Senegal
Country Environmental Analysis

November 12, 2008

Sustainable Development Department
Africa Region
## Contents

Acknowledgments........................................................................................................... vi

Acronyms, Abbreviations, and Initialisms................................................................. ix

Executive Summary ................................................................................................. xvii

Institutional Framework for Environmental Management........................................ xvii

Sustainable Management of Terrestrial Ecosystems .................................................. xviii

Water Resources Management ..................................................................................... xxii

Fisheries Management ............................................................................................... xxiii

Urban Environmental Management in Dakar........................................................... xxv

Introduction .................................................................................................................. 1

Context ....................................................................................................................... 1

Objectives ................................................................................................................... 2

Approach ..................................................................................................................... 3

Report Structure ........................................................................................................ 3

Section 1 – Main Environmental Issues .............................................................. 5

1.1 Summary of Issues............................................................................................... 5

1.2 Institutional Framework for Environmental Management.................................. 10

1.3 Sustainable Management of Terrestrial Ecosystems......................................... 14

1.3.1 Sustainable Land Management ..................................................................... 14

1.3.2 Management of Forests and Biodiversity ..................................................... 19

1.4 Water Resource Management .......................................................................... 22

1.4.1 Management of National Resources ......................................................... 22

1.4.2 Management of Transboundary Resources in the Senegal River Basin .......... 24

1.5 Fisheries Management ...................................................................................... 26

1.6 Urban Environmental Management in Dakar.................................................. 31

1.7 Other Environmental Issues ............................................................................. 36

1.7.1 Urban Environmental Management in the Regions ..................................... 36

1.7.2 Waste Management ..................................................................................... 37

1.7.3 Coastal Zone Management ......................................................................... 39

1.7.4 Management of Retention Basins and Artificial Lakes .............................. 41

Section 2 — Main Environmental Issues .............................................................. 43

2.1 Institutional Framework for Environmental Management............................... 43

2.1.1 Environmental Management at the National Level ..................................... 43

2.1.1.1 Functions and organization of the Ministry of the Environment............. 43
2.1.1.2 Main gaps at the structure level.................................................................52
2.1.1.3 Budget ...........................................................................................................56
2.1.1.4 Available resources .......................................................................................60
2.1.1.5 Environmental assessment and authorization process.................................61
2.1.1.6 Environmental monitoring.............................................................................62
2.1.1.7 Consultation process.........................................................................................63
2.1.1.8 Political interference and corruption.................................................................64
2.1.1.9 Governance.......................................................................................................64

2.1.2 Environmental Management Below the National Level..................................65
2.1.2.1 Structures and functions...................................................................................65
2.1.2.2 Support and coordination with national institutions..........................................66
2.1.2.3 Financing sources...........................................................................................68
2.1.2.4 Available resources.........................................................................................68
2.1.2.5 Governance.......................................................................................................69
2.1.2.6 Environmental monitoring.............................................................................70
2.1.2.7 Political interference and corruption.................................................................70

2.1.3 Intersectoral Coordination.................................................................................70
2.1.3.1 Other actors involved in environmental management......................................70
2.1.3.2 Transversal structures.....................................................................................72
2.1.3.3 Roles and responsibilities...............................................................................73
2.1.3.4 Coordination between sectors.........................................................................74
2.1.3.5 Budget allocations by sector..........................................................................75
2.1.3.6 Integration of environmental considerations into sectoral policies ..............75

2.1.4 Role of NGOs and Society................................................................................76
2.1.5 Role of the Private Sector.................................................................................76

2.1.6 Lessons learned................................................................................................76

2.1.7 Other actors involved in environmental management.....................................70
2.1.8 Transversal structures......................................................................................72
2.1.9 Roles and responsibilities.................................................................................73
2.1.10 Coordination between sectors..........................................................................74
2.1.11 Budget allocations by sector............................................................................75
2.1.12 Integration of environmental considerations into sectoral policies ............75

2.1.13 Other actors involved in environmental management....................................70
2.1.14 Transversal structures.....................................................................................72
2.1.15 Roles and responsibilities...............................................................................73
2.1.16 Coordination between sectors.........................................................................74
2.1.17 Budget allocations by sector............................................................................75
2.1.18 Integration of environmental considerations into sectoral policies ............75

2.2 Sustainable Management of Terrestrial Ecosystems.........................................77
2.2.1 Sustainable Land Management........................................................................77
2.2.1.1 Experience to date.........................................................................................77
2.2.1.2 SLM stakeholders.........................................................................................78
2.2.1.3 Regulations or laws governing SLM...............................................................80
2.2.1.4 Barriers to SLM............................................................................................81
2.2.1.5 Chances of SLM in Senegal..........................................................................84
2.2.1.6 Lessons learned............................................................................................88

2.2.2 Management of Forests and Biodiversity.......................................................88
2.2.2.1 State of forest resources.................................................................................88
2.2.2.2 Logging problems...........................................................................................89
2.2.2.3 Impact of forestry on biodiversity.................................................................92
Problems in hunting reserves................................................................................94
Brush fire management problems...........................................................................96
2.2.2.6 New forestry policy......................................................................................97
2.2.2.7 Lessons learned............................................................................................98

2.3 Water Resource Management..........................................................................103
2.3.1 Management of National Water Resources.....................................................103
2.3.1.1 Status of water management.........................................................................103
2.3.1.2 Development and implementation of PEPAM 2015......................................104
2.3.1.3 Development and implementation of the PAGIRE......................................108

2.3.2 Management of Transboundary Resources in the Senegal River Basin........109
2.3.2.1 Environmental and social issues related to dam management...................109
2.3.2.2 Recent interventions improve management of river resources..................111

2.3.3 Lessons Learned...............................................................................................113
2.4 Fisheries Management .......................................................................................................................... 113
  2.4.1 Resource Management Problems ........................................................................................................ 113
  2.4.2 State of the Marine Ecosystem (Biodiversity and Critical Habitats) ...................................................... 115
  2.4.3 Adaptation Efforts in the Fisheries Sector .............................................................................................. 116
  2.4.4 Fisheries Sector Strategy (2006) ............................................................................................................. 118
  2.4.5 Letter of Sectoral Policy on Fisheries and Aquaculture (2007) .............................................................. 120
  2.4.6 Recently Introduced Reforms .............................................................................................................. 121
  2.4.7 Lessons Learned .................................................................................................................................. 122

2.5 Public Health and Environmental Degradation in Dakar ........................................................................ 124
  2.5.1 Public Health Costs of Environmental Degradation .............................................................................. 124
    2.5.1.1 Urban air pollution ......................................................................................................................... 124
    2.5.1.2 Water supply, sanitation, and hygiene ......................................................................................... 124
    2.5.1.3 Malaria .......................................................................................................................................... 138
    2.5.2 Cost-Benefit Analysis of Certain Policy Options in Dakar .................................................................. 140
      2.5.2.1 Options to control PM emissions from road vehicles ................................................................. 142
      2.5.2.2 Water supply, sanitation, and hygiene ......................................................................................... 147
      2.5.2.3 Malaria vector control ................................................................................................................. 154
    2.5.3 Lessons Learned .................................................................................................................................. 155

2.6 Environmental Policies — Lessons from Other Countries ........................................................................ 156
  2.6.1 Environmental Impact Assessments ....................................................................................................... 157
  2.6.2 Command and Control Instruments ..................................................................................................... 157
  2.6.3 Economic Instruments ........................................................................................................................... 159
  2.6.4 Legal Actions ......................................................................................................................................... 160
  2.6.5 Public Disclosure ................................................................................................................................... 160
  2.6.6 Extrapolating Best Practices to Senegal ................................................................................................. 161

Section 3 – Operational Recommendations .................................................................................................. 163
  3.1 Institutional Framework for Environmental Management ........................................................................... 163
    3.1.1 Improvements to Government Structures and Coordination .............................................................. 163
    3.1.2 Policies and Regulations ..................................................................................................................... 164
    3.1.3 Funding Sources ................................................................................................................................. 165
    3.1.4 Capacity Building ............................................................................................................................... 165
    3.1.5 Reinforcement of Environmental Assessment and Authorization Processes ..................................... 166
3.1.6 Intersectoral Coordination .................................................................166
3.1.7 Information and Public Consultation ..................................................167
3.1.8 Governance ......................................................................................168
3.1.9 Decentralization ................................................................................168
3.1.10 Role of NGOs and Civil Society .......................................................169
3.1.11 Role of the Private Sector ..............................................................169

3.2 Sustainable Management of Terrestrial Ecosystems ..............................169
  3.2.1 Sustainable Land Management .......................................................169
  3.2.2 Management of Forests and Biodiversity ..........................................171

3.3 Water Resources Management ............................................................173

3.4 Fisheries Management ........................................................................173

3.5 Urban Environmental Management in Dakar .......................................174

3.6 Environmental Monitoring ..................................................................175

3.7 Environmental Information, Education, and Awareness .......................176

Bibliography .......................................................................................... 183

