



**DEVELOPMENT OF TIDAL AREAS - SOME PRINCIPLES AND
ISSUES TOWARDS SUSTAINABILITY**

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DEVELOPMENT OF TIDAL AREAS SOME PRINCIPLES AND ISSUES TOWARDS SUSTAINABILITY^Ψ

An ICID Position Paper

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ABSTRACT

The coastal zone comprises only 3% of the earth's surface, but contains a disproportionately high amount of its assets. Tidal areas include all those coastal areas where the tidal processes are capable of affecting man's activity or of being influenced by man. Tidal areas differ greatly depending on their location, geo-physical conditions, climate, tidal range and cultural differences. Throughout the world, tidal areas have been and are being developed. These developments will continue as food production will need to be doubled in the next 25 years. To address questions related to a sustainable development of tidal areas, the International Commission of Irrigation and Drainage established the Working Group on Sustainable Development of Tidal Areas in 2001. The working group has studied these questions and formulated principles and issues for sustainable development of tidal areas based on the relevant international conventions. The aim of this paper is to represent the official position of the International Commission on Irrigation and Drainage (ICID) and to support the preparation of the ICID Handbook *'Towards Sustainable Development of Tidal Area: Some Principles and Experiences'*.

^Ψ Développement de zones de marée. Certains principes et les questions vers le développement durable

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6 KEY WORDS: tidal areas, sustainable development, integrated land and water management
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11 RESUME
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14 La zone côtière représente seulement 3% de la surface de la terre, mais contient une quantité
15 anormalement élevée de ses actifs. Les zones de marée comprennent tous ceux des zones
16 côtières où le processus de marée sont susceptibles d'affecter l'activité de l'homme ou d'être
17 influencé par l'homme. Les zones de marée diffèrent considérablement en fonction de leur
18 situation géographique, géo-physique, le climat, amplitude de la marée et les différences
19 culturelles. Dans le monde entier, les zones de marée ont été et sont en cours d'élaboration. Ces
20 évolutions vont continuer tant que la production alimentaire devra être doublé dans les 25
21 prochaines années. Pour traiter des questions liées à un développement durable des zones de
22 marée, la Commission internationale des irrigations et du drainage créé le Groupe de travail sur
23 le développement durable des zones de marée en 2001. Le groupe de travail a étudié de ces
24 questions et formulé les principes et les questions de développement durable des zones de marée
25 sur la base des conventions internationales pertinentes. Le but de ce papier est de représenter la
26 position officielle de la CIID et d'appuyer la préparation de la CIID Manuel "Vers le
27 développement durable de la zone des marées: Quelques principes et expériences».
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38 MOTS CLÉS: les zones de marée, le développement durable, intégrée des terres et la gestion de
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45 INTRODUCTION
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48 The coastal zone comprises only 3% of the earth's surface, but contains a disproportionately
49 high amount of its assets (Schultz, 2001; Huntington, 2002). Coastal zones accommodate 60%
50 of the world's population, a figure set to increase to 80% by 2050. As a result, two-third of the
51 cities in the world with a population of more than 1.6 million people is found in coastal areas. It
52 contains ports and harbours for international trade and a major portion of the world's prime
53 agricultural land, together accounting for 25% of global primary productivity. Coastal areas
54 have a great ecological value, offer recreation and tourism and provide habitat for many
55 endangered species and, at the other hand, are the source of 90% of the world's fish catch.
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4 Tidal areas include all those coastal areas where the tidal processes are capable of
5 affecting man's activity or of being influenced by man (Simm *et al.*, 2003)¹. This roughly
6 extends tidal areas between the following limits: (i) on the seaward side up to the limit of
7 conventional construction or dredging activity (typically of the order of 30 m water depth) and
8 (ii); on the landward side up to the limit of the action of the sea, including all those areas that
9 might be subject to flooding by seawater and up all estuaries and rivers to the tidal. Tidal areas
10 differ greatly depending on their location, geo-physical conditions, climate, tidal range and
11 cultural differences.
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17 Throughout the world, tidal areas have been and are being developed. The initial
18 development is generally for agriculture, often in combination with flood protection. These
19 developments will continue as food production will need to be doubled in the next 25 years
20 (Molden, 2007). This will be required to meet the needs of the expanding population and the
21 expectation of this growing population for a higher standard of living. It is estimated that, whilst
22 the major part of increase will need to come from already cultivated land, 10% of the increase
23 will have to come from newly reclaimed lands (Van Hofwegen and Svendsen, 2000). These
24 lands will be required partly to compensate for loss of agricultural land by urbanisation and
25 industrialisation, erosion, desertification and partly to compensate for reduction in yields by
26 waterlogging, salinization, environmental considerations or degeneration of existing irrigation
27 and drainage systems.
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35 The development focus in tidal areas is, however, gradually moving to ports, harbours,
36 transportation routes, industries, aquaculture, housing and recreation facilities. Reclamation of
37 these areas may sterilise their availability for such uses as waste disposal, abstraction of
38 construction aggregates and other materials and as the location of renewable energy generators
39 such as wind turbines. At the same time, these developments threaten their valuable natural
40 resource functions. On this basis, the burden of guaranteeing sustainable development must be
41 shared locally and globally for the wise use and conservation of tidal areas (Convention of
42 Ramsar²). Doing nothing is not an option.
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48 Development of tidal areas is closely linked to the availability of fresh water: a finite and
49 vulnerable resource, essential to sustain life, development and the environment. Development
50 would have to be based on the Dublin principles². In tidal areas, fresh water is needed to reclaim
51 saline land for agriculture, to irrigate new agricultural land, to create and maintain fresh water
52 lakes, etc. The quality of fresh water resources is threatened by the various (land) uses, e.g. non-
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¹ Definitions used in this paper are presented in Annex 1.

