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Gambia National Adaptation Programme of Action (NAPA) on Climate Change

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Last but certainly not the least, the NCT wishes to extend its gratitude to the Global Environment Facility (GEF) and UNEP for providing financial and technical support, respectively, that made the preparation of this plan a reality.

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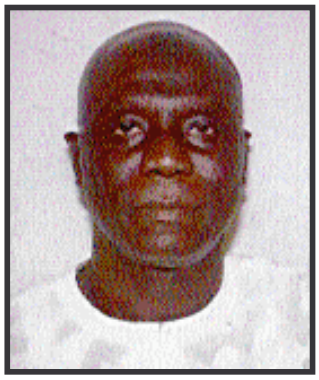
Foreword



On behalf of the Government and people of The Gambia, it is a great honour and pleasure for me to present the Gambia National Adaptation Programme of Action on Climate Change (NAPA). The development of the NAPA has once again demonstrated the great importance that my Government attaches to the threat from current climate variability and projected climate change. The climate system, considered in our national development context is a major factor influencing our development status. Like any resource, too much or too little may be harmful to the beneficiaries of the resource and thus, the concern on current climate variability and the projected impacts of climate change.

The Gambia with its low-lying coastline, poor infrastructure and with the vast majority of livelihoods depending on the exploitation of natural resources, certainly has to take the threat from climate change very seriously and should earnestly look for urgent ways of adaptation or else face the consequence of increased poverty, malnutrition, loss of lives and properties from natural (climate) hazards, which are projected to increase.

As detailed in the First National Communication of The Gambia to UNFCCC, the potential impacts of climate change on the socio-economic sectors of the country are mostly negative and therefore the populations are vulnerable. The Government of The Gambia has recognised the need for action in containing the threat and has taken bold steps to this effect. At the national level, the beach nourishment project implemented in 2005 shows clear proof of the threat from sea-level rise and the urgent need to build resilience. Meanwhile, the deficiencies observed in this project clearly manifest the absence of adequate technological and human capacity to properly address the challenge.

As clearly documented in the NAPA, the challenge is enormous and Government alone cannot face up to it. The international community is, therefore, called upon to be supportive of the proposed actions to increase the resilience to climate change of the local communities and ecosystems. This is particularly necessary as vulnerability to climate change is synonymous to continued under-development as climate change impacts on all socio-economic sectors in this country, where more than 90 percent of livelihoods thrive on climate-sensitive activities.

The preparation of the NAPA has been very consultative and rigorous, involving all sectors of the society. In addition to being highly inclusive of local stakeholder views and concerns, the NAPA has significantly factored current Government concerns in poverty alleviation spearheaded by the PRSP II and the achievement of MDGs.

Momodou A. Cham
Secretary of State (Minister)
Department of State for Forestry & the Environment

List of Acronyms

AF	Adaptation Fund
AI	Avian Influenza
ATU	Appropriate Technology Unit
BCC	Banjul City Council
COP	Conference of the Parties
CSO	Civil Society Organisations
CZMP	Coastal Zone Management Plan
CZMU	Coastal Management Unit
DCD	Department of Community Development
DPPH	Department of Physical Planning and Housing
DPWM	Department of Parks and Wildlife Management
DWR	Department of Water Resources
GBA	Greater Banjul Area
GBoS	Gambia Bureau of Statistics
GEAP	Gambia Environmental Action Plan
GEF	Global Environment Facility
GREC	Gambia Renewable Energy Centre
ICTs	Information Communication Technologies
ICZM	Integrated Coastal Zone Management
IEP	Integrated Energy Planning
INC	Initial National Communication
IPM	Integrated Pest Management
IWRM	Integrated Water Resources Management
KMC	Kanifing Municipal Council
LCDF	Least Developed Country Fund
LDCs	Least Developing Countries
LEG	Least Developed Countries Expert Group
LPG	Liquefied Petroleum Gas -
MCA	Multi-Criteria Analysis
MDGs	Millennium Development Goals
MEAs	Multi-lateral Environmental Agreements
MIAT	Multi-disciplinary Impact Assessment Team
MTP	Medium-Term Plan
MWG	Multidisciplinary Working Group
NADA	National Agricultural Development Agency
NAP(coD)	National Action Programme (to combat Desertification)
NAPA	National Adaptation Programme of Action
NARI	National Agricultural Research Institute
NBSAP	National Biodiversity Strategy and Action Plan
NCC	National Climate Committee
NEA	National Environment Agency

NERICA	NEw RICe for Africa
NGOs	Non-Governmental Organisations
NSA	Non-State Actors
PMT	Project Management Team
PMU	Project Management Unit
PRSP	Poverty Reduction Strategy Paper
PSC	Project Steering Committee
SARS	Severe Acute Respiratory Syndrome
SCCF	Special Climate Change Fund
TAU	Tropical Animal Unit
TOE	Tonnes of Oil Equivalent
UNCBD	United Nations Convention on Biodiversity
UNCCD	United Nations Convention for Combating Desertification
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organisation
WMO	World Meteorological Organisation

Executive Summary

Together with the United Nations Convention on Biodiversity (UNCBD) and United Nations Convention for Combating Desertification (UNCCD), the United Nations Framework Convention on Climate Change (UNFCCC) belong to the triumvirate of multi-lateral environmental agreements (MEAs) signed by The Gambia at the historic Earth Summit held in Rio de Janeiro, Brazil, in 1992. Prior to the UNFCCC's seventh Conference of the Parties (COP 7) held in 2001, in Marrakech, Morocco, COP debates were dominated by mitigation issues in line with the ultimate objective of the UNFCCC, that is, "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". At COP7 however, parties took full cognisance of immediate, medium-, and long-term impacts of climate change on the most vulnerable countries and adopted Decision 28/CP.7 and Decision 29/CP.7 buttressing the urgent need for adaptation to climate change in Least Developing Countries (LDCs) and setting out a framework for developing NAPAs (National Adaptation Programmes of Action) in these countries.

Considering The Gambia's small size, its location relative to regional hydrological and biogeographical systems, its economic structure and development status, and the key role of weather and climate on physical, social and economic vulnerability, it is not surprising that The Gambia's NAPA interacts and overlaps to some extent with its flagship environmental management and poverty reduction programmes. However, the NAPA is distinguished in some ways. The NAPA dispels the notion that climate is unchanging or inherently benign, integrates climate change and variability explicitly in its diagnostic analyses, and blends different stakeholder values in a coherent and transparent manner that leads to solutions to known and emerging problems. Crucially, the NAPA stimulates a critical re-examination of the role of climate on societal and natural systems; agriculture (crops and livestock), fisheries, wildlife, energy, health, water resources and forests/woodlands.

The NAPA preparation process was strongly influenced by standard guidelines developed by the Least Developed Countries Expert Group (LEG), and made available to The Gambia by UNEP.

Evidence of climate change, its impacts and current coping strategies, was gathered from commissioned studies, expert/peer review of studies, site visits and focus group discussions with diverse stakeholder groups. Group analyses were used at latter stages of the NAPA development to build consensus on adaptation strategies that were identified earlier on in the process, and independently re-assessed by policy makers to ensure that national priorities are reflected in the NAPA.

In all parts of the country, a wide cross-section of society was involved in stakeholder consultations, their participation emanating from third-party identification by the Regional Development Committees and gubernatorial/mayoral offices using a broad set of criteria including occupational background, ethnic diversity, gender and commitment to the NAPA process. Consultations were held at pre-defined, mostly central locations, to examine intermediate outputs of the NAPA project. And, depending on the circumstances, either English or Vernacular or both were used by research teams to share/exchange information, ideas, and views with stakeholders. Consultations also provided opportunities to build support for and foster ownership of projects outlined in the NAPA document.

All activities were carried out under the supervision and oversight of a project steering committee (PSC) comprising representatives of National MEA Focal Points; the Global Environment Facility (GEF) Operational Focal Point in The Gambia; Departments of State responsible for budgetary issues, poverty alleviation, and oversight of local government and decentralisation; The Gambia National Assembly; and non-governmental organisations (NGOs) whose work is related to environmental issues.

Climate Change is not science fiction and its adverse effects are not going away soon

The phenomenon of climate change is not an urban myth or science fiction. Instrumental data going back to the mid 1940s show without ambiguity that the total area of the country with July-August-September (JAS) rainfall less than 800mm on average has dramatically increased from 36 to 93 per cent of the national territory since 1965. Climate records also reveal an increase of 0.40ºC per decade or higher in the average minimum monthly temperatures across the country.

Due to the time lag between cause and effect within the global climate system, adverse impacts are likely to persist for decades/generations even after the global community succeeds in stabilising greenhouse gas concentrations in the atmosphere.

Despite the absence of a history of research on climate interactions with natural and societal systems, and inadequate observation networks and monitoring programmes; spatial analogues, biophysical models, the international scientific literature, logical reasoning and anecdotal evidence suggest that combined effects of increased atmospheric carbon dioxide (CO_2) concentration, sea level rise, and global warming with and without increasing aridity are likely to cause: a decline in species richness and diversity of terrestrial, wetland and aquatic ecosystems; impairment of ecosystem goods and services; and, spread of invasive species and vector-borne diseases. Other detrimental climate change impacts include livelihood insecurity, increase in respiratory diseases, facetious questions on water security projections and a real threat to national food security.

Based on actual experiences, rural stakeholders – the majority of whom depend on agriculture and animal husbandry for their livelihood – see a strong connection between erratic rains (onset and cessation of rainy season, and intra-seasonal variability) and: 1) lower crop yields; 2) reduced availability of forest products; and 3) poor animal pasture.

Traditional coping strategies may no longer work: New adaptation strategies are needed to handle creeping or abrupt climate change

For people whose livelihoods are dependent on climate-sensitive natural resources, climate variability in all its forms has provided sufficient incentives for evolving ingenious solutions that allow them to adjust to and live with departures from the norm.

Climate scientists note however that, since the advent of the industrial revolution, humankind has come to rival nature in its impact on the global climate system. Over the years, some critical thresholds have been exceeded or are close to being over-stepped, reducing the effectiveness of previous and current societal strategies for coping with natural systems variability. In this regard, conventional wisdom suggests fuller use of under-utilised but proven coping strategies, and development of new ones that make the best use of up-to-date knowledge and available resources.

In the agricultural sector the following strategic directions: 1) optimal use of natural resources (water, land, labour); 2) increasing and stabililising crop productivity; 3) making agriculture a profitable economic activity; and 4) stabilising rural population, are proposed in the face of adverse climate change. Fundamental changes to current/traditional animal husbandry practices include: 5) rangeland management including preservation of eco-assets; 6) enhancement of animal productivity; and 7) easing constraints on livestock-based livelihoods.

In the fisheries sector, strategies that address climate-induced or climate-amplified changes in aquatic ecosystems are centred on: 1) optimal exploitation of fish resources; and 2) reducing the demand and supply disequilibria. Saving lives and property of fisherfolk, and making fisheries a profitable economic activity, are equally valued strategic lines of action.

Integrated energy planning (IEP) in the energy sector, a totally new approach in The Gambian context, calls for adaptation options/activities that contribute to: 1) reducing pressure on natural forests; 2) providing access to reliable technologies and/or better/cheaper fuels; 3) limiting damage to infrastructure; and 4) improving energy efficiency.

Recent suggestions of increasing variability in precipitation (ECHAM4 and HadCM3 Global Circulation Models), and accelerated sea level rise call for new strategies that enhance: 1) water security; 2) preservation of aquatic ecosystems; and 3) disaster planning and management in the area of water resources.

Industrial substitutes of forest products have contributed in no small measure to cushioning the effects of reduced forest productivity. Yet, loss of genetic resources and wildlife habitat remains a central issue in forest and woodland conservation. In this regard, adaptation efforts are geared towards: 1) sustainable commercial and non-commercial use of forest resources; 2) raising public awareness; and 3) restoring ecosystem health and biodiversity.

Cutting down the incremental disease burden due to climate change relies on screening techniques in the health sector, and dogged pursuit of current preventive and curative measures. New strategies such as: 1) promotion of clean technology; 2) development of a less polluting public transport system, and 3) accelerated capacity building in the area of disease surveillance, reflect new lines of thinking, technological developments, and need for emergency and disaster preparedness.

Research and consultations pertaining to the economically vibrant and densely populated coastal zone point to strategies and activities aimed at: 1) preserving biodiversity and ecological assets; 2) improving livelihood security; 3) strengthening coastal defences; 4) minimising impact of flooding in lowlands; and 5) minimising impact of saline intrusion in lowlands.

Effective partnerships are vital to the successful implementation of priority adaptation activities

Priority Projects proposed are guided by the best adaptation strategies in the eyes of stakeholders and policy-makers. Collectively, projects in the NAPA project portfolio seek to address urgent and significant climate threats through actions that: 1) deliver immediate adaptation benefits; 2) contribute to building local and national adaptive capacity; and 3) create awareness and build foundations for maximising long-term adaptation benefits.

The main thrust of priority interventions in water resources management, agriculture and forest conservation include infrastructure development (water security, flood protection); early warning systems (flood protection); expanded irrigation (optimising land and water resources use); diversification (spreading climate risks); bushfire control and afforestation (enhance vitality of environmental, economic and social functions of forest); genetic improvements (livelihood security, food security, poverty alleviation); and, rangeland and wildlife management (sustainable use of resources).

In other key sectors, use of alternative and renewable energy sources (solar, liquefied petroleum gas - LPG), technological innovation and diffusion, promotion and strengthening of integrated coastal zone management (ICZM) including the adaptive capacity of coastal communities, and optimal use of marine resources are expected to make significant contributions to poverty reduction, energy, national food and livelihood security for large sections of the population. Reducing morbidity and mortality related to direct and indirect climate change impacts is the overarching objective of priority activities in the health sector.

By virtue of their potential contribution to the reduction of systemic sectoral and regional vulnerability, and shared objectives with flagship environmental management and poverty reduction programmes, actions proposed constitute a coherent package that can deliver unequivocal benefits to communities, and strengthen result-oriented capacities of national, regional and local institutions/organisations. At a deeper level of analysis, projects can be readily demonstrated to be mutually supportive, thus calling on national and external support agencies to work in concert to implement the portfolio as a package.

Adaptation strategies are not frozen in time, but guided by contextual changes and best available information

Sparse data and large uncertainties represent a big handicap to the development and re-alignment of effective adaptation strategies. To this effect, the NAPA preparation process has been quite useful in uncovering compelling areas of research that could add value to adaptation strategies pursued by The Gambia.

In the area of environmental research, species composition of various forest biomes and die-back phenomena associated with climate variability and change are two important and profitable areas of research. Wetland and mangrove destruction on estuarine productivity and fisheries production also command a high priority.

In the area of policy research, manifold opportunities beckon. For instance, research to bridge the concept of food security popularly associated with crop production to a nutrition-based assessment is a key area of research. Equally important is the need to investigate synergies, tradeoffs and advantages offered by different food production sectors. Other dimensions including equity, sustainability, and international trade constitute virgin territory for researchers. An active climate policy hitherto absent should provide the framework and direction of future climate change research.

I. Introduction and Setting

1.1. Background

Geography, Topography, Climate, and Regional Systems of Interest

Located between 13 and 14ºN and between 13.7 and 17ºW, the Gambia, occupies a land area of 10,690 sq. km making it the smallest country in mainland Africa (see Figure1). A sliver of land 15 to 80 km wide, extending more than 400 km from the Atlantic Ocean, the country is dissected into northern and southern areas by the River Gambia which runs from East to West and debouches into the Atlantic Ocean. With nearly 50 per cent of its total land area under 20 metres above mean sea level, one-third at or below 10 metres above sea level, and 10 to 20 per cent seasonally or diurnally flooded, The Gambia has little pronounced topographic features to boast of (see Figure 2). Indeed, its low elevation puts some areas of the country such as the capital city of Banjul at significant risk from sea level rise.

Except for a small fraction of territory on its Atlantic seaboard, The Gambia is perfectly nested within the Gambia River Basin, shared with the republics of Guinea, Guinea-Bissau and Senegal. Coastal and estuarine areas of The Gambia also form an integral part of the East Atlantic marine ecosystem, stretching from the Canary Islands to Angola (Open University, 1995). Monsoon circulation over West Africa, correlated to Sea Surface Temperature (SST) in the Gulf of Guinea and modulated by the strength and location of the African Easterly Jet (AEJ), determines the character of the unimodal rainy season lasting from June to October (Gu and Adler, 2004; Gianini *et al*., 2003). Annual rainfall decreases roughly from South to North, with insignificant geographical differences in variability. Temperatures on the other hand increase with distance from the Atlantic coast. Seasonal Northeast trade winds, known as Harmattan, also have an associative relationship with atmospheric circulations, and are notable for their chill factor, and significant amounts of dust picked up from the margins of the Sahara desert.

Economic Structure and Performance

In the past 40 years, the structure of the Gambian economy has not changed significantly and may, for analytical or descriptive purposes, be broken down into: 1) agriculture and natural resources, 2) services, and 3) industry. Within the last five years, agriculture and natural resources-based economic activities account on average for 30 per cent of GDP, whilst services and industry contribute 65 and 5 per cent respectively (Source: GBoS).

The Gambia pursues a liberal trade policy regimen consistent with regional integration goals and economic globalisation processes. Its principal exports are groundnuts and fishery products, whilst imports are dominated by food, machinery, and transport equipment. On a global basis, EU and Asian countries are the country's main trading partners. Trade with African countries is dominated by goods transiting to and from the Ivory Coast, Ghana, Nigeria, and Senegal. Export to import ratios computed for the last five years oscillate between 2 and 11 per cent (Source: GBoS).

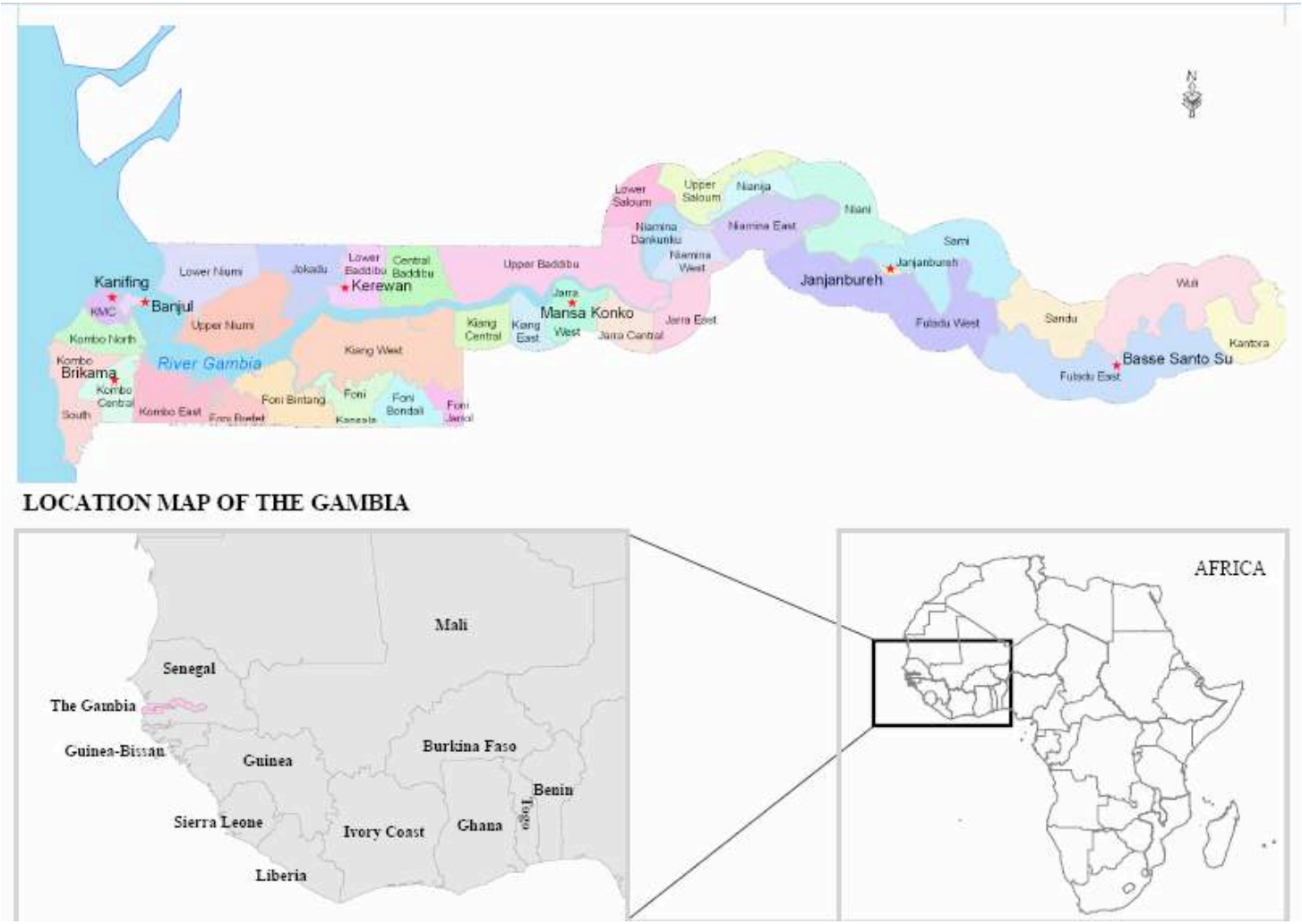
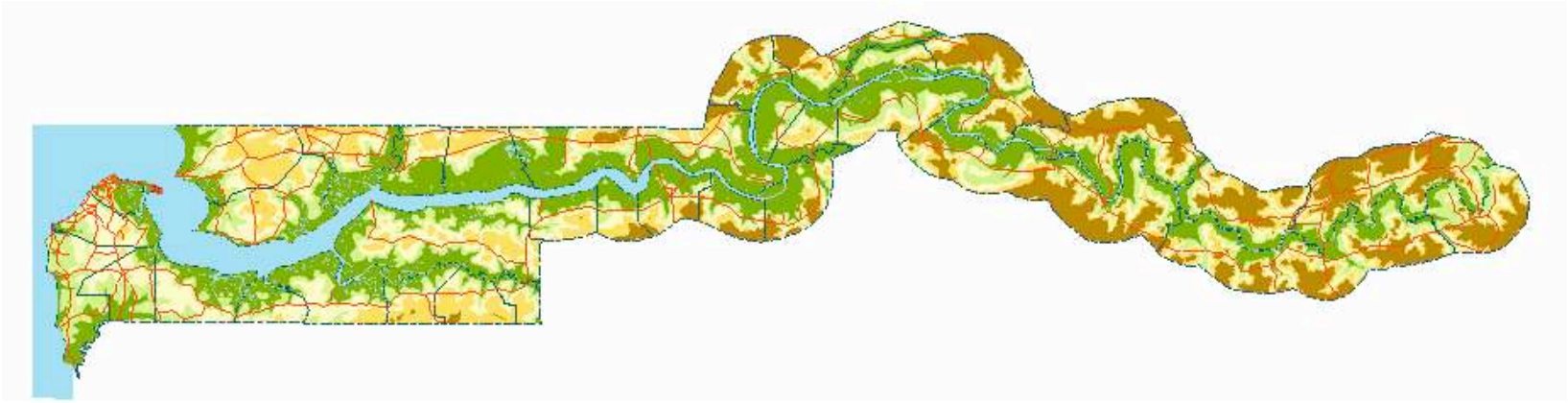


Figure 1.1: *Location map of The Gambia (source: Jaiteh and Saho, 2006)*



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	Land area (sq. km) within specified elevation category (meters above sea level)				
	<10	10 - 20	20 - 30	30 - 40	>40
Banjul	11	0	0	0	0
Kanifing	52	27	1	0	0
Brikama	560	477	512	202	11
Mansakonko	615	284	332	228	101
Kerewan	924	383	405	446	39
Kuntaur	413	223	188	196	475
Janjangbureh	567	270	203	170	254
Basse	373	371	287	329	681

Figure 1.2: *Elevation map of The Gambia.* Map and statistics prepared by Dr. Malanding S. Jaiteh using Gambia 50000 GIS Database 2003 and ArcGIS Spatial Analysis Extension

GDP is currently estimated at 13,138 million dalasis (US$461million equivalent). Annual growth registered by individual sectors range from 5 to 10 per cent. Within the catering and hospitality industry however, growth typically exceeds this upper limit, whilst electricity and water sectors are chronic underperformers (Source: GBoS).[1] Although economic activities are not climate-indexed, intuitive logic/knowledge of cause-effect relationships suggest that global warming trends, and changes in precipitation/rainfall and wind patterns, could have a significant impact on the structure and performance of the Gambian economy. Notice in particular that key sectors of the economy: Agriculture, Livestock, Forestry, Energy and Tourism together contributing 34 per cent to the country's GDP are highly sensitive to adverse weather, climate variability and change.