Tables

Table 2.1 Main environmental indicators followed by national institutions ..........53
Table 2.2 MEPNBRRLA budget, 2006 (million FCFA) .......................................57
Table 2.3 Summary of the MEPNBRRLA budget projected in the CDMT plan, 2005-2007, by sector .................................................................58
Table 2.4 Summary of MEPNBRRLA budget projected in the CDMT plan, 2005-2007, by department .................................................................59
Table 2.5 Forest and wooded area of Senegal in 1990 and 2000 (‘000 ha) ...............89
Table 2.6 Protected land areas in Senegal ........................................................93
Table 2.7 Estimate of local economic benefits related to hunting in hunting reserves ........95
Table 2.8 PAGIRE — Integrated water resource management (IWRM) strategies .....110
Table 2.9 Volume of traditional and industrial maritime fisheries and exports ........114
Table 2.10 Urban air pollution dose-response coefficients ................................126
Table 2.11 Health impact of urban air pollution .............................................127
Table 2.12 Calculation of Disability Adjusted Life Years (DALYs) per case of annual health effects .................................................................128
Table 2.13 Baseline data for cost estimates ....................................................129
Table 2.14 Cost of morbidity caused by urban air pollution ............................132
Table 2.15 Total health cost of urban air pollution (billion FCFA) .....................132
Table 2.16 Morbidity cases attributable to inadequate water supply, sanitation, and hygiene .................................................................135
Table 2.17 Baseline data for cost estimates of inadequate water, improper sanitation, and unsafe hygiene .............................................................136
Table 2.18 Cost of morbidity attributed to inadequate water, improper sanitation, and unsafe hygiene .................................................................136
Table 2.19 Total health cost of water supply, sanitation, and hygiene (billion FCFA) 137
Table 2.20 Morbidity of malaria, Dakar, 2005 ................................................137
Table 2.21 Cost of morbidity attributed to malaria ..........................................141
Table 2.22 Total health cost of malaria (billion FCFA) .....................................141
Table 3.1  Summary of recommendations.................................................................177

Figures

Figure ES 1. Annual cost of environmental health effects in urban greater Dakar (billion FCFA per year)..................................................................................................................xxvi
Figure ES 2. Annual cost of environmental health effects in urban greater Dakar (percent of GDP, 2004)..................................................................................................................xxvi
Figure ES 3. Benefit-cost ratios of malaria control, hygiene, and water and sanitation interventions in greater Dakar............................................................... xxviii
Figure ES 4. Benefit-cost ratios of low-sulfur diesel and diesel vehicle particulate control in greater Dakar.................................................................................. xxviii
Figure 1.1  Senegal gross national product by sector, 2004.................................6
Figure 1.2  Main water-bearing systems in Senegal.............................................23
Figure 1.3  Hydrographic network in Senegal.......................................................23
Figure 1.4  Location of protected marine areas in Senegal.................................30
Figure 2.1  Organizational structure of MEPNBRLA..........................................45
Figure 2.2  Organizational structure of the DEFCCS...........................................46
Figure 2.3  Organizational structure of the DEEC...............................................47
Figure 2.4  Chain of the different DPN actors......................................................48
Figure 2.5  Environmental management and support of national institutions....51
Figure 2.7  Concentration of PM10 (micrograms/m³) in Senegal cities, 2004........125
Figure 2.8  Region of Dakar....................................................................................143
Figure 2.9  From emissions to health effects......................................................143
Figure 2.10  Estimated emissions of PM2.5 in the region of Dakar (tonnes/year)....143

Boxes

Box 1.  Adaptation to climate change in Senegal.....................................................16
Box 2.  Corruption in Senegal in 2005..................................................................64
Box 3.  Support to local communities for environmental management...............68
Box 4.  Community participation in the search for adapted solutions...............70
Box 5.  Statements from the Forum Civil on natural resource management in Senegal......71
Box 6.  Alternatives envisioned to reform the Law on National Domain.............82
Box 7.  Review of public expenditures...............................................................86
Box 8.  Types of energy used for cooking in Senegal...........................................92
Box 9.  The Wula Nafaa project (the benefits of the forest)..................................100
Box 10.  Potential additional income available from Parc national des oiseaux du Djoudj 100
Box 11.  Economic value of non-timber forestry resources..................................100
Box 12.  Wealth and sustainability in Senegal — the economic case for natural resource management..........................................................101
Box 13.  Sanitation improvement program for the peri-urban neighborhoods of Dakar (PAQPUD)..........................................................107
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# Acronyms, Abbreviations, and Initialisms

<table>
<thead>
<tr>
<th>Acronym</th>
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<tbody>
<tr>
<td>AEP</td>
<td>Analyse Environnementale Pays (Country Environmental Analysis)</td>
</tr>
<tr>
<td>AFD</td>
<td>Agence Française de Développement</td>
</tr>
<tr>
<td>AFNOR</td>
<td>Association Française de Normalisation</td>
</tr>
<tr>
<td>ANCAR</td>
<td>Agence Nationale pour le Conseil Agricole et Rural</td>
</tr>
<tr>
<td>APCR</td>
<td>Association des Présidents des Communautés Rurales</td>
</tr>
<tr>
<td>ARD</td>
<td>Association Régionale de Développement (Regional Development Agency)</td>
</tr>
<tr>
<td>APRODAK</td>
<td>Agence pour la Propreté de Dakar</td>
</tr>
<tr>
<td>APROSEN</td>
<td>Agence pour la Propreté du Sénégal</td>
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<tr>
<td>ASSS</td>
<td>Association Senegalaise de la Science du Sol</td>
</tr>
<tr>
<td>BAD</td>
<td>Banque Africaine pour le Développement (African Development Bank)</td>
</tr>
<tr>
<td>BCI</td>
<td>Budget Consolidé d’Investissement (Consolidated Investment Budget)</td>
</tr>
<tr>
<td>BM</td>
<td>Banque mondiale (World Bank)</td>
</tr>
<tr>
<td>CAS</td>
<td>Country Assistance Strategy (Stratégie d’Assistance Pays)</td>
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<tr>
<td>CEA</td>
<td>Country Environmental Assessment (Analyse Environnementale Pays)</td>
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<tr>
<td>CNCAS</td>
<td>National Agriculture Credit Funds</td>
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<tr>
<td>CCNUCC</td>
<td>Convention Cadre des Nations Unies sur les Changements Climatiques</td>
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<tr>
<td>CDMT</td>
<td>Cadre de Dépenses Sectorielles à Moyen Terme</td>
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<tr>
<td>CEPS</td>
<td>Cellule d’Études, de Planification et de Suivi (Study, Planning and Monitoring Unit)</td>
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<tr>
<td>CES/DRS</td>
<td>Contrôle des Eaux et des Sols/Défense et Restauration des Sols</td>
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<td>CIDA</td>
<td>Canadian International Development Agency/Agence Canadienne pour le Développement International</td>
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<tr>
<td>CIRAD</td>
<td>Centre de coopération Internationale en Recherche Agronomique pour le Développement</td>
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<tr>
<td>CL</td>
<td>Collectivité locale</td>
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<td>CNCR</td>
<td>Conseil National pour la Coopération Rurale (National Council for Rural Dialogue and Cooperation)</td>
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<td>CNDD</td>
<td>Conseil National pour le Développement Durable (National Committee for Sustainable Development)</td>
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<tr>
<td>CONGAD</td>
<td>Conseil des ONG pour le Développement (Council of NGOs for Development)</td>
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<tr>
<td>CONSERE</td>
<td>Conseil Supérieur de l’Environnement et des Ressources Naturelles (High Level Council for Natural Resources and the Environment)</td>
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</table>
CR  Communauté rurale
CRODT  Centre de Recherches Océanographiques de Dakar-Thiaroye
CSE  Centre de Suivi Écologique (Center for Ecological Monitoring)
DA  Direction de l’Agriculture (Directorate of Agriculture)
DAPS  Direction de l’Analyse de la Prévision et des Statistiques (Directorate of Analysis, Forecasting and Statistics)
DAS  Direction de l’Assainissement (Directorate of Sanitation)
DAT  Direction de l’Aménagement du Territoire (Directorate of Land Use Planning)
DCEF  Direction de la Coopération Économique et Financière (Directorate of Economic and Financial Cooperation)
DEEC  Direction de l’Environnement et des Établissements Classés (Directorate of the Environment and of Registered Lands)
DEFCCS  Direction des Eaux, Forêts, Chasse et Conservation des sols (Directorate for Water, Forests, Hunting and Soil Conservation)
DEM  Direction de l’Exploitation et de la Maintenance (Directorate for Operations and Maintenance)
DGRE  Direction de la Gestion des Ressources en Eau (Directorate for Water Resources Management)
DHY  Direction de l’hydraulique (Directorate for Hydraulics)
DIREL  Direction de l’Élevage (Directorate for Livestock Development)
DISA  Direction des Statistiques Agricoles (Directorate for Agricultural Statistics)
DM  Direction des Mines (Directorate for Mines)
DMG  Direction des Mines et de la Géologie (Directorate for Mines and Geology)
DMN  Direction de la Météorologique Nationale (Directorate for National Meteorology)
DOPM  Direction de l’Océanographie et des Pêches Maritimes (Directorate for Oceanography and Maritime Fishing)
DPN  Direction des Parcs Nationaux (National Parks Directorate)
DPRH  Direction de la Planification et des Ressources Humaines (Planning and Human Resources Directorate)
DPS  Direction de la Prévision et des Statistiques (Statistics and Forecasting Directorate)
DSRP  Document de Stratégie de Réduction de la Pauvreté (Poverty Reduction Strategy Paper)
DTGC  Direction des Travaux Géographiques et Cartographiques (Directorate for
**Geographic and Cartographic Works**

