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THE POTENTIAL ROLE OF SUSTAINABILITY SCIENCE IN COASTAL ZONE MANAGEMENT

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Abstract

Sustainability Science invokes a co-produced approach to research between researchers and managers, involving a shared participatory, policy-centred process. The COREPOINT project which was developed with the principles of Sustainability Science in mind, provides evidence of the effectiveness and challenges involved in the knowledge transfer process between research centres and local government officials involved in coastal research and management. The Expert Couplet Nodes (ECN) embedded within the project aimed to ensure that a paradigm shift in attitude and behaviour towards traditional science and management practices took place. A comparison of the ECN process in two study sites in Ireland provided an opportunity to review the process and outcomes of the collaborative enquiry arrangements by referring to a suite of Sustainability Science principles developed during the project. In doing so, this paper demonstrates how the ECN approach built capacity for improved coastal management and how Sustainability Science has a key role to play in ICZM.

1. Introduction

Complex environmental problems, such as deforestation and habitat destruction, soil problems, water management problems, over-hunting, over-fishing, invasive species, and human population growth, have been demonstrated by Diamond (2005) to undermine past societies. These problems, in addition to climate change, chemical toxicity, and energy shortages continue to threaten global communities and pose serious challenges to scientists, politicians, and policy makers alike. All of these issues occur in the coastal zone, where they are inherently exacerbated by demands for space and resources which characterise coastal use. In the parlance of Hardin (1968) the resolution of such issues is hindered by the *Tragedy of the Commons* implying that free access to shared resources ultimately results in the loss or destruction of those resources. While the *Tragedy of the Commons* is not a universal phenomenon (Burke, 2001; Kinzig *et al.*, 2004), it has been cited as a cause for concern in the coastal zone (Connolly and Cummins, 2001). The *Tragedy of the Commons* can be diluted or negated when resource management solutions integrate a system of weightings. This insinuates that black or white technical solutions to environmental problems must be complemented by moral or ethical considerations (Lele and Norgaard, 2002). An idealised role of science in this process is one with the breadth of competencies to deal with complex situations while making value

judgements. However, Lovelock (1988:xvii), argued that *'scientists are constrained by the tribal rules of the discipline to which they belong'*. Overcoming this constraint via interdisciplinary interaction is accepted as an important step towards improving our understanding of complex systems, such as the coastal zone (GESAMP, 1996). Furthermore, Pilke (2007) advocates co-working among a collection of experts with a diverse range of views, experience and knowledge as the best way of achieving the types of innovative policy alternatives that can stem the tide of resource destruction.

As scientific endeavour and the society within which it operates have become more complex, society's expectations from science have begun to shift. Sustainability Science has emerged as an approach which aims to meet these societal expectations through policy led engagement. The discipline of Sustainability Science brings together established sciences in a multidisciplinary environment to address a common policy problem via stakeholder interaction, with questions of sustainable development at the core. The aim of this paper is to investigate the role of Sustainability Science in coastal zone management and to suggest mechanisms for the juxtaposition of the two in an operational context. This approach seeks to clarify the linkages between these two science and management philosophies. ICZM has been comprehensively documented and described in the academic literature since its emergence in the 1970s. By comparison, there is a paucity of literature on Sustainability Science in practice and/or within a coastal management scenario. Central questions include the following. What can Sustainability Science contribute to ICZM? How can Sustainability Science be embedded in an ICZM process? What outcomes or synergies can be anticipated from the two concepts in practice? What are the exclusive principles of Sustainability Science and ICZM? What are the enabling or limiting factors to implementing Sustainability Science in a coastal management scenario?

2. Sustainability Science & ICZM

The concept of Sustainability Science is derived from the theoretical framework of sustainable development which is commonly accepted as *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'* (WCED, 1987). Global understanding of the need for sustainable development was significantly advanced by the United Nations Conference on Environment and Development in 1992. Local level action on sustainable development was facilitated by Agenda 21, which emerged at the same time. By comparison, Sustainability Science, as a relatively new field of science, has not impacted in the same way on society's global consciousness. Instead, it is a topic of interest for a relatively small, but growing academic community, given prominence by a dedicated section in the Proceedings of the National Academy of Sciences (PNAS) in 2007 (Clark, 2007).

In contrast to sustainable development, there is no common or widely accepted definition of Sustainability Science. Reitan (2005) describes Sustainability Science as the use of science to sustain successful human societies, including their ecological support systems. In order to achieve this, Sustainability Science helps scientists to seek solutions to environmental problems by creating links in seemingly disparate fields. A seminal report by the International Council for Science (ICSU) describes the

need for a *'new contract between science and society for sustainable development'* (ICSU, 2002:7), where scientific endeavour is mobilised to resolve socially determined issues of sustainable development. Clark *et al.*, (2005:15) discuss Sustainability Science in the context of the German idea of *Wissenschaft* which embraces the systematic pursuit of all knowledge, learning and scholarship. More discrete definitions for Sustainability Science have been given by PNAS, (2008); Kieffer *et al.*, (2003); Komiyama & Takeuchi, (2006); and Kates *et al.*, (2001). These definitions vary considerably in their level of detail; however, a common theme prevails, - the need to re-orientate scientific practice to meet a sustainable development agenda.