Demography

At the last national population and housing census in 2003, The Gambia had a population of 1.36 million people (Jaiteh and Saho, 2006), growing at 2.8 per cent per annum. An increasing percentage of the population lives in urban agglomerations in the western part of the country. However, this trend is likely to stabilise and/or spill over into other regions as space becomes a limiting factor. Consistent with a dispersed settlement pattern in largely agrarian societies, the number of inhabitants is less than 500 in 77 per cent of settlements. Only four big towns in the rural countryside; Barra-Kanuma, Farafenni, Soma, and Basse, have more than 10,000 residents.

According to the same census, five ethnic or cultural groups, namely, the Mandinka-Jahanke, Fula-Tukulor-Lorobo, Wolof, Jola-Karoninke and Serahule have population sizes representing more than 8 per cent of the total population.[2] In terms of residence, the majority Mandinka-Jahanke community represents more than 15 per cent of the population in all regions of the country. The high concentration and almost exclusive presence of Jola-Karoninke in Brikama and Serahule in Basse local government areas (LGAs) mirrors these ethnic groups' sedentary habits and livelihood systems.

Institutions

British colonial rule in the late 19th century introduced a governance model under which modern administrative and customary/traditional structures have continued to co-exist to this day.

At the national level, proposed policies and measures are discussed within a Cabinet, composed of the President who is head of state, a vice president and secretaries of state (ministers) all appointed by the head of state. A unicameral legislature (called National Assembly) elected every five years, passes legislation to give policies legal muscle. Public policies are implemented and coordinated through a centralised public administration system, and decentralised (local) government structures.

[1] With the recent participation of Global Electric Group as an Independent Power Producer for the National Water and Electricity Companay (NAWEC) however, there has been a remarkable improvement in the performance of the electricity sector since the last quarter of 2006.

[2] The cutoff at 8 percent seems arbitrary, but from observation is slightly higher than the proportion of non-Gambians (7.9 per cent).

In traditional rural Gambia, organisation of communal affairs rests with village councils. Interest groups constituted on the basis of age, gender and blood relations, known as '*Kafo*' in Mandinka-Jahanke society, are equally ubiquitous. The basis for association in urban areas is usually broader, reflecting the complexity of challenges and diversity of members. Civil society organisations (CSO) or political pressure groups with sufficient recognition and clout, as seen elsewhere, hardly exist in The Gambia. Kafos have a considerable degree of autonomy in managing their affairs, but may refer controversial and sensitive issues to village councils, village heads, chiefs, or governors. Matters of interest to the whole community are discussed and resolved by an appropriate body. Although the constitution and administrative hierarchy eliminates the prospect of conflicts of competence between village heads and chiefs/governors, political authorities are acutely aware of the need to build bridges and foster partnerships with communities who, acting through their representatives, are key stakeholders in natural resources and environmental management. Quite understandably, mobilisation of volunteers under the "*nyodema*" (self-help in Mandinka-Jahanke) flag is much easier in small communities.

The government relies on the work of inter-ministerial/inter-sectoral committees and working groups, enlarged to include non-state actors (NSA) such as non-governmental organisations (NGOs), members of professional groups, and private individuals to meet its obligations under various conventions and treaties to which The Gambia is a signatory, namely, Biodiversity, Climate Change, Desertification, Trade in Endangered Species, Transport of Hazardous Wastes, Ozone Layer Protection, and Protection of Wetlands.

1.2. Key Environmental Stresses

Climate and non-climate stressors have a significant influence on the status and evolution of The Gambia's natural endowments. Climate change and variability in particular, best exemplified by a negative step trend in rainfall in the late 1960s, and persisting into the present, has placed tremendous pressure on natural resources and ecosystems.

Figure 1.3 illustrates spatial patterns and temporal changes in rainfall in the last sixty years. The fact that components of the natural environment, that is, atmospheric, water, soil and biological resources have inherent capacities for regeneration is not in dispute. Failure however to recognise or acknowledge finite environmental capacity or process time scales often underpin actions overstepping critical thresholds. Anecdotal and empirical evidence for environmental degradation linked to protracted drought abound (Cham *et al*., 2001).

Partly as a result of population pressure, the natural environment in The Gambia has taken the full brunt of unsustainable use of natural resources, as seen in the negative effects on the forest cover, rangelands, aquatic and marine organisms. Rapid urbanisation from 23 per cent to 41 per cent (Source: GBoS) in the last three decades is paralleled by clearing of forests and woodlands, expansion of cultivated area, over-fishing of particular species and severe coastal erosion.[3] To fix some ideas, fish landings increased from

[3] Growth in the construction industry has often come at high environmental costs. Mining of beach sand and its subsequent use as construction aggregate in public projects and real estate development has caused severe coastline degradation which required US$20 million (or 570 million Gambian dalasis) to fix temporarily.

15,000 to 40,000 tonnes between 1980 and 2000 (Source: Fisheries Department), and closed woodland forest area decreased by 86 per cent between 1968 and 1993 in response to agricultural expansion and commercial logging for timber and fuelwood (Bojang *et al*, 2005; GOTG, 2000). Disappearance of species from affected areas is further exacerbated by human wildlife conflicts and/or hunting pressure. Indeed, over-fishing which is a form of excessive hunting pressure within the aquatic environment is a key factor behind the closure of fish processing factories, and the scaling down of operations in the Greater Banjul area (GBA).

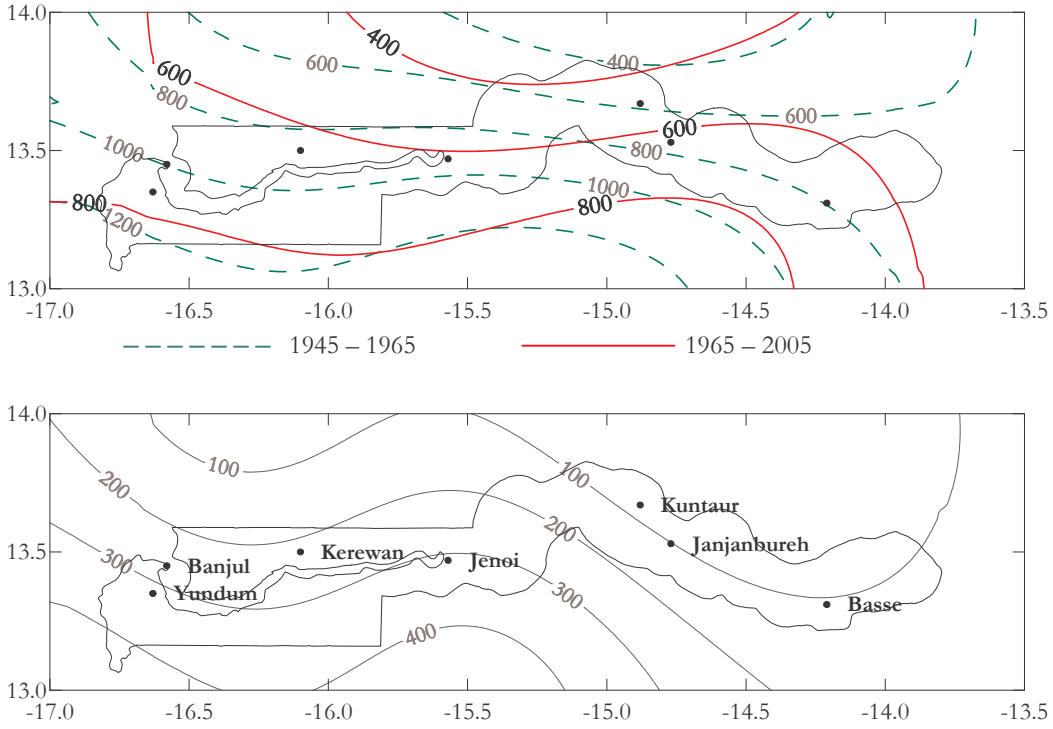


Figure 1.3: *Spatial patterns and temporal changes in rainfall in the last sixty years. The **top panel** shows a south to south-westerly drift of cumulative JAS (July-August-September) rainfall contours. Notice that the area with average JAS rainfall less than 800mm has increased from 36 per cent to 93 per cent since 1965. The **bottom panel** shows geographical variation of absolute decrease in JAS rainfall. Yundum, Banjul, Kerewan and Jenoi located westward of longitude 15º30'W (here indicated in world geographic coordinates as –15.5º) have experienced a fall in JAS rainfall exceeding 200mm. Climatological stations to the East of 15º30'W (Kuntaur, Janjangbureh, and Basse) have experienced somewhat smaller changes since 1965 when The Gambia became an independent state.*

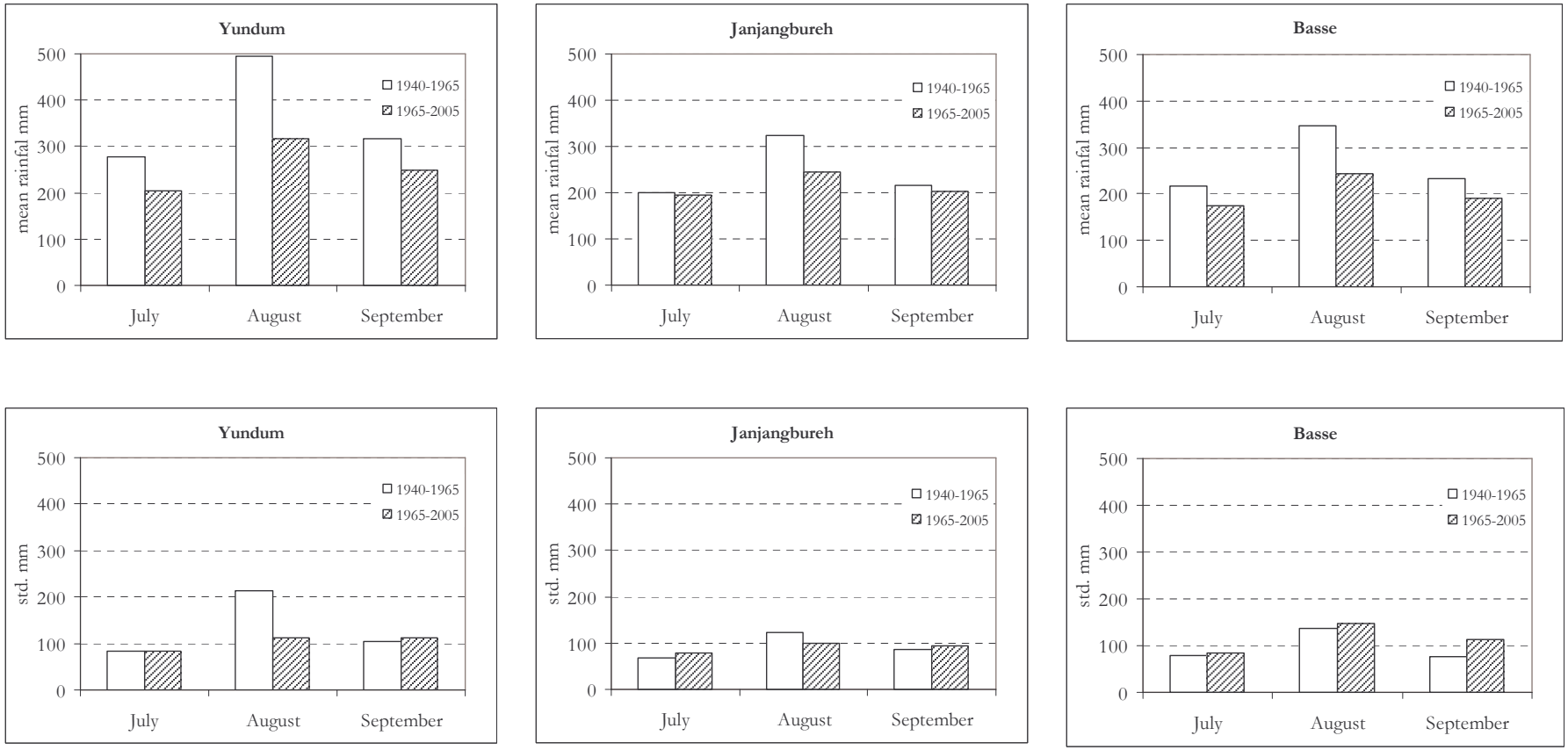


Figure 1.4: *Change in rainfall statistics at Yundum (16º35'W, 13º27'N), Janjangbureh (14º46'W, 13º32'N and Basse (14º13'W, 13º19'N)*

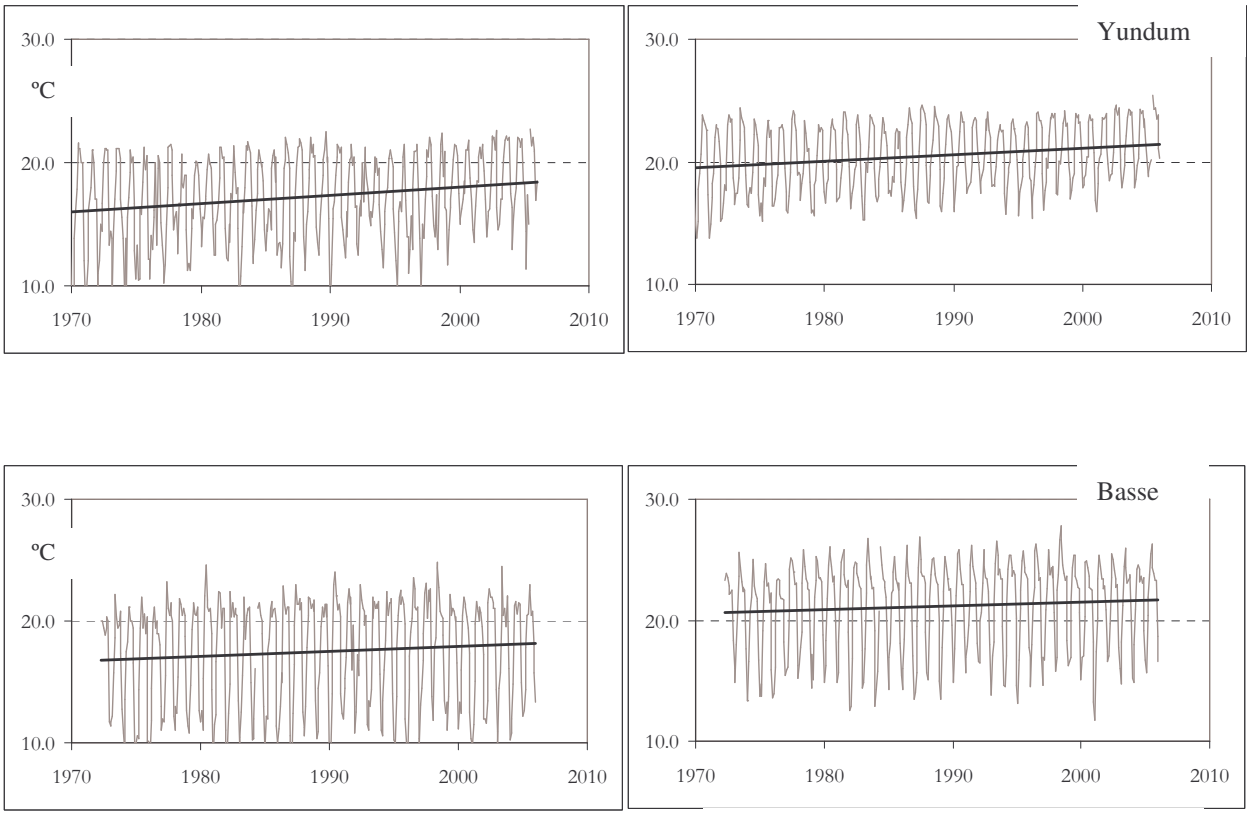


Figure 1.5: *Trends in minimum temperature at Yundum and Basse, showing respectively increases of 0.67 and 0.40 degree Celsius per decade in the average minimum monthly temperatures. Line slopes (i.e. rate of change) verified as statistically significant at the 95% confidence level.*

One may also wish to point out that waste streams, including stormwater runoff, untreated sewage and wastewater discharging into aquatic environments are linked to bio-accumulation of pesticides in fish and molluscs (Jallow, 1989), and long-term ecosystem integrity (Cadbury, 1997). In retrospect, roads built as part of massive infrastructure programmes rarely respected ecosystem integrity, or the movement or migration behaviour of resident fauna.

Traditional livestock production, albeit not fully integrated within the economy, needs to be cited because of its scale and reliance on natural pasture. Grazing pressure accentuated by successive years of poor pasture re-growth encourages selective herbivory, thereby contributing to loss of diversity and dominance of unpalatable grass/fodder species. Cham *et al*. (2001) document the case where goats, whose grazing habits have a devastating impact on vegetation dynamics, are excluded from one of the islands in the Niumi National Park.

1.3. Adverse Effects of Climate Change and Variability on Biophysical Processes

Little or no research has been done in The Gambia on the linkages between climate and biophysical processes. Adverse effects operating indirectly through soil (salinisation, erosion), and water quality degradation (pollution/sediment load, salinity, temperature, dissolved oxygen), concentration of ground-level ozone, and other environmental stresses have not been studied either. From general ecological principles however, some useful conclusions can be drawn from the sparse literature. For a start, time trends and the magnitude of projected climate change may trigger slight to irreversible changes in the physical environment that is home to many plant and animal species.

Ordinarily, plants and animals respond to fluctuations and variations in climate through specific adaptation and survival strategies. To a large extent, these are dependent on the climate attribute, magnitude of change, and cause-effect time lag. We note that synchronised and synlocalised global warming, sea level rise, change in rainfall patterns, and frequency of extreme events are major climate change phenomena relevant to The Gambia.

Increased tides, wave activity and salinity would most probably lead to a decline in the productivity of mangrove ecosystems**.** Photosynthetic and regeneration processes of trees, grass, agricultural crops may initially benefit from carbon dioxide (CO_2) fertilisation, but continued global warming is expected to offset these gains. Norman *et al*. (1995) reveal that most tropical crops are already growing close to the upper limit of the ecological envelopes. This is corroborated by Cole *et al*. (2005) who report an inverse relationship between higher temperatures and the pod filling period, and groundnut yields ultimately.

Forecasting direct effects on animal communities is much more complex, considering the preponderance and scope of variables such as life history, size, morphology, physiology, habitat and behavioural responses to climate and environmental change. Despite such difficulties, relevant biophysical processes summarised as body heat control, production and reproduction could be discussed from general principles and anecdotal evidence. Experimental evidence further suggests that unfavorable change in the physical environment or simply a change in climatological conditions could have dramatic effect on particular species (Strüssmann *et al*., 2002; Pieau *et al*., 1994). Fish which are highly mobile, selective about their habitats, and endowed with thermoregulatory and osmoregulatory organs, are likely to be the least affected species.

Domesticated and terrestrial wildlife are expected, in the face of fodder shortage or quality degradation, to lose weight or tend towards smaller body sizes.[4] Increasing temperatures, acting through changes in population structure, have a potentially devastating impact on ectothermic vertebrates, and could lead to the extinction of amphibians and reptiles (Pieau *et al*., 1994).[5] Associated with weakening ecological controls, one may reasonably expect an explosion in the population of insect pests, unless inter- and intra-species competition for food acts as a limiting constraint on the reproductive success of species. A combination of stress factors could place an additional

[4] As long as common pasture has zero marginal cost compared to feed grain, cattle owners are likely to remain passive about the change in herd quality.

[5] The proportion of young males in a clutch changes with temperature. In some species of amphibians and reptiles, 100 per cent of young develop into males when temperature rises above a certain threshold.

burden on animal health and production. Poultry and dairy cattle, in particular are quite sensitive to heat stress (Bobb *et al*., 2005).

1.4. Adverse Effects of Climate Change and Variability on Key Sectors

Considering differences in natural endowments, contrasting levels of economic development and diversity of social systems within and between countries, not to mention national aspirations, it is not too difficult to understand why one country's choice set of key sectors is different from another's.

In The Gambia, three economic sectors, two of which are already flagged as highly sensitive to climate change, two natural resources sectors, and one social sector, are selected for inclusion in the National Adaptation Programme of Action (NAPA) study. These are shown below under relevant headings:

Economic Sector

- ✓ Agriculture (crop and livestock production sub-sectors)
- ✓ Fisheries
- ✓ Energy

Natural Resources Sector

- ✓ Water Resources
- ✓ Forest Resources

Social Sector

- ✓ Health

The **coastal zone**, an important geographic area, from social, economic, and environmental perspectives was also studied. Consistent with the layout of the report however, discussions pertaining to the coastal zone are deferred to Chapter 2, alongside a synthesis of regional impacts.

It could be argued that economic sectors included in the NAPA study are managed systems that can offset adverse effects through investment, deployment of appropriate technology and best practice. This may be true to some extent, but the central question is - What is The Gambia's capacity to deal with potentially adverse climate change? There is no straightforward answer. In fact, the country's low human development and average environmental sustainability index (UNDP, 2006; Esty *et al*., 2005), suggest it would be more prudent to assess adverse impacts without mitigating factors. After all, it is better to err on the side of caution.

Agriculture

Changes in rainfall and temperature are expected to constrain productivity of some crops. Cole *et al.* (2005) estimated that there will be a 40 per cent drop in groundnut yields due to rising temperatures. However, Njie *et al.* (2006) report a more complex set of results, which show model- and policy-dependence of food security projections for The Gambia. Notwithstanding, inter-annual variability of yields is shown to increase in the absence of compensatory management strategies.

Additionally, the disappearance of freshwater swamps and soil salinisation in lowland areas resulting from sea level rise is likely to impact negatively on rice production and the lives of women farers in these areas. Elsewhere, intensive cropping and/or shorter fallow periods threaten soil fertility and the natural resource base (Cole *et al.*, 2005). The dominance of heat- and drought-tolerant species could lead to further loss of agricultural biodiversity.

One has to recognise that detrimental impacts are not limited to crop yields, but extend to social welfare, and population dynamics. Poor intra-seasonal rainfall distribution also serves to increase food insecurity, rural poverty and hardship. Land that has lost its labour-absorbing and income-generating capacity is hardly likely to retain the able-bodied rural workforce that migrates to urban areas in search of alternative/non-farm livelihoods (Stark and Katz, 1986; Todaro, 1971).

In contrast to crops, research into climate-livestock interactions is more sparse and fragmented, and focuses more on rangeland productivity. According to Bobb *et al.* (2005), a 29 per cent to 40 per cent drop in live biomass, depending on species considered, is expected to accompany projected climate changes. Notice however that climate change will also change species composition, which complicates net impact estimates. Water and heat stress in particular are expected to take a heavy toll on perennials and shallow-rooted forage species. In a cattle-raising system largely based on extensive common land grazing,[6] a decline in fodder availability and quality is expected to translate into loss of animal production (BGS, 2005).

Higher temperatures and humidity have measurably adverse impacts on small ruminants (i.e., goats and sheep), which make important contributions to household economies. The result of intense climatic stress on free grazing small ruminants include: significant reduction in milk yields; slow growth rates; decreased reproductive rates and increased mortality rates. Continued global warming and increasing humidity are also expected to have a negative effect on food intake of birds, thus reducing the productivity of poultry. However, animals can be economically protected from intense climatic stress by providing adequate shelter and cooling systems.[7] Notable adverse climate that indirectly impacts animal production include the rapid spread of animal diseases and thermophilic vectors/hosts, and increased cost of processing and marketing animal products.

Fisheries

Climate change impacts on fisheries derive their essence from changes to the Eastern Atlantic marine ecosystem, which incorporates the coastal and estuarine areas of the River Gambia. Within the continental shelf area, productivity is likely to be given an initial boost by the changing heat budget of the overlying ocean, CO_2 enrichment, and

[6] An economic feasibility analysis of cattle ranching shows that animal feed account for 98 per cent of investment and operational costs. A net present value (NPV) in millions of Gambian Dalasis (GMD), found during the analysis, illustrate why Gambian cattle owners practise open grazing, and also provided some illumination on the issue of subsidies paid out to cattle farmers by governments in developed countries.

[7] Based on communication from Jerro Maane, Department of Planning, Department of State for Agriculture.

seasonal upwelling.[8] Similar to terrestrial plants however, the effects of CO_2 enrichment may peak quite early, and lose importance thereafter as respiration consumes a greater proportion of gross primary productivity (Tait and Dipper, 1998).

In the estuarine zone of the River Gambia, sea level rise may initially favour the mobilisation and export of nutrients from wetland sediments (Hemond *et al.*, 1984), but the same process could equally release pollutants into the aquatic ecosystem.[9] Most significantly, Darboe and Bojang (2005) articulate national apprehensions about possible spawning and recruitment failures associated with the loss of estuarine mangroves. Crucially, primary productivity is linked to the fate of mangroves (*Rhizophora spp*., *Avecennia spp*.), which provide important life cycle habitat, food and refuge for crustaceans, shellfish, oceanic nekton and marine mammals. In broad strategic terms, lower productivity means a lowering of the maximum sustainable yield threshold (Cham *et al*., 2001), which, according to anecdotal evidence may already have been exceeded. Additional climate forcing is therefore likely to: 1) precipitate the collapse of some pelagic fish populations, 2) threaten food security for a significant proportion of Gambians, and 3) undermine the livelihood and traditional way of life of fisherfolk in the country.

