Shoreline Management Planning: Can It Benefit Ghana? A Case Study of UK SMPs and Their Potential Relevance in Ghana

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Key words: Shoreline Management Plans, Coastal Sediment cell, Littoral Cell, Sediment Budget, Coastal Erosion and Integrated Coastal Zone Management.

SUMMARY

This paper assesses the potential for the adaptation of UK Shoreline Management Planning to address Ghana's problems of coastal erosion and resultant shoreline retreat in an environmentally acceptable and sustainable way. Management strategies, past and existing, have largely focussed upon provision of hard protection at specific locations where risk levels to life and economic assets are high. There has been little commitment to the concepts of integration of management interventions with wider natural processes and longer-term sustainability. In most cases, such 'ad hoc' management interventions classically tend to stabilise the shoreline at the protected section and aggravate the situation elsewhere along the shoreline ("knock-on effects").

Such problems have occurred previously on many other developed coastlines leading in recent decades to more holistic and potentially sustainable shoreline management methods (Hooke, 1999). For example, UK shoreline management planning since the mid 1990s has achieved success in reducing the occurrence of "knock on effects." It has altered thinking away from the basic provision of defences towards a more holistic management of risks at the coast, setting out clearly locations where protection is likely to be required and others where alternative options are more sustainable. This paper reviews the progress achieved in the UK and assesses the extent to which the methods devised could be adapted towards the requirements of Ghana's shoreline. It concludes that many of the concepts and methods should be transferable provided that a sound understanding is developed of the physical coastal processes based on application of littoral cell and sediment budget methodology.

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1. INTRODUCTION

Ghana is located in West Africa, bordered on the East by the Republic of Togo, to the West by La Cote d'Ivoire, Burkina Faso to the North and to the South by the Gulf of Guinea (Atlantic Ocean). The total land area of Ghana is 238,533 km^2 and has a coastline of 550km facing southwards. The country is under the influence of tropical humid savannah climatic conditions and experiences two major seasons, namely the wet (rainy) and dry (harmattan) seasons. The coastal zone in Ghana (below the 30m contour) represents only about 6.5% of the land area but is home to 25% of nation's total population of 18.8 million (Armah and Amlalo, 1998).

Physical Characteristics: The coast of Ghana has been sub-divided into three major zones (Figure 1) based on geomorphologic characteristics. They are Eastern, Central and Western coast. The **Eastern coast**, which is about 149km, stretches from Aflao (Togo Border) in the East to the Laloi lagoon west of Prampram. It is a high-energy beach with wave heights often exceeding 1 metre in the surf zone (Ly, 1980). It consists of an eroding sandy shoreline and is characterised by barrier beaches and bars confining lagoons. These barrier bars vary in width both spatially and with time. Wellens-Mensah et al, (2001) explained that the Volta River has a dominant influence on the geomorphology of the Eastern coast. The surface geology of the area is made up of fluvial sediments delivered from the river as well as marine and fluvial-marine sediments. The barrier beaches, comprised of medium to coarse sand, rise steeply in elevation to about 2m above mean sea level.