- **DUA**  *Direction de l’Urbanisme et de l’Architecture* (Directorate for Planning and Architecture)
- **EEZ**  Exclusive Economic Zone
- **ENDA/TM**  *Environnement Développement Afrique / Tiers Monde*
- **FAO**  *Organisation des Nations Unies pour l’Alimentation et l’Agriculture* (United Nations Food and Agriculture Organization)
- **FECL**  *Fonds d’Équipement des Collectivités locales*
- **FED**  *Fonds Européen pour le Développement* (European Development Fund)
- **FEM**  *Fonds pour l’Environnement Mondial* (Global Environment Facility)
- **FNRAA**  Fonds National pour la Recherche Agronomique et Agro-alimentaire
- **FNUAP**  *Fonds des Nations-Unies pour les Affaires de Population*
- **FCFA**  *Francs CFA*
- **GIRE**  *Gestion Intégrée des Ressources en Eau* (Integrated Water Resources Management)
- **GoS**  *Gouvernement du Sénégal* (Government of Senegal)
- **GTZ**  *Gesellschaft für Technische Zusammenarbeit* (German Development Agency)
- **IAGU**  *Institut Africain de Gestion Urbaine*
- **IFAD**  International Fund for Agricultural Development (*Fonds International pour le Développement Agricole*)
- **IFAN**  *Institut Fondamental d’Afrique du Nord*
- **IGN**  *Institute Géographique National* (National Geographic Institute)
- **INP**  National Institute of Pedology (Soils) – (*Institut National de Pédologie*)
- **IMAP**  *Instruments et Modèle pour un Aménagement Participatif*
- **IRAT**  *Institut de Recherches Agronomiques Tropicales*
- **IRD**  *Institut Français de Recherches Scientifique pour le Développement en Coopération* (French Research And Development Institute)
- **ISE**  *Institut des Sciences de l’Environnement* (Institute of Environmental Sciences)
- **ISN**  *Institut Sénégalais de Normalisation*
- **ISO**  *Organisation Internationale de Normalisation*
- **ISRA**  *Institut Sénégalais de Recherches Agricoles* (Senegal Agricultural Research Institute)
- **IVDN**  *Indice de Végétation par la Différence Normalisée* (Normalized Difference Vegetation Index)
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<tr>
<td>LADA</td>
<td>Land Degradation Assessment in Dryland Areas</td>
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<td>LCD</td>
<td>Lutte contre la désertification</td>
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<tr>
<td>LDN</td>
<td>Loi de domaine national</td>
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<td>LIFE</td>
<td>Fonds d’appui aux initiatives locales pour l’amélioration de l’environnement urbain</td>
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<td>LOASP</td>
<td>Loi Agro-sylvo-pastoral</td>
</tr>
<tr>
<td>MAH</td>
<td>Ministère de l’Agriculture et de l’Hydraulique rurale et de la sécurité alimentaire (Ministry of Agriculture and Rural Water and Food Security)</td>
</tr>
<tr>
<td>MCDPR</td>
<td>Ministère de la Coopération Décentralisée et du Développement Régional (Ministry of Decentralized Cooperation and Regional Planning)</td>
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<tr>
<td>M&amp;E</td>
<td>Monitoring and Evaluation</td>
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<tr>
<td>MEF</td>
<td>Ministère de l’Économie et des Finances (Ministry of Economy and Finances)</td>
</tr>
<tr>
<td>MEPNBLRA</td>
<td>Ministre de l’Environnement, de la Protection de la Nature, des Bassins de Rétention et des Lacs Artificiels (Ministry of the Environment, of Natural Resources Protection of Retention basins and of Artificial Lakes)</td>
</tr>
<tr>
<td>MH</td>
<td>Ministère de l’Hydraulique (Ministry of Hydraulics)</td>
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<tr>
<td>MJEHP</td>
<td>Ministère de la Jeunesse, de l’Environnement et de l’Hygiène Publique (Ministry of Youth, the Environment and Public Hygiene)</td>
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<tr>
<td>MPHA</td>
<td>Ministère de la Prévention, de l’Hygiène publique et de l’Assainissement (Ministry of Prevention, Public Hygiene and of Sanitation)</td>
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<tr>
<td>NEPAD</td>
<td>Nouveau Partenariat pour le Développement de l’Afrique (New Partnership for African Development)</td>
</tr>
<tr>
<td>NRM</td>
<td>Natural Resource Management (Gestion des ressources naturelles)</td>
</tr>
<tr>
<td>OCB</td>
<td>Organisation Communautaire de Base (Grassroots Community Organization)</td>
</tr>
<tr>
<td>OCDE</td>
<td>Organisation de Coopération et de Développement Économiques (Organization for Economic Cooperation and Development)</td>
</tr>
<tr>
<td>OMD</td>
<td>Objectifs du millénaire pour le développement (Millennium Development Goals)</td>
</tr>
<tr>
<td>OMS</td>
<td>Organisation Mondiale de la Santé (World Health Organization)</td>
</tr>
<tr>
<td>OMVG</td>
<td>Organisation de la Mise en Valeur du Fleuve Gambie (Gambia River Basin Management Organization)</td>
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<tr>
<td>OMVS</td>
<td>Organisation de la Mise en Valeur du Fleuve Senegal (Senegal River Basin Management Organization)</td>
</tr>
</tbody>
</table>
ONAS  Office Nationale de l’Assainissement (National Sanitation Agency)
ONC  Organe National de Coordination (National Coordination Unit)
ONG  Organisation Non Gouvernementale (Non-Governmental Organization)
OP 15 Operational Program 15 of the GEF (SLM)
ORSTOM  Institut Français de Recherches Scientifique pour le Développement en Coopération
PADDEL  Projet d’Appui à la Décentralisation et au Développement Local
PADE  Processus d’Amélioration Durable de l’Environnement urbain
PADF  Programme d’Appui au Développement Forestier (Forestry Development Support Program)
PAE  Plan d’Action de l’Élevage (Livestock Development Action Plan)
PAEP  Projet d’Appui à l’Entrepreneuriat Paysan
PAFR  Plan d’Action Forestier Régional (Regional Forests Action Plan)
PAFS  Plan d’Action Forestier du Sénégal (Senegal Forestry Action Plan)
PAFT  Plans d’Action Forestier Tropical (Tropical Forests Action Plan)
PAN/LCD  Programme d’Action Nationale / Lutte Contre la Désertification (National Action Programme (for combating desertification)
PAPEL  Projet d’Appui à l’Élevage
PAPIC  Programme d’Action Prioritaire pour l’Investissement Communal
PAQPUD  Programme d’assainissement des quartiers péri-urbains de Dakar
PARPEBA  Projet d’amélioration et de renforcement des points d’eau dans le bassin arachidier
PASA  Programme d’Ajustement Sectoriel de l’Agriculture
PDDF  Plan Directeur de Développement Forestier
PDES  Plan de Développement Économique et Social
PDFR  Projet de Développement de la Foresterie Rurale
PDU  Plan Directeur d’Urbanisme
PDV  Direction de la Protection des Végétaux
PELT  Projet Eau à long Terme
PEPAM  Programme national d’Eau Potable et d'Assainissement du Millénaire (National Millennium Water Supply and Treatment Programme)
PER  Public Expenditure Review
PGIES  Projet Gestion Intégré des Ecosystèmes (Integrated Ecosystem Management Project)
<table>
<thead>
<tr>
<th>Acronyme</th>
<th>Signification</th>
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<tbody>
<tr>
<td>PIB</td>
<td>Produit Intérieur Brut (Gross Internal Product)</td>
</tr>
<tr>
<td>PLCP</td>
<td>Programme National de Lutte contre la Pauvreté</td>
</tr>
<tr>
<td>PMIA</td>
<td>Projet de Modernisation et d’Intensification Agricole</td>
</tr>
<tr>
<td>PNAT</td>
<td>Plan National d’Aménagement du Territoire (National Land Use Action Plan)</td>
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<tr>
<td>PNB</td>
<td>Produit National Brut (Gross National Product)</td>
</tr>
<tr>
<td>PNG</td>
<td>Plan National Géomatique</td>
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<tr>
<td>PNIR</td>
<td>Programme National d’Infrastructures Rurales (National Rural Infrastructure Programme)</td>
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<tr>
<td>PNUD</td>
<td>Programme des Nations-Unies pour le Développement (United Nations Development Programme)</td>
</tr>
<tr>
<td>PODES</td>
<td>Plan d’Orientation de Développement Économique et Social</td>
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<tr>
<td>POGV</td>
<td>Projet d’Organisation et de Gestion Villageoise</td>
</tr>
<tr>
<td>PPEA</td>
<td>Projet de Promotion des Exportations Agricoles</td>
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<tr>
<td>PRODAM</td>
<td>Projet de Développement Agricole de Matam</td>
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<tr>
<td>PROGEDE</td>
<td>Projet de Gestion Durable et participative des Énergies traditionnelles et de substitution</td>
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<td>PROMER</td>
<td>Projet de Promotion de Micro-Entreprises Rurales</td>
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<td>PSAOP</td>
<td>Programme des Services Agricoles et d’Appui aux Organisations de Producteurs</td>
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<td>PSE</td>
<td>Projet Sectoriel Eau</td>
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<td>PSAOP</td>
<td>Programme des Services Agricoles et d’Appui aux Organisations de Producteurs</td>
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<td>PSSA</td>
<td>Programme Spécial pour la Sécurité Alimentaire</td>
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<td>PST</td>
<td>Programme Sectoriel des Transports</td>
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<td>PTIT</td>
<td>Plan Triennal d’Investissement Publics</td>
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<td>PUD</td>
<td>Plan d’Urbanisme Détailé</td>
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<tr>
<td>SAED</td>
<td>Société d’Aménagement des Eaux du Delta</td>
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<td>SDAU</td>
<td>Schéma Directeur d’Aménagement et d’Urbanisme</td>
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<tr>
<td>SDE</td>
<td>Sénégalaise Des Eaux</td>
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<tr>
<td>SGII</td>
<td>Système de gestion de l’information sur les infrastructures socio-</td>
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économiques de la zone urbaine de Dakar

