How Integrated Is River Basin Management?

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ABSTRACT / Land and water management is increasingly focused upon the drainage basin. Thirty-six terms recently used for schemes of "integrated basin management" include reference to the subject or area and to the aims of integrated river basin management, often without allusion to the multiobjective nature. Diversity in usage of terms has occurred because of the involvement of different disciplines, of the increasing coherence of the drainage basin approach, and the problems posed in particular parts of the world. The components included in 21 different approaches are analyzed, and, in addition to showing that components related broadly to water supply, river channel, land, and leisure aspects, it is concluded that there are essentially five interrelated facets of integrated basin management that involved water, channel, land, ecology, and human activity. Two aspects not fully included in many previous schemes concern river channel changes and the dynamic integrity of the fluvial system. To clarify the terminology used, it is suggested that the term *comprehensive river basin management* should be used where a wide range of components is involved, whereas *integrated basin management* can signify the interactions of components and the dominance of certain components in the particular area. *Holistic river basin management* is advocated as a term representing an approach that is both fully comprehensive and integrated but also embraces the energetics of the river system and consideration of changes of river channels and of human impacts throughout the river system. The paradigm of working with the river can be extended to one of working with the river in the holistic basin context.

The need for a coordinated approach to river basin planning and development has been increasingly evident during the last decade. This arises because major river valleys will remain the focus for human civilization (Ambroggi 1980, quoted in Falkenmark 1981) and wise use requires an integrated approach. The drainage basin is the obvious unit for analysis and planning. It is not easy to establish when appreciation of the hydrological significance of the drainage basin first emerged in the research literature (Gregory 1976), although developments in relation to management (White 1977) and as an historical basis for human activity (Smith 1969) have been traced. Using the drainage basin as the fundamental unit, Pantulu (1981) has argued for the river basin to be considered as a primary ecosystem characterized by direct feedback from human action and seen as "a naturally evolving complex of environmental components, linked by a pathway of energy flows." Similarly Dovers and Day (1988) have argued that "rivers are integraters of everything that happens in their catchments and by the time a river empties into the sea, it has been subject to innumerable influences."

KEY WORDS: Integrated river basin management; Drainage basin management; River channel changes; Holistic river basin management

Following White (1977), McDonald and Kay (1988) have suggested that the modern development of water resource systems has proceeded from single-purpose projects through multipurpose schemes, towards more integrated river basin planning, which began particularly with the United Nations proposals in 1970. Important in the progress towards more integrated planning was the development of the Tennessee Valley Authority (TVA) from 1935 onwards. Despite the progress that has been made towards integrated basin management, there have been criticisms of a technocentric approach by Saha and Barrow (1981); it has been suggested that a more integrated environmental view (Falkenmark 1985, p. 120) is required, that there is a need for a more holistic approach to river management (McDonald and Kay 1988, p. 239), and that practitioners, although working in the same field, do not understand or communicate sufficiently with each other and that they need the common language of a shared paradigm (Saha 1981, p. 33). There are signs in the developing world that too little care is being taken with complete river systems despite the impressive titles given to the many river basin development

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programs (Newson 1987, pp. 29–30). Burchi (1985) recognized three main groups of river basin entities established in different parts of the world, namely: valley authorities, basin entities, and coordinating commissions or committees.

In the literature of the last two decades, a variety of terms has been used to refer to aspects of integrated drainage basin management and planning. Arguably, it is important to know the extent to which different terms are really associated with different objectives and also how complete and integrated are the activities that the terms signify. This article therefore endeavors to summarize the terms that have been employed, to suggest why that diversity of terms has been used, to analyze the constituents of different integrated basin management strategies, to suggest what aspects have been omitted from some studies and therefore require further consideration in future procedures, and finally to make a series of provisional recommendations for debate in relation to increasing international requirement for holistic river basin management and to the technological advances now available. It is concluded that, as implied by Day (1988), there is a real need to include geomorphologic as well as ecologic and hydrologic concepts in river management. This could be of increasing importance because Herricks and Braga (1987) have argued that river basin management must extend beyond narrowly focused programs dealing with water quantity or water quality, and they advocated the use of habitat measures, whereas Gardiner (1990) has shown how recent technical advances have permitted the inception of developing integrated river catchment plans.