² The international conventions and principles on which this paper is based are summarized in Annex 2.

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4 point source pollution by intensive agriculture, point-source pollution by untreated wastewater
5 from industries and households and salt water intrusion.
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8 Development of tidal areas will also be affected by systemic changes such as population
9 growth and those arising from climate change, e.g. the predicted sea level rise and increases in
10 storminess (Van Schaik *et al.*, 2003). To make development sustainable, it needs to meet the
11 needs of current generations without compromising the ability of future generations to meet
12 their needs and aspirations (Bruntland, 1987). Sustainable development is often conceptualised
13 as having three dimensions: (i) Environment; (ii) Economy and; (iii) Society (Global Water
14 Partnership, 2003). These three dimensions can be symbolised as overlapping circles with a
15 triangle in the centre representing sustainable development (“*triple bottom line concept*”), based
16 on three overriding criteria: (i) Economic efficiency in water use; (ii) Equity, and; (iii)
17 Environmental and ecological sustainability.
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20 In tidal areas, the principles on Integrated Coastal Zone Management (ICZM²) and
21 Integrated Water Resources Management (IWRM²) are consistent with sustainable
22 development. ICZM and IWRM are both processes that promote the co-ordinated development
23 and management of water, land and related resources, in order to maximize the resultant
24 economic and social welfare in an equitable manner without compromising the sustainability of
25 vital ecosystems. Public participation in decision-making and access to information and to
26 justice would have to be guaranteed (United Nations Economic Commission for Europe, 1998).
27 Capacity building plays an essential role in this (Global Water Partnership, 2003).
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30 To address these issues, the International Commission on Irrigation and Drainage (ICID)
31 launched the Working Group on Sustainable Development of Tidal Areas (WG-SDTA) during
32 the International Executive Council (IEC) Meeting in 2001, Seoul, Korea. The objectives of the
33 WG-SDTA are based on the recommendations of the Task Force on ‘*Environmentally*
34 *Sustainable Options of Tidal Lands and Estuaries*’ which was constituted by the Asian Regional
35 Working Group (ASRWG) of ICID during the pre-Council meetings at the 51st IEC Meeting at
36 Cape Town, South Africa in October 2000 and are as follows:
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- collect information about the natural environment in tidal areas around the world;
 - identify sustainable development and conservation options in the tidal areas;
 - find a balance between the preservation and development of tidal areas.