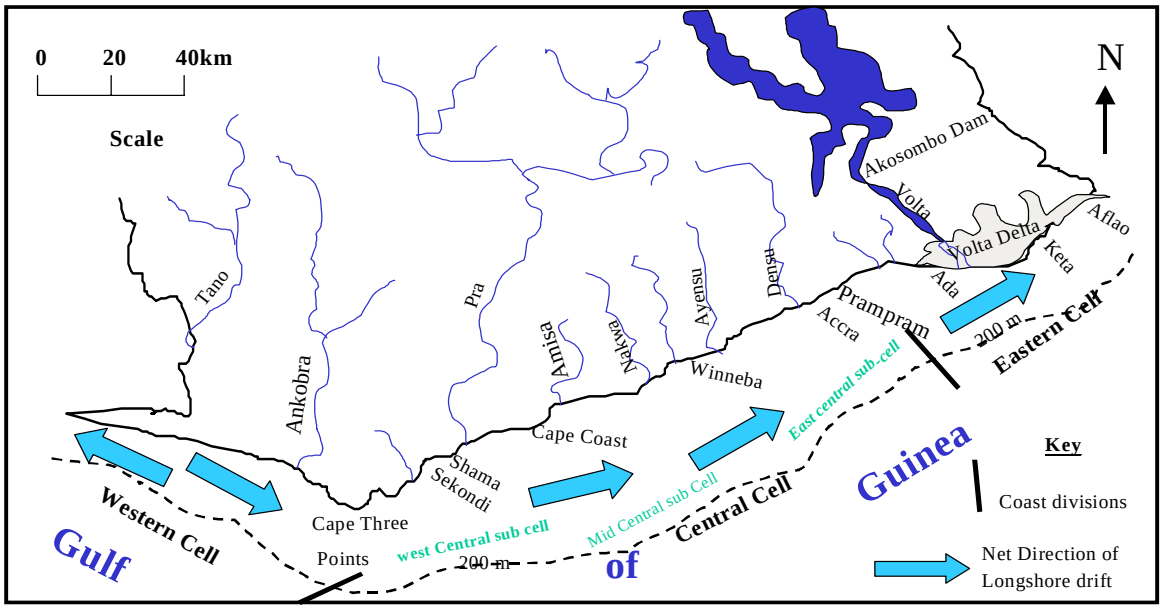
The **Central coast** represents a medium energy environment. It is an embayment coast of rocky headlands and sand bars with spits enclosing coastal lagoons. It consists of 321km of shoreline extending from Laloi Lagoon west of Prampram to the estuary of River Ankobra near Axim. The morphology of this coast is influenced by sediment delivered from a series of north to south draining rivers including the Densu River on the West of Accra, Ayensu River on the West of Winneba. River Nakwa East of Cape Coast, River Pra East of Shama and Ankobra River West of Axim. Sediments tend to be confined within embayments between rocky headlands and promontories. The beaches along certain sections of this coast are thought to be fairly stable (Armah and Amlalo, 1998).

The **Western coast** covers 95km of shoreline and it is a relatively low energy beach. It consists of a flat and wide beach backed by a coastal lagoon. The coast extends from the estuary of the Ankobra River to the border with La Cote d'Ivoire. This coast comprises gently sloping fine sandy beaches backed by coastal lagoons. Sediments forming these beaches are likely to be derived from the Ankobra and the Tano Rivers.

Extent and rate of Erosion: Comparison of Ghana's coastal surveys in 1945 and 1972 shows that progradation continues only in sectors adjacent to breakwaters (New Takoradi; Nyiasia) and rocky headlands (Apam) where the Eastward drift of beach sand had been intercepted on the ends of spits bordering lagoon entrances and river mouths. All other parts of the coastline especially around Volta delta have been retreating. The survey revealed that sandy coastlines that had previously prograded had altered to retreat, with beach rock exposed in places up to 45 metres offshore (Dei, 1972). Latest research has revealed that erosion is present along the entire coast (Plate 1) and as many as 25 locations with serious problems have been identified (Nail et al., 1993 in Armah & Amlalo, 1998). Only the most serious of these 25 'erosion hot spots' have been protected, by a combination of gabions and boulder revetments.

The widespread unregulated practice of beach sand mining or "winning" for building purposes, is one of the reasons that have led to starvation of beach sediments and consequent retreat of Ghana's coastline. The problem of coastal erosion is serious on the East coast, especially the area close to the mouth of Volta River where human settlements, roads and recreational resources are constantly threatened (Nail, Addo and Wellens-Mensah, 1993).
The reason is that a hydroelectric dam built on the Volta River in 1964 has greatly reduced the supply of sediments to the beach (Ly, 1980).

Figure 1: Drainage and Divisions of Ghana's Coastline



after Ly (1980) & Benneh and Dickson (1988)

Plate 1: Serious Erosion Downdrift of Takoradi Port

The factors above, coupled with sea level rise and natural processes controlling shoreline retreat have impacted negatively on Ghana's shoreline. It should be noted that erosion is not confined to the East coast alone, but occurs to varying extents along the entire coastline of Ghana and neighbouring countries. Coastal erosion and its associated shoreline retreat and flooding risk are a threat to life, property and economic development of the entire nation. The reason is that many key industries, major residential settlements (e.g. Accra, the capital city), tourism and conservation sites, heritage and historical monument are located within a 200m radius from the shoreline. Furthermore, many of the most densely populated coastal areas are low-lying coastal plains susceptible to flooding. There is therefore, a need for effective management to address problems of shoreline retreat, coastal flooding and ill-informed use of coastal resources in Ghana (Table 1).

Table 1: Problems Caused By Lack Of Knowledge Of Integrated Management

Schemes/practices	Impacts
Beach mining permitted /not controlled	Sediment deficit, beach erosion/shoreline retreat
Development permitted on eroding coasts and within flood plains.	Increased risks involving loss of life, livelihoods and properties
Stabilisation schemes	Prevents erosion and/or littoral drift causing sediment deficit, erosion and shore retreat downdrift.
Port schemes	Breakwaters, jetties and dredged channels intercept sediment transport; causing erosion and shore retreat downdrift.
Damming of rivers	Interception of the major sediment supply to the coast causing deficit and erosion.