Diversity of Terms Employed

A range of terms has been used to describe what is now generally thought of as "integrated river basin management." A list of 36 terms used was compiled from published sources by a manual literature search combined with an interrogation of relevant computer data bases. Many examples were obtained from conference proceedings or from edited volumes generally devoted to drainage basin scale river management (e.g., Jenkins 1978, North and others 1981, Allee and others 1982, Mitchell and Gardner 1983, Lundqvist and others 1985). The 36 terms were classified into three groups according to multiobjective nature, subject or area, and aims (Table 1).

Emphasis upon the multiobjective nature of the management process is necessary for two reasons. First, because water-based systems involve feedback processes, separate management objectives will be linked to some degree. Therefore, management actions taken in one part of the system will have consequences for the operation of another part of the same system, and Wolman (1980) noted that very few river management designs can be truly single purpose. A second, practical, need for integration concerns the inevitability of expanding responsibilities for the management body. For instance, Coy (1981) observed that during his long period of employment with the Miami Conservancy District, the early management objective ". . . keep the water away from my door" became ". . . keep the water away from my door, clean up my waste, let me recreate on the river, keep my groundwater pure, reclaim my wetlands, provide water for my irrigation, and keep my lands free from erosion" (Coy 1981, p 286). Overall, an integrated outlook in the planning stage can lead to a more efficient management service, which is not detrimental to other parts of the system and can possibly extend the range of activities that become cost effective (Hatcher 1982). Many terms imply a multiobjective nature, but where a specific word is included in the term, the word *integrated* (Table 1) is favored.

Terms also refer to the subject and area over which management takes place. A river basin or drainage basin focus is most frequently used but other terms are employed (Table 1) for particular subjects or areas. An integrated approach necessarily recognizes how water resources are part of a physical system that involves the interaction of hydrological, geomorphological, and ecological components (Day 1988), against a background of particular geological conditions. The system's most dynamic determining aspects are the hydrological and geomorphological interactions and, because they relate to the drainage basin as their basic functioning unit area, the logical focus for a management strategy based on the integrated development of water-based resources is the drainage basin (Pantulu 1983, Lundqvist and others 1985). Furthermore, Cunningham (1986) considers that, in addition to providing physically meaningful boundaries, a drainage basin unit provides physical boundaries that are comparatively easily identified, and Mitchell and Pigram (1989) believe that the use of the basin unit potentially could solve many of the political boundary problems that plague integrated resource management.

Aims (Table 1) are a further element in the terms used and may be spatially distinct and temporally transient. Aims vary according to the perceived societal objectives (Parker and Penning-Rowsell 1980), the level of scientific achievement possible (Wengert 1981), and the institutional arrangements afforded to the management body. The adequacy of institutional

Table 1. Summary analysis of terms and words used to describe integrated river basin management

Reference to	Word or term used more than twice	Less frequently used
1. Multiobjective nature	No term (26)	Comprehensive (1)
	Integrated (7)	Total (1)
		Unified (1)
2. Subject or area	River basin (21)	Ecosystem (2)
	Basin (/wide) (6)	River (1)
	Catchment (3)	Watershed (1)
		Floodplain (1)
		Water resources (1)
3. Aims	Management (25)	Modeling (1)
	Planning (6)	Approach (1)
	Development (3)	

arrangements is often cited as critical to the success of management strategies (Adams 1985, Mitchell 1987, Crabb 1988, Mitchell and Pigram 1989).

Table 1 summarizes the wide range of terminology that has been used and shows that the phrase most frequently used to describe integrated basin management is "river basin management." Hitherto no one term has been used to incorporate the multiobjective management concern.

Reasons for Diversity of Terms

The considerable diversity of terms in use reflects the varying blend of components that has been included. Analyses of the basin have centered on the components of land, water, and ecology; on the functions of water supply, water management, or soil and water conservation; and on the physical, biological, and human forces that determine the basin system. Thus Saha (1981) argued that the prime function of river basin planning is to ensure that the operational unity of these three systems—land, water, and ecology, and their numerous subsystems is maintained.

The idea of unified river basin management is an old one but the content of that idea has been progressively enriched (Lord 1982, p. 59). Although the favored words included in terms have been analyzed in Table 1 according to frequency of usage, it is also possible to detect a sequence of usage of terms that reflects the way in which the idea of integrated basin management has been enriched and elaborated.