<table>
<thead>
<tr>
<th>Acronyme</th>
<th>Définition</th>
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<tbody>
<tr>
<td>SID</td>
<td>Système d’Information sur la Désertification (Information System for Desertification)</td>
</tr>
<tr>
<td>SIG</td>
<td>Systèmes d’Information Géographiques</td>
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<tr>
<td>SISEI</td>
<td>Système d’Information et de Suivi de l’Environnement par Internet</td>
</tr>
<tr>
<td>SLM</td>
<td>Sustainable Land Management</td>
</tr>
<tr>
<td>SODAGRI</td>
<td>Société de Développement Agricole et Industriel</td>
</tr>
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<td>SODIDA</td>
<td>Société de Gestion du Domaine Industriel de Dakar</td>
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<tr>
<td>SONEES</td>
<td>Société Nationale d’Exploitation des Eaux du Sénégal</td>
</tr>
<tr>
<td>STN</td>
<td>Société de la Terre Nouvelle (New Land Society)</td>
</tr>
<tr>
<td>UAEL</td>
<td>Union des Associations des Élus Locaux</td>
</tr>
<tr>
<td>UCAD</td>
<td>Université Cheikh Anta DIOP de Dakar</td>
</tr>
<tr>
<td>UE</td>
<td>Union Européenne</td>
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<tr>
<td>UICN</td>
<td>Union Mondiale pour la Conservation de la Nature</td>
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<tr>
<td>UNESCO</td>
<td>Programme des Nations Unies pour l’Éducation, les Sciences et la Culture</td>
</tr>
<tr>
<td>UNICEF</td>
<td>Programme des Nations Unies pour l’Enfance</td>
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<tr>
<td>USAID</td>
<td>Agence de Développement International des États-Unis (United States Agency for International Development)</td>
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<tr>
<td>USD</td>
<td>United States Dollar</td>
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<tr>
<td>WB</td>
<td>World Bank (Banque mondiale)</td>
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<td>WRI</td>
<td>World Resources Institute</td>
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<tr>
<td>ZAC</td>
<td>Zone d’Aménagement Concerté</td>
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<tr>
<td>ZEE</td>
<td>Zone Économique Exclusive</td>
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Executive Summary

1. The main objective of the Senegal Country Environmental Analysis (CEA) is to reinforce the ongoing dialogue on environmental issues between the World Bank and the Government of Senegal. The CEA also aims to support the ongoing Government implementation of a strategic results-based planning process at the Environment Ministry (MEPNBRLA). The main goal is to enable Senegal to have the necessary tools to attain the Millennium Development Goals (MDGs) and manage its natural resources and environment in a sustainable manner that contributes to sharing wealth and reducing poverty. The CEA presents a review of national environmental priorities and the institutional framework for managing these priorities. The CEA also proposes recommendations about reforms that could be implemented with the support of international development partners.

2. The main environmental issues identified in the CEA are: (i) the institutional framework for environmental management; (ii) the sustainable management of terrestrial ecosystems (including sustainable land management and management of forests and biodiversity); (iii) integrated water resources management (including national and transboundary resources); (iv) fisheries management; and (v) urban environmental management in Dakar. Other environmental issues covered in the CEA include coastal zone management, the management of water retention basins and artificial lakes, urban environmental management outside of Dakar, and solid waste management.

Institutional Framework for Environmental Management

3. Reform environmental management. The CEA proposes that the Government of Senegal consider an in-depth reform of its institutional framework for environmental management. Such a reform should apply more specifically to two components of this structure — environmental regulation and the management of biodiversity, in a fashion similar to approaches that have been adopted by other countries in Africa or elsewhere over the past 20 years. The institutional framework for environmental management in Senegal has been progressively derived from an initial structure based on the management of water and forestry resources and is not well adapted to the management of current issues.

4. Polluter-payer principle. Environmental regulation based on the polluter-payer principle is the most efficient method available to the Government to influence development policies and programs and the management of their externalities. Regulatory aspects to be revised include: (i) overview and monitoring of environmental assessments and audits; (ii) monitoring the implementation of environmental management plans; and (iii) monitoring and control of pollution from industrial facilities. Three specific challenges must be met to implement an effective and efficient environmental regulatory structure: (i) obtaining a mandate with sufficient authority to supervise the activities of ministries more powerful than the Environment Ministry, (ii) acquiring the specialized resources required to handle technically complex files; and (iii) acquiring the necessary financial independence to confront operators with deep pockets.
5. **The network of protected areas in Senegal is severely threatened.** The Niokolo Koba National Park has already lost a large part of its wildlife over the past 15 years and coastal marine resources are in crisis. The existing institutional framework has not been able to preserve the integrity of protected areas because of a lack of financial resources and deficiencies in the technical and scientific quality of management. Restructuring the institutional framework is a critical element of any solution adopted to address these issues.

6. **Public-private partnerships.** An option that could be considered by Senegal is the promotion of public-private partnerships (PPPs) to manage natural resources, either at the national level or at the level of protected areas. A key element to consider in restructuring the institutional framework is integration of wildlife conservation and hunting activities to consolidate wildlife management and fund conservation activities through income derived from hunting, similar to approaches adopted in Southern Africa. Structures based on PPPs could be supported by a public-private foundation (trust fund) with an enlarged governance structure. Revenues from the foundation from hunting fees and fees derived from the use of resources drawn from protected marine reserves could ensure the long-term financial viability of such a system.

7. **Other related aspects would also require reinforcement, including:**

   - Monitoring and control capacities related to environmental regulations, both within MEPNBRLA and other ministries involved in environmental management.
   - Coordination between MEPNBRLA departments and others involved in environmental management.
   - Implementation of an information and consultation process and active public participation upstream of the environmental assessment process, a time when projects can be influenced the most at minimal cost. Such a process should contribute to optimizing project design from environmental and socioeconomic standpoints and to integrating local community concerns into project design.
   - Use of sectoral, regional, or strategic assessments and cost-benefit analyses as tools to develop policies and select sectoral programs.
   - Providing support to NGOs to enable them to act as go-betweens and voice the concerns of civil society.
   - Integrating the concerns of the private sector to optimize the beneficial effects of environmental regulation.

**Sustainable Management of Terrestrial Ecosystems**

8. **Degraded land.** Senegal’s land is an important part of its natural capital and roughly two-thirds of it is degraded. Maintenance of land quality is widely recognized as critical for economic growth, food security, and to secure a wide range of environmental benefits. The Government’s Poverty Reduction Strategy Paper (PRSP-II) identifies rural land as a growth engine because agriculture engages almost 60 percent of the country’s population, but yields of cereal, roots, tubers, and pulses have been stagnant or falling...
since the 1960s. The natural wealth is jeopardized by the physical processes of land
degradation, amplified by human pressure — unsustainable agricultural practices,
overgrazing, bush fires, population growth, and poverty, plus uncertain land tenure and
other disincentives, as well as weak land-use planning.

9. **Lost potential.** Compared to the potential of the land, the value of production
foregone in the major sectors (crops, livestock, and forestry) is estimated by the
Government to be 140 billion FCFA per year (about US$ 262 million) between 1990 and
2000, about 4.5 percent of the GDP in 2000.