Energy

An assessment of impacts on the energy sector is handicapped by a serious research deficit on the subject (Saho and Ceesay, 2005). In this context, IPCC reports (IPCC, 2001; 1996) and other studies (Njie, 2006) provide invaluable insights into potential climate change impacts.

Changes in mean rainfall and temperature, as well as increased variability are expected to reduce the potential for hydroelectric power and biomass energy production. This has ramifications, which have often been overlooked in the past. Fuelwood, a biomass energy source with low solar energy conversion efficiency (Miyamoto, 1997), currently provides 84 per cent of national energy consumption (Saho and Ceesay, 2005). Alternative biofuels billed as solutions to petroleum energy crises however, obey the same laws of photosynthesis, which makes them equally inefficient solar energy converters. Until suitable alternatives are found therefore, The Gambia's energy dependence is bound to increase.[10]

Subject to caveats on technological progress, higher temperature will further increase energy demand across a range of end-uses. An example that is not so evident is the increase in fuel consumption by vehicles using radiative cooling systems. Ohmic resistance of power transmission lines, known to increase with temperature, will also increase current transmission losses within power grids (Saho and Ceesay, 2005).

[8] Rivers flowing into the Atlantic Ocean, between Cape Blanc and Cape Frio, have similar thermal characteristics to the ocean, and generally have discharge volumes too small to alter ocean salinity beyond the coastline. Furthermore, a 1-meter sea level rise is not expected to alter the thermal structure of the ocean.

[9] Protected coastlines have little wave activity, but human activities (e.g. river transport) can generate wave trains that cause the re-suspension of sediment when they impact on shorelines. On the other hand, the most likely and important source of pollution are sewage and/or outfalls, and diffuse urban runoff.

[10] Biofuels are further constrained by competing land and water uses.

In general, construction, protection and maintenance costs of energy delivery systems would increase in conformity with added design specifications, and facility location decisions that incorporate climate change considerations (Saho and Ceesay, 2005). It can be argued that failure to do so would increase insurance and replacement costs.

Water Resources

Changes in temperature and rainfall will almost certainly alter relative magnitudes of hydrological cycle components. Regimes and sizes of small surface water bodies would be hardest hit. In the medium- to long-term, regulated flow on the River Gambia is expected to counteract natural variability.

The combination of sea level rise, global warming and changes in rainfall patterns, could impact freshwater resources qualitatively and quantitatively. Surface evaporation is expected to increase, whilst groundwater recharge is expected to take the reverse trend. Both phenomena enhance advective salt transport n the River Gambia (Verkerk and van Rens, 2005; Njie, 2002; Savenije, 1988), and place additional constraints on management rules of an upstream reservoir. However, the biggest threat of saline intrusion into the River Gambia and coastal aquifers comes from projected sea level rise (Njie, 2002). Further surface water quality degradation is linked to the export of nutrients from inundated areas (Hemond *et al*., 1984), and increased biogeochemical activity in relatively warmer waters. In this connection, altered frequency of extreme events may lead to more frequent water quality problems.

Integrated Water Resources Management (IWRM) institutions face a host of problems associated with flooding from sea level rise, drainage congestion and torrential rains. Water supply-demand disequilibria arising from trends outlined above will also take on new poignancy. Water resources facilities may need to be moved from areas currently under twin threats of shoreline retreat (Jallow and Barrow, 1997) and saline intrusion (Scott Wilson Kirkpatrick, 1993). Water quality management for the primary purpose of preserving the integrity of aquatic ecosystems also faces tough challenges from climate change and associated water quality degradation. Flow regulation would certainly help, but additional resources will be required to deal with diffuse inflow from agricultural activities and return flows downstream of irrigated perimeters (DWR, 2001).

Forest Resources

Similar to agricultural crops and other biomes, forest regeneration rates are expected to suffer a decline under combined effects of rising temperature and more erratic rainfall patterns. Beneficial effects of CO_2 fertilisation are likely to be short-lived in mature forest stands. Dry conditions and high temperatures are also noted for their contribution to forests fire hazards (Whelan, 1995). Overall effects of climate change depend on their timing and synergy. On the one hand, reduced forest productivity cuts down the amount of flammable material, thereby suppressing fire intensity. Conversely, low productivity increases susceptibility to insect attack (Sukardjo, 1994) and death. If left unharvested, deadwood could make future fires more devastating. In freshwater parts along the estuary, lowland mangroves are likely to suffer a setback from flooding and inadequate sediment supply (Verkerk and van Rens, 2005; Sogreah *et al*., 1999).

Indirect negative effects may also arise from the juxtaposition of impaired ecosystem services and over-exploitation by humans and livestock (Bojang *et al*., 2005). Low establishment rate of new forests would precipitate further decline in the area of

exploitable forest. Changes in species composition within natural vegetation cover types could arise from a combination of climatic stresses, initial composition, inter-species competition and forest use. There is already some evidence that more drought-resistant and fire-tolerant species are becoming dominant within different biomes. It is highly probable that establishment of species in new places would stem from species migration and succession rather than seed dispersal.

Health

Direct effects of climate change include stress and health complications due to thermal extremes. Although heat stress mortality may be a completely new phenomenon, irrational behavioural responses such as unprotected out-door cooling could increase the incidence of malaria, dengue and yellow fever. Beneficial effects of global warming on parasite ecology, insect vector population and infectivity (Dobler and Jendritsky, 2001), could only make matters worse.

Increased flooding could put more people at risk from injury and drowning (Conteh *et al*., 2005). The spread of freshwater snails (*Bulinus spp.*) into newly flooded areas would expose a larger population to schistosomiasis. Other indirect health risks of flooding include exposure to biologically-active pollutants that may be present in flood waters. If an evacuation exercise becomes necessary, then the risk of infectious disease transmission increases with overcrowding.

Additional financial resources for health infrastructure development and disease/vector control programmes would be needed to stay within target of major health policy objectives. According to WHO (2003) cited in Conteh *et al.* (2005), a year-long study in Latin America indicated an 8 per cent increase in diarrhoeal admissions to a paediatric hospital, for every degree rise in temperature.

An increase in ground-level ozone is expected to increase respiratory problems of people living, working or doing business in major business districts and along major roads (Borja-Aburto *et al*., 1997; Hoek *et al*., 1997; Sartor *et al.,* 1995).[11] A synergy between temperature, ozone and high concentrations of total suspended particulates could cause immediate health problems (aggravate cardiovascular and respiratory illnesses) for persons over 65, and long-term/permanent health effects (accelerated aging of lungs, decreased lung capacity, asthma, bronchitis, emphysema) in other age groups. Relative risks of meningococcal meningitis outbreaks also increase with the frequency of dust storms. Although locations of future outbreaks may not be known with exactitude, urban centres with high population densities constitute the highest risk areas.

Trade in and migration of domesticated animals (transhumance) or wildlife (for example birds) could be an avenue for introduction of zoonoses. Avian influenza (AI) is a typical case.

[11] Urban air pollution 'more dangerous than Chernobyl' *by* Ian Sample, published on 03 April 2007 http://environment.guardian.co.uk/waste/story/0,,2048662,00.html

2. Framework of Adaptation Programme

2.1. Climate Hazards

Despite its diversity of environments, The Gambia is a small country by synoptic standards. It could therefore be considered a single climate zone without the need to refute the existence of small-scale heterogeneities. From experience and an observational record that spans over a century in some places, climate hazards in The Gambia include: torrential rainfall, storms, drought, cold spells, intra-seasonal-drought, heat waves, and unseasonal rains. The last three are perceived as hallmarks of a slowly changing climate, which is notably characterised by increasing atmospheric CO_2 concentrations, and sea level rise. Related hazards include limited ability to predict the incidence of some hazards, and the concomitance of multiple and mutually reinforcing hazards.

Far from considering current discussions on climate threats/hazards as abstract, or limited to physical impacts/manifestations, stakeholders demonstrate reasonable awareness of climate hazards, but also attach greater importance to higher-order social and economic impacts of these hazards. However, focus group discussions held in different localities reveal a distinct urban- rural divide when curtailed sampling is used to identify priority concerns of different stakeholder groups (Ngum, 2006). Reliable and affordable water supplies, control of water-related infectious diseases and improved flood management are issues of common concern to all consultees. Climate variability and change are generally associated with supernatural causes.[12]

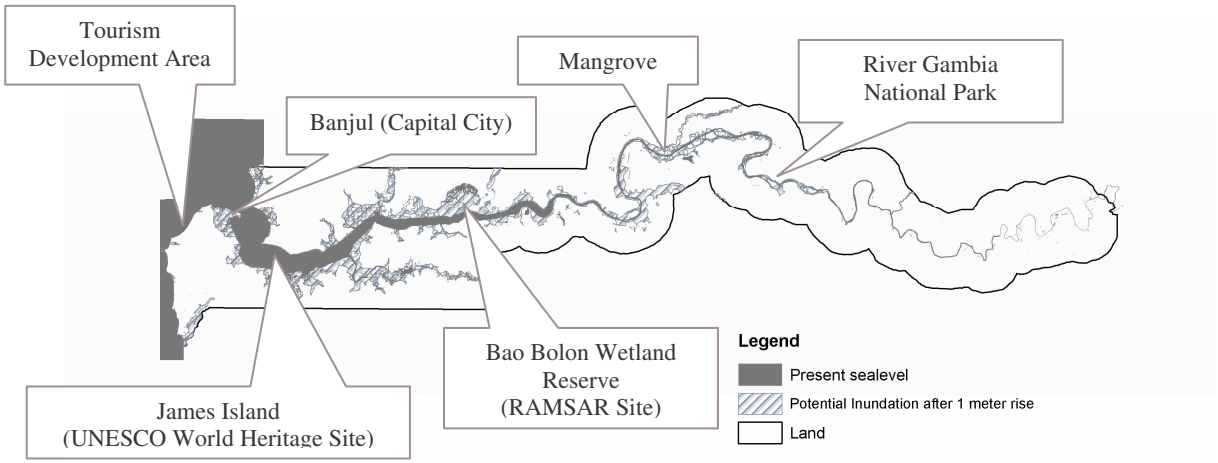


Figure 2.1: *Area liable to permanent flooding from a 100 cm sea level rise scenario. Notice that total area flooded also depends on diurnal tidal cycles and seasonal flooding. Erosion of beaches and potential breaching of barrier dunes on the Atlantic seaboard, as a result of increased wave activity could further aggravate the degree of flooding in coastal areas.* Map and statistics prepared by Dr. Malanding S. Jaiteh using Gambia 50000 GIS Database 2003 and ArcGIS Spatial Analysis Extension

[12] Those previously exposed to the climate change research findings and outreach programmes notable exceptions.

Table 2.1: *Area at or below sea level for different sea level rise (SLR) scenarios within local government authorities LGA across the country*

LGA	Total Area (km^2)	SLR = 0cm	SLR= 50cm	SLR= 100cm
Banjul	11.0	5.7	6.5	7.0
Kanifing	80.0	34.2	35.0	36.0
Brikama	1763.0	184.0	219.0	240.0
Mansakonko	1561.0	93.0	154.0	197.0
Kerewan	2200.0	254.0	326.0	385.0
Kuntaur	1495.0	41.0	55.0	71.0
Janjangbureh	1466.0	51.0	86.0	124.0
Basse	2046.0	9.0	10.0	10.0

Source: DEM and administrative boundary data- The Gambia 50000 GIS Database 2001. Department of States for Local Government and Lands

Stakeholders drawn from urban communities located in the Greater Banjul Area (GBA) consider coastal erosion, loss of mangroves associated with impairment of ecosystem services and increasing food prices (fish products) as key concerns. Damage to infrastructure is also considered a threat to the livelihood of some coastal communities. Extreme weather in the form of storms increases the likelihood of accidents and loss of lives at sea.

Based on actual experiences, rural stakeholders see a strong relationship between erratic rains (exemplified by less predictable onset of rainy season and frequent dry spells) and: 1) lower crop yield; 2) reduced availability of forest products; and 3) poor animal pasture. In concert with loss of soil fertility/soil degradation (erosion, sedimentation, etc.) and bush fires, stakeholders consulted foresee a drop in rural household incomes, which are essentially derived from crop production, exploitation of forest products, and animal production. The high cost of living and inadequate opportunities for income diversification are likely to remain major factors behind permanent migration of youth to urban areas.

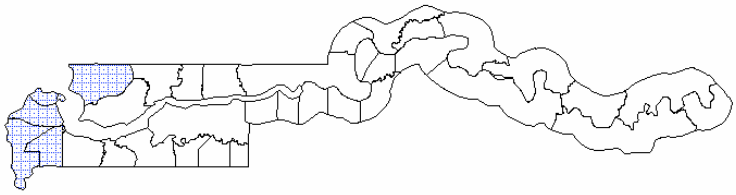
In contrast, health and energy issues are paramount in peri-urban areas. Here, environmental sanitation, availability of fuelwood, and their association with high health and energy bills take centre stage. The loss of natural resources-based livelihoods and malnutrition/increased poverty due to climate change impacts has also been evoked.

2.2. Climate Vulnerability

In the previous chapter, possibly detrimental impacts of climate change were presented in a general manner and along sectoral lines. In this section of the report, we take a regional approach that provides more location-specific details and therefore, better aligned to stakeholder awareness, concerns and interests. Indisputably, climate vulnerability differs according to the nature of hazard(s), degree of exposure, sensitivity and adaptive capacity of exposed units.

Coastal Zone

(Banjul, Kombo St. Mary, Kombo North, Kombo South, Kombo Central, Lower Niumi)



This area is most vulnerable to sea-level rise because of its low-lying coast and heavy development in many areas (ROTG, 2003; Jallow and Barrow, 1997). Changes in seasonal rainfall patterns combined with sea level rise and global warming could also alter mangrove ecosystems significantly. Considering that 85 percent of organic carbon input to the River Gambia estuary originates from the mangrove ecosystem (Twilley, 1985), and virtually all ichthyofauna[13] captured in commercial/industrial and artisanal fisheries depend on mangroves for habitat, refuge from predators and food during part of their life cycle,[14] impairment of mangrove ecosystem productivity would lead to substantial net social welfare losses. Populations of species associated with the mangroves, including locally rare/endangered species[15] such as the West African manatee (*Trichechus senegalensis*), Cape clawless otter (*Aonyx capensis*), brown-necked parrot (*Poicephalus robustus fuscicollis*) and Pel's fishing owl (*Scotopelia peli*), amongst others, would very likely go into sharp decline.

Disruption of migratory behaviour of birds is likely to change due to global warming (Bairlein and Winkel, 2001). Contraction and eventual disappearance of feeding and roosting areas (Njai *et al*., 2005) in the Bijol Islands would force migrant birds to seek out other feeding areas or risk dying from exhaustion and hunger. New nesting sites for marine turtles on sandy coastline would bring them into closer contact and conflict with humans. People whose livelihoods are linked to the vitality of ecosystems are at significant risk of losing their livelihood. Twilley (1985) found that 51 per cent of fish caught in artisanal fisheries are involved in food webs related to mangroves. Livelihoods for hundreds of women rice and vegetable farmers working on the margins of the Tanbi wetland complex are equally threatened by rising tidal levels. Eco-tourism may be harmed by changes in the mangrove ecosystems. Environmental changes could favour parasite ecology increasing endemicity and drug resistance. Structural changes to savanna woodland on higher ground are likely to be insignificant. In the absence of proper drainage or effective stormwater management, torrential rainfall is likely to aggravate deterioration of road stock and increase sediment and nutrient loading in lowlands. Water supplies, already straining to meet demand, are most sensitive to seasonal rainfall distribution, global warming and heat waves. Infectious diseases could be a problem considering the high population density and mobility of the population in this area.

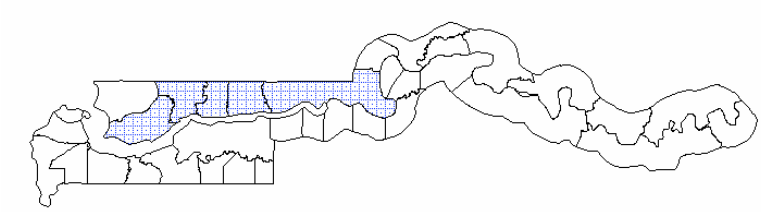
[13] Ichthyofauna: fish species

[14] Based on communication from Famara Darboe, Department of Fisheries, Department of State for Fisheries and Water Resources

[15] See IUCN Red list categories at www.iucnredlist.org , or www.**iucn**.org/themes/ssc/**redlist** archive/index_archive.htm)

Respiratory diseases or distress could increase from a concoction of traffic emissions and ground-level ozone.

Continental North Bank Region[16]
(Jokadou, Lower Baddibou, Central Baddibou, Upper Baddibou)



Dominant landscapes in this region comprise of agricultural land with trees and extensive mangroves dissected by an intricate system of channels. In some places, flood plain woodland is found on higher ground behind mangroves. The region contains most of the nation's pristine mangrove with central Baddibou alone accounting for 60 percent of country total. Barren flats[17] are found in the lower reaches of major freshwater tributaries of the River Gambia, Miniminium and Bao Bolon (Twilley, 1985).

Key aspects of climate change are expected to have a significant impact on lowland communities. With the exception of the Bao Bolon Wetland Reserve, backward migration of mangroves would be hampered by topographic gradients and other land uses. The character and vegetation of seasonal fresh or brackish marshes bordering the Bao Bolon is also likely to change, with lower presence of *gramineae* and *cyperaceae* species. Hemmed in by a more challenging environment, human settlements and activities, wetland communities would concentrate in the most favourable areas within the Miniminium Basin and Bao Bolon Wetland Reserve (Birdlife International, 2005). A weaker salt flushing and inundation of wetlands would reduce productivity and diversity of brackish water species in the lower estuary. Faunal species at greatest risk from habitat modification include the Nile crocodile (*Crocodylus niloticus*), African rock python (*Python sebae*) and royal python (*Python regius*).

Cultivation patterns and choice of crops may come under increasing pressure to adapt to circumstances.[18] As a counter-measure to saline intrusion, higher investments would be required to maintain and protect rice cultivation in seasonally flooded freshwater swamps. Subject to radical management changes, open grazing may no longer be sufficient to maintain the quality of livestock products. Harvesting of timber and non-timber natural products from woodland is also jeopardised by decline in productivity. It is

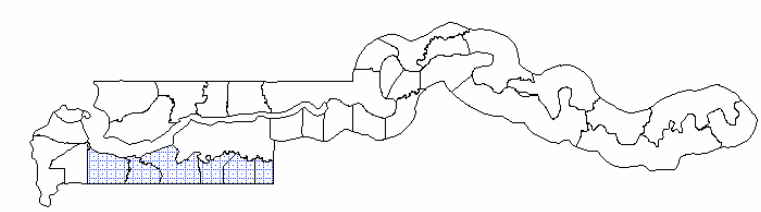
[16] Publications on The Gambia prior to April 2006 refer to "Divisions" instead of "Regions". The change in nomenclature which took effect after that date is a reflection of changes in the country's local governance model

[17] Barren flats: Tidal flats that are rarely flooded by diurnal tides with high concentration of salt and low pH both inimical to the presence of vegetation. In comparison to adjacent mangroves these areas are cryptically described as barren flats.

[18] Evidence of such adaptation taking place is already available. In some places, traditional cereal crops are replaced by water melon (*Citrulus vignata*), which fetches a higher price per unit area cultivated. Disadvantages include market saturation and loss of food autonomy.

notable that forest resources are an important or supplementary source of livelihood for the poor, and constitute the bedrock for traditional medicines. Therefore, a significant proportion of the population could be affected by the loss of specific forest services (Bojang *et al*., 2005). Irrespective of its magnitude, sea level rise places some of the country's UNESCO World Heritage sites namely, James Island, Juffureh[19] and Albreda, which are steeped in African and European colonial history, including the slave trade in this part of the world under threat from wave erosion and submergence.

Continental Western Region
(Kombo East, Foni Brefet, Foni Karenai, Foni Kansala, Foni Bondali, Foni Jarrol)



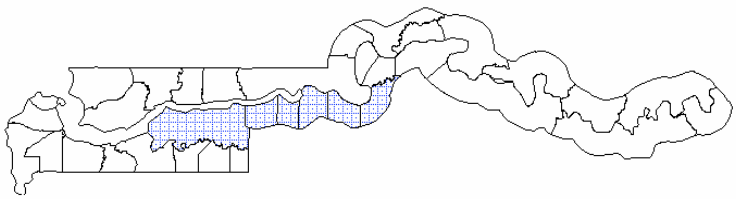
This part of the country is covered by a mosaic of savannah woodland, shrubs, fallow areas and mangroves. Species composition of vegetation stands are determined by a host of natural and human factors. Natural ones include topography, tidal hydrology, soil physical and chemical properties, climate, etc.

Climate change could alter some of these factors thereby making climate one of the most important drivers of environmental change. Approximately 10 per cent of the area covered by mangroves could be flooded by sea level rise. However, loss of mangrove cover could be mitigated by migration into and succession of floodplain savannah species. A potential drop in forest productivity is also cushioned by relatively high rainfall and groundwater resources in this part of the country. However, the situation may be complicated by water use in fruit plantations and horticultural operations. Protection of rice fields in the floodplains and the viability of backswamps would increasingly depend on the presence of water control works/infrastructure.

According to Jaiteh and Saho (2006), 65 to 75 per cent of the population in this region is involved in agriculture and animal husbandry. The authors also report the population in this region as being one of the least mobile in the country. Cattle ownership being more concentrated, pressures to bring reforms to the livestock economy are likely to create social tensions. Conflict prevention and resolution mechanisms are therefore likely to determine the persistence or otherwise of conflicts. Water-borne diseases, such as malaria, dengue fever and yellow fever may increase following the emergence of new habitat for *Anopheles* and *Aedes spp.* and non-commensurate protection measures. Fuelwood supplies for urban areas are likely to become less dependable and more costly.

[19] Juffureh: Home of Alex Haley's Mandinka ancestor, Kunta Kinte, immortalised in the author's book and TV series 'Roots'.

Lower River Region
(Kiang West, Kiang Central, Kiang East, Jarra West, Jarra Central, Jarra East)

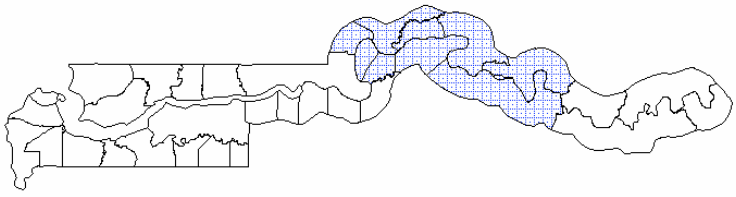


This part of the country has the largest patch of savannah woodland. Not surprisingly one of its administrative units, Kiang West district, has the lowest population density in the country. Jarra Central district also endowed with significant forest cover is one of three districts that are among the six least densely populated in the country (Jaiteh and Saho, 2006).

Dense mangrove belts along the River Gambia and numerous creeks in this region are expected to suffer some stress due to sea level rise, and also from reduced salt flushing arising from natural and regulated freshwater inflows (COTECO, 2006). Escarpments stretching between Mootah Point (River KM65) and Krul Point (River KM120), overlooking the River Gambia would be a formidable constraint for species migration. Slow-moving threatened species such as *Rhizophora spp*., and *Laguncularia racemosa* could disappear locally. The resilience of savannah woodland and anomalous vegetation patterns along the Bintang Bolon (Cham *et al*., 2001) suggest that climate change will have little impact on vegetation. Grazing pressure from lowland migrant species is not expected to make any difference.

Farming and animal husbandry which constitute a source of livelihood for more than 65 per cent of the population could be harmed by erratic rainfall patterns, contraction of shrub savannah and bush fires (Bojang *et al.*, 2005; Cham *et al.*, 2001). Artisanal fishing will also suffer from mangrove losses and changes in the hydrological regime of bolons and the River Gambia. Sediment mobilised by cross-currents from submerged barren flats could compound these problems Due to high mobility and distance travelled by users of the TransGambia route and national highway that meet at Soma, the risk of infectious disease outbreaks in this region, and/or outward propagation may be relatively high.