Improving our understanding of Sustainability Science in the context of ICZM, complements work to date on Sustainability Science in health (Bloom, 2007), food security (Easterling, 2007; Kates and Dasgupta, 2007), engineering (Michelcic *et al.*, 2003) and urban planning (Turner and Lambin, 2007). Much has been written about the broad role of science in ICZM (NRC, 1995; Knecht, 1995; Cicin-Sain & Knecht, 1998). It was highlighted in particular by the GESAMP report (1996), which describes as an essential pre-requisite for successful ICZM: '*collaboration between managers and scientists at all stages of the formulation of management policy and programmes, and in the design, conduct, interpretation and application of research and monitoring*.' The report advocates the development of close working relationships between nearby scientific institutions that are likely to be familiar with the historical and social roots of conflicts, and may therefore be able to deal with them. The GESAMP report also highlights the need for close working relationships between the natural and social sciences at each stage of the ICZM process. The natural sciences are essential for understanding physical coastal processes, while the social sciences are necessary to help understand the human impact on the coastal zone. Cicin-Sain & Knecht (1998) identified eight key topics within ICZM that require scientific input, from both the physical and social sciences, as: beach management and coastal erosion, wetlands protection, coastal hazards, non-point source pollution, sea level rise, coastal and estuarine water quality, threatened and endangered species, and coral reef management.

Surprisingly, although coastal zone management is highly dependent on reliable scientific information, the EU ICZM principles of best practice fail to make any reference to the need for such input. A possible explanation for this is in the fact that the ICZM principles emerged following the EU Demonstration Programme on ICZM. The aim of the Demonstration Programme was to identify practical approaches to the implementation of coastal management. It was heavily weighted towards identifying solutions for decision making that tried to resolve the dichotomy between bottom up (participatory) and top down (regulatory) approaches, which exercised much of the debate at the time. Of the 35 Demonstration Programme projects, only three contained objectives relevant to the resolution of issues dependent on information from scientific disciplines (Cummins *et al.*, 2004). A rationale for why this gap needs to be addressed is provided below.

ICZM principles of best practice (European Commission, 2000)

1. *Adopt a broad perspective (thematic and geographic)*
2. *Take a long term perspective taking into account the precautionary principle*
3. *Apply adaptive management during a gradual process*

4. *Address local specificity and the consider the great diversity of European coastal zones*
5. *Work with natural processes and respect the carrying capacity of ecosystems*
6. *Involve all the parties involved in the management process*
7. *Support and involve all relevant administrative bodies*
8. *Use a combination of instruments designed to facilitate coherence*

3. The Development of Principles of Best Practice for Sustainability Science

As collaborative approaches to natural resource management become more widespread, it is necessary to be able to differentiate between the distinct features of each, to help evaluate what works best in the transition towards sustainability (Conley and Moote, 2003). At this stage in its development, it makes sense to focus on improving understanding of Sustainability Science as a process in itself. It is necessary to be able to classify what constitutes such an approach, before deciding on what variables influence its effectiveness.

Principles of Sustainability Science

Before examining mechanisms for evaluating process or applying the principles of Sustainability Science in the coastal zone, it is first necessary to describe what those principles are. While many papers refer indirectly to various components of Sustainability Science (Clark & Dickson, 2003; Clark *et al.,* 2005; ICSU, 2002; Komiyama and Yakeuchi, 2006; Parris & Kates, 2003); a concise set of principles have not been articulated; - although Kates *et al.,* (2001) proposed a comprehensive set of core questions to promote the research necessary to progress the Sustainability Science agenda. The six principles listed below were developed for this paper following a review of the literature on the topic. Strategic overview papers by ICSU (2002), Clark and Dickson (2003) and Clark *et al.,* (2005) were particularly useful in this extractive process. It is hypothesised that these six principles presented below provide the basis of a framework for assessing the effectiveness of Sustainability Science in coastal management. A system for testing this hypothesis draws on the Expert Couplet Nodes implemented in the EU Interreg IVB Corepoint project, described below. This analysis reveals if the principles can be evolved into a useful indicator set for operational monitoring purposes.