The use of *comprehensive,* which may be defined as "including much or all," refers to the subjects involved and is largely an inventory stage. Thus Stone (1980) referred to comprehensive water resources development as an aspect of a modern systems analysis approach achieved by focusing on the river basin as the appropriate unit for planning because of the basin's interconnectivity. Use of the word *integrated,* which is literally "complete by addition of parts," signifies a relationship between the subjects involved. Thus Falkenmark (1981, p. 269) argued that an integrated view of the river basin is required in the decades ahead and that this should be supported by worldwide research on the interactions in different environments between land and water as the basis for a practical methodology to be used in the planning process. Although integrated is associated with interrelationships, the term *ecosystem approach* has been used in the sense of Odum and Odum (1976): that everything is related to everything else and may simply be defined as "the relationships between a set of objects and the attribution of those objects." Thus Pantalu (1981) suggested that the functional ecosystem is a "naturally evolving complex of environmental components, linked by pathways of energy flows." These three stages have been followed most recently by use of the word *holistic,* which, following the dictionary definition, connotes that "the whole is more than the sum of the parts." Thus Newson (1988, p. 69) suggested that it is possible that the holistic view of river basins provided by the geographical approach might reform river basin management in the developing world, and Gardiner (1988b, 1991) also has employed the term holistic in holistic basin management. These four terms—comprehensive, integrated, ecosystem, and holistic—are now used to some extent interchangeably, although they have slightly different meanings and can be seen as expressing a gradual clarification of the unified approach to basin management.

In addition, two other terms that have been used relating to aims are *planning,* which relates to the controlled design and develoment of the basin, and *management,* which connotes the process of implementing and undertaking a management plan. The word *development* has also been used (e.g., Stone 1980). Pentland

Table 2. Examples of "integrated basin management" for particular subjects of area

Author(s)	Term employed	Basin/area to which term relates
Adams (1985)	River basin planning	Gongola/Sokoto, Nigeria
Mageed (1985)	Integrated river basin development	Nile, especially Sudan
Mbumwae (1988)	Integrated river management	Zambezi, Zambia, and others
Mosely (1985)	Basin-wide planning	Huang, China
Pantulu (1985)	Ecosystem modeling	Nam Pong, Thailand
Siann (1981)	River basin planning	Ogun/Oshum, Nigeria
Wall (1981)	Basin management	Acelhuate, El Salvador
Ziyun (1985)	River basin development	Han, China
Crabb (1988)	Basin management	Murray-Darling, Australia
Cunningham (1986)	Total catchment management	N.S.W. general, Australia
McFadden (1983)	River basin management	Thames (Ontario), Canada
Osmond and McQuay (1983)	Watershed management	central Ontario, Canada
Pentland (1983)	Comprehensive basin planning studies	various, Canada
Primus (1983)	River basin management	Alberta province, Canada
Reynolds (1985)	Ecosystem approach	Great Lakes/St. Lawrence, Canada
Schenk (1983)	Comprehensive water quality management	Stratford/Avon (Ontario), Canada
Sinclair Knight (1981)	Floodplain management	Hunter Valley, N.S.W., Australia
Ullah (1983)	River basin planning	Newfoundland province, Canada
Annen (1978)	River basin management	F.R. Germany general
Van Beek (1981)	Integrated river basin management	Atchafalaya, USA
Dart (1983)	River basin management	Thames, England
David (1985)	River basin management strategy	Tisza, Hungary
Graf (1985)	Basin management	Colorado, USA
N.Z. C.A.A. (1988)	Catchment management	New Zealand general
Young (1978)	River basin management	England and Wales general

(1983, p. 74) concluded that "The evaluation process in river basin planning studies includes the definition of public planning goals and objectives, an assessment of water resources capability to meet present and future use requirements, the development and evaluation of management alternatives to enhance resource capability, and the combining of these alternatives into a unified management plan".

The spectrum of terms demonstrates the involvement of practitioners from a range of disciplines; thus Saha (1981, p. 33) lists engineers, geographers, economists, sociologists, biologists, chemists, soil scientists and epidemiologists. Saha (1981) concludes that river basin planning is somewhat analogous to quantum mechanics for physical scientists in that it provides a paradigm for many scientific groups but is not the same paradigm for all. Reynolds (1985, p. 46) suggests that the geomorphologist, social scientist, hydrologist, and climatologist can all contribute to an ecosystem approach to river basins but, because they are all so bound up with other aspects of the ecosystems, it is necessary to have an integrated approach. Different disciplines have reacted in slightly different ways to the sequence identified above from comprehensive and integrated, which existed in the early 1980s, to ecosystem, and then to holistic, introduced at the end of the decade.