There is no holistic policy and integrated plan for the management of coastal erosion and flooding in Ghana. Management remains traditional, reactive, site specific, and dominated by hard engineering approaches. The current shoreline management regime in Ghana is not sustainable given the global perspective of climate change and associated sea-level rise. Hence, there is much reason for concern on the need for a holistic shoreline management plan that is sustainable and can stand future pressures of sea-level rise, climate change and economic development.

In the UK, coastal policy has progressively moved away from the traditional re-active and parochial approaches of providing localised hard- engineered coastal defence work to solve what was perceived to be a local problem with little consideration of wider effects. The present day approach adopts a more pro-active long-term (e.g. 50 years) strategic assessment of shoreline management requirements and the associated benefits and potential impacts, covering a regional scale (Cooper, et al 2002).

In 1995, the central government agency with overall responsibility for the progression and funding of national coastal protection in the UK (Ministry of Agriculture, Fisheries and Food – MAFF) introduced the concept of non-statutory Shoreline Management Plans (SMPs) as the preferred means of progressing co-ordinated, strategic planning and management. This was done after pressure from informal regional coastal groups, formed in the mid to late 1980s to address problems of knock-on effects produced by protection works of neighbouring, but independent local authorities (Hooke and Bray, 1995).

The statutory instrument that defined MAFF's responsibility, and therefore the remit of SMPs, is the Coastal Protection Act (1949). This Act was confined initially to the protection against erosion, but has been enlarged subsequently to relate to all forms of hazard and risk along the open coast. However defence against flooding is the specific responsibility of the Environment Agency, as encompassed in the Water Resource Act (1991) (Halsbury's Law of England 49(2) paragraph 38, p.31).

2. COASTAL GROUPS IN ENGLAND AND WALES

Based on the, initiative of the local authorities, which were concerned with the lack of co-ordinated policy, a regional coastal group covering south-central England named SCOPAC emerged in 1986 (Hooke and Bray, 1995).

The main objectives of SCOPAC include: Support the duties and responsibilities of member organization relating to coastal defence and protection; Promoting and coordinating regional strategic shoreline management objectives; The Commission, dissemination and application of research; Facilitate the communication of experiences and good practices; and Influence the development of national and European Union policy and programmes.

SCOPAC is a funded, non-statutory organization, which represents the interest of its member organizations and provided the impetus for the formation of other similar regional groups around the coast of England and Wales. It organises national defence forum, which involved the government in the process. The initiative led within 10 years, to the emergence of formal SMPs, after the setting up by central government of the National Defence Forum. This was a regular meeting of all the 12 Regional coastal groups, with the purpose of influencing government policy.

3. DEFINITION OF SMPS

A Shoreline Management Plan (SMP) is a plan that identifies one coastal defence strategy for a specific length of coastline (a "management Unit") and for a defined period of time, typically up to 50 years. The first plans were prepared to cover the coast of England and Wales following issue of policy (MAFF 1993) and practical guidance by central government (MAFF 1995). Guidance was then revised following an extensive review of the first set of plans produced in 1999 (DEFRA, 2001; Cooper et al 2002). The account given here draws effective practices from both phases of development. An SMP provides a large-scale assessment of the risks associated with coastal processes and presents a long-term policy framework to reduce these risks to people and the developed, historic and natural environments in a sustainable manner. In doing so, an SMP is a high level document that defines the broad requirement for provision of flood and coastal defence and protection. It also takes into account the impacts of defences on the natural environment (i.e. habitats) through European Union Directives.

In the UK, the creation of each SMP is the responsibility of a group of geographically adjacent maritime local authorities, together with regional or county divisions of national agencies with statutory responsibilities that interface with coastal protection (e.g. English Nature, the Environment Agency). Other public or privatised bodies with significant ownership of coastal land may contribute either formally or informally (e.g. Ministry of Defence, Railtrack, Port and Harbour authorities). These organisations form the steering group and appoint one or more consultants to complete the task of SMP production according to a prescriptive brief (DEFRA, 2001).