Long debates within the Working Group have clarified new concepts for the development of tidal areas but also have raised the sensitivity of the subject, the diversity of approaches according to different cultures, histories and governmental policies. The aim of this position

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4 paper is to represent the official position of ICID. The paper has to be approved by the
5 International Executive Council and is considered by ICID national committees.
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9 The position paper addresses the following questions:

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11 • *question 1.* Why are tidal areas changing or being developed? What are the sustainable
12 options for future development?
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14 • *question 2.* Is it possible to balance environmental, social and economic objectives in the
15 development of tidal areas?
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17 • *question 3.* Who needs to be involved in that balancing process?
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19 • *question 4.* How would development options have to be selected that optimise the
20 potential for a particular area?
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24 These questions have been studied by the working group members and used to formulate
25 principles and issues for sustainable development of tidal areas based on the relevant
26 international conventions. The principles and issues presented in this position paper have been
27 further elaborated in the Handbook '*Towards Sustainable Development of Tidal Area: Some*
28 *Principles and Experiences*'.
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35 PRINCIPLES AND ISSUES TOWARDS SUSTAINABLE DEVELOPMENT OF TIDAL 36 AREAS 37 38 39

40 Considering four principles consistent with ICID's Strategy, we, ICID members, propose to ask
41 our countries to address the following issues to promote sustainability in development of tidal
42 areas:
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47 *Principle 1 – Integrated multi-functional approaches*

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50 Issue 1.1: Integrated land management

51 Which approaches are most strategic taking account of future changes (see also Issue
52 3.2)? Is it possible to identify and promote multi-functional approaches (e.g. agriculture,
53 aquaculture, recreation facilities, housing, industries, ports, transport, renewable energy, water
54 supply, material resource abstraction, waste disposal) as part of the development scheme being
55 considered? Are integrated catchment (watershed) management and integrated coastal zone
56 management being adopted? Which international conventions, laws and government policies
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4 need to be taken into account? Have social conventions, economic regeneration and biodiversity
5 been considered? How can strong partnerships be built with other stakeholders in catchment and
6 coastal zone management?
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11 Issue 1.2: Integrated water management

12 How can the adoption of integrated water resource management be promoted, both now
13 and in the future? How can the (sometimes conflicting) quantity and quality requirements of
14 irrigation, drinking and industrial water, of water for nature and aquaculture and of drainage and
15 flood control be managed? Which water management approaches help to implement agreed
16 multi-functional requirements? How can strong partnerships be built with all stakeholders in
17 integrated water management?
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24 *Principle 2 – Holistic engagement with social, economic and environmental issues*
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27 Issue 2.1: Engagement with all stakeholders

28 Have all stakeholders involved in or affected by the management and development of
29 tidal areas been considered (see also Issue 4.1)? What kinds of information, communication
30 techniques, technical tools and institutional framework(s) will support stakeholder engagement?
31 Should innovative or previously unused approaches to stakeholder consultation be considered?
32 How may enduring partnerships with stakeholders be built? How may the awareness and
33 responsibility of local communities and other stakeholders be increased? What kinds of risk
34 management measures will reduce the consequences of natural and man-made hazards for local
35 communities and other stakeholders (see also Issue 3.1)? Has the scientific and systemic
36 information on natural and man-made hazards been made available in a form that can be
37 understood by all?
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46 Issue 2.2: Management of resources and promotion of sustainable production

47 How may the use of non-renewable resources be minimised and the use of renewable
48 resources and re-useable and recycled materials be promoted? To what extent will reclamation
49 developments sterilise the availability of the tidal lands for waste disposal, material resource
50 abstraction and renewable energy generation? How might the amount of waste generated in
51 developing and managing tidal areas be minimised? In what ways could the amount of energy
52 from non-renewable sources used in construction and management of land and water be
53 minimised and those of renewable resources be maximized? How may sustainable agricultural
54 production be promoted and the level of greenhouse gas emissions be reduced? Could more
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efficient use be made of any capital assets?

Issue 2.3: Environmental enhancement and stewardship of natural resources.

To what extent have existing developments ‘modified’ the natural environment of the tidal area? How could developments or uses of tidal areas be promoted that preserve or enhance their natural functions? Are there innovative solutions that would enhance the ecological status of modified tidal areas and/or the creation of new wetland habitats in reclaimed areas, e.g. in paddy fields, irrigation and drainage canals and freshwater lakes? How might future impacts on natural systems, including water quality, biodiversity and landscape be mitigated? To what extent is environmental degradation likely to be a temporary effect and can ecological recovery be achieved with time?