Two other determinants that affect the terms used are the type of area and environment to which the strategy is to be applied and the organizational framework in which it is used. The type of environment dictates the emphasis that may be dominant and this may be water resources or water management, soil and water conservation, or pollution and water quality (Table 2). Somewhat related are the different organizations responsible that may influence the terms and the emphasis in the components included. Thus, in Australia, the New South Wales government introduced integrated catchment management as state policy in 1987 (Mitchell and Pigram, 1989), and in California cumulative watershed effects analysis (Cobourn, 1989) is used in relation to controlling nonpoint source pollution. In the Netherlands, Policy Analysis for Water Management for the Netherlands (PAWN) was described by Veen and Baarse (1982, p. 113) and river basin development areas have been used in Nigeria (Adams 1985, p. 299). Although river basin management was identified as a guiding principle in 1968, Gustafson (1989) suggested that it has been undertaken in relatively few countries because of

Table 3. Contents from examples of "integrated basin management"[a]

	Provision objectives												
	Water supply—quantity and quality					River channel			Land			Leisure	
	Industrial demand	Domestic demand	Hydro Electric Power	Fish-eries	Flood control	Navi-gation	Channel stability	Channel manage-ment	Agri-culture	Soil conser-vation	Preserve land-scape	Recre-ation	An-gling
Developing													
Adams (1985)	*	*		+	*	"			*				
Mageed (1985)	*		*		*				*				
Mbumwae (1988)	*	*	*	+	*				*	*	+		
Mosely (1985)			*		*			"	*	*	+		
Pantulu (1985)	*	*	*	+	*				*	*			
Siann (1981)		*		+	*	"			*	*			
Wall (1981)	*	*					"	?	*	*	+		
Ziyun (1985)	*		*		*				*	*	+		
Developed													
Canada/Australia													
Crabb	*	*							*	"			
Cunningham (1984)	*	*							*	"	*		
McFadden (1983)	*	*			*		"		*		*	"	
Pentland (1983)	*	*	"		*						*	"	"
Primus (1983)	*	*											
Sinclair Knight (1981)					*		"	"	*				
Ullah (1983)	*	*	"	"	*		"		*		*	"	"
Other developed													
Annen (1978)	*	*	+		*	+	+		*	"			
Van Beek (1981)					*						*		
Dart (1983)	*	*	+	+	*	+	+		*		*	*	"
David (1985)	*	*			*	+	+		*			*	
N.Z. C.A.A. (1988)	*	*	+	+	*				*	"	*	*	
Young (1978)	*	*		+	*						*	*	

[a]All marks indicate inclusion in that basin management scheme. Marks differ in proportion to the "importance" of the objective relative to the total number of examples in that group.
*"important," over 50% of the examples included this objective; +"quite important," 50% inclusion; ""less important," less than 50% inclusion.

the recognition, communication, and action barriers that have to be overcome to achieve a consensus.

Detailed Components Included

Against this background it is possible to consider the detailed components that are embraced by particular terms. Twenty-one of the 36 strategies included in Table 1 were scrutinized according to detailed components that they appear to involve. While Table 3 may not include all the components embraced by these 21 schemes, it does give a general indication of the concerns involved in each strategy. The frequency of occurrence of each component was analyzed and the relative importance was derived to give three categories of importance shown in Table 3.

Table 3 is structured to compare the management needs in developed and developing nations, which are partially determined by variations in the administrative infrastructure (McDonald and Kay 1988). In the developed world integrated approaches to basin management have been assimilated into, and then have evolved within, existing management bodies. However, in the developing nations integrated basin management may provide the primary focus from which the administrative infrastructure has developed. Table 3 also distinguishes developed nations with particularly low overall population densities and that experience climatic extremes (Canada and Australia) because they may have particular management needs.

Components associated with particular terms can be broadly categorized according to association with water supply quantity and quality, with river channels, with land aspects, and with leisure. The most frequently involved components (Table 3) relate to provision of water and its management in relation to industrial, agricultural, and domestic uses and to flood control. Other components reflect type of area, and in the developing countries the emphasis is upon support for development, particularly for energy and agriculture, so that hydroelectric power generation and soil conservation are frequently included. In developed nations other objectives are more apparent, the most dominant being the pressure for conservation and the need to provide recreational facilities. Further components arise from intense industrial utilization of the rivers including provision of hydroelectric power, fisheries, navigable waterways, and stable river channels to

Table 4. Facets of integrated basin management

Facet		Aspects of each management facet
Physical[a]	Water management	Water quality control
		Hydrologic regulation
	River channel management	Channel control
	Land management	Land degradation control
		Land-use regulation
Biological	Ecological management	Preservation/diversification
	Human management	Socioeconomic benefits

[a]Management of the physical facets of the drainage basin requires a completely integrated approach to the facets of land, water, and river channel.

allow land drainage, flood control, and navigation. In contrast, integrated basin management in Canada and Australia is characterized by a less intensive approach, which may reflect lower population densities.