10. **Land degradation and severe rural poverty are intimately linked,** particularly in
the economically important groundnut basin where the vast majority of arable land is
located, and in the forest-pastoral zone in western and central Senegal. In these areas,
water and wind erosion, soil nutrient mining, and overuse are among the challenges that
reduce land quality. Casamance and the Senegal River basin also present natural
resource management challenges such as soil salinization and acidification, deforestation,
and water quality impacts. Most rural people make a meager subsistence living; the
subsequent migration is continuing to affect both urban areas and open lands in
Tambacounda and Kolda where clearing and tilling provoke more degradation. The
effects of climate change in these areas are still unknown, but may intensify the problem
and constrain responses.

11. **Limited success with combating land degradation.** Although annual public
expenditures to combat land degradation have increased from about US$ 28 million in
the 1990s to about US$ 72 million this decade, efforts have had limited success. In many
cases, this is because of an over reliance on technical “fixes;” top-down, centralized
approaches; and fragmented policies, sectors, institutions, and knowledge related to land
management, a problem that cuts across sectors.

12. **Multisectoral programs.** Better progress can be achieved through multisectoral
grassroots programs, including land users and local communities partnering with
researchers, extension services, NGOs, and ministries. However, this partnership has to
be supported with sound technical solutions, proper scientific and technological
backstopping, and adequate incentives, resources, and tools.

13. **Barriers to progress exist mainly in the policy and institutional environment,**
such as by (i) perverse, unenforced, or contradictory regulations and policies; (ii) insecure
tenure, including lack of transferable resource rights for customary users; (iii) weak

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1. From the *Fiches techniques sectorielles pour l’élaboration du 10e Plan d’Orientation pour le

2. About 1.15 million hectares are degraded in the groundnut basin alone, about one-third of all arable
land in the country. A LADA (*L’évaluation de la dégradation des terres au Sénégal,
FAO/UNEP/CSE*) study shows that 20 percent of the forest-agricultural zones have been affected by
substantial degradation. In the agropastoral zone, land use characteristics have changed on almost 65
percent of the area, notably with degradation of natural vegetation in just 11 years, with woody
savannah evolving toward poorer types of scrub savannah. Detailed studies in Kaffrine between 1989
and 1999 show that land use on 64 percent of the study area degraded, while only 1 percent improved
(LADA, 2005).
capacities and coordination among agencies to provide technical and institutional support to farmer/herder associations or to prioritize, sequence, and monitor investments; (iv) land users’ lack of access to markets and market-priced credit, (v) over-taxation of agriculture; and (vi) food subsidies that favor urban areas to the detriment of rural producers. On the other hand, recent reforms such as decentralization, along with increased awareness of land degradation, offer hope for improved performance in the future. It is important to build on this momentum.

14. **Isolated successes have been identified in Senegal** (and elsewhere) where community-based efforts have significantly increased both productivity and environmental sustainability. These successes demonstrate that land quality can be improved. This can be scaled up with the right mix of policies and public investments. Land users are active and motivated in maintaining land quality, but they have limited capacities to invest, to cope with complex or contradictory regulations and policies, and to absorb shocks. The Government has not sufficiently capitalized on the strengths, knowledge, and capacities of local land users.³

15. **Scale-up SLM.** In response, Sustainable Land Management (SLM) practices should be scaled up, partly based on known success stories. SLM practices must be tuned to local settings and generate a relatively early and tangible benefit to be adopted by land users. In general, simple agronomic techniques such as low tillage have demonstrated a benefit-cost ratio higher than one in other developing countries.⁴

16. **Improve coordination of stakeholders and agencies.** Scaling up SLM requires increasing not only the amount of financing but also improving the efficiency and effectiveness of domestic and international financing across all land use sectors. To accomplish this it is recommended that the Government focus on improving coordination of stakeholders and agencies to identify, prioritize, and monitor investment. This in turn requires the formulation of a comprehensive, long-term program for investing in rural land quality. Individual and possibly fragmented projects will not address the long-term problem or sustain the momentum needed to scale up SLM. The SLM program should focus on the groundnut basin and the forest-pastoral zone (the geographic entry points) because these are regions of high population density, severe rural poverty and vulnerability, productive importance, and severe land degradation. A second important focus is Casamance and the Senegal River valley because these are areas where SLM approaches such as watershed planning can bring to scale existing successes identified in these areas to control degradation of forests, cropland, pasture, and water resources. In

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³ For example, the Rodale Institute has worked closely with 2,000 farmers in 59 groups to improve soil quality, integrate stall-fed livestock into crop systems, add legumes and green manures, improve the use of manures and rock phosphate, incorporate water harvesting systems, and develop composting systems. The result has been a 75-195 percent improvement in millet yields – from 330 to 600-1,000 kilograms per hectare, and groundnut yields from 340 to 600-900 kilograms per hectare. Yields are also less variable year to year, with consequent improvements in household food security (Africa’s Vision for SLM [draft], TerrAfrica 2008).

17. **Country SLM Investment Framework.** A key approach that should be used for sectors and stakeholders to operationalize this SLM program is to formulate a Country SLM Investment Framework. This is in line with the TerrAfrica dialogue already initiated in Senegal. This investment framework would include the following elements:

- Identify mechanisms for institutional coordination, both vertically and horizontally, based on current functions.
- Shared and improved diagnostics. Key analytical gaps should build on the CEA findings and could include (i) cost-benefit analyses of land management options, and (ii) quantifying land degradation impacts on production land and managing climate risk.
- Shared dialogue and actions on coordinating, enforcing, and harmonizing key policy and laws.
- A country-led prioritization process of investment, linked to specific financial instruments, and based on current, pipeline, and planned investments from multiple sources, donors, and all related sectors.
- A national comprehensive SLM information system that includes: (i) a repository of information and tools that target each of the barriers mentioned above, (ii) a GIS-equipped M&E system for tracking progress on the ground and benchmarking various interventions that target land quality, and (iii) development of impact and process indicators needed to track program progress across actors and investment themes and locations.

18. **SLM can contribute to the country’s economic growth** and environmental objectives but requires committed governance, a favorable policy environment, equitable and effective operational frameworks, incentives for and cooperation among all relevant stakeholders, and the empowerment of communities, farmers, and herders as full partners.

19. **To manage forestry resources and biodiversity,** the CEA recommends reinforcing decentralization and participation of local communities in the management and conservation of such resources. This includes forestry, hunting in hunting reserves (*zones amodiées*), tourism, national parks, and promotion of non-traditional forest resources to maximize the interest of local communities in preserving biodiversity and natural resources and better control resource-related activities. Updating legislation on biodiversity is essential, as is the improvement of environmental monitoring of forestry and hunting activities. Implementation of such a monitoring process initially requires a comprehensive inventory of existing resources. The CEA recommends transfer of responsibilities over hunting activities from the Directorate of Water, Forests, Hunting, and Soil Conservation (DEFCSS) to the Directorate of National Parks (DPN) to better
ensure the preservation of wildlife resources and biodiversity. The CEA also recommends reform of funding and management of protected areas by promoting community partnerships or public-private partnerships.

20. Decentralize management of non-protected forests. The main challenge for management of water and forest resources in Senegal is to decentralize management of non-protected forests (forêts non-classées) to local communities, as required by the Forestry Code and by the Law on Decentralization, as well as establishing co-management mechanisms for protected forests (forêts classées). The Government should transfer more funds and expertise to local administrations to enable them to play the role actually envisioned for them by law. It is also recommended that the Directorate of Water, Forests, Hunting, and Soil Conservation (DEFCSS) more ambitiously pursue the devolution of its budgets and human resources to the regions to better play its supporting role in relation to local administrations.

Water Resources Management

21. Water resources are among the main attributes that can enable Senegal to attain its objectives of supplying water to all inhabitants, ensuring food security, providing comprehensive public health coverage, and preserving ecosystems. According to the Action Plan for Integrated Water Resources Management (Plan d’Actions pour la Gestion Intégrée des Ressources en Eau, PAGIRE) recently adopted by the Government, “. . . the country is faced with continued growth in demand for water in its capital city that is now estimated at 4.5 percent per year. The additional demands for water by other urban centers of the hinterland as well as those of the 13,000 villages in rural areas and of their numerous livestock herds require that sustainable water supply solutions be adopted. . . . The development of irrigated agriculture, an important consumer of water and source of pollution, has been considerably reinforced through the efforts of the public and private sectors. A number of irrigated areas have been developed in the Niayes zone, along the full length of the Senegal River valley, in Casamance, in the Ananbé River basin, as well as along the Gambia River.”

22. Because water is a fundamental resource to sustain livelihoods, particular efforts should be made to clarify responsibilities in this sector. The CEA recommends that the Government improve the cohesion and coordination among institutions to ensure proper management of different functions (including in particular the protection and conservation of water resources) and a better use of available water. The implementation of the PAGIRE’s 2008-2015 program of priority actions should contribute significantly to facing the challenges of national water resource management.