Proposed Principles of Sustainability Science:

1. Resolve sustainable development policy issues by a problem driven agenda
2. Co-produce knowledge in collaboration with stakeholder groups
3. Implement a multidisciplinary approach
4. Address earth system complexity
5. Focus communication and research activities at the local level
6. Facilitate a process of social learning rather than providing definitive answers

1. Resolving sustainable development policy issues by a problem driven agenda: Lubchenco (1998) describes a shift in knowledge requirements, - from scientific knowledge to generate new products and processes, to scientific knowledge to inform management and policy decisions. The aim of focusing on a policy issue is to harness knowledge in support of decision making for sustainable development. This

represents a move away from conducting research at the personal preference of a research scientist, towards research based on policy needs. The resolution of sustainable development policy issues implies addressing the three pillars of sustainable development, - environment, economy and society, referred to as the 'development triads' by Sandbrook (2003). In a coastal context, this involves studies of the bio geophysical and socioeconomic aspects of the coastal zone, in addition to the interactions between these factors (Steffen *et al.*, 2003).

The definition of a problem is given by the Oxford English Dictionary as: *'A doubtful or difficult matter requiring a solution; something hard to understand or accomplish or deal with; an enquiry starting from given conditions to investigate or demonstrate a fact, result or law'* (Oxford University Press, 2008). The 'problems' that need to be addressed by Sustainability Science combine all three elements of this definition. Typical problems that manifest themselves in the coastal zone include eutrophication, coastal erosion, flooding and over-fishing. Issues such as these can be examined myopically; for example by studying coastal erosion solely in relation to changing sediment budgets. However, Sustainability Science requires a broader approach to problem definition and to subsequent problem solving. In the example of coastal erosion, problem definition can relate to examining cause and effect of coastal change invoking a broader understanding of the situation, including the human dimension.

2. Co-producing knowledge: According to the National Research Council (1999) knowledge generated through research needs to be co-produced through close collaboration and by promoting dialogue between scientists, policy makers and practitioners. The co-production of knowledge depends on the creation of new processes for interaction between these stakeholders (Wondolleck and Yaffee, 2000). The co-production of knowledge can also be referred to as collaborative enquiry. Co-produced knowledge or collaborative enquiry interacts with three fields of knowledge: the knowledge that we bring to the table, publicly available knowledge from theory and research, and new knowledge created by collaborative practice. Policy makers and practitioners add value to the research process by contributing their local knowledge, professional experience and political realities to the equation.

3. A multidisciplinary approach: Geographers, sociologists, anthropologists, economists, historians and political scientists can contribute to the understanding of nature-society interactions, especially in terms of human behaviour in relation to the marine and coastal environment (Smith, 2002). This includes improving our understanding of the mechanisms by which the processes of coastal governance are expressed: the marketplace, the government and the institutions and arrangements of civil society (Juda & Hennessy, 2001). However, it is not sufficient to concentrate on building capacity for ICZM by focusing on social sciences alone. The challenge of an ecosystems approach to coastal management is to realise the links between the social and natural dimensions of the system and to integrate knowledge by taking a holistic, multidisciplinary approach to science and management. Adopting a multidisciplinary approach is complicated by the very different world views maintained by social scientists and natural scientists. According to Komiyama and Takeuchi (2006) the fragmented approach to problem solving among the scientific disciplines can be resolved by assembling 'platforms of knowledge'.

4. Earth system complexity: A greater appreciation of the need to understand the complexity of the dynamic interactions between nature and society has emerged over the last decade (Clark & Dickson, 2003). Essentially Earth systems complexity promotes the combination of the human system and natural system into a greater complex system in order that their interactions can resolve towards a steady level of sustainability with mutual benefit (Odum, 1994). Coastal ecosystems consist of physical parameters which interact with ocean and land masses, as well as social parameters which cover the interaction of the human dimension. Coastal zones can be described as complex systems due to their diversity, their multiple interconnected elements and their capacity to change. Adopting a systems approach to coastal zone management requires a holistic approach to problem solving, implemented through multidisciplinary research. A systems approach also requires vulnerability assessments, with the ability to deal with coupled human-environment systems (Turner *et al.,* 2003). Vulnerability arises when the life support system of the planet is exposed to hazards (perturbations and stresses). Turner *et al.,* (2003) proposed a framework for vulnerability analysis in Sustainability Science. The model details the exposure (components and characteristics), sensitivity (human and environmental conditions) and resilience (impact/response and adjustment and adaptation/response) components of the vulnerability framework.

According to Clark *et al.,* (2005:18) the nature of the policy issue to be addressed by Sustainability Science should be linked to the sustainable development agenda with issues of resilience and vulnerability at the core. This involves an improved understanding of the resilience of the coastal ecosystem to recover from disturbance and an improved understanding of how complex ecological social and economic systems respond to stress. Policy issues limited to studies of carrying capacity, ecological footprints and limits to growth fail to integrate earth system complexity and should be avoided.