Principle 3 – Management of risk and uncertainty and adaptation to change

Issue 3.1: Risk management to protect people, property and the environment from natural and man-made hazards

What options have been considered either to reduce the probability of natural and man-made hazards such as flooding, or the consequences of such events? How have risks and uncertainties in the management and development of tidal areas been considered? How has the performance of the reclamation and flood protection works been assessed and assured? How may safety, health and environment risks be minimised? Are effective and efficient warning systems in place to predict the occurrence of natural and manmade hazards and to promote appropriate responses from those at risk? Have all interested parties been provided with the best available information as to the locations and degree of natural and manmade hazards? What strategies will be used to prevent inappropriate housing or industrial development in areas at significant risk? How could land and water quality pollution be limited? Has risk management been matched with opportunities to identify economic, social and environmental improvements?

Issue 3.2: Adaptive management to take account of climate change, population growth and other long-term changes and uncertainties

Have the effects of climate change (e.g. sea level rise, increased storminess) and of population growth been assessed? Has the precautionary principle been adopted? How may resilient and adaptive management be promoted? Have social, economic and environmental uncertainties been taken into account in decision-making? Will developments ensure a fair balance between reducing risks and increasing opportunities both for present and future

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4 generations? Will developments reduce energy consumption and greenhouse gas emissions (see
5 also Issue 2.2)?
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9 *Principle 4 – Enabling methods and means*
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12 Issue 4.1: Appraisal using methods that are rigorous, coherent and transparent and consider
13 social, environmental and economic costs and benefits
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15 Have alternative courses of action been compared by a process that is open and
16 transparent and that adopts a rigorous, logical and accountable framework? Have local
17 communities and stakeholders participated from the beginning (see also Issue 2.1)? Has multi-
18 functionality been optimised? Have all important societal objectives including equity been taken
19 into account? Do the adopted appraisal methods increase understanding of the nature of the
20 choices that must be made and encourage the invention of new and better approaches to the
21 management and development of tidal areas? Have full life-cycle costs been taken into account
22 in making decisions?
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30 Issue 4.2: Knowledge, skills and awareness to promote sustainable approaches
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32 Has an enabling environment with appropriate policy and legal frameworks been created?
33 Has awareness of key sustainable development issues been raised amongst all those involved in
34 or affected by the management and development of the tidal area(s)? Have decision-makers,
35 planners, engineers and scientists been trained in principles of sustainable development? Is
36 ongoing professional development of planners, engineers and scientists in place to ensure that
37 their practice is up-to-date and appropriate to the engineering, social and environmental
38 challenges? Has best practice and guidance been disseminated to them? Do all practitioners
39 understand the dynamic nature of tidal areas and systems? Has the human resources
40 development strengthened the management systems and is there appropriate institutional
41 development?
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52 CONCLUSIONS
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55 By 2050, 80% of the world population is expected to live in coastal areas. Tidal areas around
56 the world are being developed to accommodate and feed this growing population, to develop
57 and safeguard land and water resources and to protect people and property from water shortages
58 and flooding. These developments, which are of particular interest to ICID, have caused
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conflicts between economic social and environmental objectives. Therefore tidal areas would have to be managed to provide appropriate safe social and economic development and productivity, whilst caring for and working with the natural environment, in a way that is fair and affordable both now and in the future.

This Position Paper sets out principles which would have to assist in achieving this goal. These principles and issues have been further elaborated in the Handbook *'Towards Sustainable Development of Tidal Area: Some Principles and Experiences'*. These principles include the adoption of integrated multi-functional approaches, a holistic engagement with relevant social economic and environmental issues, stakeholder participation, management of risk, change and uncertainty, and enabling methods and means. Through this position paper, ICID seeks to promote dialogue and actions towards sustainable development and management of tidal areas.