23. The effective management of rainwater drainage systems in Dakar appears to be a priority. It is too early to know if the Sectoral Policy Paper on Water and Wastewater Management in Rural Areas (Lettre de politique sectorielle de l’hydraulique et de l’assainissement en milieu urbain et rural) and its application in the context of the Programme national d’Eau Potable et d’Assainissement du Millénaire (PEPAM) will be as successful as hoped for. However, this policy is clearly a step forward to provide the
necessary resources to all water users throughout the country to ensure that water can be captured and treated in conditions that ensure sustainability.

24. There are increasing environmental pressures related to irrigated agriculture in the Senegal River valley, where local populations have traditionally practiced flood recession agriculture and artisanal fishing activities with low impacts on the environment. The River Delta Water Resources Development Corporation (Société d’Aménagement des Eaux du Delta, SAED) has promoted development of large-scale irrigated agriculture perimeters that today represent about 75,000 hectares in the Senegal River valley. This intensive agriculture contributes to increased runoff of nutrients to the Senegal River at a time when the Government is investing large sums to: (i) treat water in Guiers Lake (an important source of drinking water for Dakar); (ii) control the proliferation of harmful aquatic plants in Guiers Lake and at the Diama Dam (MEPNBRLA, SOGED); and (iii) protect Senegal River wetlands and ecosystems that are vital for the preservation of continental fishing for rural communities that are among the country’s poorest.

25. Regulations not adequate. Existing regulations do not address authorized levels of fertilizer use, the intensity of agricultural uses, or soil drainage near Guiers Lake or the Senegal River. This example for the agricultural sector provides an illustration of the reinforcement required to integrate environmental considerations and ensure that all sectors are involved in the sustainable management of natural resources. The combined efforts and energy of all concerned partners must coalesce at the national level to ensure an optimal use of resources and have an impact. The institutional responsibilities to coordinate management activities related to transboundary environmental issues such as those that apply to the management of the Senegal River remain to be better defined. This role is presently devolved to the Senegal River Basin Organization (OMVS), an organization that does not appear to effectively manage environmental issues.

**Fisheries Management**

26. Maritime fishing has undergone a spectacular expansion over the last 20 to 30 years as a result of public sector fisheries management and development programs that have promoted increased production and transformation of available resources. The fisheries sector has been prominent in national macroeconomic objectives, e.g., increased exports, economic growth, reduction of underemployment or unemployment in rural and urban areas, increased cash income, food security, etc.

27. Artisanal fishing villages threatened. Over the last few years, marine and coastal resources and fishing activities have been faced with a severe environmental and socioeconomic crisis that threatens the survival of artisanal fishing villages and may compromise the supply of fish to local populations and the future of the export-based maritime fisheries industry.

28. Much smaller fish harvests. This crisis is reflected by an average drop of 32 percent between 1988 and 2003 of demersal species that contribute most of the value added to the fisheries sector as well as a drop of 26 percent in the tonnage of exported demersal species. In general terms, the annual tonnage in the Senegalese Exclusive Economic Zone
(EEZ) has varied between 440,000 and 450,000 tonnes since 2003. However, these trends are obscured by the increased numbers of fish reported in neighboring countries that are unloaded in Senegal. The low income of a large number of fishing communities, large unused production and transformation capacity, as well as the low capture levels of individual fishing units combined with decreasing productivity, are other important aspects related to the Senegalese maritime fisheries crisis.

29. **Over-exploitation of the main demersal species.** This situation is the result of sectoral policies that were not founded on sustainable fisheries principles, and has been largely caused by occasional severe over-exploitation of the main demersal species (coastal and deepwater species). The main factors are an overcapacity of industrial and artisanal fishing fleets focused on locally available resources, excessive and uncontrolled levels of fishing, and the use of methods, technologies, and practices that are not selective or destroy local species or their habitats. These factors have become the main threats to the sustainability of fish resources and the conservation of ecosystems on which they depend.

30. **Effects of fishing practices.** Senegalese fish resources are not only affected by overcapacity and overfishing but also by the environmental impact of practices on habitats (mangroves, hatcheries, breeding areas, nurseries, growth areas). Fish resources are also affected by exogenous environmental factors (pollution, climate change, destruction of fish habitats by activities of other sectors). The increased degradation of the main fish stocks between 2002 and 2007 demonstrates the inefficiency of fisheries management systems that have been implemented over the last few years.

31. **A collapse of fish stocks would affect the lives** of hundreds of thousands of people whose livelihoods are directly dependant upon fishing as their main source of income. The collapse of fish stocks would also reduce income from export markets that provide an important share of revenue even for companies that have been affected by structural problems related to the fisheries crisis.

32. **Efficient management and conservation approaches.** In such a context, solutions to the crisis must be based on adoption of efficient management and conservation approaches that depend on increased participation and devolution of responsibilities to local fishing communities. This can be done with advanced resource co-management models, sound planning of fisheries development, and the adoption of ecosystem management that integrates the principles of sustainable development and conservation. The use of protected marine areas and other mechanisms (such as artificial reefs) as well as closed periods in certain zones or specific seasons of the year should be promoted where relevant to preserve fish hatcheries, nurseries, and growth.

33. **A new fisheries management system** will require a new administrative, consultative, and managerial framework for the entire sector. Such a system will also require the adoption of a new legal framework (adaptation of the Maritime Fisheries Code, development of a Framework Law on biodiversity, etc.). This will require clarification of the responsibilities of the sectoral ministries involved in the management of the productive marine environment (Environment Ministry, Maritime Economy Ministry).
34. **Fish farming.** Finally, development of fish farming (marine and continental), which is the other main priority of the ministry responsible for fisheries, will also require full consideration of environmental factors in the planning and implementation of aquaculture projects (salinization, chemical fertilizers, hormone-based food additives, antibiotics, etc.) to ensure that such projects are sustainable.

**Urban Environmental Management in Dakar**

35. **Greater urban Dakar, with a population of more than 2.3 million, boasts several environmental accomplishments.** For example, over 90 percent of the population is now using LPG for cooking (GDHS, 2005), greatly reducing indoor air pollution, a major health threat in much of sub-Saharan Africa. Solid waste collection services reach 85 percent of households, although collection rates vary from 65 percent in Rufisque, 75 percent in Pikine, to 98 percent in Guediawaye and CA Dakar (GDHS, 2005).

36. **There are, however, major environmental challenges to be addressed.** Risk of malaria is still high, compounded by poor management of water resources, especially in peri-urban areas, and low rates of bed net use. Ambient air pollution is exacerbated by the high rate of diesel use — especially by an old vehicle fleet — and emissions from power plants, the cement industry, and industrial areas near population centers. Although water and sanitation coverage rates exceed 90 percent in greater Dakar, the incidence of diarrheal disease continues to be high (GDHS, 2005). Use of wastewater for vegetable irrigation is widespread in some peri-urban areas, and the Mbeubeuss landfill in Pikine is in need of improvement.

37. **These environmental conditions result in high costs to the population in terms of health effects and quality of life.** An assessment of the health effects of malaria, urban air pollution, and inadequate water supplies, sanitation, and hygiene in urban greater Dakar indicates a cost of about 65 to 90 billion FCFA per year, or 1.75 to 2.3 percent of national GDP in 2004. The cost of malaria is estimated at 35 billion FCFA per year. This is based on an estimated annual incidence of over 800,000 malaria episodes and over 1,000 malaria deaths in the greater Dakar population. The cost of urban air pollution is estimated at 13 to 34 billion FCFA per year. This cost arises from more than 1,000 estimated cardiopulmonary deaths, 300 new cases of chronic bronchitis, 1,900 hospitalizations, 38,000 emergency room or outpatient hospital visits, over 5 million restricted activity days, as well as other respiratory effects occurring each year as a result of particulate pollution. The cost of inadequate water supplies, sanitation, and hygiene is estimated at 19 billion FCFA per year from more than 2 million estimated cases of diarrheal illness and nearly 650 diarrheal deaths each year (Tables ES 1 and ES 2).

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5. Annual incidence is based on regional per capita estimates for Sub-Saharan Africa reported in Korenromp (2005).

6. The lower bound of 13 billion FCFA is based on a human capital value of 4 million FCFA per death (foregone remaining lifetime income). The higher bound of 34 billion FCFA is based on a value of statistical life of 24 million FCFA per death.
38. A number of management actions to alleviate some of these pressing issues are already in place. A national malaria control program, a hygiene program for improved hand washing practices, and a peri-urban onsite sanitation project in greater Dakar are currently being implemented. Monitoring of ambient urban air has also been developed, which helps identify areas in greater Dakar of particular concern. Actions to curb air pollution have also been initiated, such as a vehicle inspection and maintenance program, replacement of old mini-buses, and control of pollution from cement plants. Supply of low-sulfur diesel is, however, essential to combat particulate pollution from road transport, which is the sector that contributes most to urban air pollution from particulates. Low-sulfur diesel is also a requirement for the introduction of diesel vehicles with particulate control technology.

39. An assessment of the benefits and costs of existing and other potential management options is key to make the most of scarce financial resources. A benefit-cost analysis of malaria control, improved hand washing, improved water supplies and sanitation, and low-sulfur diesel and diesel vehicle particulate control technology was
undertaken to illustrate the use of economic analysis as an instrument for setting environmental priorities.