5. Local level implementation: The concept of 'think global, act local' relates strongly to the notion of local specificity. Local specificity relates to the significant role that local actors can play in delivering the global agenda of environmental sustainability through the implementation of cumulative local action. According to Raven (2002) the kinds of grassroots activities that are promoting sustainability on a local scale have become a powerful force throughout the world. The need for local specificity was made prominent in UNCED in 1992, in particular through the Local Agenda 21 initiative; and again in relation to coastal management following the EU Demonstration Programme on ICZM. This takes into consideration the diversity of Europe's coasts, and the need for locally specific solutions that can bring about tangible benefits to coastal communities. In the context of Sustainability Science, the notion of local level implementation evolves the 'think global, act local', paradigm into practice. In the seminal report on Science and Technology for Sustainability, the ICSU (2002) stressed the need for local place or enterprise based dialogue to allow locally specific sustainable development issues to be addressed. According to the ICSU report, agenda setting at the global, continental or national scale can obscure the most important sustainable development needs.

6. Social learning: Social learning means learning together to manage together (HarmoniCOP, 2006). It is based on the need for learning by doing, rather than the need to provide definitive answers. Social learning seeks to turn knowledge into

action via a refined interplay between iterative practice and planning. Stakeholder dialogue is a fundamental component of the process, as is the development of shared perceptions of problems, joint decision making and critical reflection on the management process and its outcomes by those involved. For example, social learning is dependent on the use of reference points/indicators to measure practical progress and to evaluate which lessons can be transferred from one location to another. The principle of social learning is strongly linked to the principle of adaptive management. Adaptive management is an approach that deals with the uncertainty in managing natural ecosystems by treating policies as experiments (Holling, 1978). The relationship between these two principles was expressed by Lee (1999), whereby social learning can be facilitated by adaptive management in ecosystem governance. Clark *et al.*, (2005) cite the global assessment of climate change by the IPCC (REF) as providing the basis for adaptive management strategies worldwide that need to respond to new knowledge based on ongoing scientific analysis. Both social learning and adaptive management require the input of the scientific community as stakeholders in the decision making process / management philosophy they inspire.

4. The Corepoint Approach

The Interreg IIIB Corepoint project provided an opportunity to explore the linkages between Sustainability Science and ICZM between 2004 and 2008. Corepoint was concerned with COastal REsearch and POlicy INTegration, with a particular focus on local level ICZM activities. Nine Corepoint case studies from across north-west Europe were implemented. The two Irish case studies from County Donegal and from Cork Harbour are used for analysis in this paper, providing comparative institutional and cultural dimensions. The approach employed was based upon empirical research on the functioning of these two Expert Couplet Nodes (ECNs) within the Corepoint project. In-depth interviews and participant observation were employed for the process evaluation. Relationships between local authorities and research groups formed the basis of the operation of the Corepoint ECNs. A guiding theoretical concern was the need for a conceptual framework for discussing Sustainability Science in ICZM and the need to differentiate this from traditional ICZM projects which happened to have scientific inputs.

5. ECN Review Relative to Sustainability Science Criteria

Donegal Expert Couplet Node

ECN Partner Profiles: The Centre for Coastal & Marine Research (CCMR), in the University of Ulster, Coleraine, examines various aspects of coastal environments, from physical processes to human impacts. Research areas include coastal and oceanic processes, coastal management, marine habitat mapping, quaternary environmental change and maritime archaeology. Donegal County Council is the local authority for County Donegal, responsible for planning control, social housing, upkeep and improvements of roads, pollution control, fire services, library services and sanitary services. Staff in the planning, environment and engineering departments were involved to varying degrees in the ECN activities.

Context: The coastline of Donegal is rural and remote in nature and characterised by scenic, sandy beaches and 37 separate sand dune systems, as well as estuarine inlets rocky foreshores and offshore islands. County Donegal is sparsely populated. There are problems of high unemployment due to the demise of the textile industry and to a certain extent, to changes in the agricultural sector. Tourism is promoted but remoteness and lack of infrastructure limit the growth potential of this industry. Issues such as coastal erosion, the proliferation of holiday homes in the coastal zone and the need for sustainable livelihoods exercise the minds of scientists, policy makers and practitioners alike.

The recent history of ICZM in Donegal is strongly linked to the relationship between the Corepoint ECN partners – Donegal County Council and the Centre for Coastal & Marine Research in the University of Ulster, Coleraine. The relationship between these two groups commenced when a beach management project was implemented in Donegal from 1997 to 2000, as one of 35 Demonstration Programme projects on ICZM that took place across Europe at that time. Participation in the Donegal Beach Management Demonstration Programme Project was a 'win win' situation for the Council and for the University. The Council acquired knowledge and management advice and the research group acquired income, practical experience and therefore credibility, publication and teaching material. A process of stakeholder interaction ensued with the ultimate development of a Beach Management Good Practice Guide written by the CCMR and published by the Council. The Demonstration Programme project ultimately served to build and broaden the relationship between the two couplet entities, a relationship which became less formal and eventually involved the Environment as well as the Planning Department within the County Council at the time. This initial link was followed by an Integrated Pilot Project in Beach Management for Rural Activity Beaches funded under the EU Programme for Peace and Reconciliation in Northern Ireland and the Border Region of Ireland. These early projects served to evolve the relationship between Donegal County Council and the CCMR, although it was essentially a client/customer relationship that prevailed. The nature of the relationship shifted more fundamentally during the subsequent Corepoint experience in Donegal. Whether that relationship matured because of participation in a Sustainability Science process is explored further below.

