EPM: Environmental Planning & Management 2(5): 1991

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Design and layout: Darryl James
Typesetting: Cindy Mole
Advertising production: Paula Bester
Circulation: Desiree Goldman

Reproduction:
Phase 4 Graphics

Printed by Phase 4 (Pty) Ltd

Published bi-monthly by:
Phase 4 (Pty) Ltd
9 Charles Crescent, Eastgate, Sandton
P O Box 784279, Sandton 2146
Tel: (011) 444-4566
Fax: (011) 444-7888

One year's subscription:
R32,00 (excl GST)

Two year's subscription:
R55,00 (excl GST)

TOWARDS HARMONY WITH THE LAND: THE DRAINAGE BASIN ECOSYSTEM CONTEXT

by Dr Ken Tinley, landscape ecologist

"In the great chain of causes and effects nothing and no activity should be regarded in isolation." Alexander von Humboldt 1807.

"Nothing happens in living nature that is not in relation to the whole." Rudolf Steiner 1924.

In learning to live in harmony with one's land and resources, one of the first needs is to identify whether proposed developments are appropriate, necessary or desirable in social, environmental and real economic terms. The growing conflict between husbanding the ecological viability of life support systems and the increasing invasion of them by heedless material developments and land uses driven by cash and market compulsions requires allocation of uses, where these are matched to a site or an area's biophysical characteristics.

This matching requires, firstly, a synoptic field analysis to identify the key features, processes and interrelationships of the proposal's locality. The synoptic assessment should be in the form of an ecological land suitability analysis as the basis for generating an environmental and land use planning and management framework for any development whether agricultural, dam building or the positioning of roads and settlements etc.

The quick assured answer would be — 'that is now done as a matter of course. What's more we now apply an Integrated Environmental Management approach to our evaluative process which considers all relevant aspects'. Great, but it must be asked *within what unifying context are these assessments, plans, management decisions and programmes made?* In other words what defines the boundary of a land use survey or study? Environment by definition is everything external to the organism(s) under study, hence it is boundless or at best has vague or diffuse limits. Are the survey, planning and management area boundaries defined by the edge of a map or airphoto, or the client's property, sphere of interest, area of development, or by a road or river course?

How do you know that what you are doing in one place is not entraining a chain of negative, and possibly cumulative, ecological interactions detrimental to natural life support systems and people downdrift or downstream (of wind or longshore currents) in the one direction, or initiating, if not increasing, headward erosion (landscape incision and drying out, filling in of estuaries) in the other? The answer to these predicaments may be that smaller area developments are assessed within the context of a regional management plan, but what are the regional boundaries based on — political, cadastral or physiographic?

However, despite the huge advances in knowledge on land use and social and environmental matters, the evidence of unabated and increasing damage and degradation of environmental life support systems and whole habitats indicates the continued predominance of a fragmented ad-hoc approach to environmental and resource planning and management.

Examples of this divergent approach to land use abound in South Africa. They include the revoking of the one kilometre broad buffer zone of conditional usage along the coast (at the beginning of 1990), which opens this vulnerable and valuable resource all over again to development speculators and the whims of local councillors at a time of accelerated wastage of resources and multiplying abuse; the permanent inundation of unique valley systems and food producing soils by big dams, where, in the example of the greater Cape Town metropolitan demands, these should be met by re-using treated water captured from recycled sewage, instead of wasting a crucial finite resource and polluting the sea; the self-pollution from wrong positioning of urban and industrial developments, such as townships, in dam catchments; the acidification of Highveld rivers and wetlands by sulphur outfalls; and the persuasion, by those who stand to gain, for the public to accept nuclear energy as the

'clean and safe' alternative in place of coal-burning, instead of concentrating the country's brilliant minds on developing a post-industrial non-polluting energy such as hydrogen — and so on.

An integrating medium and rallying focus is required that engenders cooperative and participatory conservation practices and attitudes (ethics), the present lack of which seems to be the key underlying the general failure of countrywide conservation measures.

There are as many kinds of regions delineated on maps as there are subjects and interests. Most of these are artificial, convenient, straight-line-bounded compartments quite unreleated to the functional ecological unity of natural regions and their sub-units. Ignoring natural processes, artificial 'regions' are constructed by superimposing grids of development activities which disrupt the landscape unity. This misfit initiates, then compounds, the disharmony of man with land such that environmental degradation and damage, and hence poor or ineffective economy, is entrained in a cumulative way. Much social, economic and political instability can be traced back to poor integration of resource management. There are also many kinds of natural regions and ecosystems that are made up of a hierarchy of units of decreasing magnitude.