Central River Region
(Niamina Dankunku, Niamina West, Niamina East, Fulladou West, Lower Saloum, Upper Saloum, Nianija, Niani, Janjangbureh, Sami)



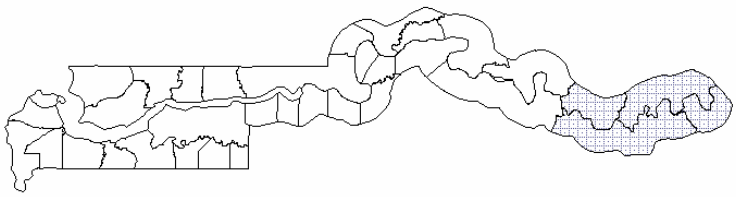
The River Gambia in this part of the country is characterised by meanders, anabranches, and islands. The river valley which cuts into alluvial deposits is up to 2 kilometres wide in places, and flanked by mangrove that gradually morph into freshwater riverine forest and thickets. Seasonally flooded riverine forest in the Gambia River National Park is dominated by *Mitragyna inermis*. On the northern side of the River Gambia, extensive swathes of original savannah woodland

have been converted to agriculture and fallow land. Shrub savannah can be found on thinner soils in the Niani and Sandu districts. Agricultural land on the South bank is carved from extensive savannah woodland close to settlements. Floodplain shrub savannah vegetation is found upstream of Bansang.

In conjunction with changes in rainfall and global warming, sea level rise could alter the tidal hydrology and physical environment significantly. According to Birdlife International (2005), river islands in The Gambia are important habitats for water fowl such as the white-faced whistling duck (*Dendrocygna viduata),* garganey (*Anas querquedula)* and spur-winged goose (*Plecopterus gambensis).* Faunal species most at risk include those perceived as pests, and/or a threat to human safety, and/or a source of animal protein. The hippopotamus (*Hippopotamus amphibius*), which meet all three criteria could therefore be under serious threat of extinction.

Agricultural and horticultural production on the river islands would become increasingly costly to protect from natural hazards and pests. Pests in particular would be drawn by successful husbandry in an otherwise devastated environment. Dry season cattle grazing and scientific research best exemplified by the River Gambia National Park Chimpanzee Rehabilitation Programme could become casualties of contracting range. A similar challenge is faced by cattle owners and herders in other places. As much as 90 to 95 per cent of the population who are engaged in agriculture and husbandry (Jaiteh and Saho, 2006) may need to make some tough choices in keeping with expected changes in rangeland and agricultural productivity. It is notable that attempts to bring marginal land into production runs the risk of irreversible degradation. The overall impact of bushfires is uncertain. Fires may destroy soil organic matter (NEA, 1997) and alter species composition, but are also recognised for their positive role in releasing nutrients and controlling pest (Whelan, 1995). Direct impacts of erratic rainfall and higher temperatures include lower groundwater recharge, but this effect is likely to be overshadowed by river regulation and relatively low groundwater abstraction rates. New and increased public investments in causeways and dykes would be needed to access, protect and/or secure rice growing areas. Further channel braiding and increased meander sinuosity is also expected with rising sea levels. A combination of higher temperatures and permanent flooding in rice-growing areas in the lowlands is expected to increase the range of snails (*Bulinus spp*.) hosting bilharzias.

Upper River Region
(Fulladou East, Sandou, Wuli, Kantora)



Three broad classes of vegetation cover are found in this region. Their spatial distribution is roughly determined by a combination of landscape and surface geological factors. Flood plain shrub savannah is confined to the River Gambia valley and imperfectly-drained depressions separated from the river by minor levees. On thinner soils outside the flood plains, shrub savannah is the dominant vegetation. *Securidaca longipedunculata, Combretum spp, Cassia spp.* are the major

species in shrub savannah, whilst *Avicennia africana* and *Mitragyna inermis* co-dominate the floodplain shrub savannah. Dominant species owe much of their preeminence to fire, and drought resistant characteristics. Large tracts of savannah woodland are found in the Fulladou East and Sandu districts where elevation is between 20 and 30 meters above current sea level.

Climate change may alter vegetation patterns and associated faunal species. In high elevation frontier areas dominated by shrub savannah, erratic rainfall and higher temperatures may constrain the survival of annual species. These are likely to be replaced by grasses and species with higher tolerance of environmental stress. Habitat loss would compound the threat to *Securidaca longipedunculata, Combretum spp, Cassia spp.,* normally associated with shrub savannah. Medicinal plants (e.g. *Cassia sieberiana, Cassia nigricans, Detarium microcarpum, Eythrophleus guieense*) and valuable grazing may be lost in the transformation process.

Subject to the degree to which annual floods are downgraded by flow regulation, sea level rise may compound flooding problems in the regional capital of Basse and environs including farmland. Torrential and unseasonal rains are also likely to take a heavy toll on agricultural production. In general, inter-annual variability of crop yields is expected to increase. Extensive flooding and high temperatures make outbreaks of infectious disease more likely.

2.3. NAPA Framework

Following the opening for signature of the United Nations Framework Convention on Climate Change (UNFCCC) at the historic Earth Summit held in Rio de Janeiro, Brazil, in 1992, The Gambia moved to undertake an inventory of sources and sinks of greenhouses in compliance with Article 12, paragraph 1, subparagraph (a) of the UNFCCC.[20] By way of comparison, issues of adaptation, integral to the text of the UNFCCC, only took on meaning in The Gambia after completion of sectoral vulnerability studies under the umbrella of the US Country Studies Programme (USCSP) in 1997, and landmark decisions of the Conference of the Parties (COP), notably Decision 28/CP.7, Decision 29/CP.7, Decision 1/CP.10, Decision 28/CMP.1, putting adaptation issues firmly on the negotiating table.[21] In the last decade and a half however, greater progress has been made in other areas, with strategies and action plans developed for the UNCCD (United Nations Convention Combating Desertification), and UNCBD: (United Nations Convention on Biodiversity); two other multi-lateral environmental agreements (MEAs) launched in Rio. With the passage of time, national institutional dynamics, and regional cooperative frameworks have added new dimensions and complexity to environmental governance challenges.

[20] The activity was conducted in 1993 with GEF funding, and UNEP serving as Implementing Agency (IA).

[21] Decision 28/CP.7 set the guidelines for NAPAs
Decision 29/CP.7 set up an LDC Expert Group (LEG) to provide guidance and advice on the preparation and implementation strategy for NAPAs. Decision 1/CP.10 relates to the Buenos Aires programme of work on adaptation and response measures. Decision 28/CMP.1 sets out basis for guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Adaptation Fund

Since climate is a key determinant of civilisation and culture (WMO, 2004), and climate change increasingly acknowledged as the gravest challenge facing humanity (Drexhage *et al*., 2007; Ackerman and Stanton, 2006; Stern, 2006; Simms, 2005), the NAPA, albeit a relative newcomer, brings in a fresh perspective to existing development and environmental management plans. Depending on the degree of convergence on issues of common interest, the NAPA will seek to: 1) consolidate gains, or 2) rectify current trajectories, or 3) propose new solutions to existing and emergent problems.

Essentially, the NAPA stimulates a critical re-examination of the role of climate on societal and natural systems. Implied assumptions of a stationary and/or benign climate, as well as oversight or denial of its centrality are brought into sharp focus. Preceding sections of the report have already shown that major sectors of the Gambian economy, natural resources and ecosystems are and will continue to be adversely affected by climate change and variability. According to Jaiteh and Saho (2006), nearly half the economically active population owe their livelihoods to agriculture and animal husbandry, which in turn rely heavily on ecosystem services.

2.3.1. NAPA Goals

Collectively, projects in the NAPA portfolio seek to address urgent and significant climate threats through actions that:

- Deliver immediate adaptation benefits
- Contribute to building local and national adaptive capacities
- Create awareness and build foundations for maximising long-term adaptation benefits

Success depends to large extent on planners/managers ability to maintain control over the implementation process, resources availability and strategies to overcome barriers.

2.3.2. NAPA Strategies

The NAPA in its first and subsequent phases is built on an approach that combines participatory action to generate commitment; capacity development to enhance stakeholder participation; proactive learning to deal with evolving risks; and policy integration to build a supportive environment for adaptation activities funded through traditional and new sources/partnerships.

Achievement of NAPA goals measured by: 1) significant reduction in the degree of exposure and/or sensitivity of natural and societal systems to climate hazards; and 2) increase in the resilience of impacted communities/systems, is mediated by a set of cross-linked strategies, briefly discussed below.

Participatory Planning, Implementation, and Monitoring

In order to be effective many adaptation strategies need to be accepted by key players. Elitist/technocratic approaches in the past have failed to generate a sense of ownership and commitment leading to failure of government policies and projects in many places.

To maintain public interest and support therefore, community, private sector, and civil society participation that was initiated during the NAPA preparation process would need to be sustained. The experience of the Department of Community Development (DCD),

Department of Agricultural Services (DAS), and partner NGOs with a long history of community engagement would be invaluable to inclusion of the poor and socially-marginalised, as well as management of decentralised activities/initiatives. If the evidence on coping strategies/autonomous action taken in response to climate variability is any guide, one can safely say that people have strong incentives to espouse adaptation actions.

Mobilisation of funds

Successful implementation of adaptation activities and achievement of NAPA goals no doubt requires mobilisation and timely availability of funds. Notwithstanding the climate change levy under the Kyoto Protocol, and goodwill (voluntary contributions/pledges, donations) of Parties to the UNFCCC, and towards replenishing the Adaptation Fund (AF), Least Developed Country Fund (LDCF), Special Climate Change Fund (SCCF), the protracted negotiation process is proving a bottleneck to accessing these funds. Considering possible linkages between timing and benefits of adaptation (Leary *et al*., 2007), a fresh look at the financial mechanism of the UNFCCC and fast tracking of disbursements is needed. Here, public diplomacy and collective bargaining has a fundamental role to play. Additionally, The Gambia may wish to consider tapping sources of non-traditional funding. [22]

Mainstreaming and Policy Linkages

Building on the platform of gradual awareness of climate change hazards and challenges, and the incontrovertible need for adaptation in most vulnerable countries including The Gambia, adaptation actions should be mainstreamed into development policy and planning at every level. An important first step towards mainstreaming adaptive activities is their integration into the national budget framework, and association with sectoral priorities to help ensure adequate funding from multiple sources.

Drexhage *et al*. (2007) highlight a number of examples and opportunities whereby foreign policy linked to trade, energy, and international cooperation can leverage opportunities to advance climate change objectives. Foreign policy in particular could influence negotiating positions under the UNFCCC and greatly facilitate mobilisation of funds in order to meet climate change challenges. Integration of broad social and economic policy issues in a new climate policy would certainly create greater understanding an appreciation of adaptation among policy- and decision-makers. Putting the right policy frameworks in place will further encourage and facilitate effective adaptation by households, communities, and the private sector in the medium- to long-term.

Capacity Building

Whereas inadequate technical and human capacities are some of the hallmarks of widespread poverty and underdevelopment in LDCs, on-going and projected climate change is likely to place further strain on the Gambia's already over-stretched resources. The only way out of this difficult situation is to strengthen capacity at different levels of social organisations, and in both public and private sectors.

[22] This does not discharge developed counties of their obligations under the UNFCCC and its Kyoto Protocol.

The true extent of the human capacity deficit is not known with any accuracy, but a National Self-Assessment Capacity Study by Jallow and Gomez (2003) provides an insight into the technical, management, leadership skills needed within the public sector for effective management of natural resources. If used as a tool for NAPA implementation, its scope would have to be re-defined and capacity development in the informal and private sector assessed. Government could assist people to build/strengthen their adaptive capacity through participatory planning/multi-stakeholder processes, which favour the kind of proactive learning needed for continuous assessment of climate risks, and effectiveness of measures deployed.

Sectoral Intervention

Sectoral linkages are well recognised, and the arguments for integration well founded to some extent. However, integration is best done at the conceptual stage of complex interventions/projects when sector-specific components could be clearly identified and assigned to professionals with a heavy dose of sectoral expertise. Coordination by a seasoned professional with broad experience is of course essential for smooth and successful implementation of a multi-component project.

2.3.3. NAPA Implementation Arrangements

The proposed projects, being priority interventions of Government to adapt to climate change will be implemented through the existing institutional arrangements for the preparation of the NAPA for The Gambia. These institutional arrangements can be visualized at three levels: central (Policy Focal line Department of State for UNFCCC (Department of State for Forestry and the Environment (DOSFE)), and National Climate Committee); regional (Divisional Development Committee and Climate Change Committee); and community (Ward Development Committees and Village Development Committees).

Central level: DOSFE will have overall policy and technical oversight for the implementation of the projects and the technical functions will be executed by the National Climate Committee (NCC) chaired by the Director of Water Resources (Technical Focal Point of UNFCCC). The NCC will be assisted in its coordination functions of the day-to-day implementation, management and administration of the project by a Project Management Unit headed by a Project Coordinator in the lead technical institution. The collaborating technical departments will be responsible for the day-to-day implementation management and administrative functions of the project through contact persons for the various projects.

Regional Level: At the regional level, the Regional Coordinating Committee (RCC) will have overall regional policy and technical oversight for the implementation of the project. Its technical coordination functions will be provided by the Climate Change Committee chaired by the Governor. The Committee will guide and supervise the implementation process of the project at the regional level. Responsibility for implementation will lie with the relevant technical departments, NGOs, local authorities and participating community-based organizations.

Community Level: The community level institutions are the entry point for community development activities and will therefore be responsible for the day-to-day implementation management and administrative functions of the project. Since all settlements in both the rural and urban areas are clustered in wards the Ward Development Committee will be responsible for coordinating, organizing and supervising the day-to-day inputs of the settlements in the cluster in the project implementation. The Village Development Committees (VDCs) will be responsible for initiating, organizing and ensuring the day-to-day input of their respective villages in the project implementation process on a timely basis. The Multi-Disciplinary Facilitation Teams (MDFTs) will backstop the WDCs and VDCs in organizing their daily technical inputs.

2.3.4. Relationship with national development plans and MEAs

NAPA and the PRSP/MDGs

Despite a culture of diligence and relevant government social and economic policies, household poverty reduction remains an elusive goal (ROTG, 2006). Factors contributing to poverty such as lack of access to quality health services; poor educational achievement; gender inequalities; and, biological capacity of the environment - singled out for attention in the Strategy for Poverty Alleviation (ROTG, 2003), are remarkably similar to challenges addressed by the Millennium Development Goals (MDGs). Not surprisingly therefore, the Gambia's second poverty reduction strategy (2007 – 2011) uses MDGs as benchmarks for sustainable human development. The NAPA and MDGs share common objectives of promoting national food security, and enhancing livelihoods of those actively engaged in the agriculture, livestock, and fisheries sectors (GOTG, 2006; Samba and Ceesay, 2004). We perceive three dimensions to the relationship between the NAPA and MDGs. First, the NAPA provides the means for assessing sectoral vulnerability to climate change and ripple effects on progress towards attainment of MDGs 1, 6 and 7. Second, a heightened understanding of adaptation mechanisms/strategies avoids duplication whilst highlighting adaptation deficits (Burton and May, 2004). Finally, the NAPA serves as a relay or conduit for interventions beyond 2015. To be successful some of these may need immediate action.

Strategies common to the PRSP and NAPA under the **agricultural sector** respond to the need for: 1) optimal use of natural resources, 2) higher and stable productivity levels, and 3) increased net profits from agricultural activities. To accelerate progress and keep the momentum towards attainment of the MDGs, the NAPA also prescribes: 1) measures to reduce demand and supply disequilibria, 2) novel financial mechanisms for stabilising rural population, and 3) strategies for managing human-wildlife conflicts, and preserving agro-biodiversity. In the **fisheries sector**, great emphasis is placed on optimal resource exploitation strategies. The NAPA also proposes strategies for: 1) reducing demand and supply disequilibria, 2) minimising loss of lives and property, and 3) making fisheries a profitable economic activity under adverse climate change. Both NAPA and PRSP agree on the need for improved rangeland management and disease control in the **livestock sector**. Complementary strategies (under the NAPA) designed to reduce the impact of climate hazards include: 1) the deployment of techniques/technologies for increasing animal productivity, 2) controlled use of fire, and 3) establishment of legal and technical props for livestock-based livelihoods.

Integration of ethnomedical treatment into the **health service delivery system** (GOTG, 2006) could be another point of convergence between the NAPA and PRSP. Essentially, NAPA strategies for the conservation of (valuable and rare) genetic species *Mitragina inermis, Tamarindus indica, and Sterculia setigera,* amongst others, is a *sine qua non* for the survival of traditional medicine and the knowledge behind it. This dovetails neatly with strategies to upgrade **forest resources** that have deteriorated significantly in the past six decades (Bojang *et al*., 2005; Samba and Ceesay, 2004; GOTG, 2000). Afforestation, social forestry, transboundary management of contiguous forest/wetlands, and strengthened forestry management (research, laws, and institutions) constitute the basis for a common raft of PRSP and NAPA strategies (GOTG, 2006, Bojang *et al*., 2005; Samba and Ceesay, 2004). Preparation or finalisation of resource management tools (policy, legislation, action plans), and augmentation of supplies are key priorities for **water resources** management.

NAPA and the Gambia Environmental Action Plan (GEAP)

The GEAP is based on utilitarian principles, which weigh the benefits of improved economic performance and quality of life against societal costs created by particular developmental actions/strategies. Thus, the principal goal of the GEAP is to ensure sustainable development (GOTG, 2000).

The GEAP and NAPA have overlapping interests in agriculture and livestock, natural resources and coastal zone management. Agricultural expansion into forest and marginal areas and encroachment into Ramsar wetland areas is not an issue under the NAPA. Nonetheless, agroforestry and agricultural market reforms *inter alia* are perceived as catalysts for optimal forest resource utilisation. Both NAPA and GEAP place a strong emphasis on afforestation and sustainable management of forest resources, with the GEAP strongly advocating for the introduction of private woodlots/plantation forestry, and alternative fish processing technologies (Njai, 2000). Bush fire control, a key element under the NAPA, does not have sufficient visibility in the GEAP. Regarding water resources, the GEAP focuses more on sustainability of supplies, and measures to overcome infrastructural deficits. The NAPA explores other dimensions such as climate change impact on water resources and linkages with ecosystem services. Whereas no management plan for the coastal zone has been developed under the GEAP, the NAPA is aligned to the general principle of distributed benefits among different stakeholders, and protection of physical infrastructure, economic and cultural assets.

At the time the GEAP was prepared, there was no energy policy but the basic tenets espoused under the GEAP process are the production of energy from environmentally acceptable sources, and better demand management. It is widely acknowledged that the Gambia has a narrow energy resource base (Sahel Invest International, 2005), and priority actions similar to those in the NAPA are centred on sustainable and efficient use of fuelwood resources (GOTG, 2006; Bojang *et al*., 2005), safety and security of supply of petroleum products (Saho and Ceesay, 2005), and energy conservation (Njie, 2006). It is notable that the efficiency of biofuels is quite low (Miyamoto, 1997), and large scale commercial plantations of energy crops may have a disproportionate footprint on the environment. [23]

[23] UN warns on impacts of biofuels
http://news.bbc.co.uk/2/hi/science/nature/6636467.stm

NAPA and Disaster Preparedness

The fact that climate characteristics have changed in the last six decades is now beyond debate. An upward trend in observed maximum temperature (Nkomo and Gomez, 2006), increasing minimum temperatures (see figure 1.5), increased frequency of daily rainfall above 50 mm, and record number of lowest and highest rainfall years in the last ten years militate in favour of mainstreaming adaptation into contingency and disaster planning. Noticeably, the Gambia's Contingency Planning and Disaster Preparedness Strategy (Njie, 1997) does not adequately address the consequences of climate change. Climate-triggered emergencies in two key sectors under the NAPA are nonetheless pertinent.

The NAPA points out the need to build and enhance capacity in dealing with meningitis, malaria and cholera outbreaks. Minimal infrastructure and information networks especially surveillance and detections systems are also needed in the face of emergent and new diseases (e.g. SARS and Avian Influenza). Increasingly common natural disasters (floods, droughts) also require early warning systems, drainage infrastructure improvements, land use zoning and efficient drought relief. A focus on extreme events reveals the need to enlarge or revise the composition of the National Committee for Disaster Relief and Resettlement in order to bring in critical input at all stages of unfolding emergencies (Njie, 1997)

NAPA and other MEAs

The UNCBD, UNCCD, and UNFCCC constitute the triumvirate of MEAs opened for signature in Rio de Janeiro in 1992. Follow-up action by the Gambia on the first two has resulted in a National Biodiversity Strategy and Action Plan (NBSAP), and National Action Programme (NAP) to combat desertification, finalised in 1999 and 2000 respectively.

It is well documented that pressure on land and forests (WMO, 2005; GOTG, 2000) are proximate cause of land degradation. Not surprisingly therefore, causal mechanisms and remedies of land degradation lie at the heart of the NAP (GOTG, 2000). The NBSAP also recognises forest cover with certain structural and qualitative attributes as essential to terrestrial biodiversity conservation (ROTG, 1999). Indeed, the loss and fragmentation of natural habitats due to deforestation is perhaps the single biggest threat to biodiversity. Suffice to state the obvious that climate characteristics, rainfall and temperature in particular, play a decisive role on the spatial distribution of vegetation (Rodriguez-Iturbe, 2000). Crucially, the viability of aquatic/terrestrial ecosystems, life cycle habitats, and food webs depend on the net effect of environmental improvement and degradation. The NAPA may be considered therefore as the common thread between the NPA and NBSAP.

However, synergies and complementarities implied or mentioned above do not mean that the whole spectrum of climate change issues has been addressed. Because the NAP and NBSAP focus on different thematic areas, they are naturally self-limiting, with frequent omission of important issues. For instance, a forestry sectoral target (30 per cent of total land area, 75 per cent of which is to be placed under controlled management) appears to relegate other land use and livelihood issues to the background, hence in need of a re-analysis. Similarly, sections of the NAP, which advocate for mixed farming practices need to be analysed within the context of mixed farming centres closures countrywide.

2.4. Obstacles to NAPA Implementation

This section of the NAPA document is a reflection on eventualities that could impede implementation of the NAPA, or practically derail the whole works. Key issues distilled from previous experience and scenario planning point to obstacles generated by **in-country institutional processes**, and others arising from **interactions with influential external entities**.[24] Notably, debt payments exceeding 35 per cent of national budget create a difficult environment for financing social investments that could complement and further reduce vulnerability to climate change. We note in passing however that it may be possible to find matching solutions for some of the innumerable and ignored/unknown risks as probabilities turn to certainty.

At country level, obstacles anticipated include: **financial, organisational, cultural, and natural resource constraints**. Cost overruns due to implementation delays and spending on non-budgeted items which belong to the first category could be avoided by a strong monitoring and evaluation framework, and supportive environment. Indeed, bureaucratic red tape is identified as a key organisational barrier to delivery of project outputs within budgets and time schedules. Other organisational constraints that could harm inter-agency cooperation and project/coordination include stakeholder rivalries, and competing pressures on key officials. Whereas clear rules of participation (roles/responsibilities/benefits) have the potential to solve these problems, corrupt practices exacerbated by inadequate capacity may stymie positive contributions by other partners.

Occasionally, cultural values may clash with project/programme objectives. This is more likely to happen when view/opinions of supposed beneficiaries of project/programme interventions have been discarded without justification during consultations, or local opinion leaders have been marginalised. In these circumstances, social discourse aimed at persuading stakeholders whilst demonstrating a willingness to learn and flexibility in approach appears to be the only way to salvage the situation. Underestimation of natural resource constraints could lead to failure to meet stakeholder expectations. Yet implementing agencies may be able to maintain credibility and support through ingenious use of substitutes, scaling down activities and/or breaking down implementation into successive phases.

In conclusion, obstacles do not necessarily lead to failure. To increase chances of success however, the need for a competent and committed team, which could comprise of professionals from government, non-government, civil society, and private sector entities, cannot be overemphasised. Government commitment above all should send strong positive signals to stakeholders and observers alike.

[24] *Ku gis nen neh gis na nen sakatouma neni Baa* (He who spots an egg and points out the fact should not be criticised for doing so especially if the egg in question is an ostrich's egg) – *Wollof* proverb.
The danger of denial is aptly captured by the French poet and philosopher, Paul Valéry (1871- 1945), in one of his numerous aphorisms in these words "A fact poorly observed is more treacherous than faulty reasoning"

3. Identification of Basic Adaptation Needs

Whilst paleoclimatologists and scientists working in related disciplines have long recognised that the earth's climate changes in synchrony with its driving forces, non-stationarity of climate in general, and the evidence for current climate change on a global scale, has only begun to register in the minds of people across the world. In contrast, high impact weather events and year-to-year climate variability have been experienced by all adults at some stage in their lives. In particular, people's personal experiences in the last two generations, augmented by folklore and oral traditions, add to the collective consciousness of a climate variability and change.

For people whose livelihoods are dependent on climate-sensitive natural resources, climate variability in all its forms has provided sufficient incentives for evolving ingenious solutions that allow them to adjust to and live with departures from the norm. The role of the modern state in promoting peaceful pursuit of sustainable livelihoods, mediating quality-of-life improvements, and promoting international solidarity amongst others, places state institutions at the centre of the search for solutions to challenges faced by citizens.