Process - Sustainability Science Narrative

From the beginning of the Corepoint project in November 2004, all interactions between Donegal County Council and CCMR were classified as Corepoint Expert Couplet activities. Throughout the period of the Corepoint project there was frequent interaction between the ECN partners. While the ECN activities in Donegal were based on a problem driven agenda, - how to deal with dune erosion and shoreline management, how to effectively manage Blue Flag beaches and how to promote the coast as an economic driver, it cannot be said that the ECN process was policy led *per se*. The decision to engage with Corepoint, and with the preceding projects, did not emerge from Council policy, as there were no policies to deal with the issues to hand at the time. In the case of the Demonstration Programme project and again in the case of the Corepoint project, it was individual, insightful Council employees that paved the way for action. Thus, it could be said that the need to deal with issues of coastal erosion and marine tourism was governed more by individual pragmatism than by institutional policy.

The coastal problem to be addressed was multifaceted. Increased pressure on Donegal beaches was anticipated as a consequence of greater visitor mobility following the cease-fire in Northern Ireland. At the same time, beach stability was impacted by unsustainable human activities such as the use of cars on beaches. Coastal defences were inadequate in dealing with beach erosion, and they often led to increased erosion problems downdrift. An integrated, County wide approach to addressing the problems was favoured by the research group. The Council favoured a representative approach, involving the study of one beach in each of the twelve electoral areas. Seven beaches were finally selected as a compromise for site level investigations.

As a local authority, Donegal County Council frequently engaged external consultants to undertake technical work, particularly in relation to coastal issues, as in-house expertise in this area is limited. Consequently, it was a challenge within the Corepoint ECN to bridge the gap between academic and administrative traditions, which were particularly entrenched from the local authority side. Opportunities for the co-production of knowledge were limited by the client/consultant culture that prevailed. This occurred despite the expectation that a greater degree of integration would be achieved through the Corepoint project. A two way transfer of knowledge, rather than co-produced knowledge, took place. For example, the research group obtained an improved understanding of ICZM constraints in an operational context, while the local authority was guided by CCMR advice on soft engineering options such as the use of hay bale defences to protect two eroding beaches.

A multidisciplinary approach was used in the Donegal ECN to improve understanding of the links between physical coastal processes and human activity at the seven beach study sites. Geomorphological studies were combined with social and human use studies, e.g. studies of public opinion and public perception, and studies of the legislative and administrative framework for beach management. Economic factors were not investigated at the beach level as the most significant economic drivers were considered to be at the regional or County level.

Despite the narrow focus of the site level investigations, the CCMR used the Corepoint project as a mechanism to gradually develop awareness within the Council of the need for a more holistic, strategic approach to coastal planning and management. This was done by a process of ‘osmosis’ as CCMR personnel got to know and relate to Council personnel on a personal level. In essence, the Corepoint project marked a transition from one spatial scale (beach level) to another (County level). The debate about what constitutes ‘locally specific’ in the Donegal context remains unresolved. However, what is clear is that a strategic, County level framework for ICZM was considered by the CCMR team to be an important pre-requisite to enable the delivery of tangible benefits for nested geographical areas. This message was inculcated among the most senior and influential officers within the Local Authority.

In relation to complexity, there was no direct communication about the need to consider this aspect of Sustainability Science between the ECN partners. It was important not to alienate the Local Authority staff by using seemingly abstract terms and academic theories in discourse with them. A two day Corepoint training module

on ICZM, run in Northern Ireland in June 2006, helped local authority staff to 'think outside the box'. However, the course organisers were challenged to make the topic of ICZM relevant to the day job of local authority staff with indirect responsibilities for the coastal zone. This was an obstacle that had to be overcome throughout the lifespan of the Donegal ECN. The same obstacle restricted the introduction of a debate on complexity. Nevertheless, the pursuit of an enhanced understanding of Earth systems including the constituents of resilient coastlines was inherent in the coastal processes research undertaken by the CCMR. Instruction in complexity of natural systems occurred in an informal manner. CCMR would frequently point out that 'it is not as simple as that' or 'it might have knock on effects'. Similarly, the Council often revealed the realities of dealing with political and social complexities.