The principal aim of SMP is to provide the basis for sustainable strategic coastal defence policies and to set objectives for the future management of the shoreline that take full account of the interrelationships between the coastal dynamics and other environmental and planning policies of co-operating authorities. This policy was instigated in 1994 and by 1995 had led to the production of some 47 SMPs covering the whole coast of England and Wales (Cooper et al 2002). SMPs are intended to be live documents and should be reviewed every 5-7 years. Review and updating informed by revised guidance (DEFRA, 2001) is planned for the period 2006-2008 with the latest information being posted on the DEFRA website at: *http://www.defra.gov.uk/environ/fcd/policy/smp.htm*.

4. SMP OBJECTIVES AND ISSUES

The main objectives of SMPs can be outlined as: Develop improved understanding of the coastal process operating with the sediment cell or sub-cell; Predict the likely future evolution of the coast over a minimum period of 50 years; Identify all the assets within the area covered by the plan, which are likely to be affected by predicted coastal change and by defence provision; Facilitate consultations between those bodies (stakeholders) with an interest in the future management of defence and protection, and take account of all view points to collect data, determine policy, minimise both risk and conflict in future scheme implementation;

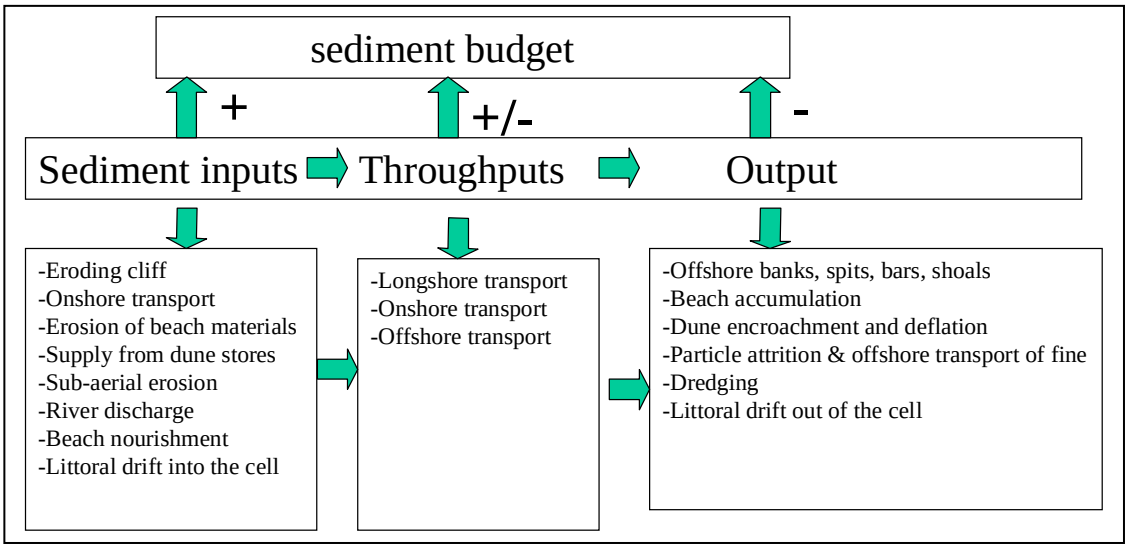
Assess a range of strategic coastal defence options and agreed a preferred approach for each of a sequence of formally identified management units; ensure that all options satisfy economic, environmental criteria; Outline future requirement for appropriate monitoring, management of data and research into physical processes and defence or protection techniques; Inform and pro-actively involve the statutory planning process and any related coastal zone planning initiative; co-ordinate with local and structural plans; Identify opportunities for maintaining and enhancing the natural coastal environment, taking account of any specific targets set by national legislation or locally; and Preserve and enhance where possible, cultural (archaeological and historical) features of the coastal landscape.

5. DEFINE MANAGEMENT UNITS

To develop sustainable strategic coastal defence options within the plan area, operating authorities divide coastline into cells, sub-cells and management units. In most cases the SMP will approximately coincide with a defined littoral cell or sub-cell (Bray, Carter and Hooke, 1995).

Sediment cells and sub-cells (Coastal Process Units) refer to the length of shoreline (it may include an estuary) in which physical processes are largely independent from those operating in adjacent process units. These sediment cells normally have specific sediment input and output as well as a throughput (sediment transport) that links sources to stores and sinks (Hooke and Bray 1995). The compilation of the inputs, stores and outputs or sinks (Figure 2) to assess the net erosion or accretion is termed as sediment budget and may be accomplished using techniques such as those discussed by Komar (1996; 1998) and Rosati (2005).