This chapter examines past and current strategies deployed by people facing climate risks, and synergistic strategies implemented by state and non-state actors with the objective of improving people's resilience to climate variability and change. The chapter also evaluates the likely performance of these strategies in the context of projected climate trends.

3.1. Previous and Current Adaptation Practices

The section follows the sub-division of sectors into: economic, natural resources and social sectors introduced in Chapter 2.

3. 1.1. Economic Sector

Agriculture

Production on 98 per cent of cropland in The Gambia relies on rainfall. Climate records, illustrated by figures 1.3 and 1.4, indicate unequivocal negative changes in the last forty years. A distance based analysis of rainfall at Jenoi (15º34'W, 13º29'N), Yallal (15º50'W, 13º30'N), and Kerewan (16º13'W, 13º29'N), in the central part of the country shows that variability is even greater at smaller time scales (Nkomo and Gomez, 2005).

Corroborating stakeholder perceptions, statistical analyses of rainfall (Alimi *et al*., 1992) confirm a decline in rainfall; shorter season; and, increased inter-annual variability as the most important climate risks faced by farmers. To offset direct effects of these interdependent rainy season characteristics including: 1) loss of soil fertility, 2) lower production, and 3) loss of household income, farming households have evolved and still rely to some extent on the following strategies: '

a) operational changes in farming activities (mechanisation, use of short-cycle cultivars, early planting, change in crops, shifting cultivation, use of organic fertiliser);
b) spreading risks (crop diversification, mixed cropping, plot dispersal);
c) sharing losses (kinship networks); and
d) other risk management strategies (sale of assets, harvesting of natural forest food)

State institutions complement and enhance the effectiveness of these risk-aversion strategies through the provision of: (1) engineering and technical leadership in land rehabilitation/conservation, and water control; (2) scientific advice, (3) relief assistance, in collaboration with United Nations (UN) agencies, multilateral institutions, and nongovernmental organisations (Cole *et al.*, 2005; Jallow, 1995).

Based essentially on pastoralism, cattle-raising in The Gambia faces problems of inadequate rangeland productivity linked to rainfall patterns. Herdsmen (who may be owner or trustees) graze their animals by moving from dry to wetter areas, in search of food and water for their animals, as the dry season intensifies and reaches its climax. Dry season grazing areas include swamps, open forest, agricultural and fallow land (Bobb *et al*., 2005; Cham *et al.*, 2001). Stock manipulation is often used to control numbers of small or other livestock, including chicken, goats, and sheep. Indeed, it is not unusual for families to sell off these animals during pre-harvest periods. For both small and large livestock, vaccinations are used to control diseases triggered and/or spread under specific climate conditions.

Fisheries

The fisheries sector in The Gambia is characterised by sharply contrasting marine fisheries and a nondescript freshwater fisheries sector. Accordingly, fishing activities are focused on the detection, pursuit and capture of fish schools in coastal waters. Shrimping is also practiced in the lower estuary of the River Gambia.

Although climate variability effects on Gambian fisheries have not been studied, evidence from analogous geographic environments (Nagy *et al.*, 2006), indicate that changes and increased variability in key climate variables have direct impacts on the aquatic environment and its ecology. Occasional events known to affect efficiency of fishing operations include above normal sea surface temperatures (SSTs), frequency and/or duration of inclement weather.[25] Long-term or persistent climate trends affecting fisheries include reduced fresh/salt water mixing in the lower estuary. Shorter flooding duration and lower flood levels in the lower and middle estuary and contiguous backswamps have resulted in the permanent drying of fish spawning ground (Darboe and Bojang, 2005), and contributed to the irreversible loss of *salmonidae*, and *arius species.*[26]

In order to compensate for seasonal sub-abundance of fish arising from bad weather or abnormally high SSTs, artisanal and commercial fisheries sub-sectors routinely increase fishing efforts, reflected by greater travel distances and increased number of days at sea. One or two operators also briefly, but unsuccessfully, engage in mariculture of tiger shrimps (*Panaeus monodon*) to meet year-round demand on the European market. Artisanal and commercial fisheries sub-sectors response to reduction of species diversity, due to climate trends and other proximate causes[27] is hardly revolutionary. Thematic studies and stakeholder consultations reveal three basic response strategies: 1) change in fishery (harvest previously under-utilised species); 2) reduction of post-harvest losses (use of preservation techniques); and 3) seasonal/permanent migration of fisherfolk (to

[25] Storms during summer months (JAS), and freezing conditions (DJF)

[26] Based on communication from Malanding Jaiteh, CIESIN, University of Columbia (USA), who recalls catching these species (as a young boy) in seasonal freshwater swamps in the lower estuary region.

[27] Compared to other factors, population dynamics is most affected by selective harvesting.

high productivity areas). State institutions responsible for orderly development of the sector and resources conservation exercise their influence through regulations on fishing gear and fishing zones.

Energy

Energy demand and consumption in The Gambia is a highly skewed affair. When expressed in tonnes of oil equivalent (TOE), fuelwood accounts for up to 84 per cent of energy consumption. Electricity and petroleum products increase this figure to 99.5 per cent, the remaining 0.5 per cent being dominated by liquefied petroleum gas (LPG) products (Njie, 2006; Saho and Ceesay, 2005). This situation obviously makes climate an important driver of changes in the energy sector.

To cushion the effects of declining natural energy products (fuelwood) resulting from continuous human pressure on forests/woodlands and decreased levels of forest productivity associated with lower rainfall since the late 1960s, households have responded by adopting one of the following measures: 1) alternative fuels (groundnut briquettes, LPG), or 2) new technology (improved cooking stoves). Big traders in fuelwood have taken to importing fuelwood from Senegal in order to maintain interrupted supplies to urban areas. A government ban on the production of in charcoal products in the early 1980s was meant to slow down the rate of forest destruction, encourage uptake of new fuel-saving technology, and spur the development of private and community woodlots. It is important to highlight that a switch in energy sources is much easier for high income households, whereas middle and lower income households are more inclined towards fuel-saving technology.

Electricity supplies face seasonal threats of disruption from tree limbs detached and tossed about by violent storms. However, properly planned and timely executed tree surgery exercises appear to minimise the threat. With peak summer time demand for cooling and refrigeration routinely exceeding installed capacity, load-shedding is the power utilities favourite tool for demand management. Regarding petroleum products, it does appear that tanker delivery to Banjul port and distribution countrywide are not overly sensitive to climate variability and extremes, hence the absence of specific coping strategies.

3.1.2. Natural Resources Sector

Water Resources

Outside salinity risk areas (Scott Wilson Kirkpatrick, 1993), freshwater can be found throughout The Gambia, at depths ranging from 4 to 30 mbgl (metres below ground level). In general, depths increase with proximity to the border with Senegal. Groundwater recharge depends on the quantity and spatial and temporal distribution of rainfall, surface geology, and land use (Howard Humphreys and Sons, 1974; Chow, 1964). Good quality surface water within the country is only found in the eastern third of the River Gambia. From June to December, freshwater availability is boosted by flows from the middle and upper Gambia River Basin areas. Low flows from January to May are mostly sustained by local rainfall (Njie, 2002).

Anecdotal evidence and instrumental data, where the latter exists, suggest that dramatic changes in regional rainfall around 1970 that persist into the present had a profound impact on water resources. Dried-up springs and streams, as well as falling water tables (GITEC, 1992), contraction of seasonally flooded swamps (Darboe and Bojang, 2005), and enhanced saline intrusion (Cham *et al.*, 2001), epitomise the challenges faced by the public authorities and the general populace.

In all parts of the country, reliance on seasonal water bodies has shifted to more dependable ground and surface water sources. Settlements along the stretch of river between.Carrol's wharf (219 km upriver from Banjul) and Kuntaur (254 km upriver from Banjul), seasonally brackish only in the last forty years, have had to find alternative water sources. Notably, wells with insufficient water columns countrywide, are re-deepened to accommodate extreme dry season water levels. Changes in seasonal salinity distribution in the River Gambia and lower parts of its tributaries are instrumental to a phased approach to irrigation development and efficient water use (Ceesay and Uphoff, 2003). Observe that natural flows in the dry season drops below $1m^3/s$ in most years, and over-abstraction could lead to further movement upstream of the saline front (concentration of dissolved solids = 1g/litre). Unfortunately, communities do not have containment or coping strategies for torrential rainfall that is increasing in frequency. For now, disaster relief, and reconstruction are the only options being exploited .

Forests and Woodlands

Natural forest and woodlands (including mangroves) cover approximately 46 per cent of the country, with marked spatial differences. Amongst others, Bojang *et al*., (2005), and NEA (1997) report that contraction of forest area and degradation of forest quality owes more to human activities than any other causes. Nonetheless, direct and indirect impacts of climate on regeneration processes, as well as biomass productivity are non-trivial. Tree growth parameters are affected by dry matter partitioning between wood/stems, leaves, storage organs, and roots (Spitters *et al.*, 1989), and closely tied to climate-related factors such as soil and air temperatures, soil moisture conditions, solar radiation, etc. (Jacoby and D'arrigo, 1997).

Coping with reduced productivity, stresses, and disturbances, involves the development of innovative conservation methods, and use of alternatives to forest resources. It has to be said however that not all responses are driven by conscious thought of protecting forests. In some cases urbanisation and aspirations for a modern lifestyle deserve recognition.

Whilst selective logging targets specific/marketable species, it is not clear what species are most affected by agricultural clearing. Logic points however to the rarest species in remaining mixed forest/woodland areas. Pressure on timber species such as the African copaiba balsam (*Daniella oliveri*), African mahogany *(Khaya senegalensis),* and African rosewood (*Pterocarpus erinaues*) is relieved to some extent by wood imports. Roof trusses made from fabricated metal are increasingly displacing the use of split trunks of the African Palmyra palm (*Borasus aethiopium*), and oil palm (*Elaies guineensis*). A change in food preferences in rural and urban areas alike, minimises the nutritional impact associated with the loss of important species including the baobab (*Adansonia digitata*), African locust bean (*Parkia biglobosa*), and African mango (*Cordyla africana*). Increasingly, people are setting up private plantations of cashew (*Anacardium occidentale*), mango (*Mangifera indica*), and *Citrus spp*. for commercial

and other uses. One has to admit however that plantations and orchards lack the species diversity of forests, and are of questionable value for wildlife uses. Communities in the North Bank Region (NBR), which have the lowest per capita forest cover in the country, secure essential supplies of forest products through well-developed supply chains from other parts of the country.[28]

There are apparently no specific compensatory measures to the loss of trees with known medicinal properties. Scarcity in the rural areas is addressed by wide-area searches, and/or purchase of medicinal products (bark, leaves, and roots) on local or trans-border markets. Urban areas, which are served by modern health facilities, rely less and less on medicinal plants for first aid or more chronic ailments. On the side of government, pressure on forest is reduced by setting aside forest reserves, embarking on enrichment planting and instituting a licensing system for commercial exploitation of forest resources (Bojang *et al.* 2005). Transfer of trusteeship to communities under social forestry programmes is a recent policy shift and practical improvement to previous forest conservation practices.

Rangelands

Rangelands loosely described as land not suitable for agricultural production, but incorporating fallow agricultural land and uncultivated swamps, cover an area of 500,000 hectares across the country (Bobb *et al*., 2005). Estimates vary by ± 10 per cent among authors (Bobb *et al*., 2005; NEA, 1997) due to differences in the definition of rangelands, and the dynamic changes of rangeland area. Rangeland vegetation is dominated by *Andropogon spp*. Fodder trees thinly populating the grasslands include *Acacia seyal*, *Daniella oliveri, Ceiba pentranda, Mangifera olifera, and Pterocarpus erinaceus* specimens. *Oryza longistemma, Echinochloa stagnina* and *Vossia cuspidate* are found on halomorphic soils.

In general rangelands are covered by a verdant carpet of grass during the rainy season. Wilting and desiccation of grass cover occurs in patches and follows depletion of soil moisture reserves. Natural pressure on rangelands comes from rainfall variability and sustained periods of hot weather. A pioneering attempt to arrest and reverse impoverishment/degradation in the 1980s, within the context of the Dankunku Rangelands Management Project, fell far below expectation (Bobb *et al*., 2005; NEA, 1997). In retrospect, it is clear that project developers and farmers/herdsmen did not share the same objectives. However, continuous shrinkage of rangelands due to shorter fallow periods, and conversion of woodland to agricultural land, is now serving as a catalyst for closer cooperation between herdsmen and extension workers. Planting of fodder trees and start-up of intensive feed gardens are indeed some of the new approaches to increasing the biocapacity of rangelands.

Sensitive Coastal Environments

These are small offshore islands, sandy shores on the Atlantic coast, and wetlands and forest biomes located approximately 20 km from the ocean. For convenience and consistency, administrative regions identified in chapter 2 are considered to represent the coastal area of the Gambia. Values at risk from climate change and variability include

[28] Based on communication from Lamin Bojang, Department of Forestry, Department of State for Forestry and the Environment

ecological assets, real estate, fisheries and tourism sectors of the Gambian economy. Diversion of diffuse runoff and uncontrolled storm runoff from highly urbanised catchments is responsible for sediment and nutrient loading in lowlands. An increasing trend in tidal water levels is also potentially destabilising for biota living in, and economic activities in coastal margins.

Risk analysts are quick to point out that sea level rise is a creeping phenomenon with hardly noticeable effects on short time scales. However, expected damages and performance of coping strategies can be assessed from sporadic storm surges especially when these coincide with spring tides. Accelerated coastal erosion and shoreline retreat are kept within limits by a raft of measures including beach nourishment, shoreline defense (rock groynes, revetments), and regulation of sand mining operations. Regulations are also used to reduce or remove human pressure on wildlife habitats and refuges. In essence, the protected area 'off-limits' philosophy theoretically increases ecosystem resilience (Von Maltiz *et al*., 2005).

Because of a significant human presence, and the absence of manipulative experiments, it is not easy to separate the effect of natural variability and human influences on the coastal environment. Suffice to say that inter-tidal communities have adequate mechanisms to cope with diurnal and intra-seasonal heat, osmotic and mechanical stresses (Tait and Dipper, 1998).

3.1.3. Social Sector

Health

Health care in the Gambia is delivered at government dispensaries/hospitals, approved non-governmental dispensaries, registered private clinics/hospitals, and by traditional healers. The number of inhabitants per physician in different administrative districts across the country varies between 2,600 and 10,000 (Source: HMIS, Department of State for Health). Although health statistics compiled at government health facilities are not climate-indexed, malaria stands out as a major public health concern.[29]

In general, people have a wide choice of strategies for coping with direct effects of climate variability including extreme temperatures. Living through seasonal heat waves involves the use of shading, hand fans, electrical fans and air-conditioning (for those who can afford it). Change in building codes and materials, and interior decorations serve to insulate dwellings from freezing exterior temperatures. Vitamin supplements and appropriate seasonal clothing provide further safeguards against cold-related ailments 'Rolling Back Malaria' involves both preventive and therapeutic measures. (Conteh *et al*., 2005). Quinine derivatives are sold over-the-counter, whilst natural mosquito repellent incense (*Hyptis suaveolus* leaves, *Daniella oliveri* bark) and pyrethroid insecticides (slow-burning mosquito coils, aerosol sprays) are available in corner shops/local markets and from ambulant traders. Bed nets are also commonly used, with permethrin-treated nets slowly gaining greater popularity through awareness campaigns, subsidised costs, and linkage with post-natal services and national immunisation

[29] In combination with other environmental factors, rainfall variability appears to have altered *Anopheles spp.* ecology. Anecdotal accounts portray mosquitoes as becoming more tenacious, opportunistic (feeding during diurnal, crepuscular, and nocturnal hours alike), and devious (approaching victims silently) feeders.

programmes for children. It may be useful however to highlight the risk of contracting malaria from sleeping or staying long hours outdoors. There is a high probability that the surge of malaria cases from an average 25,000 cases per year to 76,000 in 2004 (Source: HMIS, Department of State for Health) is due to sleeping or staying outdoors without taking necessary precautions.

Drinking water wells recently contaminated by flooding (in 1999, 2002, and 2005) are decontaminated by dewatering the well and disinfecting its shaft. Water in the well is subsequently tested for the presence of pathogens before being declared fit for drinking. In cases where structural integrity of wells is a major issue, new wells that conform to standard design (WSWG, 1995) are sunk as a replacement. Relief/Emergency water supplies are provided during this period.

3.2. Filling the Adaptation Deficit

As new research findings become available and better understanding of climate change takes root at all levels of society, it is increasingly obvious that humankind, its institutions, and practices must find new ways of living in security and prosperity under increasing climate stress. Coping mechanisms arrayed against current climate variability may no longer provide sufficient insurance. Conventional wisdom suggests fuller use of under-utilised but proven coping strategies, and the development of new ones that make the best use of available climate change science.

This section of the NAPA document is a natural continuation of the previous section on coping strategies. Whilst uncovering pertinent adaptation strategies for the future, it also serves to confirm the validity of some current coping strategies. Planners recognise that it is one thing to identify a solution, and another to implement it. Therefore removal of barriers to action (poverty, lack of incentives and ignorance or denial) is an integral part of proposed actions.

Agriculture

Against the background of projected climate change, adaptation options/activities in the agricultural sector can be linked to two general objectives: 1) enhancing food security, and 2) enhancing agriculture-based livelihoods (uplands/lowlands). In turn these can be measured by household income and food security.

Although some coping strategies worked sufficiently well in the past, Njie *et al.* (2006) highlight factors limiting their continued relevance or effectiveness. Rainfall variability, continued decline in per capita availability of land, further land degradation, social mutations and poverty effects make it increasingly necessary to seek out new and better solutions to climate hazards. Food security challenges identified under the NAPA also forces a reflection on the coherence of export-oriented agricultural policy (DOSTIE, 2002). Notice that major food/vegetable items are imported into the country, and, further export promotion may bring about loss of autonomy and food security (Meier, 1997; Sen, 1987).

Reflection and consultations on the issue of adaptation to climate change suggest the following strategic directions: 1) optimal use of natural resources (water, land, labour); 2) increasing and stabililising crop productivity; 3) making agriculture a profitable economic activity; and 4) stabilising rural population. Adaptation options/activities aligned to these, and shown in table 3.1, are organised according to a typology developed

by researchers working under the umbrella of the Assessment of Impacts and Adaptation to climate Change (AIACC) Project (www.aiaccproject.org).

Observe that some options are not entirely new and call for wider deployment/application. Others however require careful consideration on the basis of their merit. Short cycle crops for instance are not synonymous with yield increase, but may be life-savers for poor households. Conversely, irrigation minimises the impacts of spatial and temporal variability of rainfall, and also offers the opportunity to extend the natural growing season and expand total cultivated area. Integrated Pest Management (IPM) is also highly appropriate in the face of expected changes in parasite ecology. No options have been identified to counteract adverse effects of excessive/unseasonal rains and other extreme events.[30]

Table 3.1a: *Adaptation options and their relationship to vulnerability in the agricultural sector*

		Thrust of Adaptation		
		1	2	3
Agriculture	Erosion control	X		
	Water control **(not new)**	X	X	X
	Crop rotation			X
	Irrigated agriculture **(not new)**		X	X
	Agroforestry		X	
	Integrated Pest Management		X	
	Irrigated agriculture and fish farming	X	X	
	Crop diversification **(not new)**		X	X
	Farm support	X	X	X
	Animal traction ploughing **(not new)**			X
	Mechanised ploughing **(not new)**			X
	Suitable crop varieties **(not new)**		X	X
	Micro-finance **(not new)**	X	X	X
	Off-farm employment **(not new)**	X	X	X
	Food processing			X

Note:
1. **Reduce exposures to climatic stressors**: reduce the frequency, duration or severity of contact of an entity with climatic stresses (e.g. high temperatures, extreme precipitation, high winds) and/or with the direct physical and hydrological effects of climatic variations and changes (e.g. sea level rise, flooding, drying soils).
2. **Reduce climate sensitivity**: reduce the degree to which the state of an exposed entity is affected by or varies with variations in climate and/or with the direct physical and hydrological effects of climate variations.
3. **Increase climate resilience and adaptive capacity**: increase the ability of an entity to withstand and recover from climate related shocks and/or to adapt to changing climatic conditions (source: AIACC Research Group)

Seasonal migration of herders and their animals in search of pasture and water looks set to face greater challenges from: 1) blockage of stock migrations routes; 2) continuous contraction of grazing areas; and 3) conservation policies/activities. Moreover,

[30] Freezing temperatures in 2004, exacerbated by wind chill and unseasonal rains, caught livestock owners and herdsmen completely off guard, causing them heavy stock losses..

agroforestry cannot be relied on to provide enough fodder for the national herd of approximately 400,000 tropical animal units (TAUs) equivalent. Needless to say, stall-fed animals and small ruminants would require sufficient feed to justify their upkeep. Presumably, this should come from domestic left-overs, crop residue, grain or special animal feed.

In the circumstances, fundamental changes to current/traditional animal husbandry practices are likely to be inevitable. New approaches include: 1) rangeland management including preservation of eco-assets; 2) enhancement of animal productivity; and 3) easing constraints on livestock-based livelihoods. Corresponding adaptation options/activities shown in table 3.2 are a mixture of old (coping) and new strategies/lines of action.

Table 3.1b: *Adaptation options and their relationship to vulnerability in the agricultural sector (livestock sub-sector)*

		Thrust of Adaptation[31]		
		1	2	3
Agriculture	Genetic improvements	X	X	
	Improved animal watering **(not new)**		X	
	Domestic farming of fast-breeding wild animals		X	
	Controlled use of fire	X		
	Establishment of intensive feed gardens **(extension of agroforestry)**	X	X	X
	Demarcation of rangelands	X		X
	Stock size management		X	X
	Restricted grazing		X	X
	Rangeland regeneration		X	X
	Animal vaccination **(not new, except for PPR)**	X	X	

Whilst improved animal watering reduces the burden of trekking to water sources, it is also implicated in land degradation and overgrazing (WMO, 2005). Integrated land and water management should therefore be accorded higher priority. Intensive feed gardens (IFG), in reality, intensification of agroforestry practice also requires complimentary measures to make any headway in reducing vulnerability.

Restricted grazing and rangeland regeneration both have the potential to increase resilience of the livestock sector, except that the former may generate social discord under a continued traditional management system. Success of stock size management ultimately depends on genetic improvements, carrying capacity of rangelands, and market forces. The *Ndama* breed raised in The Gambia is relatively tolerant to trypanosomiasis, but veterinary services need to monitor and deal with *peste du petit ruminant* (PPR), a rinderpest-like disease, more effectively.

[31] See Notes associated with Table 3.1

Fisheries

Most coping strategies employed in the fisheries sector are unsustainable in the long run. Seasonal migration, change in target species, or long-distance fishing all fail to address the twin issues of sustainable fisheries and livelihood security in the context of increasing fishing pressure and ecological disturbances. Longer journey from base (greater fishing effort) may potentially assist recovery of fish stocks in closer, less intensively fished areas, but a lot depends on whether or not critical ecological thresholds have been exceeded, and the effects of continued low-intensity fishing activity on aquatic ecosystems.

Strategies that address the effects of climate-induced or climate-amplified changes in aquatic ecosystems are therefore focused on: 1) optimal exploitation of fish resources; and 2) reducing the demand and supply disequilibria. Minimising loss of lives and property, and making fisheries a profitable economic activity, are other equally worthwhile objectives of adaptation.

Table 3.2: *Adaptation options and their relationship to vulnerability in the fisheries sector*

		Thrust of Adaptation[32]		
		1	2	3
Fisheries	Closed seasons		X	X
	Closed areas		X	X
	Fishing gear restrictions **(not new)**			X
	Regulating Total Allowable Catch (TAC)		X	X
	Regulating fleet size			X
	Aquaculture **(not new)**	X		
	Dietary adjustments **(not new)**	X	X	X
	Fish imports	X		
	Post harvest preservation of fish **(not new)**	X	X	
	Improved fish marketing		X	X
	Improved fishing infrastructure		X	X
	Improved Weather Forecasting	X		

Similar to other sectors, adaptation options/activities relevant to the fisheries sector (cf. table 3.2) are a mixture of old (coping) and new strategies/lines of action. Notably, new options aim to reduce fishing pressure through technical and/or regulatory measures. Notice that infrastructure development, fish marketing, and weather forecasting are not highlighted as new options. This is because of the qualifying adjective 'improved' associated with these options. Improved weather forecasting in particular should make a significant contribution to minimising loss of lives and property in heavy seas.

From past experience, it is important to properly assess the negative externalities of aquaculture, and risk of cultivated species escaping into the wild. Demand for fish is relatively inelastic as demonstrated by public acceptance of previously unfancied puffer fish (*Lagocephalus laevigatus*) and sharks (*Elasmobranchii spp.*).