40. A number of remediation activities have shown a high benefit-cost ratio under median assumptions. Examples include:

- **Malaria control.** Benefits are estimated at over three times greater than costs if 70 percent of the population would use insecticide-treated bed nets (ITBN) and regular indoor residual spraying (IRS). As a result of these actions, malaria incidence and mortality would be reduced by 50 percent.

- **Hand washing promotion program targeting mothers and caretakers of young children.** Benefits are estimated at nearly 2.5 times greater than costs if 15 percent of mothers and caretakers improve their hand washing behavior for at least two years at critical times such as before cooking and feeding the child, and after cleaning the child and going to the toilet. As a result of these hand washing improvements, diarrheal illness in children would be reduced by about 45 percent. Main costs included in this analysis are program costs and cost of soap.

- **Program to promote household point-of-use drinking water purification.** Benefits are estimated at about 1.5 times greater than costs if 15 percent of households start purification and continue for at least two years. Reduction in diarrheal illness would be about 25 percent. Main costs included in this analysis are program costs and the cost of boiling water.

41. For other activities, a larger than one benefit-cost ratio under median assumptions depends on the type of benefits and the monetary value given to mortality. Examples analyzed include:

- **Household water basin with soakway (BALP) and a pour-flush toilet (TCM) connected to a pit.** The benefits of these interventions include health improvements — reduced diarrheal illness, and time saved from not having to fetch water at a distance from the dwelling or going to a community toilet. Reductions in diarrheal illness from BALP and TCM may be on the order of 15 and 20 percent, respectively. If so, the health benefits are estimated to be less than the costs of providing BALP and TCM. However, with time benefits included, i.e., about 15 minutes per household per day for a BALP and 30 minutes per household per day for a TCM, benefits are about 2.3 and 1.7 times greater than costs for a BALP and TCM, respectively.

- **Diesel with sulfur content at a maximum of 500 ppm in greater Dakar** for both heavy and light diesel vehicles. Benefits are estimated at 2 to 2.5 times the incremental cost of 500 parts per million (ppm) diesel if reduced mortality from air pollution improvements is valued by using a value of statistical life of 24 million FCFA per death. If, however, reduced mortality is valued using the human capital approach, i.e., at 4 million FCFA per death, benefits are lower than the costs of lower sulfur diesel.
• **Moving from 500 to 50 ppm diesel.** The benefits of this extra measure are estimated at 1.5 times or more than the cost if the value of statistical life is used. If, however, the human capital value is used, benefits are below the costs.

• **Installing diesel oxidation catalysts (DOC) and diesel particulate filters (DPF) on some types of vehicles that are in use.** Benefits are also estimated to be greater than the costs of these particulate control technologies. If, however, reduced mortality is valued at the human capital value, benefits are lower than the costs of particulate control technologies.

Figure ES 3. Benefit-cost ratios of malaria control, hygiene, and water and sanitation interventions in greater Dakar

![Figure ES 3. Benefit-cost ratios of malaria control, hygiene, and water and sanitation interventions in greater Dakar](image)

Figure ES 4. Benefit-cost ratios of low-sulfur diesel and diesel vehicle particulate control in greater Dakar

![Figure ES 4. Benefit-cost ratios of low-sulfur diesel and diesel vehicle particulate control in greater Dakar](image)

Notes: HCV (human capital value)= 4 million FCFA per death; VSL (value of statistical life)= 24 million FCFA per death.
Introduction

Context

42. **Economic growth in Senegal has been stable at 4.9 percent of GNP** over the last decade (1994 to 2004), and the country is considered one of the better performing countries in sub-Saharan Africa. This Country Environmental Analysis (CEA) assesses to what extent environmental resources can help or hamper sustainable economic development, and formulates recommendations. This report also summarizes environmental conditions and national environmental management capacity since the first CEA was published in 1994.

43. **The national priorities outlined in 2006** in the second Poverty Reduction Strategy Paper (PRSP-II) had four emphases: (i) growth that favors the poor; (ii) accelerating access to basic social services; (iii) social protection and the prevention and management of catastrophic risk; and (iv) good governance and decentralized and participatory development. Management of the environment and natural resources is prioritized to a certain point in the PRSP, but the specific issues subject to environmental management are scarcely defined. The CEA thus supports Senegal’s efforts to improve environmental management, but from now on, it will promote a multisectoral approach to foster better integration of environmental priorities into national and sectoral policy.

44. **The Country Assistance Strategy (CAS)** of the World Bank defines the vision and role of the Bank and establishes the foundations for specific investments and loan programs supported by the Bank. The priorities outlined in this strategy are governance and the three pillars of growth: (i) accelerated growth, wealth creation, and strengthening drivers of growth; (ii) human development, social services, and shared growth; and (iii) rural and urban synergies, urbanization, and migration. The CAS attempts to capitalize on the PRSP to reach the Millennium Development Goals (MDG) and support investment sectors where the Bank enjoys a comparative advantage.

45. **The CEA should contribute to the Country Assistance Strategy (CAS) that is under development.** Environment, land management, and natural resource management all play an important role in Senegal’s economic growth, especially in rural areas. The cost of environmental degradation can be high and affect living conditions and food security for the poorest segments of the population in both urban and rural areas. It is thus vital that environmental considerations be integrated into the CAS development process. The issues of environmental and natural resource management such as fisheries, sustainable land management, environmental health, and the institutional setting for environmental management are fully integrated into the Bank’s CAS in Senegal.

46. **The CEA is based on a multisectoral dialogue with the Government** of Senegal involving the Ministère de l’Environnement, de la Protection de la Nature, des Bassins de Rétention et des Lacs Artificiels (MEPNBRLA) and the Ministère de l’Économie et des Finances (MEF). Following the CEA identification mission, an interministerial working group was set up to supervise preparation and validate CEA results. This working group
also represents a bedrock for developing the national TerrAfrica platform on sustainable land management.

47. **Financial support for the CEA.** The CEA enjoyed financial support from the Canadian trust fund, the Japanese trust fund, and the World Bank-Netherlands partnership program. The Embassy of the Netherlands in Dakar also pledged about US$ 100,000 to hire the services of an institutional expert and cover the costs of inception and CEA validation workshops. The CEA preparation was coordinated by the environment sector donor group based in Dakar — USAID, France, the European Commission and others — with support from the Netherlands Embassy in Dakar.

**Objectives**

48. **The global objective of this CEA is to strengthen the dialogue on environmental issues** between the World Bank and the Government of Senegal. This dialogue is necessary to support the Government in its efforts to integrate environmental issues into the PRSP-II and the Accelerated Growth Strategy (AGS). The CEA also aims to support the Government process to strengthen strategic planning through results being implemented within the MEPNRLA. The main goal is to ensure that Senegal has the necessary tools to achieve the Millennium Development Goals (MDGs) and manage its natural resources and environment sustainably to contribute to sharing growth and reducing poverty.

49. **Specific CEA goals include:**

- **Promoting better integration of environmental priorities into national and sectoral policy** by providing recommendations on how to integrate into national development priorities the results of analyses from the sectors of water and water purification, energy, transport, sustainable land and natural resource management, rural development and the environment, as well as synergy among these sectors.

- **Guiding the environmental support and capacity development activities** supported by the Bank or other development partners based on analysis of institutional capacities, especially the environment, sustainable land and natural resource management, rural development, water and water purification, energy, and transport.

- **Favoring a strategic approach to priority environmental issues** by providing information and analysis on synergies between the environment and development from preliminary decision-making stages, with an aim toward guiding the main decisions in the area of government investments and guidelines at the national and sectoral levels.

50. **The CEA provides advice on national environmental priorities** and the national institutional framework for managing these priorities. It also provides recommendations on reforms that could be implemented with the support of trust funds.
Approach

51. The approach adopted to prepare the CEA was based on four broad activities:

- Analysis of the evolution of broad environmental issues in Senegal and the resources to manage them. The main environmental issues in Senegal were identified and analyzed using the best indicators and studies available to discern broad trends observed over the last 10 years and their consequences for the Senegalese people. Second, management of these issues was examined to see to what extent national policies and resources are adapted to requirements. Third, recommendations were formulated to improve management of the main environmental issues in Senegal.

- Economic analysis of urban environmental degradation. The main environmental factors that put public health in Dakar at risk were the object of an economic analysis of mortality from urban environmental degradation. Second, a sample of programs to reduce environmental risk factors for public health in Dakar was analyzed to see to what extent these programs could help reduce mortality associated with urban environmental degradation. Third, recommendations were drafted to improve urban environmental management in Senegal.

- Sustainable land management. The main issues linked to sustainable land management were examined based on an analysis of soil degradation, including a typology of degraded soils and the degradation process and recommendations for implementing sustainable land management programs in priority sectors. The analysis was completed by a review of public spending for land management to assess Government action in the area of sustainable land management.