There have been suggestions that basin management, which is really integrated should be concerned with both land and water issues (e.g., Haas 1981, Saha 1981, Pantulu 1983, Cunningham 1986), and Saha and Barrow (1981) considered that basin planning must include biological, hydrological, atmospheric, and geomorphological systems. Combining these arguments and using the components of existing strategies (Table 3), it appears that truly integrated basin management can be visualized as comprising five main facets, which relate to management of water, channel, land, ecology, and human activity, as summarized in Table 4.

Aspects Not Fully Included

Variations necessarily occur in the terms used from one area to another (Table 2) and according to the emphasis of the particular discipline. However, some aspects have not been considered as frequently as others, and the least mentioned (Table 3) relate to river channel stability, channel management, and recreational issues. Land and river channel aspects have been included less frequently than other considerations, and Richter and others (1985, p. 11) argued that soil and water conservation are integral parts of watershed management and should be included to achieve an integrated management of watersheds. In Canada it has been suggested (Mitchell and Gardner 1983, pp. 2–4) that land-based issues have been neglected. It is possible that unified river basin management has been mainly concerned with the supply side and with the science and technology, the nature and management of the physical resource and, until recently, has almost entirely ignored the demand side, which embraces the behavior and control of water users (Lord 1982). In addition, some aspects have become more evident recently as a result of the advent of GIS technology, and Gardiner (1988a, p. 468) commended the "new technology-driven catchment data storage and analysis capabilities, coupled with environmental assessment backed by legislation and the philosophy of environmental conservation and enhancement" in the context of a more environmentally sound river engineering (see also National Rivers Authority 1989, Gardiner 1990). In relation to appraisal of options for flood alleviation Gardiner and others (1987) contended that a holistic river management plan should include a range of environmental resources. They list agriculture, amenity, angling, archaeology, fisheries, landscape, maintenance, planning, recreation, water quality, and wildlife and aquatic biology as resources that should be considered.

Two particular aspects that have not featured very significantly are the acknowledgment of river channel change and of the integrity of the fluvial system. River channel changes need to be considered in relation to river channel management in the context of drainage basin management, and Gregory (1979b) summarized ways in which hydrogeomorphological changes could be pertinent to aspects of channel management. Although the significance of water quality changes, for example, in producing algal blooms and changes of instream ecology have been noted, less attention has been accorded to adjustments of river channels. It is important to know what causes river channel change, how much will occur, when it will take place, and where it will be located (Gregory 1987a). The changes of river channels that can occur have been described as the degrees of freedom of the fluvial system (Hey 1982, Gregory 1987b). From a data base of river channel adjustments compiled from a range of reported studies, the degrees of freedom that have been reported in more than 200 research investigations can be analyzed (Gregory 1987b). However, there is no systematically compiled summary of river channel change types, and Table 5 attempts such a summary

Table 5. Implications of river channel changes

Cause of change	Changes of process		Channel adjustments	Effects on fluvial system		
	Hydrology	Sediment	Adjacent to cause of change	Upstream	Downstream	Throughout network
Point						
Bridge crossings			*		*	
Drains/outfalls	*		*		*	
Abstraction	*		*	*	*	*
Gravel extraction		*	*	*	*	
Channelization	*	*	*	*	*	
Cutoffs			*			
Dredging		*	*			
Clearing and snagging			*			
Dams and reservoirs	*	*	*	*	*	*
Gully control		*	*	*	*	
Gully development		*	*			
Urbanization—drainage system	*		*		*	*
Land drainage	*				*	*
Land use change						
Arable land	*		*		*	*
Deforestation	*		*		*	*
Afforestation	*		*		*	*
Basin						

incorporating degrees of freedom of the fluvial system. This table summarizes the causes of change ranging from those at a single point location to basin-wide changes, then suggests the hydrological and morphological consequences that can occur, and then indicates how such consequences, which are effectively the degrees of freedom of the fluvial system, may be significant upstream or downstream from the source of change.