Figure 2: Components Of Sediment Budget



Coastal sediment cells are identified according to morphological and process information (Bray, Carter and Hooke, 1991, 1995). It must be acknowledged that effective shoreline management should depends on the understanding of the interactions between coastal processes and morphology as well as development and application of shoreline management

option that is compatible to a coastal process unit and its environmental and socio-economic attributes. These are achieved through identification of process units, shoreline form, estimation of sediment budget, definition of management units and appraisal of strategic coastal defence options. Process unit boundaries are defined by discontinuities in the rate or direction of sediment transport (Bray, Carter and Hooke, 1995). As illustrated in Figure 3, Process unit boundaries can be fixed or transient. Depending on the level of permeability to sediment transport, these two can further be sub-divided into absolute (defining major cells) or partial (defining sub-cells).

A management unit is a length of shoreline with coherent characteristics in terms of natural coastal processes and/or land use as indicated by Figure 4. Ideally, a unit has distinctive, often regionally unique, characteristics; these may often be the product of long term interaction between natural and socio-economic processes, example tourism; fishing; mineral working; port development and urbanisation (Carter 2003).

6. APPRAISE STRATEGIC COASTAL DEFENCE OPTIONS (SCDOS)

The generic options adopted for the appraisal of strategic defence options are (MAFF, 1995):
- Do nothing; (non-intervention or perhaps small-scale intervention to protect public health and safety)
- Hold the existing defence line by maintaining or changing the standard of protection;
- Advance the existing defence line (reclaim some eroded land);
- Retreat the existing defence line; (e.g. Manage Retreat).

Figure 3: Sediment Cell Boundaries

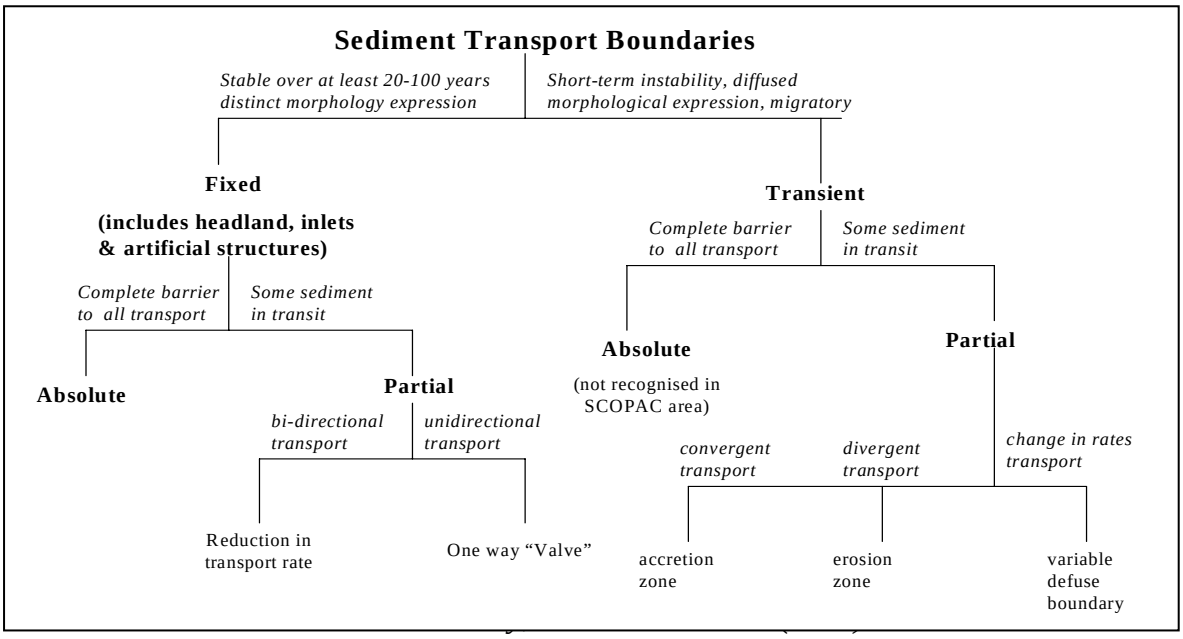
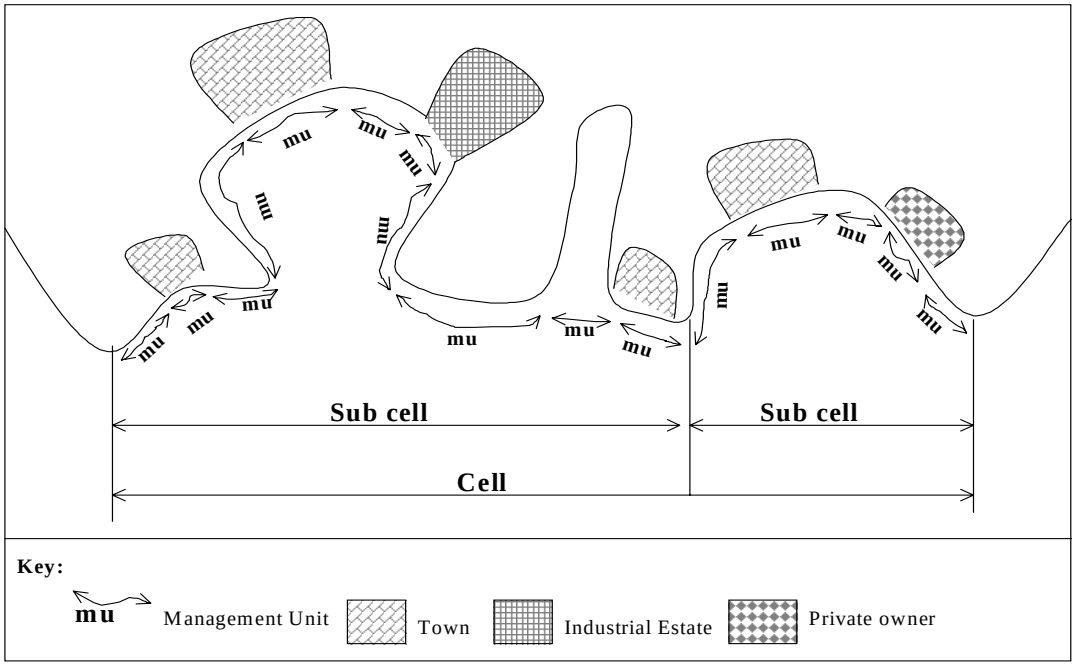


