communication, 43, Harpenden.

Minhas, B.S.et.al. (1965): "Growth of Crop Output in India", *Journal of the Indian Society of Agricultural Statistics*, XVII No.2.

Mitra, A. (1965): *Levels of Regional Development*, Census of India, Vol. I, Part A (i) and (ii).

National Bureau of Soil Survey and Landuse Planning, ICAR (1990): *Agro-ECOLOGICAL Regions of India*, N.B.S.S. Publ. 24, Nagpur.

Ryabchikov, A.M. (1962): *Natural Regionalization in the USSR.* Indian Statistical Institute, Mimeo.

Stewart, G.A. (1968): *Land Evaluation*, Papers of a CSIRO Symposium, Canberra.

Thornthwaite, C.W. (1948): "An Approach Towards a Rational Classification of Climate", *Geographical Review*, XXXVIII, 55-94.

Young Anthony (1981): *Soil Survey and Land Evaluation*, George Allen and Unwin, London.

L.S.Bhat
Formerly Professor, Indian Statistical Institute, New Delhi
National Fellow, Indian Council of Social Science Research, New Delhi