Social learning in the Donegal ECN occurred in a limited fashion. Social learning by its nature is a lengthy process. The four year timeframe of the Corepoint project enabled capacity to be built and political momentum to be gained in favour of a County wide approach to ICZM, including a specific policy for coastal erosion. The learning that was achieved in Donegal primarily related to recognition of the fact that maintaining the status quo, characterised by an absence of policy objectives for the coastal zone, was unsustainable. The need for a more holistic approach to coastal management was advocated strongly by the scientists working in the project and evidence was procured and presented to support this argument. The relationship building within the ECN helped the Council partners to re-orientate policy in a more proactive direction, although much work still needs to be done in the area of integrated policy formulation and implementation. A key outcome was the appointment of a beach manager as a direct result of the influence of the Corepoint project in County Donegal.

Summary of ECN activity outcomes in Donegal

- A strengthening of the relationship for resolving site level technical issues between scientists in CCMR and practitioners (planners and engineers) in Donegal County Council.
- The development of a relationship for County level strategic planning between scientists in CCMR and policy makers in Donegal County Council.
- Enhancement of ICZM capacity in Donegal County Council.[1]
- The development of a County level strategy for ICZM as a new way of thinking and of working to resolve coastal issues.
- The appointment of a County beach manager.
- The Donegal expert couplet facilitated the use of soft engineering approaches to coastal erosion, addressing both regional and local scale coastal erosion, sea defence and effects of sea level rise.

[1] Corepoint Expert Surgery, 28th June 2006. The one day surgery was attended by 13 politicians, and 16 local and regional authority executives and civil servants with a policy remit for the coast. Accompanied by Corepoint experts from North West Europe, the surgery examined current development practice on the coast of Northern Ireland from Antrim to Donegal. Corepoint Training Course, 29th-30th June 2006. The Corepoint Training Course held in Portrush, Northern Ireland, was facilitated by CCMR and delivered by the Corepoint partners. Training on ICZM in practice was provided to 25 local authority officials, including officials from Donegal County Council.

Cork Expert Couplet Node

ECN Partner Profiles: The Coastal and Marine Resources Centre in University College Cork is a multidisciplinary research group. Thirty researchers work on projects relating to coastal governance, coastal processes and seabed mapping, marine ecology and coastal geomatics. This draws upon a diverse range of disciplines including marine biology, computer science, environmental science, engineering, marine geography, social science and geology. Cork County Council is the local authority for County Cork. The County Council employs over 2,700 people working in departments covering roads, waste management, water services, corporate affairs, infrastructure, planning, community and enterprise, economic development and information technology. The Planning Department was the primary partner in the Cork ECN.

Context: Cork Harbour, a large natural harbour on the Cork coastline, was the focal point for the Cork ECN. Cork Harbour is of considerable importance to the socio-economic well being of County Cork and the surrounding region. For example, the Harbour area is a hub for global pharmaceutical industries and the Port of Cork is the second largest port in the Republic of Ireland. Cork Harbour has a long tradition of recreational boating, including sailing, fishing and power boating. It is steeped in maritime heritage; the heritage town of Cobh is intertwined with the history of the Titanic, the Lusitania and emigration. The Harbour is designated as both a Special Protection Area for birds and a Ramsar wetland site of international importance. Salt marsh habitats and intertidal mudflats are also designated as Special Areas of Conservation. Balancing the development and conservation needs of stakeholders in this multiple use harbour is a key issue facing policy makers.

As in the case of the Donegal ECN, the Cork ECN partners worked together on a previous EU Demonstration Programme project on ICZM. However, that project was concerned with Bantry Bay, located approximately 100km west of Cork Harbour. The aim of the Bantry Bay Charter project was to achieve consensus for an integrated approach to the management of Bantry Bay. The success of the project was marked when the project partners received a National Planning Achievement Award in 2000. At the completion of the Demonstration Programme, Cork County Council funded a project office to pursue the implementation of the Charter objectives. However, the office was closed during budgetary streamlining in 2002. This setback was linked to the fact that ICZM was seen as peripheral to the core functions of the local authority. Lessons from Bantry Bay set the context for the Cork Harbour ECN. A consensus building approach to ICZM, involving high expectations on behalf of a large numbers of stakeholders, was to be avoided. The focus shifted to what could be achieved through the Couplet partnership, which brought together significant research expertise and experience of ICZM in practice. Staff changeover in both the County Council and in the CMRC meant that new relationships had to be developed in the Corepoint project, although a certain amount of institutional memory existed between the two groups.

Process - Sustainability Science Narrative

The Cork ECN was characterised by a high level of interaction between the local authority and the university research group from the outset. The policy issue that framed the approach to the Cork ECN was established in the County Development

Plan 2003, which stated that: "*because of the importance of Cork Harbour to the economic, leisure, amenity, marine transport and heritage role of the county, it is appropriate to promote the idea of managing the area in line with the best principles of Coastal Zone Management that have developed over recent years throughout Europe*" (Cork County Council 2003:164). While the need for an ICZM strategy for Cork Harbour set the context for the ECN partners, specific, more tangible objectives were also defined based on the needs of the Planning Department. These included a study of the potential of coastal brown field sites within the Harbour, a study of the recreational carrying capacity of the Harbour and a landscape character assessment of the coastal zone.