Figure 4: Sub-cells and management units: theoretical example



Source: MAFF 1995

Table 2. Indicative Criteria for the 4 Generic Options

Option	Appropriate for	Adopt Where	Notes
Do Nothing	Undeveloped coast.	No development present or planned.	Should benefit adjacent units unless these are constrained such that relative change between units is exacerbated.
	Lengths defending obsolete development or infrastructure.	Development / infrastructure no longer functional, or expendable.	Additional environmental benefit may be achieved by removing any existing defences.
Hold the line	Existing development	Industrial or urban development present.	May also be appropriate for satellites or ribbon development, depending on value protected and cost of protection
	Infrastructure	Present and cannot be moved.	Coastal infrastructure is often sited to take advantage of the combined land and sea resource. Any impacts, particularly on the adjacent coast must be accounted for.
	Future planning allocation	Infrastructure or development planned which can justify the need for and coast of production.	Current planning guidance presumes against development in areas subject to coastal flooding or erosion.
	Conservation sites	Need for protection and positive benefit to the site, or a site exists as a consequence of the present "shoreline"	This needs careful consideration of how the site would evolve if it were reconnected or exposed to an open and active shoreline.
Advance the line.	Future planning allocation.	Development must use coastal frontage or requires direct access to sea.	Likely to have significant impact on remainder of management unit and adjacent units
	Advancing shoreline.	Coast is advancing and value of reclaimed land > any protection costs and there is no attendant negative impact on adjacent coast.	Great care is needed to ensure that this is a long-term trend and that enclosing a sediment sink is not to the net detriment of the system.
Retreat the line	Conservation sites	Protection is detrimental to conservation interests and could be improved by adopting a retired line	May need to be managed as a single, stepped or progressive change depending on the conservation interests
	Retreating shoreline	Foreshore is eroding and value of land lost < cost of continued protection	For this to be worthwhile option there should also be a nature conservation benefits or at least no loss.
	Mobile natural features	A future moves with time, often in a cyclic pattern	Providing room to move is particularly appropriate in the vicinity spits, tidal inlet, estuary margins etc.
	Narrow coastal margin	Coast is defended and is retreating or steepening and there is room to set defences back or remove landward constraint	As coastal margins gets narrower (steepening beaches, loss of salt marsh etc) exposure increases and leads more massive and expensive defences.

Source: Carter 2003

Each strategic option is considered in relation to its likely effects on adjacent management units and the sediment cell as a whole. Detailed assessment is undertaken to determine the extent to which a particular option satisfies the objectives and criteria set. The indicative criteria for the 4 generic options are listed in the table 2 below. A cost benefit analysis of the strategic options is undertaken to confirm the economic viability of an option, but does not constitute an exhaustive economic justification. Sufficient engineering detail should be included to ensure that the selected option is technically feasible. Benefits of damage/losses averted must exceed costs of implementing the option by at least a factor of two.