[32] See Notes associated with Table 3.1

Energy

Considering that domestic/household energy consumption dominates that of all other end-uses, and more than 80 per cent of this demand is catered by natural forest products (fuelwood, and charcoal to a lesser extent), the use of fuelwood-saving technology has proven a politically successful coping mechanism in the face of relatively slow forest regeneration rates. Alternative sources, including fuelwood plantations have been less successful. To this effect, fuelwood imports constitute an important part of the domestic energy conundrum that is likely to get more complex as source areas also come under increasing pressure from climate and non-climate stressors.

Integrated Energy Planning (IEP), a totally new approach in the Gambian context calls for adaptation options/activities that contribute to: 1) reducing pressure on natural forests; 2) providing access to reliable technologies and/or better/cheaper fuels; 3) limiting damage to infrastructure; and 4) improving energy efficiency

Table 3.3 lists the options that fit the national vision of greater energy security in the near and distant future. Understandably, a number of these options are not new, but need to be re-assessed and the most effective ones implemented on a wider scale. Whilst, expansion of solar applications is limited by high capital costs, prepaid metering in urban areas is limited by the financial and technical capacity of power utilities. In general, there is a noticeable shift away from fuelwood as a primary source of energy, and greater strategic use of petroleum products.

In a significant number of options, engineering design and materials are central to energy generation, efficiency, and conservation. In some cases, public awareness and economic incentives may be needed to support changes in technology, fuel use and consumption patterns. Implementation and oversight could also benefit immensely from institutional reforms.

Water Resources

With the exception of a few places that have groundwater quality problems, and along saline stretches of the River Gambia and its tributaries, freshwater resources availability is not a major problem in The Gambia. Impacts of increased rainfall variability and a persistent drop in regional rainfall have been sufficiently contained by engineering and management responses. In contrast, localised flood damages appear to increase, partly due to climate extremes, but also on human factors. Disaster relief provides succour to victims but the underlying problem remains.

Although Njie (2003) paints a picture of water security up to 2050, the situation becomes increasingly shaky with time. Moreover, Njie (2003) was premised on insignificant changes in the mean and standard deviation of rainfall (GFDL model).

Recent suggestions of increasing variability (ECHAM4 and HadCM3 models), and accelerated sea level rise suggest therefore the need for new options/strategies that contribute to: 1) continued water security; 2) preservation of aquatic ecosystems; 3) disaster planning and management.

Corresponding adaptation options/activities in table 3.4 show a mixture of new, and old approaches, as well as ‘hard’ and ‘soft’ alternatives to specific problems. It is also noteworthy that flow regulation, artificial recharge, and dyke construction, just to name a few options, serve multiple functions.

Table 3.3: *Adaptation options and their relationship to vulnerability in the energy sector*

		Thrust of Adaptation[33]		
		1	2	3
Energy	Bio-gas	X	X	
	LPG **(not new)**	X	X	
	Solar **(small scale use is not new)**		X	
	Woodlots **(not new)**		X	
	Saw dust **(not new)**		X	
	Briquettes **(not new)**		X	
	Ethanol		X	
	Jathropa		X	
	Burial of low voltage cables	X		
	Re-routing of high voltage lines	X		
	Redesign pylon foundations	X		
	Infrastructure and technology enhancement		X	X
	Development of incineration technology	X	X	X
	Development of renewables (wind, hydropower)	X	X	X
	Mini-grids		X	X
	Inter-connected grids		X	X
	Fuelwood saving stoves **(not new)**		X	X
	Electricity saving devices		X	X
	Prepaid metering system **(not new)**		X	X
	Thermally efficient buildings	X	X	X
	Public information and sensitisation		X	X
	Public transport		X	X

Forests and Woodlands

As previously mentioned, industrial substitutes of forest products have contributed in no small measure to cushioning the effects of reduced forest productivity. Yet loss of genetic resources and wildlife habitat remains a major problem. In this regard, adaptation efforts are geared towards: 1) sustainable commercial and non-commercial use of forest resources; 2) raising awareness; 3) restoring ecosystem health and biodiversity.

More than half the options/activities listed in Table 3.5 are quite familiar which is hardly surprising considering the prominent role of forests in the social and economic fabric of the country. Notice also the appearance of action lines already identified as adaptation options under the agricultural and energy sectors. This could be attributed to stakeholder conceptualisation of issues, but is nonetheless reflective of the fact that pressure on forest resources is mostly coming from these sectors. Some new options may also need rigourous assessment in terms of their social acceptability, negative externalities, and undesirable effects on forest ecology.

[33] See Notes associated with Table 3.1

Table 3.4: *Adaptation options and their relationship to vulnerability of water resources systems*

		Thrust of Adaptation[34]		
		1	2	3
Water Resources	Change in pumping policies		X	
	Relocation of boreholes	X		
	Artificial recharge			X
	Interception wells	X		
	Flow regulation		X	X
	Phytoextraction of salt	X		
	Water harvesting **(not new)**		X	X
	Increase water column in wells/boreholes **(not new)**		X	
	Erosion control	X		
	Improve drainage system	X	X	X
	Construction of protection dykes **(not new)**	X		
	Resettlement of people	X		
	Water supply infrastructure development		X	X
	Drought relief		X	

Table 3.5: *Adaptation options and their relationship to vulnerability of forest and woodland ecosystems*

		Thrust of Adaptation[35]		
		1	2	3
Forests and Woodlands	Reforestation		X	X
	Agroforestry		X	X
	Agricultural market reforms **(not new)**		X	X
	Energy saving devices **(not new)**		X	X
	Metal roofing **(not new)**		X	X
	Biogas	X	X	X
	Solar **(not new)**	X	X	X
	Medicines/pharmaceuticals **(not new)**	X	X	X
	Importation **(not new)**		X	X
	Expansion of protected areas		X	X
	Rehabilitation of mangroves areas		X	X
	Bushfire control **(not new)**		X	X
	Propagation of resistant species		X	X
	Public sensitisation **(not new)**		X	X

[34] See Notes associated with Table 3.1

[35] See Notes associated with Table 3.1

Sensitive Coastal Environments

Considering that half the Gambian population live in the coastal area, adverse climate change under a business-as-usual scenario could have significant impacts on the coastal environment and societal systems. Research conducted to date, and wide consultations identify a set of adaptation options and activities aimed at: 1) preserving biodiversity and ecological assets; 2) improving livelihood security; 3) strengthening coastal defences; 4) minimising impact of flooding in lowlands; and 5) minimising impact of saline intrusion in lowlands.

Table 3.6 lists options/activities, old and new, that could contribute towards achieving these aims. In general, new options are based on improved problem diagnostics and understanding, and focus crucially on long-term changes. Options that have been tried and tested call for wider application, with or without innovations, provided of course they are not in contention with new and better options. Evaluation of benefits and costs would almost certainly be part of a selection process of competing options. Note that experience and lessons acquired from previous implementation of some options give actors a better chance of success (for example Ex-situ conservation of endangered species). Catering to conflicting interests, dispute resolution, and optimal use of resources is contingent on the development of a holistic and forward-looking coastal zone management plan (CZMP).

Table 3.6: *Adaptation options and their relationship to vulnerability in sensitive coastal environments*

		Thrust of Adaptation[36]		
		1	2	3
Sensitive coastal environ-ments	Rehabilitation of mangroves areas		X	X
	Flexible zoning of reserve boundaries		X	
	Change fishing techniques		X	
	Ex-situ conservation of endangered species **(not new)**		X	X
	Aquaculture **(not new)**	X		
	Ecotourism **(not new)**		X	
	Rice cultivation **(not new)**		X	X
	Salt production **(not new)**	X	X	
	Revetment **(not new)**	X		
	Beach nourishment **(not new)**	X	X	
	Nourishment and stabilisation	X	X	X
	Groynes **(not new)**		X	
	Seawall	X		
	Water control system		X	
	Construction of dykes **(not new)**	X		
	Resettlement of people	X		

[36] See Notes associated with Table 3.1

Health

Although little research on the association between climate and health been conducted, intuitive logic and spatial analogues suggest an increase in diseases that are transmitted by insect vectors. This list includes malaria, dengue, and yellow fever, all benefiting from beneficial effects of global warming and sea level rise on insect vector population, parasite ecology and infectivity. Changes in air and water quality could also elevate the risks of schistosomiasis and acute respiratory infections (ARI).

In essence, diseases remain the same. However, risks and actual disease burdens are likely to be unevenly distributed geographically, and among different socio-economic groups. To this effect, cutting down the incremental disease burden due to climate change relies on scoping/screening techniques, and dogged pursuit of current preventive and curative measures. Adaptation options/activities in Table 3.6 confirm this line of action. New options reflect new lines of thinking, technological developments, and need for emergency and disaster preparedness.

Table 3.7: *Adaptation options and their relationship to vulnerability in the health sector*

		Thrust of Adaptation[37]		
		1	2	3
Health	Environmental sanitation **(not new)**		X	X
	*Vaccination programmes **(not new)***	X	X	
	Improved water management **(not new)**	X	X	
	Public awareness creation **(not new)**	X	X	X
	Provision of drugs and medical supplies **(not new)**		X	X
	Clean technology	X	X	
	Public transport			
	Testing programmes/Quarantine **(not new)**	X	X	X
	Training of disease surveillance personnel	X	X	X

It may be useful to also point out that some options have multiple benefits, and are therefore of great merit. Some options are not mutually exclusive but complimentary to each other. The importance of training, surveillance and quarantine measures cannot be over-emphasised when new diseases are at the centre of control efforts.

3.3. Key Uncertainties and Future Research Directions

Poorly documented/researched changes in natural vegetation cover types (gallery forest, closed woodland, herbaceous/grassland savannah, etc.) species composition and die-back phenomena associated with climate variability and change could benefit immensely from biome modelling to substantiate current assumptions, and also incorporate human influence on forest cover. Wetland and mangrove destruction on estuarine productivity and fisheries production also command a high priority.

[37] See Notes associated with Table 3.1

Considering that forest and rangeland resources are central to biodiversity conservation, ethnomedical practice, livelihood security, and quality of life for a significant part of the population, a well-designed and executed national forest survey/inventory is also in order. Species abundance, endemicity, and direct threats would logically determine conservation priorities. Agriculture, energy, and forest policy interactions should also be investigated for tradeoffs and synergies.

Research conducted to date also suggests the need to move away from the narrow concept of food security based on crop production to a nutrition-based assessment. Thus, policies/adaptation options in food production sectors (e.g., fisheries and livestock) should be cross-compared for synergies and tradeoffs. Other dimensions including equity, sustainability, and international trade also need to be factored in such assessments.

4. Criteria for selecting priority activities

The Gambia's First National Communication and NAPA thematic studies established a menu of options (consistent with the previous chapter), recognised individually and collectively as having the potential to offset some detrimental impacts of climate change. Naturally, the menu of options, which tries to be as comprehensive as possible, does not take into account limiting constraints or relative merit when the process moves on from prescription to implementation of adaptation activities. In particular, financial resources, human capacity, and time constraints are facts of life one has to manage most of the time.

To make an informed choice between options/alternatives with similar objectives (and time frame), a balanced set of criteria is indispensable to analysts/decision-makers who have the task of comparing the contribution of different options/alternatives towards meeting associated objectives. Essentially, a good criterion should contribute to establishing preference between options/alternatives (Keeney and Raiffa, 1993).

4.1. Identification of Criteria

Since climate change impacts are pervasive in natural and societal systems, the number of stakeholders or representative groups is quite high. Crucially, stakeholder perspectives and interests are not likely to be the same, yet they need recognition and integration.

Placing options that have previously been identified within the logical framework for multi-criteria analysis (MCA), specific higher level objectives and sub-objectives are mapped to individual options. Options are thus organised into sets of alternative adaptation measures (policies, programmes, project) that are assessed according to explicitly: 1) economic; 2) environmental/ecological; 3) social/cultural/religious; 4) technical; and 5) political criteria. Every effort is made to incorporate criteria suggested in paragraph 15 of the Annotated Guidelines for the preparation of NAPAs (LEG, 2002). Echoing Keeney and Raiffa (1993), BGS (2006) highlights the advantages of clustering criteria in the matter of: a) avoiding redundancies/double counting; b) identifying inconsistencies; c) making tradeoffs between criteria; and d) assessing relative weights of criteria clusters.

Considering the multiple impacts of climate change and diversity of adaptation options, criteria suggested by NAPA study groups, with inputs from extension workers and local government representatives are debated, agreed, and recorded. The minimum requirement of any criterion is that it can be used to assess options, and is clearly defined to forestall ambiguities in their interpretation and application.

Twenty-four criteria identified across eight sectors/thematic areas are shown in Table 4.1. Fourteen criteria appear to be sector-specific, but closer examination shows the number to be significantly lower. To give examples of how criteria in paragraphs15 of the Annotated Guidelines (LEG, 2002) are integrated, suffice to point out that crop yield and species availability are strong indicators of the *level or degree of adverse effects of climate change.* Similarly, *poverty reduction activities that enhance adaptive capacity* can be linked with service coverage and sustainability of interventions (ROTG, 2006). As the most widely applied criterion*, cost-effectiveness* does not require much comment.

Table 4.1: *Criteria used in MCA analyses of sectoral adaptation options*

	Energy	Water	Rangelands	Coastal	Forests	Agriculture	Health	Fisheries
Cost effectiveness	X	X	X	X	X		X	X
Acceptability	X	X		X	X	X	X	
Sustainability	X			X		X	X	X
Technical feasibility	X	X		X		X	X	
Adaptability		X	X	X		X		
Affordability	X				X		X	
Environmental benefits/sustainability		X		X	X			
Appropriate Technology			X		X		X	
Reliability	X							X
Health and safety	X							
Maximum abstraction rate		X						
Species availability		X						
Land suitability				X				
Durability				X				
Annual allowable cut					X			
Employment opportunity						X		
Crop yield						X		
Coverage							X	
Relevance							X	
Accessibility							X	
Fish catch								X
Regional cooperation								X
Illegal Unrecorded Unregulated (IUU) exploitation								X

On the other hand, *synergy with other multi-lateral environmental agreements* may be the weakest spot, but is hopefully compensated to some extent by a measure of regional cooperation. The observant reader will also notice that criteria in Table 4.1 do not differentiate between immediate and future benefits, both useful proxies for urgency of intervention.

Within the NAPA context, the criteria in table 4.1 are defined as follows:

Cost effectiveness	*the quality of providing* **1**. value for money (Dalasi, Ordinal units). **2.** maximum output for minimal input (dimensionless).
Acceptability	**1**. *prospect of approval or acceptance of an option depending on its relationship with* socio-cultural values and norms, or public policy (Ordinal). **2**. compatibility with technical expectation of end-users (Ordinal)
Sustainability	*quality/ability of maintaining functions or services undiminished on* a continuous basis (Ordinal)
Technical feasibility	can be successfully implemented (Ordinal)
Adaptability	**1.** flexibility (Ordinal). **2**. ability to integrate new ideas and lessons (Ordinal)
Affordability	**1.** purchasing power (Ordinal) . **2**. ability to meet cost of services (Dalasi);
Environmental benefits/sustainability	environmentally friendly (Ordinal)
Appropriate Technology	**1**. compatible with local know-how (Ordinal). **2**. socially and culturally acceptable (Ordinal).
Reliability	*the quality of being* available when required (Ordinal)
Health and safety	safety from hazards (Ordinal)
Maximum abstraction rate	sustainable rate of abstraction in the context of saline intrusion (m3/day)
Species availability	plant and animal species *within ecosystem* (Number)
Land suitability	Appropriateness (of use)
Durability	*the quality of being* long-lasting (Ordinal)
Annual allowable cut	maximum sustainable yield that can be removed from a forest (m3/year)
Employment opportunity	employment (Ordinal)
Yield	average crop yield (tonnes/ha)
Coverage	access to water and sanitation services (%)
Relevance	appropriateness (Ordinal)
Accessibility	Ability to acquire and use when needed
fish catch	mean annual return of fish catch (kg/km)
Regional cooperation	Level of successful cooperation in transboundary management of marine fish resources (Ordinal)
Illegal Unrecorded Unregulated (IUU) exploitation	Intensity of unauthorised fishing in Gambian waters (%)
Consumer/market preference	Choice exhibited by buyers confronted with different fish species/products (Ordinal)

Subtle differences in meaning are usually due to the context/sector in which the criteria are applied. This is one of the drawbacks of minimising the criteria set used in the analyses.

Criteria in Table 4.1 are clustered and summarised in Table 4.2 to highlight: 1) economic; 2) environmental/ecological; 3) social/cultural/religious; 4) technical; and 5) political aspects of adaptation. Weights are assigned to individual criteria in such manner as to ensure a proper balance (in the judgment of participants/analysts) of these different aspects within each specific context.

Table 4.2: *The different dimensions of adaptation in MCA analyses*

Aspect	Frequency
Economic	9
Environmental	7
Political	1
Social	18
Technical	18

Going by the relatively high frequency of use of social criteria, the observant reader will notice the importance of public validation of MCA results (and prioritisation of adaptation activities) presented in chapter 5.

4.2. Validation of Criteria and Results of Multi-Criteria Analyses

Evaluation criteria suggested by technical experts with inputs from local government representatives and extension/change agents constitute the basis for multi-criteria analysis (MCA) of adaptation options/strategies. Validation took place in two stages: 1) at policy-making level to ensure that national priorities are reflected in the NAPA; and 2) at local/community level to ensure that social concerns and aspirations are adequately addressed. At either stage, it is important to note that validation was not about technical adequacy of MCA results, but their reasonableness from policy makers' and stakeholder perspectives.

Policy-makers contributed to the validation exercise by re-examining adaptation options/strategies in the context of national priorities and development plans, and presenting different priority rankings in the economic and social sectors studied. Short-comings emerging at this point in the validation exercise include: 1) the absence of explanations/clarifications/commentaries for major differences, and 2) non-pronouncement on the comparative weighting of sectors. To explain the differences in ranking, one may wish to note that climate change is not necessarily on some policy-makers minds due to the absence of guiding policy/government white paper on climate change and development. On the technical side, insufficient expertise in MCA methodology, absence of feedback from stakeholders,[38] and lack of data on key indicators, may also explain some of the differences.

[38] A good MCA requires time for consultation with key informants/stakeholders, and, depending on the complexity of issues, may go through several iterative cycles.

To narrow down differences in ranking, some form of closure was attempted by joint ranking of adaptation options/strategies from the MCA exercise (development practitioners/MIAT), and public investment programme perspectives (policy-makers). Results are shown in Tables 4.3 through 4.10. These tables show the top six adaptation options in relation to crop production, water resources management, and forest woodland management, coastal zone management, marine resources management, livestock production, energy, and health sectors.

Table 4.3: *Priority options in the agricultural sector (crop production sub-sector)*

Option	MCA Ranking	Policy Makers Ranking	Joint Ranking
Irrigated agriculture	1 (0.688)	4	1
Suitable crop varieties	1 (0.688)	4	1
Erosion Control	3 (0.640)	4	3
Micro-finance	7 (0.550)	1	4
Crop diversification	8 (0.378)	1	5
Food Processing	8 (0.378)	1	5

Notes: The figures in parentheses in the second column are standardised MCA scores (0 < S < 1)

$S = a_j U(X)$

in which,

$$U(X) = \sum_{i=1}^{n} k_i u_i(x) \quad , \quad \sum_{i=1}^{n} k_i = 1$$

u_i = performance score of competing options, measured individually against a specific criterion, k_i = scaling constants (criteria weights) lying between 0 and 1, $U(X)$ is the non-standardised utility score, appropriate for the comparison of competing options (i.e., alternatives to achieving a specific adaptation sub-objective). Multipliers, a_j , j =1, 2, ...n, are used to standardise utility scores across different sub-objectives to allow a sectoral ranking of all adaptation options. Multipliers reflect the contribution of sub-objectives to a higher/general objective. Detailed steps and background material used in the analysis are contained in a Training Report that can be obtained from the NAPA Project Coordinator, or downloadable from www.bgs.gm/resources.html

Table 4.4: *Priority options in water resources management*

Option	MCA Ranking	Policy Makers Ranking	Joint Ranking
Changing pumping policies	3 (0.560)	1	1
Improved drainage system	5 (0.435)	1	2
Relocation of boreholes	1 (0.635)	6	3
Construction of protection dykes	2 (0.630)	6	4
Water supply	9 (0.390)	1	5
Artificial recharge	6 (0.385)	4	6

Notes: The figures in parentheses in the second column are standardised MCA scores ($0 < S < 1$)
See Table 4.3 for full explanations

Table 4.5: *Priority options in forest and woodland management*

Option	MCA Ranking	Policy Makers Ranking	Joint Ranking
Bushfire control	1 (0.760)	1	1
Reforestation	2 (0.642)	2	2
Propagation of fire resistant species	3 (0.550)	3	3
Public sensitisation	4 (0490)	4	4
Expansion of protected areas	5 (0.483)	5	5
Services (eco-tourism)	6 (0.420)	6	6

Notes: The figures in parentheses in the second column are standardised MCA scores ($0 < S < 1$)
See Table 4.3 for full explanations

Table 4.6: *Priority options in the coastal zone management*

Option	MCA Ranking	Policy Makers Ranking	Joint Ranking
Flexible zoning of reserve boundaries	1 (0.563)	1	1
Use of responsible fishing techniques	2 (0.500)	2	2
Revetment	2 (0.500)	2	2
Beach nourishment and stabilisation	4 (0.478)	4	4
Establish/rehabilitation of protected wetland areas	5 (0.475)	5	5
Rice cultivation	6 (0.460)	6	6

Notes: The figures in parentheses in the second column are standardised MCA scores (0 < S < 1)

Table 4.7: *Priority options in the fisheries sector*

Option	MCA Ranking	Policy Makers Ranking	Joint Ranking
Aquaculture	1 (0.600)	1	1
Post harvest preservation	2 (0.500)	4	2
Fish imports	2 (0.500)	7	3
Fishing gear restrictions	7 (0.315)	1	4
Closed seasons	6 (0.320)	4	5
Improved fishing infrastructure	9 (0.248)	1	6

Notes: The figures in parentheses in the second column are standardised MCA scores (0 < S < 1)

Table 4.8: *Priority options in livestock production*

Option	MCA Ranking	Policy Makers Ranking	Joint Ranking
Rangeland regeneration	1 (0.870)	1	1
Establishment of intensive feed gardens	2 (0.867)	1	2
Improved animal watering	3 (0.775)	1	3
Stock size management	7 (0.600)	1	4
Animal vaccination	10 (0.500)	1	5
Demarcation of rangelands	5 (0.620)	7	6

Notes: The figures in parentheses in the second column are standardised MCA scores (0 < S < 1)

Table 4.9: *Priority options in the energy sector*

Option	MCA Ranking	Policy Makers Ranking	Joint Ranking
Fuelwood saving stoves	1 (0.595)	1	1
Liquefied Petroleum Gas	2 (0.567)	5	2
Charcoal saving stoves	4 (0.516)	7	3
Electricity saving devices	5 (0506)	8	4
Ethanol	12 (0.424)	3	5
Development of renewables	11 (0.447)	11	6

Notes: The figures in parentheses in the second column are standardises MCA scores (0 < S < 1)

Table 4.10: *Priority options in the health sector*

Option	MCA Ranking	Policy Makers Ranking	Joint Ranking
Public awareness	1 (0.765)	1	1
Provision of drugs and medical supplies	4 (0.610)	1	2
Environmental sanitation	6 (0.554)	1	3
Training of disease surveillance personnel	2 (0.710)	9	4
Improved water management	3 (0.633)	10	5
Clean technology	8 (0.459)	5	6

Notes: The figures in parentheses in the second column are standardised MCA scores (0 < S < 1)

Validation by stakeholders at grassroots level required bringing together the top-rated options under well-defined project frameworks. Projects are built around priority options integrated with others having explicitly similar/reinforcing objectives. Arguably, this ransformation makes the MCA results more accessible and meaningful to the wider community of stakeholders. For policy-makers, the project framework also represent an important opportunity for mainstreaming adaptation options and achieving the strategic goals of the NAPA, viz., delivering immediate benefit, contributing to capacity building, and building foundations for long term benefits. It is important to remind ourselves that there are no purely adaptation projects (Leary *et al*., 2007), and too narrow a focus on one option risks missing out on synergies between two or more options**.**

In meetings held between the NAPA Project Steering Committee (PSC) and representatives of stakeholders in different regions across the country, the basis for, and outline of priority projects shown in the next chapter was well received. Minor cognitive/conceptual differences that emerged during these consultations were brokered and settled on the ground.

5. List of Priority Activities

Climate Change is a multiple hazard with impacts at different temporal and spatial scales. Natural and social systems subject to such change also have different sensitivities and vulnerabilities. Sectoral adaptation options prioritised according to relative merit in Chapter 4 are integrated into project concepts in this chapter.

The project portfolio presented below,[39] comprising projects numbered 1 to 10, address the following issues:

- Impairment of ecosystem goods and services
- Amplification of adverse effects of climate change by human factors
- Food security and sustainable livelihoods
- Poverty reduction and equity
- Technology acquisition, innovation, and diffusion
- Inadequate strategies for dealing with moving target (incremental effects of climate change).