New knowledge of physical, social and economic attributes of Cork Harbour was generated through the studies that were undertaken. The degree to which this knowledge was co produced is open to interpretation. In general, the research effort was led by the CMRC and recommendations were discussed with the planners who added value to the research process by contributing their local knowledge, professional experience and appreciation of political realities to the equation. The potential for intensive and equally weighted co-production of knowledge was limited due to the heavy, central workload of the planners. Time spent on Corepoint had to be balanced against existing statutory planning obligations that had to be fulfilled. On the other hand, the research partners were contracted to spend 100% of their time on Corepoint.

A multi disciplinary approach to the individual studies was implemented. This relied upon the collaborative input of geographers, engineers, environmental scientists, geomorphologists, legal experts, and GIS IT specialists. External expertise in economic resource evaluation was acquired through the Corepoint partnership. After the first year, the Local Authority acknowledged the need to formulate a strategic approach to ICZM through wider stakeholder engagement, despite initial reticence from the Bantry legacy. As a consequence the project became more process orientated, and input from the social sciences became increasingly important. This approach was advocated by the research group following a high level of awareness of the need for stakeholder engagement within a sustainable development agenda.

Taking local specificity into consideration was less problematic in Cork Harbour than in Donegal, although it had equally important implications for the geographic scope of stakeholder consultation. Cork Harbour was relatively easy to define as a virtual system for ICZM purposes. The seaward system boundary was mapped across the mouth of the Harbour, while the landward boundary was based on the administrative extent of the local planning jurisdictions.

While the Cork Harbour ECN was established with the clear objective of strengthening links between science and policy, it failed to incorporate the principle of complexity within the Sustainability Science framework. The experience on this principle was comparable to the experience in Donegal. Discussions on issues such as trans-boundary exchanges of materials and energy were considered too ethereal and unrelated to more immediate, predefined management issues and processes.

The Cork Harbour ECN experience commenced with a number of inter-related studies to be fulfilled. However, it gradually morphed into a governance process with policy

outcomes. The ultimate outcome was the publication of an Integrated Management Strategy for Cork Harbour (ref, 2008), developed through stakeholder consensus, and underpinned by the ECN relationship. This involved a considerable amount of learning by doing on behalf of all partners. It is particularly pertinent to note how the lessons of Bantry Bay were learned and built upon in the Cork Harbour process.

Summary of ECN activity outcomes in Cork

- A broader understanding of ICZM in practice
- Adoption of an Integrated Harbour Management Strategy for Cork Harbour
- Increased awareness of management options for specific problems such as recreational carrying capacity
- Enhanced relationship between the research group and the local authority

6. Discussion

The Corepoint ECN approach cannot be deemed as a panacea for integrating research and policy. However, the ECN model was flexible enough to deal with different priorities in terms of local issues and different operational timelines in Cork and Donegal. It is important to assess the value of the process as well as the actual outcomes of such partnerships. In this case, when questioned, the ECN partners in Cork and Donegal agreed that the approach added value to existing research and management operations. The Corepoint ECNs helped to initiate or consolidate a shift in attitude and behaviour towards traditional science and management practices in situations where new relationships between researchers and practitioners were formed or where a foundation for collaboration previously existed. In particular, the ECN model provided an opportunity to:

- Develop better understanding and trust between coastal research and practice communities at local levels
- Realise mutual benefits
- Build professional capital to help address future challenges
- Harness relevant and appropriate science for decision-making
- Deliver local level ICZM
- Bridge the gap between the EC Recommendation and local level implementation of ICZM.

Principles of Sustainability Science: While Sustainability Science is gathering momentum as a collaborative approach to resolving sustainable development issues, at present an idealised narrative of Sustainability Science prevails across the academic literature. This paper addresses the issue by demonstrating the real life difficulties inherent in implementing Sustainability Science in practice. A certain degree of progress in the transition to sustainability was achieved through the ECN process, as evidenced by the outcomes for Donegal beaches and Cork Harbour. The ECNs showed the usefulness of applying principles of good practice as a theoretical assessment framework. In general, the ECNs complied, to a greater or lesser degree, with each of the principles. However, it is unrealistic to expect any sustainable development process to meet a full set of best practice criteria, as the human dimension that is fundamental in decision making shapes the extent to which such criteria can ever be achieved.

The principles of good practice for Sustainability Science cover a comprehensive array of key criteria. The precautionary principle could have been included but was disregarded. Within the literature, the implementation of the precautionary approach in Sustainability Science is promoted by Komiyama and Takeuchi (2006).The precautionary principle was given credence as a key management tool in the context of sustainable development by UNCED in 1992. Despite its relative longevity and apparently ongoing popularity with policy makers, it has been argued that the principle is ill defined and poorly applied (e.g. O Riordan & Andrew, 1995; O Riordan & Cameron, 1994). The precautionary principle was not selected for inclusion here on the basis that a decision to apply the precautionary principle should be regarded as an outcome of the Sustainability Science process rather than an inherent part of the process itself.