7. ADVANTAGES OF SMPS

Following extensive review of Leafe et al 1998 and Cooper et al 2002 advantages of an SMP can be outlined as follows:

- It leads to the collation, synthesis and analysis of existing knowledge on a coastline - often not previously available;
- SMPs provide objective and comprehensive overview of coastal management issues enable all relevant issues interests to be taken into account;
- They help in the integration of biophysical and socio-economic, spatial and temporal data sets;
- Encourage strategic (longer term and larger scale) view of problems and alternative options;
- Choice of preferred options are based on cost effective and sustainable criteria
- SMPs are adaptable and flexible to altering social or physical conditions.
- Enabling mechanism for sustainable development of coastal zone.

8. WHAT GHANA CAN LEARN?

Ghana and UK have some similarities and differences with regard to physical factors, legislation, ownership and coastal management responsibilities. In the UK coastal protection and defence is an obligation of the coastal authorities (Coastal Protection (Act 1949) and Local Government Act (1972). In much the same way government of Ghana and the Local government are responsible for coastal protection and defence (Environmental Protection Agency Act, 1994, Act 490 and Local Government Act, 1993, Act 462).

In Ghana the ownership of the coastline is vested in the traditional chiefs who are custodians of the land. The chiefs then lease the coastal lands to government and private institutions and individuals. In a similar way ownerships of the coastline in the UK are in the hands of the Crown Estate, Local Authorities and private institutions and individuals. In the UK the Crown has the property rights over the territorial sea but in Ghana it is the government. In the UK, any coastal development should conform to the structural plan administered by local authorities and therefore require planning application and approval (Lee, 1993). Ghana on the other hand planning law and regulations are inadequately enforce and thus allow all sort of illegal development along the coastline. Effective planning clearly has the potential to avoid occurrences of coastal problems by diverting development away from hazardous zones.

Again, there are physical similarities between Ghana and UK coastlines. For instance, interruptions of the coastline by headlands, pocket beaches and estuaries that strongly influenced the development of SMPs in UK are also frequent in Ghana (especially within the Central Coast region). The major physical difference is that in the UK natural littoral sediment inputs are dominated by cliff and marine sources, but in Ghana littoral sediment is dominated by fluvial (river) sources. However, this difference does not limit the development of SMPs provided that the river sources can be identified. Furthermore, the shorelines of both nations are heavily influenced by management interventions so that many sediment sources and transport pathways function less effectively.

Looking at the above similarities and differences in ownership, responsibilities and physical characteristics, it can be argued that Ghana could learn and benefit a lot from the UK experience. First of all, a national coastal management forum or organisation could be formed in Ghana. The four Coastal Regions (Volta, Greater Accra, Central and Western Regions) and the 17 Districts, central government, ministries, departments, agencies, NGOs, private organisation and individual that are involve in coastal and marine activities could come together and pursue agenda of their mutual benefit like SCOPAC. This forum could serve as a capacity building toward integrated coastal zone and shoreline management.

Secondly, data are limited on a number of key coastal variables in Ghana. For instance, little or no quantitative information are available on sediment budget and hydrodynamic processes (tides, wind, wave) sea-level rise and current rates of erosion as well as accretion, flood risk, future coastline development and interrelationships with adjacent coastline at neighbouring countries. The formation of a national coastal management forum by various governmental and non-governmental organisations could also lead to effective compilation of existing knowledge and data and the pulling of resources together to commission research in the areas where data are limited if not lacking.

Using the concept of UK SMPs, Ghana's Shoreline could be sub-divided into macro cells with sub cell divisions and Management Units (MUs). The littoral cells and process units could be identified based on the known physical processes, and then available information on human issues factored in to identify the Mus. The MUs should be defined based on data on distinctive features of Coastal processes and coastal geomorphology (like major headlands and other natural breaks in the sediment transport pattern), the natural biophysical environment, land use and the human and built environment. However, those MUs defined may not conform exactly to administrative boundaries. A MU may be cross-district administrative boundaries, cross-national boundaries and the various private interests along the shoreline. This is because coastal processes do not respect administrative boundaries. Other reasons for this are the numerous overlaps and difficulties of correlating of administrative boundaries with the physical process, as well as the limited data available on private interests. However, these limitations do not rule out the numerous benefits Ghana can gain if she adopts SMP for even the process of collecting and compiling improved data is strongly beneficial. Problems of data collection, administrative boundaries and complex land

ownerships also stress the need for collaboration and networking among coastal districts and other stakeholders so that all can engage in the SMP process.