So what is one to do? Which unit should be chosen as the intrinsic base for evaluation, study, management and monitoring in all the various disciplines, including civil engineering, which manipulate the land and its resources? Which ecological unit area in the landscape best identifies the minimum arena encompassing all the process and response relationships of an ecosystem in terms of the combined interactions between physical, biotic and human activities? This unit has to be practically identifiable by most anyone in the field, on maps and air photographs, and recognisable as the single unifying system common to the greatest number of interests and objectives. On land, it is only the *hydrologic ecosystem unit* — the drainage basin and its tributary sub-units — that meets all these requirements. In drainless (areic) areas, the boundary to a process unit and its subdivisions is best identified by surface features such as sands, gravels, limestones and/or by distinct changes in natural vegetation cover.

All life is dependent on water in one form or another and is intimately connected to the hydrological cycle. In turn many physical, chemical and biological cycles, as well as landscape and ecosystem evolution are in response to the action of water or to changes in water balance from geomorphic, climatic or edaphic processes.

Geomorphic, hydrologic and ecological change is multidirectional with reciprocal effects transmitted upwards and downwards to the confines of the hydrological basin. Some changes may be transferred across system boundaries along interfluves at one end, and at the drainage confluence with estuaries, coastal seas or endoreic endpoints at the other. For example the dynamics of soft coasts and their sand exchanging compartments is closely tied to fluctuating sediment supplies from rivers. The materials and chemicals transported downstream include rainfall runoff, sediments, minerals, nutrients, and pollutants including agrochemicals and other effluent wastes introduced to the system by human activities. Drainage lines are key features to protect in any landscape not only to minimise erosion for effective soil and water conservation but also to ensure that landscape connectivity is maintained. Well-vegetated drainage lines are linking corridors for all life between the interior and coast, particularly crucial for those natural habitats otherwise isolated by development.

Because of man's total dependence on the water resource and his manipulation of it both within and between catchment basins, hydrologic units are the only kind of ecosystem which most closely meets all requirements as the principal organisational template for coordinating conservation and development. The combined action of water in the landscape, separated by watersheds, stored by aquifers and drawn together by drainage basins, is the most influential regional and local integrating medium demanding cooperative planning and management and the sharing of responsibility in its conservation use.

The drainage basin context compels a whole systems approach to both 'local' and extensive environmental impacts and their possible downstream implications, not as a one-off exercise, but as an ongoing monitoring awareness and caring responsibility, for the viability (health) of life support systems and their dependent communities in the territories and districts through which a river passes. The same applies to the application of land and resource conservation measures, successful only if practiced effectively across an entire basin.

As the hydrologic system (or group of systems when small) identifies and delimits a region, it provides a natural unifying basis for organising resource data and biophysical, social and economic sources into the same systems matrix as in the GIS process. In this way, it is possible to develop an analytical and predictive framework, from which to generate principles and policies as guidelines for right action in regard to environmental and resource usage. The hydrologic unit forms the integrative basis for relating, assessing and anticipating change from natural and man-induced influences from the immediate to long term.

By cutting through to the nub of problems, it is possible to intervene at key sites in areas to apply preventive or remedial measures. The hydrologic ecosystem should especially form the minimum context for field studies, planning, management and environmental assessments of all kinds, as the drainage divides of the unit or its sub-units provide natural compartmental boundaries. Ideal cadastral and political compartmentalisation of the landscape would follow drainage divides (interfluves). ''Man's minimum ecosystem unit is the drainage basin that includes terrestrial and aquatic systems together with man and his artifacts all functioning as a system.'' (E P Odum 1971. *The Fundamentals of Ecology.)*

Finally the drainage basin ecosystem unit provides a relatively simple means of relaying information in an easily accessible and assimilable form from the field worker to planners, managers, administrators and policy makers and back to individual land users. From this resumé it can be seen that Integrated Drainage Basin Management (IDBM) should be the basis used for all aspects of conservation (EIA's, IEM's etc) and development, as the drainage basin is the intrinsic process arena on land. Conservation measures, however, must remain tailored to transbasin and intrabasin physiographic units.

Using IDBM, a truly regional trans-territorial environmental and resource conservation policy can be generated and built-on, as all communities and their authorities, sharing the same basin, have a personal stake in ensuring that their natural resources, particularly water, can meet present needs and future potentials. Responsibility and accountability for the ecologically sustainable usage of each basin should be restored to the authorities and communities in each basin, instead of continuing to relegate to government all conservation activities — that they are failing to perform. Administrative responsibility for integrated management of larger catchments would be based on tributary basin sub-divisions, and smaller river basins would be treated in groups.

Through the media IDBM it can most clearly and strikingly be brought to public attention how human activities in one part of a drainage system effect others. That they all share the same basin, though different parts may have different names or governments, and that all are effecting each other's destiny. Once groups sharing the same drainage basin begin to exchange information on their various needs, fears and aspirations, that will be the beginning of cooperative approaches to realising the roles each needs to play to actively ensure the integrity of the life support system which they share. Most importantly too, it will develop knowledge, understanding and friendship.