Lessons learned: Three major lessons from the Corepoint ECNs can be taken on board for future Sustainability Science initiatives. The first centres on the question of scale and the problems associated with the principle of implementing communication and research activities locally. Despite the consensus in the literature regarding the need to conduct Sustainability Science initiatives at the local level, the ECNs showed that agenda setting at this level presents a number of opportunities as well as difficulties. On one hand, working relationships between scientists and local authorities in the ECNs were shown to benefit from close physical proximity and a shared understanding of socio-political heritage, important for context setting. However, at the very least, Sustainability Science needs a broad perspective and a long term view seldom found in the day to day politics of local government. If the concept of local specificity is taken to its logical conclusions, local concerns should be prioritised over strategic sustainability concerns. However, this approach is extremely problematic for policy makers tasked with achieving the common good. There is a need to strike a balance. By narrowing spatial and temporal perspective, local interests prevail. It could be argued that in both Cork and Donegal, the coastal problems to be addressed were locally specific to the extent that they failed to present a fully representative sustainable development challenge, with nature and society as a tightly coupled, complex system. This indicates that ultimately local and even regional scale management authorities are not the ideal vehicle for complexity analysis. Maybe it is only from a national or higher perspective that complexity can be handled. After all, an ant cannot comprehend the complexity of the forest! This implies that there is potential added value from the involvement of national authorities in Sustainability Science, even when the spatial extent of the issue to be addressed is focused at the local level. Regardless of the scale, complexity needs to be communicated and understood in layman's terms and this remains a key challenge for the scientific community.

Secondly, while the ECNs demonstrated that there are many synergies to be achieved between ICZM and Sustainability Science, the experience in Cork Harbour in particular showed that ICZM can often be governance and process orientated, limiting the potential for focusing on Sustainability Science questions. This conclusion emphasises a need for a more structured approach to ICZM, which acknowledges the role of Sustainability Science within best practice scenarios. Within Europe, the ICZM principles of best practice should be evolved to incorporate a new principle on the subject. The timing is good for a debate on this issue, as the role of ICZM needs

to be discussed in relation to evolving priorities in the new Maritime Strategy for Europe, including increasing calls for the implementation of Marine Spatial Planning.

Finally, the practical constraints in implementing Sustainability Science via the ECNs were fundamentally linked to the institutional characteristics of the university groups and the local authorities involved. Universities are set up to conduct research and to discover new knowledge; local authorities are not. Therefore the Sustainability Science ideal of co-production of knowledge has to be carefully dissected. Within the scientific community the scientists involved must strive to improve understanding of the integrated Earth system. However, this does not mean that Sustainability Science is the exclusive domain of earth system scientists. The diverse scientific community currently working on ICZM issues is well placed to adapt to Sustainability Science approaches. In fact, because of the broad nature of ICZM, many are already actively engaged in policy led, multidisciplinary research, from the natural sciences to social sciences, to humanities and engineering. An opportunity exists for promoting Sustainability Science among ICZM researchers, with ICZM as a well established application area with clearly defined sustainable development goals. From the local authority perspective, engagement in the process was highly dependent on individual champions within the two case studies. The opportunity for collaborative enquiry was limited if one takes a conservative interpretation of what this implies. Despite this, the subsequent opportunity to adapt to new information and to evolve more sustainable coastal policy outcomes in each of the locations was good. The acid test for local authority engagement in Sustainability Science is their willingness to participate in further Sustainability Science 'experiments'. At the time of writing the ECN partners are committed to a new Interreg IVB project. The IMCORE project, which runs from 2008 to 2012, will strengthen experience of participatory decision making in Cork and Donegal, as scientists, practitioners and policy makers co-operate to develop adaptive management strategies for their respective coastal zones in response to climate change scenarios. Model development and scenario building activities will help to build capacity to address complex problems. The process will be replicated in nine locations across north-west Europe.

Conclusion

Scientists, policy makers and practitioners concerned with the coastal zone are re-orientating themselves to address fundamental issues of sustainability. This poses institutional and organisational challenges for the partners involved. However, these challenges are not insurmountable and there are tangible benefits to be achieved. The question is whether the transition towards sustainability, aided by Sustainability Science, can occur at a pace and a level that ultimately optimises, protects and preserves coastal resources for current and future generations. Sustainability Science should be viewed as a new and emerging approach within ICZM that offers the potential to reinvigorate coastal management efforts, especially where a sense of 'ICZM fatigue' exists. Coastal futures depend on the uptake of innovative approaches to science and management such as that offered by Sustainability Science for ICZM. The COREPOINT project provides useful insights for policy makers in Europe and around the globe. In particular, the European Commission should take stock of the lessons emerging from such projects, in the drafting and evolution of their maritime and coastal strategies.

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