Furthermore, there are no physical international boundaries in the sea so; a coastal development in a neighbouring country could affect other country positively or negatively. For instance, the building of groynes in Keta that trapped littoral sediment drifting eastwards could possibly cause serious erosion in Togo. There is therefore the need for countries in the West Africa sub-region to network, share coastal management experiences and collaborate on shoreline management options along their borders. A coastal forum in Ghana could spearhead such network.

Adoption of the UK SMP methods by Ghana could lead to better understanding and reduction of the risks of coastal erosion and flooding, which may ultimately results in the occupation and economic development of the coastal zone in an environmentally acceptable and sustainable way. Thus SMPs could help Ghana to protect life, properties and economic activities along her coast in the short to medium term. However, it would also raise awareness and encourage critical thinking about the most appropriate and sustainable measures needed for the long term. This process could lead to the conservation and preservation of wetlands, mangroves and historical heritage and other special sites of scientific interest.

SMPs could help Ghana to identify and collate data on national vulnerable coastal land, and the populations and assets at risk. Such data is important for proper zoning of the coastland, planning and development control. This would go a long way to help in the formulation of policy and review legislations that relates to development at the coastal zone.

SMPs could also help Ghana to reduce the risk and effects of climate change and sea-level rise to her coastline. This is because advantages of SMPs outlined above will help Ghana to formulate adaptation and mitigation strategies to deal with this phenomenon by thinking ahead and identifying and prioritising areas at greatest risk, whilst allowing for natural coastline retreat elsewhere. This will help to maximise the use of resources.

SMPs could enhance effective implementation of Ghana's recently formulated Draft Integrated Coastal Zone Management (ICZM) policy (World Bank, 1996). This is because shoreline management, estuary and wetland management are a subset of ICZM. A critical analysis of the Agenda 21 (sustainable development policy document), which serves as the basis for the ICZM, confirms the above proposition (United Nations, 2004). In fact, effective ICZM depends on efficient integration of these subsets, institutional framework and the people who subsist on the coastal resources.

9. CONCLUSION

Many developed nations with a long history of management interventions at the coast are beginning to find that the cumulative impacts of traditional practices are no longer sustainable when considered alongside potential future risks of climate change and increased public and

legislative appreciation of landscape and environmental values. It has led to development of more holistic and potentially sustainable shoreline management methods in some nations such as the UK that have also influenced policy and initiatives prepared by the European Union (see EUROPA 2006). It would appear that some methods might now be adapted to the requirements of developing nations that are now well within the cumulative impact cycles of their own management interventions. This possibility has been examined in a preliminary manner by assessing the potential for adaptation of UK methods of shoreline management towards the requirements of Ghana.

Past and existing management interventions along Ghana's shorelines and rivers were based on site-specific and ad-hoc interventions without proper analysis and assessment of their impacts on other sections of the shoreline. This has resulted in increased coastal erosion and other coastal management problems in Ghana. Hence, there is the need to develop a more consistent framework for understanding and managing the shoreline as a system. In England and Wales shoreline management planning since the mid 1990s has achieved success in reducing the occurrence of "knock-on effects" and providing for a variety of benefits (Leafe et al, 1998; Cooper et al 2002). A comparative review of the physical factors and administrative and legislative arrangements between the two nations indicates that it should be possible to adapt and apply many of the key elements of the UK techniques. It is likely that many of the benefits of cost-effectiveness and improved sustainability identified for the UK should also apply in the case of Ghana with additional benefits in relation to adherence to World Bank and United Nations environmental and sustainability criteria. However there are notable constraints that need to be overcome to enable and effective translation of techniques including:
Improved data relating the physical, natural and human environments of Ghana's coastal zone; Improved communication and collaboration between government agencies, local administrations and landowners and other interested parties; Awareness raising and limited legislation to encourage engagement and facilitate regional scale planning; and Modest funding would be necessary to establish the processes outlined above and to sustain preparation of the SMPs.

The author is presently engaged in research to address the first item for selected case study sub-cells, although involvement of government agencies and some long-term monitoring would be needed for consistent updated coverage of the entire coast. It is recommended that a national coastal forum steered by central government should be established to address some of the constraints stated above. It is recommended that regional fora should be established representing all coastal districts in Ghana. Those regional fora would then collaborate to initiate preparation of SMPs.

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