There have been few references to the consequences of river channel adjustment in basin-wide studies, despite the fact that the significance of channel change can be very extensive. However, the contribution of fluvial geomorphology for river basin engineering is being appreciated (Newson 1986). Whereas recent views of river channel management have tended to advocate working with the river rather than against it (Winkley 1972), such views have often been applied to a particular reach of channel. Still required in integrated management is a policy of working with the river and the channel in the basin context, which acknowledges that river channels are dynamic and part of a fully integrated and changing system. This could focus upon the energetics of the system (Gregory 1987c) and, as recommended for water resources planning and management (Meyers 1977), basin management could be approached in the same series of stages that are used in the application of a systems approach. The first stage involves identification of the components of the system, and this is equivalent to the stage of entitation recognized by Huggett (1980) for systems analysis in the environment, which is, in many ways, similar to the comprehensive approaches noted above. Second, it is necessary to express the components in quantitative terms, and this stage of quantitation involves some aspects of the integrated approach identified above. These two phases of entitation and quantitation comprise the lexical phase in a systems approach to environmental analysis and are succeeded by the parsing phase (Huggett 1980), which involves establishing relationships between the system components and is analogous to the integrated approach to basin management. There is an analogy between approaches to integrated basin management and the systems approach, which provides a holistic attitude to the ecosystem.

The geomorphological and hydrogeomorphological components of the unified approach to basin management have been less evident than other components, although Brookes (1990), and Brookes and Long (1990) have shown recently how geomorphological assessment can contribute in the context of river management. This can be achieved by the assessment of the ecological or aesthetic value of water courses in relation to fluvial processes, morphological characteristics, and channel stability. To embrace a more significant hydrogeomorphological component in integrated basin management, it is necessary to focus upon the network of channels and streams, upon their continuity and interconnectivity, and upon the fact that they are part of a dynamic system that is subject to change and adjustment. Many components of integrated basin management that relate to water, channel, land, ecology, and human activity (Table 4) have effects on the river network, so it is necessary to consider the physical transmissions along the network and how impacts in one area have implications upstream and downstream. Thus many of the hydrogeomorphological effects (Table 5) have an impact not only at a point or along a reach but also throughout much of the river network. The importance of a spatial approach has been stressed by Graf (1985), who also advocated consideration of the instability of systems in his outline of the management of the Colorado basin.

If coordinated management of water and land resources is to be achieved, Mitchell (1987, p. 25) has argued that the scope of the holistic approach must be carefully thought through. He recommends a two-stage strategy embracing, first, at the conceptual level, a comprehensive viewpoint that requires identification of the widest possible range of issues and variables. Second, at the operational level, Mitchell (1987) visualizes a more focused approach that he describes as integrated and involves concentration upon those issues judged to be the most significant for the area of application. These two stages together comprise what Mitchell (1987) expresses as a bounded holistic perspective, but this may not be fully compatible with other uses of terms in the literature. Emphasis upon identification of the components (comprehensive) and upon the focused approach (integrated) does not necessarily embrace the energetics of the basin system to allow concentration upon the integrity and connectivity of the river network incorporating consideration of river channel adjustments and change.

Conclusion and Provisional Recommendations

A diversity of terms and combinations of terms has been used to express the paradigm of a unified approach to basin management. It is suggested that there are advantages to be gained by using terms in a standard way and by ensuring that the components included are as complete as possible and are focused on a dynamic view of the fluvial network.

Whereas Mitchell (1987) distinguished comprehensive and integrated stages with particular reference to the administrative–implementation aspects of the unified basin approach, these are not strictly analogous to usage by others and perhaps do not allow sufficiently for dynamics and emphasis upon energy flows and energetics. Comprehensive basin management will continue to be used for emphasis upon a wide range of issues, and integrated basin management will necessarily involve some determination of the interaction of issues or components and the indication of the most significant for the area of application. However, we provisionally recommend that holistic river basin management be used for those cases where there is a fully comprehensive approach including river channel changes, that there is inclusion of the energetics of the system involving not only connectivity aspects of the fluvial system but also consideration of impacts throughout the system, and that such a dynamic approach underpins management and planning.

This suggestion is fully compatible with greater inclusion of aspects related to the river channel, its stability, and potential for change. To realize the fullest potential of holistic river basin management, it is desirable that impacts be minimized as much as possible. The paradigm of working with the river and not against it, which has been refined since first suggested by Winkley (1972), should be developed and enhanced to one of working with the river in the integrated holistic river basin context.

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