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4 World Commission of Environment and Development. 1987. Report of the World Commission
5 on Environment and Development: Our Common Future. Report no. 42/187. United
6 Nations Department of Economic and Social Affairs.
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10 11 12 ANNEX 1. DEFINITIONS 13 14

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16 *Adaptive management.* A type of natural resource management in which decisions are made as
17 part of an ongoing science-based process. Adaptive management involves testing,
18 monitoring, and evaluating applied strategies, and incorporating new knowledge into
19 management approaches that are based on scientific findings and the needs of society.
20 Results are used to modify management policy, strategies, and practices. (Interagency
21 Watershed Coordinating Committee, 2000). Thus adaptive management involves the
22 ability to modify approaches cost-effectively, with optimum reuse of physical resources,
23 without coming up against overriding constraints.
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31 *Integrated Coastal Zone Management (ICZM).* A process of governance for coastal and marine
32 areas in order to optimise benefits from the coastal zone development and coastal
33 resource management, and to minimise negative effects of such activities on the coastal
34 resources and environment (Tiwi, 2004)
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39 *Integrated Water Resources Management (IWRM).* A process which promotes the co-ordinated
40 development and management of water, land and related resources, in order to maximize
41 the resultant economic and social welfare in an equitable manner without compromising
42 the sustainability of vital ecosystems (Global Water Partnership, 2003).
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47 *Precautionary principle.* To ensure that decisions are taken notwithstanding scientific
48 uncertainty about the nature and extent of the risk. It should be invoked when there is
49 good reason that harmful effects may occur and when the best available scientific advice
50 cannot assess the risk with sufficient confidence to inform decision making (United
51 Kingdom Interdepartmental Liaison Group on Risk Assessment , 2002).
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56 *Resilience* means 'able to recover quickly and easily'. Resilient management therefore involves
57 minimising the consequences of hazardous events or learning to live with them instead of
58 reducing the hazard (Vis et al., 2003).
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6 *Sustainable development.* Development that meet the needs of current generations without
7 compromising the ability of future generations to meet their needs and aspirations (World
8 Commission of Environment and Development, 1987).
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12 *Tidal areas.* All those coastal areas where the tidal processes are capable of affecting man's
13 activity or of being influenced by man. This roughly extends tidal areas between the
14 following limits (Simm *et al.*, 2003):
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- 17 • on the seaward side up to the limit of conventional construction or dredging activity
18 (typically of the order of 30m water depth);
- 19 • on the landward side up to the limit of the action of the sea, including all those areas that
20 might be subject to flooding by seawater and up all estuaries and rivers to the tidal limit
21 (the point where water levels are no longer influenced by tidal propagation)..
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28 ANNEX 2. PRINCIPLES 29

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32 *Convention of RAMSAR* (Convention on Wetlands, 1991)
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34 The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental
35 treaty which provides the framework for national action and international cooperation for the
36 conservation and wise use of wetlands and their resources. The contracting Parties have agreed
37 on the following principles:
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- 40 • recognizing the interdependence of Man and his environment;
- 41 • considering the fundamental ecological functions of wetlands as regulators of water
42 regimes and as habitats supporting a characteristic flora and fauna, especially waterfowl;
- 43 • being convinced that wetlands constitute a resource of great economic, cultural, scientific,
44 and recreational value, the loss of which would be irreparable;
- 45 • desiring to stem the progressive encroachment on and loss of wetlands now and in the
46 future;
- 47 • recognizing that waterfowl in their seasonal migrations may transcend frontiers and so
48 should be regarded as an international resource;
- 49 • being confident that the conservation of wetlands and their flora and fauna can be ensured
50 by combining far-sighted national policies with co-ordinated international action;
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60 *Dublin principles* (International Conference on Water and the Environment, 1992):

- fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment;
- water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels;
- women play a central part in the provision, management and safeguarding of water;
- water has an economic value in all its competing uses and should be recognized as an economic good.

Principles of Intergrated Coastal Zone Management (ICZM) (European Commission, 2000)

The EU Demonstration Programme on ICZM identified eight principles for successful ICZM:

- a broad 'holistic' perspective (thematic and geographic);
- a long term perspective;
- adaptive management during a gradual process;
- reflecting local specificity;
- working with natural processes;
- participatory planning;
- support and involvement of all relevant administrative bodies;
- use of a combination of instruments.

Principles of Integrated Water Resources Management (IWRM) (Global Water Partnership, 2003)

The Global Water Partnership defines IWRM as a process that promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. The concept of IWRM is based on the Dublin Principles.