This will be through a set of adaptative capacity building measures including:

1) public awareness building on climate change, development, and livelihood issues;
2) enhancement of technical and managerial capacities of implementing agencies, beneficiaries (artisans, technicians, civil society organisations) and extension workers;
3) participatory planning and implementation;
4) provision, construction and upgrading of physical assets essential to the reduction of sectoral vulnerabilities;
5) introduction of new/alternative technologies and production methods; and
6) institutional re-alignments and mainstreaming of adaptation.

In this regard, project activities touch on several aspects of Articles 4, 5 and 6 of the UNFCCC and overlap to a certain degree with the country's flagship environmental management (GEAP, NAP), disaster management and poverty reduction programmes (PRSP).

Depending on the nature of vulnerability addressed, some project benefits are concentrated in space whilst others have nationwide coverage. Taken from the perspective of reducing regional and national vulnerability to climate change, individual projects can be demonstrated to be mutually supportive, hence the desirability of national and external support agencies working together to implement the portfolio as a package.

[39] Individual project profiles originally prepared under contract by a select group of consultants have been amended on the basis of in-depth reviews and recommendations by the NAPA PSC, independent advisers, and stakeholders who took part in the NAPA validation workshop (August 16, 2007).

PROJECT 1

Title: Rehabilitation of Early Warning Systems on Climate-Related Natural Hazards

Sector: Water Resources

Project Area: Nationwide

Beneficiaries: Nationwide

Rationale: Climate is the main natural hazard threatening lives and livelihoods of the majority of Gambians. Despite the fact that projected changes in temperature and rainfall will almost certainly alter relative magnitudes of hydrological cycle components, the country lacks a reliable climate early warning system and basic infrastructure to reduce the impacts of extreme weather events.

Description

Objectives:

To enhance the preparedness of decision-makers and private individuals on impending climate hazards and the opportunity to harness favourable weather conditions.

Specific objectives:

- Improvement of national disaster preparedness
- Integration of climate information in socioeconomic sector planning and decision-making

Components/Activities:

Strengthening the human resource base and technical capacity of hydro-meteorological networks
Improving efficiency of climate information dissemination/delivery to end-users
Promoting use of climate information in sectoral plans

Inputs:

Hydro-meteorological equipment and information communication technologies (ICTs) for observation networks and control centre
Training
Public sensitisation

Short Term outputs:

- Functional meteorological and hydrological observation networks capable of providing reliable climate data
- A functional early warning system
- Greater awareness of the end users regarding relevance/importance of weather information

Potential long term outcomes:

- Operational data collection networks are strengthened and made responsive to users' needs
- Integration of climate information in the national planning process;
- Quality dataset for climate change detection
- Population well adapted to the adverse effects of climate change

Implementation

Institutional arrangements: The project will be implemented by the Department of Water Resources in collaboration with technical departments of the National Agricultural Development Agency responsible for Agricultural Services, Planning, Livestock Services, as well as the National Environment Agency and Local Government Authorities. Other stakeholders will be co-opted as necessary. The Department of State for Forestry and the Environment will be the executing agency

Risks and barriers:

- Inadequate coordination of the MWG to ensure timely input of data and other relevant information
- Inflation which can affect project costs if implementation is delayed
- Poor interpretation and use of climate products by end-users
- Difficulty to prepare adequately for extreme climate events

Monitoring and Evaluation: The Multidisciplinary Working Group (MWG) in Agriculture, Water Resources and Climate, with its Secretariat at DWR will be responsible for the preparation of reports that will be submitted to the authorities and the NAPA Steering Committee. At the end of the project an independent consultant would evaluate project achievements and advise on improvements needed.

Duration: 2 years

Estimated Budget: US$450,000

ACTIVITY	**COST (US $)**
Assessment of the state of existing hydro meteorological networks and the proposed flood monitoring stations	5,000
Repair, purchase and installation of hydrology and meteorology equipment /instruments	160,000
Purchase and installation of telecommunication equipment and remote sensing and data processing equipment	30,000
Provision of vehicle for countrywide trekking	25,000
Training of hydrological, meteorological forecasters and agro-meteorologists to technical and professionals levels	150,000
Data processing, publication and dissemination of information on early warning to end users	50,000
Training and Sensitisation workshops/seminars for policy makers and the local communities	15,000
Repairs and maintenance of regional meteorological offices	25,000
support to collaborating agencies	10,000
Coordination, monitoring and evaluation	5,000
TOTAL	**450,000**

PROJECT 2

Title: Improvement of Fresh Water Availability

Sector: Water Resources

Project Area: All Regions

Beneficiaries: Rural communities with inadequate and unsafe drinking water supply

Rationale: Adverse climate change manifests itself in water resources in terms of too little, too much, and/or poor temporal distribution of rainfall. Shortfalls in aquifer recharge and base flow in particular are expected to affect water availability for domestic and agricultural uses. Water shortage in these sectors risks increasing poverty, and downgrading living conditions of rural communities.

Description

Objectives:

The overall objective of the project is to ensure adequate supply of fresh water and the reduction of the negative impacts of natural disasters.

Specific objectives:

- Improving water availability in the surface and underground, in quantity and quality, suitable for agriculture, industrial and domestic needs
- Improving the water supply infrastructure
- Reducing drought impacts on domestic water supply and uses in agriculture

Components/Activities:

Construction of water supply/control infrastructure
Development and adoption of appropriate policies

Inputs:

Construction materials (including those locally available) for civil works
Labour (both skilled and unskilled)
Specialised equipment and services (for the implementation of the project)

Short Term outputs:

- Water harvesting, flow regulation and improved drainage systems
- Water supply infrastructure development
- Erosion control
- Drought relief

Potential long term outcomes:

- Greater water security for communities
- Increased protection of infrastructure from extreme climate events

Implementation

Institutional arrangements: The Department of Water Resources will be the lead implementation agency with collaboration from the offices of the regional Governors, Agriculture and Community Development, together with the NAPA Project Steering Committee. The Department of State for Fisheries and Water Resources will be responsible for the general oversight of this intervention.

Risks and barriers:

- Inflation which can affect project costs if implementation is delayed;
- Difficulty to prepare adequately for rare extreme climate events
- Multiplicity of stakeholders and the inability of implementing agencies to work in harmony
- Implementing agencies may lack the capacity to identify and implement interventions effectively
- Delays in implementation due to bureaucratic issues or lack of financing

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Monitoring and Evaluation: The Project Steering Committee with its Secretariat at DWR will be responsible for the preparation of reports that will be submitted to the authorities and the NAPA Steering Committee. Mid-way into the project life, an independent consultant would evaluate project achievements and advise on improvements needed.

Duration*:* 18 months

Estimated Budget: US$910,000

ACTIVITY	*COST (US $)*
Reconnaissance survey team to assess physical and social conditions	26,000.00
Engineering design and detail soil surveys	52,000.00
Procurement of small hand tools as specified in the bill of quantities	18,000.00
Hire of tractor complete with disc harrow and trailer as specified in the bill of quantities	32,000.00
Construction of dikes, spillways, Upland soil conservation structures i.e.; contour and diversion bunds, Irish crossings, gully plugs, road ramps, etc	600,000.00
Monitoring and evaluation and continuous site supervision of all construction works	52,000.00
Procurement and delivery of agricultural inputs, i.e.; fertilizers, rice seeds for newly created ecologies due to the dikes, and lime for the treatment of areas with low pH	92,000.00
Agronomic follow-up to advise and supervise the routine crop husbandry, and supervise vegetative measures of improved drainage	18,000.00
Provision of modern equipment to DWR for continuous comprehensive data collection	20,000.00
TOTAL	**910,000.00**

PROJECT 3

Title: Diversification and Intensification of Agricultural Production, Processing, and Marketing

Sector: Agriculture

Project Area: Central River, North Bank, Upper River, Lower River, Western Regions

Beneficiaries: Nationwide

Rationale: Rainfed agriculture is a major source of employment and livelihood in The Gambia. Erratic rainfall patterns and increasing drought frequency are implicated in soil degradation, decline in production of traditional crops, deepening poverty and food insecurity of farming households.

Description

Objectives:

The main objective of the project is to enhance food security, nutrition and socioeconomic livelihoods through agricultural diversification and intensification under increasing concentration of greenhouse gases in the atmosphere

Specific objectives:

- Increasing and diversifying agricultural production and productivity
- Establishing food processing and preservation plants
- Addressing the issue of infrastructural deficits
- Reducing demand and supply disequilibria of traded products
- Making agriculture a profitable economic activity

Components/Activities:

Establishing irrigation schemes
Promoting crop diversification
Enhancing breeding and adoption of appropriate cultivars
Establishing food processing plants

Inputs:

Physical infrastructure
Plant, equipment and machinery
Training resources

Short Term outputs:

- 14 (2 to 3 hectare size) vegetable gardens at 2 schemes per agricultural region (7)
- 60-hectare established tidal irrigated facility
- Increased multiplication and dissemination of root crops (cassava, yam, taro, sweet potatoes), NERICA, *findo* and short-cycle groundnut varieties in 12 villages
- Strengthened crop evaluation and suitable crop variety dissemination capacities of the National Agricultural Research Institute (NARI)

- Reduced post-harvest losses of crops using appropriate technologies such as solar drier, cassava grater, and threshers, mills, etc.
- Strengthened and expanded outreach programme of the Food and Nutrition Unit
- Two established central fruit and vegetable processing plants

Potential long term outcomes:

- Sustainable increased production of vegetables and household food security;
- Reduced rural-urban drift
- Reduced importation of food
- Promotion of yam cultivation
- Increased diversified cropping systems and extensive adoption of suitable crop varieties
- Improved nutritional standards and increased household food security and income

Implementation

Institutional arrangements: The Policy Focal line Department of State will be the implementing agency and the public, private and civil society agencies and institutions at central, regional and local levels will be executing agencies. The Department of State for Agriculture will be the executing agency. The National Agricultural Development Agency will lead the implementation and will work with public, private and civil society organisations and institutions at central, regional and local levels. A select number of NGO, CBO and private enterprise representatives will be co-opted into a Project Steering Committee (PSC) that reports to the National Climate Committee.

Risks and barriers:

- Multiplicity of stakeholders and the difficulties of implementing agencies to work in harmony
- Implementing agencies may have inadequate capacity to implement interventions effectively
- Delays in implementation due to bureaucratic issues or lack of financing.

Monitoring and Evaluation: The Project Steering Committee with its Secretariat at DWR will be responsible for the preparation of reports that will be submitted to the authorities and the NAPA Steering Committee. Mid-way into the project life, an independent consultant would evaluate project achievements and advise on improvements needed.

Duration: 3 years

Estimated Budget: US$2,710,000

ACTIVITY	Costs (US $)
Establishment of vegetable gardens (land dev., fence, water supply, tools, inputs)	1,040,000
Design and establish central fruit and vegetable processing plants in Brikama & Soma	1,000,000
Expand introduction/adoption of root crops, *NERICA* rice and early maturing varieties of groundnut	160,000
Strengthening/developing outreach programme of the Food and Nutrition Unit of the Department of Technical Services/NADA	90,000
Development and establishment of 60 hectares of tidal irrigated land for rice cultivation (including inputs)	270,000
TOTAL	**2,710,000**

PROJECT 4

Title: Expansion of Community Participation in the Management of Forests and Protected Areas

Sector: Forestry

Project Area: North Bank, Lower River, Western, Upper River and Central River Regions

Beneficiaries: Communities within project area of influence

Rationale: Multi-decadal trends in loss of forest cover through irrational exploitation and land use changes are exacerbated by slow rates of natural regeneration and bush fires. Social forestry is one of the new approaches in natural resources management that has proven a success in the management of protected areas and other classified forests.

Description

Objectives:

The global objective of the project is to enhance the management of forest resources for continuous supply of products for sustainable livelihood

Specific objectives:

- Maintaining and improving productive functions of forest and woodland ecosystems
- Improving and maintaining biological diversity in forest and woodland ecosystems
- Minimising soil desiccation and soil movement caused by water and wind erosion
- Empowering communities over/in their forest resource management.
- Enhancing capacity of local communities in forest management

Components/Activities:

Surveying and demarcation of the target forests and protected areas
Development and adoption of sound management policy
Establishment and equipment of regional and community level nurseries
Training of trainers in Community Forest Management concepts and techniques
Training of villagers in tree nursery attendance
Procurement and delivery of patrol and bush-fire fighting equipment to participating communities

Inputs:

Physical infrastructure
Plant, equipment and machinery
Training resources

Short Term outputs:

- Nine communities with management plans developed and adopted for sustainable forest management in project intervention areas
- 15 established district nurseries for the production of multipurpose tree species for enrichment planting
- 162 knowledgeable villages in nursery production and management
- 162 equipped villages for fire-fighting and control

Potential long term outcomes:

- Adoption of sustainable forest resource exploitation strategies
- Legal ownership over the forest and its resources by the participating communities
- Increased earning capacity of participating communities
- Well established network of community nurseries for a large scale tree planting
- Increased supply of forest resources
- Large areas of regenerated forest cover and availability of wide variety of forest resources

Implementation

Institutional arrangements: The Department of State for Forestry and the Environment will be the executing agency. The Department of Forestry will lead the implementation as Implementing Agency and will work with public, private and civil society organisations and institutions at central, regional and local levels. The Project Steering Committee will be reporting to the National Climate Committee.

Risks and barriers:

- Multiplicity of stakeholders and the inability of implementing agencies to work in harmony
- Inability to contribute effectively due to conflicts of interest
- Implementing agencies may not have adequate capacity to implement interventions effectively
- Delays in implementation due to bureaucratic issues or lack of financing
- Potential resource use and ownership conflicts

Monitoring and Evaluation: The Project Steering Committee with its Secretariat at DWR will be responsible for the preparation of reports that will be submitted to the authorities and the NAPA Steering Committee. Mid-way into the project life, an independent consultant would evaluate project achievements and advise on improvements needed.

Duration: 5 years

Estimated Budget: US$1,412,000

ACTIVITY	Costs (US $)
Surveying and demarcation of 3 target community forests	458,000
Development of 3 management plans	74,000
Establishment of District Nurseries	
Production of seedlings	80,000
Training of villagers in tree nursery production (budding and grafting techniques, methods of transplanting tree seedlings and forestry management principles)	30,000
Equipping each of the participating communities/villages (3) with patrol and bush-fire fighting equipment	20,000
Provision of boreholes fitted with appropriate water lifting devices (2)	600,000
Strengthening the forestry extension and M&E units and some selected NGOs and CBOs	150,000
TOTAL	**1,412,000**

PROJECT 5

Title: Expansion and Intensification of Agro-forestry and Re-forestation Activities

Sector: Forestry

Project Area: North Bank, Lower River, Western, Upper River and Central River Regions

Beneficiaries: Communities within project area of influence

Rationale: Local tree species play a major role in improving livelihoods and food security. Declining populations and disappearance of valuable species from specific areas due to drought and human factors (land use change, commercial exploitation) requires urgent remedial actions.

Description

Objectives:

The global objective of the project is to enhance the contributions of properly restored forest ecosystems to forest-based poverty alleviation and more broadly to other national economic goals; reduce the vulnerability of the affected stakeholders and increase their resilience to cope with climate change.

Specific objectives

- Promotion and adoption of appropriate agro-forestry systems and reforestation
- Maintenance and improvement of the productive functions of forest and woodland ecosystems
- Improvement and maintenance of biological diversity in forest and woodland ecosystems,
- Slowing down topsoil degradation (desiccation, and transport) by water and wind

Components/Activities:

Diagnostic study of technical problem for agro-forestry treatment and determination of appropriate technology packages
Sensitisation and awareness-creation campaigns
Surveying and demarcation of the target forests
Establishing nurseries of multi-purpose tree species domestication seedlings and re-forestation seedlings
Training of villagers in tree nursery production
Equipping participating communities/villages with patrol and bush-fire fighting equipment
Strengthening agro-forestry research within the National Agricultural Research Institute (NARI)

Inputs:

Physical infrastructure
Seeds

Vehicles and supplies/consumables
Training resources
Plant, equipment and machinery

Short Term outputs:

- 162 enlightened communities in the value of agro-forestry and re-forestation in the five participating regions
- Repertoire of 33 identified agro-forestry technical packages for adoption in 11 villages within three (3) regions
- Agro-forestry technical packages for 11 villages within three (3) regions
- 15 established district nurseries for the production of multipurpose tree species seedlings
- 162 knowledgeable villages in nursery production and management
- 162 equipped villages for fire-fighting and control
- 162 identified forest areas
- Well equipped agro-forestry research unit

Potential long term outcomes:

- Widely-adopted agroforestry and reforestation systems in 162 villages
- Copious supply of multipurpose domesticated tree species and reforestation planting materials
- Large areas of regenerated forest cover and availability of wide variety of forest resources
- Established capacity to produce tree seedlings for planting
- Reduced resource ownership disputes and use conflicts
- Availability of scientific knowledge and information on agro-forestry and the state of the national forest cover

Implementation

Institutional arrangements: The Department of State for Forestry and the Environment will be the executing agency. The Department of Forestry will lead the implementation as the Implementing Agency and will work with public, Civil Society Organisations/NGOs and private sector institutions at central, regional and local levels. The Project Steering Committee will be reporting to the National Climate Committee.

Risks and barriers:

- Multiplicity of stakeholders and the difficulty of implementing agencies to work in harmony with all of them;
- Implementing agencies may not have adequate capacity to implement interventions effectively; and,
- Delays in implementation due to bureaucratic issues or lack of financing

Monitoring and Evaluation: The monitoring and evaluation of this project will be within the framework of the Poverty Reduction Strategy Paper (PRSP) and Medium-Term Plan (MTP) for the agriculture & natural resources sectors. Based on information in the PRSP document, this will be possible with the establishment and functioning of the National Planning Commission.

***Duration**:* 5 years

Estimated Budget: US$2,753,000

ACTIVITY	Costs (US $)
Sensitization and awareness creation campaigns	50,000
Diagnostic study of the technical problems for agroforestry in the Region	50,000
Establishment of nurseries for the production of multipurpose tree species domestication seedlings and re-forestation seedlings	600,000
Training of villagers in tree nursery production (budding and grafting techniques, methods of transplanting tree seedlings and forestry management principles)	68,000
Equipping each of the participating communities/villages with patrol and bush-fire fighting equipment	55,000
Provision of boreholes fitted with appropriate water lifting devices	1,150,000
Surveying and demarcation of the target forests (re-forestation)	280,000
Strengthening the agro-forestry research programme of the National Agricultural Research Institute (NARI), the extension and M&E units of the Department of Forestry at local level and some selected NGOs and CBOs	500,000
TOTAL	**2,753,000**

PROJECT 6

Title: Briquetting and Carbonization of Groundnut Shells

Sector: Energy

Project Area: Western Region, Banjul Municipality

Beneficiaries: Participating households

Rationale: Fuelwood and charcoal obtained from biomass production are the main energy resources in The Gambia. Faced with decreasing precipitation and increasing temperatures, climate change will impose additional stress on energy security further compounded by volatile international energy market. As a part of the solution to the problem, this project aims to provide an alternative energy choice to charcoal and firewood, so as to reduce pressure on the forest and make domestic energy supply sustainable.

Description

Objectives:

The general objective is to ensure greater energy security in project area and to reduce the pressure on forest resources.

Components/Activities:

Procurement of equipment and hiring of expertise for briquetting and carbonisation of groundnut shells
Procurement of raw materials (groundnut shells)
Installation of the machines and initial production of carbonized briquettes by supplier
Testing the comparative burning efficiencies of charcoal and carbonised briquettes
Training of local technicians by the equipment supplier
Survey of households to determine the acceptability of the briquettes
Public sensitisation on the new the product through the media
Strengthening capacities of leading institutions; Gambia Renewable Energy Centre (GREC), Department of Community Development's appropriate technology unit- (ATU), and the National Agricultural Research Institute (NARI)

Inputs:

Equipment (agglomerating machines, hammer mill, charcoal furnace)
Raw Materials
Human resources development
Public sensitization

Short Term outputs:

- Creation of employment opportunities

new technology
- Increased incentives for agricultural production
- Increased energy security in project area
- Strengthened institutional capacities for monitoring the renewable energy sub-sector

Potential long term outcomes:
- Reduced dependence on fuelwood use
- Reduced exposure of womenfolk to indoor pollution (from fuelwood)

Implementation

The Energy Division under the Office of the President, through its Renewable Energy Centre will be the executing agency for the project. The Department of Community Development mandated to work with local communities will be a major partner in this project and partnerships will be established with the private sector in a bid to finally sell the project to the private sector.

Risks and barriers:
- Multiplicity of stakeholders and the difficulty of implementing agencies to work in harmony with all of them;
- Implementing agencies may not have adequate capacity to implement interventions effectively; and,
- Delays in implementation due to bureaucratic issues or lack of financing

Monitoring and Evaluation: The monitoring and evaluation of this project will be within the framework of GEAP II. and will include three steps:
- Measuring the progress of implementation of the budgets against the proposed time schedules;
- Analysis of any variance in the budgets execution against the planned time schedules both in terms of actual expenditures versus the budgeted amounts and times of making the expenditures versus the planned schedules; and,
- Determination of any remedial actions where necessary.

Duration*:* 18 months

Estimated Budget: US$230,000

ACTIVITY	Costs (US $)
Agglomerating machines	30,000
Hammer mill	45,000
Charcoal furnace	25,000
Training of local Technicians	15,000
Efficiency tests	10,000
Stove fabrication	20,000
Raw materials	50,000
Supervision by foreign experts	35,000
TOTAL	**230,000**

PROJECT 7

Title: Reduction of climate change related diseases

Sector: Health

Project Area: Kanifing Municipality, Central River and Upper River Regions

Beneficiaries: Communities in the project areas

Rationale: Direct negative impacts of climate change and variability include the spread of parasitic and often infectious diseases. Public health consequences of floods in particular linger on well after their occurrence.

Description

Objectives:

The overall objective is to enhance national emergency and disaster preparedness to climate change hazards in relation to human health.

Specific objectives

- Providing support in the six Regional Health Management Teams (RHMTs) in the management of epidemics and emergency public health response by 2010
- Reducing the number of climate-related diseases by 50% in 2010
- Increasing access to water and sanitary facilities by 20% in 2010
- Providing support to the epidemiological and Disease Control Unit (of the Department of Health services) in the surveillance of climate change related diseases by 2010
- Raising awareness about the prevention and control of climate-related disease by 2010

Components/Activities:

Public health education (mass media, traditional communicators, open field days)
Capacity building in the management of epidemics and emergency public health response
Provision of essential drugs, medical supplies and vector control equipment and supplies
Provision and regular monitoring of safe drinking water supply for schools, health centres and communities
Construction of ventilated improved pit (VIP) latrines in public schools, health centres and communities

Inputs:

Laboratory equipment and reagents
Medical supplies (drugs, vaccines, intravenous fluids, syringes, needles)
Construction materials

Fogging machines
Sprayers
Protective clothing
Training equipment

Short Term outputs:

- Public awareness regarding diseases related to climate change raised
- Availability of safe drinking water in public places
- Reduced vector breeding sites and habitats
- Toilet facilities for schools, health centres and markets built
- Equipment, materials and medical supplies available for use by health staff in emergency response and management of epidemics
- Early warning system for diseases' epidemic potential, including existing and emergent diseases in place

Potential long term outcomes:

- Health sector's capacity to respond to public health emergencies and the management of epidemics enhanced
- Reduction in incidence of diseases related to climate change
- Cleaner and healthier environment
- Healthier population
- Decreased government expenditure on the health sector

Implementation

Institutional arrangements: The project will be executed by the Department of State for Health and Social Welfare (DoSH&SW) in collaboration with the departments of Community Development (DCD), Water Resources, the National Water and Electricity Company and the local government authorities during the implementation phase. The National Climate Committee would be overseeing the implementation.

Risks and barriers:

- Inflation pushes cost of equipment, materials beyond project estimates
- Staff shortage complicating workload distribution at the level of collaborating institutions
- Frequent staff turnover would mean constant training for new staff deployed in the project areas.
- Buffer stock of drugs and vaccines used during routine services and not replenished on time when disaster strikes.

Monitoring and Evaluation: The Chief Public Health Officer in the Department of State for Health will be responsible for quarterly monitoring whilst the National Climate Committee will be responsible for mid and end of project evaluation.

Indicators

- Number of community sensitisation meetings/programmes and field days held.
- Proportion of health staff trained in emergency public health response and management of epidemics.
- Monthly surveillance on diseases of epidemic potential maintained.
- Drugs, vaccines and other medical supplies procured
- Community Water Management Committees formed, trained and supported.
- Number of VIP latrines constructed.
- Number of mosquito and other vector breeding sites treated

Duration: 3 years

Estimated Budget: US$1,217,000

Description	**COST (US $)**
Health education programmes	60,000
Training of health personnel	150,000
Drugs, vaccines, other medical supplies	250,000
Stand pipes, boreholes, wells	190,000
Support to Water Management Committees	30,000
Water testing and treatment	30,000
VIP latrines	175,000
Vector control equipment, materials, chemicals	305,000
Supervision, monitoring and evaluation	27,000
TOTAL	**1,217,000**

PROJECT 8

Title: Improved livestock and rangeland management for food security and environmental sustainability

Sector: Livestock

Project Area: North Bank, Lower River, and Upper River Regions

Beneficiaries: Farmers, Women, Community organisations, Extension services, Non-State actors (up to 41, 000 participants/dependents)

Rationale: Beef and dairy cattle as well as small-ruminant production in The Gambia is predominantly based on the free-range pastoral system. Accordingly, a substantial reduction in the productivity of natural pastures due to climate factors calls for the adoption of new approaches to livestock production.

Description

Objectives:

The overall objective is to enhance livestock-based livelihoods to counter the threat from climate change.

Specific objectives:

- Preserving eco-systems
- Reducing poverty
- Increasing livestock productivity

Components/Activities:

Bushfire Control
Feed resources conservation
Improved livestock watering
Demarcation of rangelands/ regeneration of rangelands
Establishment and management of fodder tree plantation including intensive feed gardens
Construction of compost pens & utilisation of compost
Promotion of fallowing

Inputs:

Technical assistance (Rangeland use expert)
Short cycle livestock (Improved poultry stock)
Animal feed
Drugs/vaccines and kits
Watering points
Animal housing (especially short cycle species)

Fencing (Intensive feed gardens etc)
Regular vaccination of animals

Short Term outputs:

- Increased awareness creation, motivation and mobilisation
- Increased productivity of poultry meat and eggs for consumption and income generation
- Increased soil fertility through organic fertiliser use and fallowing
- Improved animal health
- Diversified income generation and reduced poverty

Potential long term outcomes:

- Food security and poverty reduction
- Improved nutrition of children and mothers
- Biodiversity conservation and reduced conflict between crop and animal farmers
- Genetic improvements of local livestock species
- Land regeneration and reclamation of marginal lands

Implementation

Institutional arrangements: The Executing agency will be the Department of State for Agriculture (DOSA). Implementation will be done through the National Agricultural Development Agency (NADA) who will work with public, private, and civil society organisations and institutions at central, regional and local levels. To oversee the programme, a Project Coordinating Committee should be constituted by representatives of the major stakeholders (including the Project Steering of the National Adaptation Programme of Action). This body will report to the National Climate Committee. It is recommended that full-time, autonomous project managers and staff should be appointed or deployed.

Risks and barriers:

- Multiplicity of stakeholders and numerous intermediary bureaucratic levels of supervision often cause delays and lack of consensus
- Inadequate representation of beneficiary communities/stakeholders at decision-making, management and exploitation stages may lead to poor local commitment or ownership of the projects
- Inadequate funding or poor disbursement procedures

Monitoring and Evaluation: The National Agricultural Development Agency (NADA) is responsible for project monitoring through its planning unit, the Department of Planning (DOP).

Indicators:

- Operational village/district land use plans
- Improved dry season animal feeding
- Increased animal productivity and health

- Number of farmers trained/sensitised
- Rangeland regeneration
- Increased farmer incomes from livestock-based industries

Means of verification:

- Monthly project reports
- NADA/DOP annual reports/NASS
- Monthly DVS reports, annual reports
- National Statistics
- Natural resources surveys, inventories

***Duration**:* 5 years

Estimated Cost: US$2,800, 000

ACTIVITY	*COST (US $)*
Controlled use of fire, productivity improvement, and feed resources conservation	923,000
Improved watering	440,000
Demarcation of rangelands/ rangeland regeneration	840,000
Establishment and management of fodder tree plantation including intensive feed gardens	597,000
TOTAL	**2,800,000**

PROJECT 9

Title: Restoration/Protection of coastal environments

Sector: Coastal Zone

Project Area: Banjul and Kanifing Municipalities

Beneficiaries: Coastal communities, businesses and visitors

Rationale: The Coastal Zone is the most heavily populated part of the country. It also has many ecologically sensitive areas, and contains most of the economic development infrastructure especially in the tourist industry. Coastal squeeze due to sea level rise is expected to have substantial negative impacts on ecosystems and economic activities in this area. Economic losses from a do-nothing standpoint could run into hundreds of millions of US dollars.

Description

Objectives:

The overall objective is to strengthen integrated coastal zone management and the protection of physical infrastructure, economic and cultural assets located within the coastal zone

Specific objectives

- Improving coastal defences
- Improving livelihood security
- Conserving biological diversity and ecological assets

Components/Activities:

Topographic survey of the coastal strip and inshore area
Bathymetric survey of the coastal strip and foreshore area
Beach stabilisation
Construction or rehabilitation of groynes
Rehabilitation of wetlands
Awareness campaign on coastal issues
Comprehensive review of legal and policy instrument relating to coastal zone and wetlands
Rehabilitation of polder station (aka Pa Bokis) located on Bund Road

Inputs:

Enhanced skills and adequate equipment and materials to implement coastal protection works
Adequate funds to undertake all the envisaged activities

Short Term outputs:

The Bakau fish landing site and jetty will be protected which will ensure continuity of the livelihood activities carried out in that area.

Rehabilitation of the Kotu stream will prevent flooding of homes and property in the area and restore rice cultivation.

Minimise the frequency of dredging in the Banjul Port and ferry terminal areas

Potential long term outcomes:

- A comprehensive legislation on coastal zone management developed
- Regulatory system for enforcement and control of coastal zone put in place.
- Coastal zone management plan developed.
- Participation of all stakeholders in the implementation of the plan
- Improved livelihood security for stakeholders

Implementation

Institutional arrangements: The project should be implemented by the Coastal Management Unit (CZMU) of the National Environment Agency (NEA) in close collaboration with the Department of Technical Services. The Department of Water Resources (DWR) and Department of Physical Planning and Housing (DPPH) would also be involved in the implementation at the secondary level. The project shall be coordinated by a steering committee comprising Coastal Management Working Group and the National Climate Committee (NCC), Department of Parks and Wildlife Management (DPWM), Kanifing Municipal Council (KMC), Banjul City Council (BCC) and relevant NGOs. It will be implemented by the National Environment Agency (NEA) and monitored by the Department of Water Resources.

Risks and barriers:

- The availability of suitable sand for beach nourishment both in terms of quantities and location needs to be established.
- The Gambian coastline is very short compared to its neighbour, Senegal. Therefore any long-term coastal protection works will be more effective with the participation of Senegal.
- There are parts of the Kotu stream that are already settled upon with residential properties, the rehabilitation of the stream will displace some people. Therefore the issue of resettlement and compensation will have to be considered.
- Availability of experts to implement proposed activities
- The availability of adequate funding

Monitoring and Evaluation: The indicators to be monitored are as follows:

- Beach profile – should indicate erosion or deposition along the coastline
- Continuity and increase in tourist received in the country.

- Disappearance of destructive anthropogenic activities i.e. Cutting mangroves, sand mining, building on wetlands, littering, unwanted natural resource harvesting

The National Environment Agency will be responsible for implementation while monitoring undertaken by the departments of Water Resources and Technical Services.

***Duration**:* 3 years

Estimated Budget: US$2,300,000

ACTIVITY	*COST (US $)*
Topographic survey of the coastal strip and inshore area	50,000
Bathymetric survey of the coastal strip and foreshore area	80,000
Beach stabilization	110,000
Construction/Rehabilitation of groynes on the coastal strip from Ball Point to GPA	2,060,000
TOTAL	**2,300,000**

PROJECT 10

Title: Increasing fish production through aquaculture and conservation of post harvest fishery products

Sector: Fisheries

Project Area: Coastal and inland zones

Beneficiaries: Fishing communities along the Atlantic seaboard, fish consumers in urban areas and provincial towns and villages provisioned by the artisanal fisheries sub-sector

Rationale: Local communities are currently experiencing fish supply shortage due to drought/abnormal rainfall pattern causing dessiccation of flood plains that support spawning and nursery of most freshwater fish species. Additionally, seasonal upwelling in the Gambia's coastal waters is likely to be perturbed by changes in sea surface temperature inducing the formation of thermocline leading to the confinement in the deeper layers of essential nutrients required for plankton growth. Mangrove ecosystems are also susceptible to inundation and salinity stress associated with sea-level rise. Current management practices/coping strategies fail however to adequately address sectoral challenges which consist of meeting rising demand for fish and marine products in a sustainable and profitable manner, especially in an environmental context less favourable for the renewal of resources.

In order to curb this stress, this project aims to strengthen management practices, and to increase fish productivity through aquaculture.

Description

Objectives:

The main objective of the project is to make a positive contribution to poverty reduction, livelihood security and national food security.

Specific objectives:

- optimal exploitation of resources
- reducing climate/weather hazards and making fisheries a profitable economic venture
- reducing demand and supply disequilibria of fish and fish products
- exploring alternative measures of fish production
- produce fish for rural consumption through aquaculture

Components/Activities:

Procurement of services and supplies
Training of fisherfolk and processors
Training/sensitisation of rural communities on techniques of fish culture
Aquaculture

Inputs:

Fish storage and processing infrastructure
Plankton sampling equipment
Awareness creation and capacity building
Aquaculture infrastructure (fish ponds)
Fish feed ingredients including high yielding inputs (lime, organic fertilizer, etc.)
Fish fingerlings (brood stock)
Laboratory re-agents (pond water quality)

Short Term outputs:

- Reduced pressure on capture fisheries
- Improved fresh fish quality through icing and chill storage,
- Reduced pressure on fuelwood resources,
- Improved fish availability and affordability,
- Increased economic activity for rural population,
- Increased economic activities at fish landing sites including non-fishing related activities such as restaurants, petty trading, etc.

Potential long term outcomes:

- Sustainable increase of fish supply,
- Environmental awareness and protection,
- Improved health condition of rural communities,
- Increased private investment in fish production through aquaculture,
- Stability of fish prices,
- Improved livelihoods security and personal safety at sea.

Implementation

Institutional arrangements: A Project Management Committee (PMC) will be established to manage the project. The PMC will comprise representatives of the Department of State for Fisheries and Water Resources (DOSF&WR), the municipalities of Banjul and Kanifing and the donor community. Fishing communities in the two project locations will jointly manage the daily activities of the project. DOSF&WR with its line departments will provide technical backstopping and managerial support and weather forecasts. The PMC will report to the National Climate Committee.

Risks and barriers:

- Disregard for use of sea safety equipment and inappropriate interpretation of weather forecasts/warnings;
- Slow pace of attitudinal change from traditional to conventional fishing and related activities (methods and techniques)
- Coastal and marine pollution

Monitoring and Evaluation: The PMC will meet on a quarterly basis and reports of the meetings will be produced. The performance of the project will be evaluated on an annual basis by an independent evaluator assisted by two persons who shall

be selected by the PMC. Project performance will be assessed based on the following measurable indicators:

- Percentage increase in fish supply (as a result of reduction in post harvest losses, increase in use of ice in fisheries, utilisation of chill/cold storage facilities.
- Percentage reduction in fuelwood consumption for fish smoking (as a result of improved technology).
- Percentage reduction in sea accidents, loss of lives and equipment (as a result of increased use of sea safety equipment; improved awareness of importance of weather forecasts/reports.
- Percentage increase in non-fishing business activities at project sites (petty trading, restaurants, etc.).
- Percentage increase in fishing economic units as well as processors, fish traders, boat builders and mechanics.
- Improved livelihoods of fisherfolk families (improved earnings, health and welfare).

***Duration**:* 4 years

Estimated Budget:US$300,000

ACTIVITY	*Costs (US $)*
Component I: Aquaculture	
Baseline study of fish situation in project area prior to project implementation	5,000
Sensitization and training of communities on the techniques of fish culture	10,000
Site selection for aquaculture ponds	5,000
Construction of ponds	25,000
Fingerlings for stocking	15,000
Feed ingredients and feed formulation	10,000
Farm management including administration	25,000
High yield inputs (fertilizer, lime, etc.)	10,000
Laboratory equipment and reagents	15,000
Field visits	10,000
Protective gear	5,000
Maintenance of farm machinery (generator, pumping machine)	25,000
Sub-total	***160,000***
Component II: Post harvest Conservation	
Fish smoking houses with individual ovens	50,000
Storage facilities for processed fish (dried/smoked)	15,000
Ice making plant and chill storage facility (5-ton capacity each)	25,000
Insulated fish boxes (20 kg capacity each)	10,000
Ice boxes/containers for fresh fish storage (500 kg capacity each)	10,000
Construction of fishing canoes for fishermen training program and equipping the canoes (outboard motors, fishing nets and accessories)	10,000
Support to weather forecasting office	25,000
Sub-total	***140,000***
TOTAL	**300,000**

6. NAPA Preparation Process

The NAPA Preparation process in The Gambia roughly tracks the flow chart on page 31 of the Annotated Guidelines for the Preparation of NAPAs (LEG, 2002), with adjustments to take account of specific circumstantiates including experiences during, and learning outcomes of project implementation.

Project implementation including preparation of the NAPA was carried out by a Project Management Unit (PMU)[a] with oversight from a Project Steering Committee (PSC) comprising representatives of the: 1) MEA Focal Points; 2) GEF Operational Focal Point; 3) Budget, and Poverty Alleviation Office of the Finance Ministry; 4) Ministry with oversight for local government and decentralization; 5) National Assembly; 6) NGO community; and 7) the Implementing Agency, Department of Water Resources. The NAPA preparation was further supported by: i) stakeholders articulating public concerns and preferences; ii) independent consultants/consulting firms bringing in technical knowledge and constructive criticism into the process; and iii) policy-makers ensuring government priorities are kept in sight when it came to priortising interventions.

The PMU and PSC, which together form the Project Management Team (PMT) carried out their functions through a series of stakeholder workshops/meetings, site visits, commissioned studies and regular meetings of the PMT. The major processes involved shown in figure 6.1, are described in the ensuing sections.

6.1. Preparation and Synthesis of Sectoral Reports/Studies

Commissioned research carried out by the Multi-disciplinary Impact Assessment Team (MIAT) on eight themes identified under the NAPA. Drawing heavily on The Gambia's Initial National Communication (INC) to the COP, scientific literature held by various institutions, and analysts competencies, thematic reports submitted to the PSC were peer-reviewed by the latter and independent consultants, prior to compilation by the PSC into a tome entitled "Draft Report on the Assessment of Vulnerability and Adaptation to Climate Change" (hereinafter referred to as the V&A Report). The V&A Report containing available information on vulnerability and adaptation to climate change for The Gambia was used as an entry point for stakeholder consultations. Meanwhile, omissions and inadequate treatment of some topics were dealt with in different ways. Inadequate treatment of benefits and costs of adaptation in the thematic reports, also mirrored in the V&A Report, prompted training to build MIAT capacity in this area (see section 6.3). Due to technical and time constraints, key information missing on biodiversity, livelihoods, and health impacts are recommended to be taken up as subjects for further study (see section 3.4).

[a] PMU composition: Project Coordinator, Secretary, Administrator./Accountant

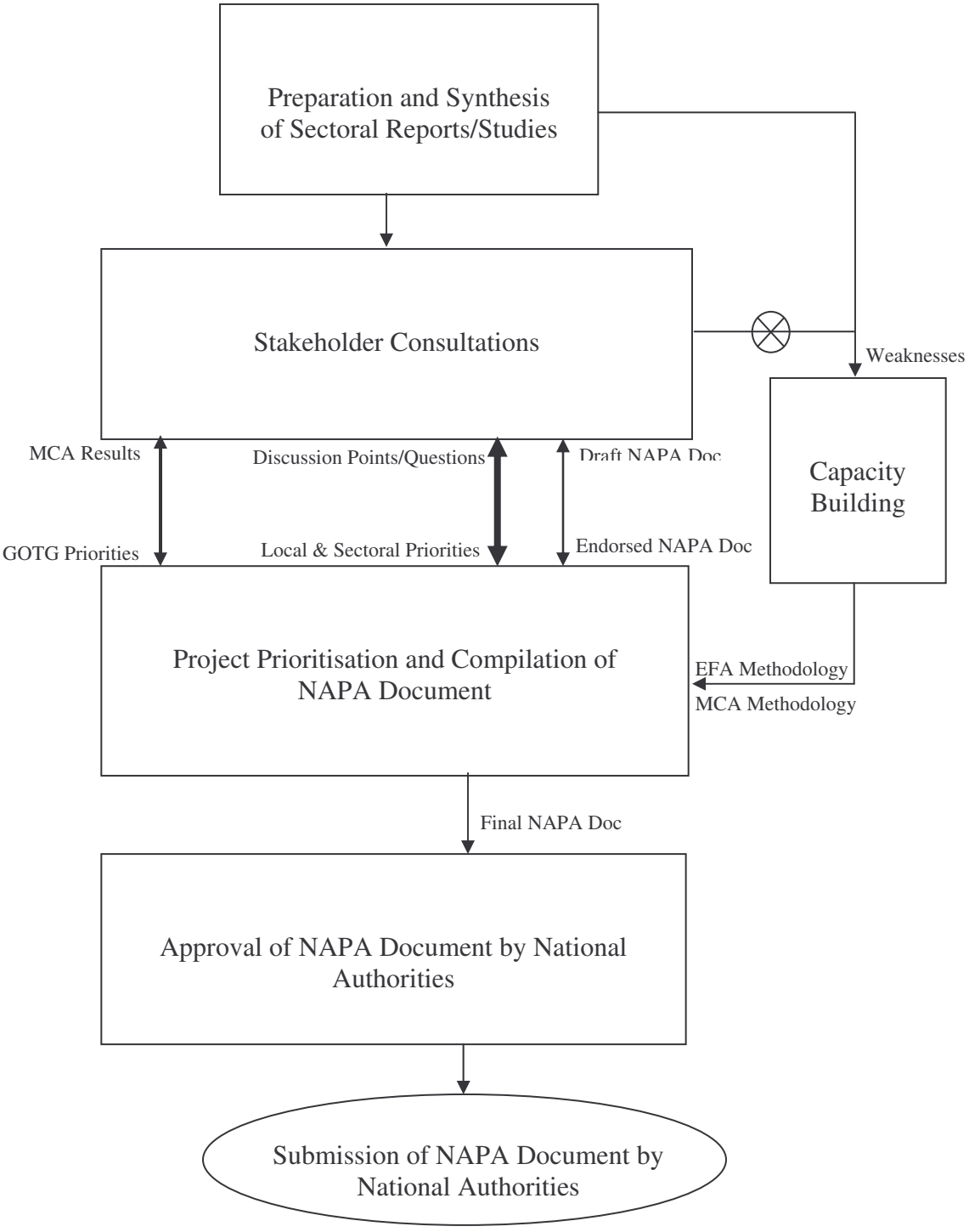

Figure 6.1: *Major processes and information fluxes of NAPA preparation*

6.2. Stakeholder Consultations

Prior to compilation of the Gambian NAPA document, the Project Management Team (PMT) consulted a wide cross-section of Gambian society, across the country to solicit information and opinions on climate change impacts and response strategies, clarify public misconceptions vis-à-vis scientific reality, engineer consensus between different stakeholder perceptions, and build support and foster ownership for projects outlined in the NAPA document.

Participants in various consultative meetings examining exposure to, impacts of, responses to (coping/adaptation), and stakeholder preferences, came from public sector institutions, scientists, the private sector, news media, public interest groups, and the general public. The latter's involvement was through third-party identification by the Regional Development Committees, gubernatorial or mayoral offices using a broad set of criteria including occupational background, ethnic diversity, gender, and commitment to the NAPA process.

Consultations were held at predefined, mostly central locations, to examine intermediate outputs of the NAPA project (V&A Report, MCA Results, and Project Prioritisation). Standard techniques used in public consultation processes were employed to strategic advantage. Presentations in English/Vernacular were used to share/exchange information and views with stakeholders. Workshops and focus group discussions (FGDs) provided even greater opportunity for interactive discussions and mutual learning by stakeholders and the PMT. A limited number of site visits were undertaken in order to augment the PMT's understanding of critical dimensions of problems, but to also galvanise and sustain stakeholder interest. PMT administration of structured questionnaires, face-to-face and telephone interviews with policy-makers, complemented by FGDs with stakeholders in different regions of the country, allowed the PMT to isolate and prioritise technically feasible and socially-acceptable adaptation strategies.

A draft version of the NAPA document was widely circulated for comments/suggestions and subsequently endorsed with some recommendations (i.e. proposals for amendments) by participants at a national validation workshop.

The entire consultation process was accomplished after 418 hours (52 working days) of formal consultations with stakeholders, and expenditure of 1.67 million Gambian Dalasis (around US$58,600), representing 29.3 per cent of the project budget.

6.3. Capacity Building

The idea of capacity building was born out of the peer-review of thematic reports (see section 6.1) which revealed a superficial treatment of cost-effectiveness and preference ranking of proposed adaptation options. Enquiry at the level of MIAT also found insufficient level of understanding of methodologies concerned.

Training on economic feasibility analysis (EFA) and multi-criteria analysis (MCA) was provided under contract by Blue Gold Solutions, a local consulting firm, in October 2005 and June 2006 respectively. A total number of 120 technicians, senior government/non-governmental organisations, MIAT members benefited from these training events. Learning outcomes consisted of improved understanding of theoretical background and practical skills to rank adaptation option using multiple criteria including cost-effectiveness. Expenditure on this process, amounted to 280,000 Gambian dalasis (roughly equivalent to US$10,000), representing 5 per cent of the project budget.

Training Reports can be obtained from the NAPA Project Coordinator, and/or UNEP Task Manager.

6.4. Project Prioritisation and Compilation of NAPA Document

A number of sub-processes were involved in and antecedent to the prioritisation of adaptation options. Notably, adaptation options recommended by technical studies, validated and augmented by development practitioners in Focused Group Discussions (FGDs) held across the country, were submitted to an MCA resulting in prioritisation of adaptation options/strategies within thematic areas identified as most critical for The Gambia.[b] Additionally, FGDs provided clear indications of stakeholder priorities on a sectoral basis, as well as potential/desirable project intervention areas. In retrospect, the method used for sectoral ranking[c] and weighting could have been done better, but thematic areas with the highest overall ranking correlate quite well with stakeholder concerns reported in the second Poverty Reduction Strategy Paper - PRSP II (GOTG, 2006).

A second sub-process aimed at capturing national planning and development priorities consisted of asking policy-makers to rank adaptation options/strategies submitted to an MCA. Cross-comparison with MCA results showed some significant differences in all, but two thematic areas (Forest and woodland; and Coastal Zone).

Final prioritisation of projects was carried out by first attempting some form of closure through joint ranking of adaptation options/strategies as seen from development practitioners/MIAT, and policy-makers perspectives.[d] Projects are identified through integration of priority options with others having explicitly similar/reinforcing objectives. The latter, bringing in synergy between options, and coherence into the project concept are not necessarily drawn from the top six sectoral adaptation options. Prioritisation of projects was based on sectoral ranking by development practitioners and regional government representatives. Project profiles prepared by a select group of independent consultants were amended after review by the PSC and author of this synthesis document.

The NAPA Document was complied and written under contract by a Gambian consulting firm using bibliographic material and other inputs supplied by the Gambian NAPA Project Management Unit, as well as its own resources. The NAPA Document was reviewed extensively by the Gambian NAPA Project Management Team, NAPA Task Manager (UNEP), Members of the Least Developed Countries Experts Group (LEG), and representatives of stakeholders (See start of document for full list of reviewers).

[b] Development practitioners and regional government representatives, divided into working groups, developed an MCA logical framework for each thematic area, and partial list of selection criteria. This information was used/further developed by the NAPA multi-disciplinary impact assessment team (MIAT) with facilitation of the appointed Trainer on MCA. Twenty four (24) criteria encompassing environmental, economic, technical and social considerations across all eight thematic areas of interest, were used in the MCA (see § 4.1)

[c] Curtailed sampling (priority/non priority) with subsequent ranking from 1 (highest) to 4 (lowest)

[d] See Tables 4.3 through 4.10

6.5. Approval of NAPA Document by National Authorities

Sequel to a national validation workshop in mid-August 2007, a revised and updated version of the NAPA document (i.e. Provisional Final NAPA document) with a Summary for Policymakers (SPM) were forwarded to the Department of State for Forestry and the Environment (DOSF&E) for approval.

Overall satisfaction with the document by the Permanent Secretary [a] and Secretary of State [b] for DOSF&E expressed in the foreword and acknowledgements of the final compilation, and authorised use of the document in the preparation of a Donor's Conference on Poverty Alleviation, add up to explicit approval of the Provisional NAPA document, and authorisation to the NAPA PSC to submit the document as Gambia's Final NAPA document to UNFCCC.

[a] Administrative head of the DOSF&E
[b] Political head of the DOSF&E

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