- Analysis of the institutional framework for environmental management. The capacity of Senegal’s institutional and regulatory framework to address the challenges caused by the management of broad environmental issues was examined to identify areas for improvement. The institutional analysis used multiple sources of information including policy, laws and regulations in the environmental and natural resource management sector, norms and environmental indicators, institutional analyses, and reports from Government sources and others. Information was also collected from a broad sample of institutional and public agencies and NGOs involved in environmental management in Senegal. The analysis covered the framework of national, regional, and multisectoral environmental management, and generated specific recommendations for institutional and legal reforms.

Report Structure

52. This final CEA report includes three sections to encourage discussion on the observations made from the analysis and the suggested recommendations:

- Section 1 summarizes the main environmental issues identified in the CEA (institutional framework for environmental management, sustainable management
of terrestrial ecosystems, management of water resources, management of fisheries, and urban environmental management in Dakar. Other environmental issues are also tackled in this section — urban environmental management in regions, waste management, management of coastal zones, and management of retention basins and artificial lakes.

- **Section 2** analyzes each of the issues and singles out specific observations and recommendations about institutional and legal reforms and ways to improve management.

- **Section 3** summarizes the operational recommendations drawn from the previous section according to the main environmental issues identified in the CEA framework.
Section 1 – Main Environmental Issues

1.1 Summary of Issues

53. Socioeconomic conditions. The population of Senegal grew from 3 million in 1960 to 9.5 million inhabitants in 2000. This strong population growth was due to a high birth rate and a declining death rate, which in recent years has led to an annual growth rate of 2.7 percent. A recent drop in the birth rate indicates that the country’s population growth should slowly begin to stabilize. The children’s death rate (5 years and younger) dropped considerably during the last 40 years and was 83 per 1,000 in 2004 (World Bank, World Development Indicators, 2005). However, this rate remains much higher in rural areas than in urban centers.

54. In 2000, 47 percent of the population lived in urban areas. One-half of the population is concentrated along the Atlantic Ocean, and one-quarter lives in the Dakar region. Another one-quarter lives in the region of Sine-Saloum, while only 5 percent lives in the region of Western Senegal, about one-third of the country’s area.

55. The population in Senegal is very young (58 percent are younger than 20) and is characterized by high levels of migration among young men. Women are 52 percent of the population even if there is a high death rate during childbirth. The number of women who are household heads has been growing constantly since the 1980s. The percentage of the population that is illiterate is high, especially among women (62 percent). The percentage of unemployed or underemployed is also high (40 percent), and the informal labor market is still in growth mode.

56. Marked socioeconomic inequalities can be observed inside the country as a whole and between regions. Results of the Senegal household survey (Enquête Sénégalaise Auprès des Ménages – ESAM II, 2001-2002) show that while there is a high percentage of people living in poverty, this group diminished considerably between 1994-1996 (67.9 percent) and 2001-2002 (57.1 percent). Poverty levels dropped more rapidly in urban areas than in rural areas. In 2001-2002, 65.2 percent of individuals lived in poverty in rural areas. In urban areas outside Dakar, 50.1 percent of individuals lived in poverty while the poverty rate was 42.0 percent in the Dakar region. As a result, 65 percent of poverty was concentrated in rural zones which represented approximately 55 percent of the population. Conversely, 18 percent of poverty was concentrated in the Dakar region, which is home to 25 percent of the population.

57. In 2001-2002, the regions of Ziguinchor and Kolda, which have been affected over many years by the insecurity linked to the crisis in Casamance, had the highest rates of poverty (67.1 percent and 66.5 percent, respectively). These were followed by the regions of Kaolack (65.3 percent) and Diourbel (61.5 percent), which are located in the heart of the Bassin Arachidier and have been affected by the economic decline associated with peanut farming and the absence of alternatives, and by the region of Tambacounda in Western Senegal (56.2 percent). The regions of Thiès (48.6 percent), Fatick (46.3 percent), and Saint Louis/Matam (42.1 percent) have income from tourism, irrigated agriculture, fishing, and remittances from overseas (especially in Matam), agricultural
processing (particularly in Saint Louis), and mining (Thiès). The two wealthiest regions, Dakar (33.6 percent) and Louga (36.6 percent), enjoy large-scale financial flow. Dakar is the economic, industrial, administrative, intellectual, and cultural bellwether of the country, while the region of Louga has large-scale ranching resources.

58. **Evolution of the Senegalese economy.** In 1960, Senegal’s economy was mainly rural based and depended on the export of peanut products (Ngaido, 2002). In 2001, 60 percent of Senegal’s population was still working in agriculture but the contribution of this activity to GNP dropped from 17.3 percent in 1979 to 10.2 percent in 2001 because of economic diversification, locust infestations, drop in rainfall, loss of fertility, and soil degradation. In 2004, the transport and communication sector represented 51 percent of GNP (Figure 1.1) (DPS/OECD, 2006). Agriculture, ranching, forestry, and fishing represented 17 percent of GNP, while the industrial and mining sectors were 14 percent and 1 percent of GNP, respectively. Despite its low contribution to GNP, ranching is an important socioeconomic and subsistence activity — 3 million people and 350,000 families are involved in pastoral and agropastoral activity (Ngaido, 2002).

![Figure 1.1 Senegal gross national product by sector, 2004](image)

59. **GNP growth.** With an average growth in GNP of 5.3 percent during the period 1995-2005 (except 2002, marked by an agricultural crisis), Senegal has shown much economic dynamism since the devaluation of the FCFA in 1994, despite episodic problems such as a rainfall deficit (1997/98) and major electrical blackouts in 1999 (OECD, 2005). All the same, the growth rate is below initial projections and below the minimal rate of 7 percent required to reduce the poverty rate by one-half from now until 2015. The recently implemented reforms to counter the negative effects of high gas prices should help generate a growth rate of about 5.2 percent in 2006 and 6 percent in 2007 (based on OECD projections for 2006).

60. **Accelerated growth strategy.** The Accelerated Growth Strategy (AGS) is the main reference document for economic development in Senegal. The founding vision of the AGS was given by the President of the Republic in May 2004: “Accelerate growth, while
improving qualitatively its structure to make it more efficient in the fight against poverty, and diversifying the sources to make it secure and long lasting” (Republic of Senegal, 2007). The AGS was developed through widespread consultation between the State, the private sector, civil society, development partners, and social partners. In particular, it renders operational the first axis of the Poverty Reduction Strategy Paper (PRSP) — creation of wealth. Preliminary works enabled five fruitful activity groups for the national economy. These clusters are agriculture and agribusiness; information and communication technology; tourism, cultural industries and art and crafts; textile packaging; and seafood and aquaculture products.

61. The cluster groups established diagnostics, prepared the development strategy, and the action plan for each cluster. The basic principle is “... that it is necessary in the short term to bring around, maintain and accelerate growth through a series of innovative or urgent reforms and by targeted investments with a powerful leverage effect” (Republic of Senegal, 2007). The two clusters whose development is the most likely to have immediate impact in terms of environmental management are agriculture-agribusiness and seafood and aquaculture products.

62. For the agriculture and agribusiness cluster, the priority development of three sub-clusters envisioned during the period 2007-2010 is: (i) horticultural products for tuning the sector to globalized supply chains; (ii) processed products to serve as a springboard to Senegalese entrepreneurship in a modern and profitable sector; and (iii) the livestock and agri-industrial products to capitalize on the progress of traditional sectors and ensure growth over time.

63. Given the current crisis of the fisheries sector, marked by over-exploitation of ocean resources and the threat of depletion of certain stocks, the development of the seafood and aquaculture products cluster is based on growth in development of catches and not an increase. It also relies on aquaculture centered mainly on food security to meet the shortfall of 75,000 tonnes of animal protein (fish and meat) projected over the medium term. The short-term development of the cluster (2007-2010) first goes through a sharp adjustment of industrial and artisanal fishing capacity as well as industrial capacity. Next the resource will be managed according to principles of sustainability of ocean resources with two key instruments: (i) managing fisheries and regulating access to all types of fish through a system of permits and access fees, and (ii) upgrading for certification with the European Union through the professionalization of artisanal sector stakeholders and various funding and training tools.

7. The notion of “cluster” can be defined as “an integrated pole with structured competitiveness around enterprises of a given sector in contact with the markets, as well as all activities which contribute to strengthening their competitiveness and benefiting from solid economic infrastructure” (Republic of Senegal, 2007).

8. The implementation of the action plan for this cluster, assessed at 34.4 billion FCFA of public investment, should generate 55.7 billion FCFA of private investment and translate into 75,000 qualified jobs, 50,000 tonnes of exports of horticultural products, and thousands of trained small producers inserted into the value chains (Republic of Senegal, 2007).
64. **For aquaculture**, the next years will be dedicated to implementing development conditions: — setting up structures, studies, site identification, setting up pilot projects, and training stakeholders (Republic of Senegal, 2007).9

65. **Need to start ecosystem management at the national level.** As illustrated by the current fisheries crisis, the success of the Accelerated Growth Strategy requires implementing ecosystem management at the national level to support the county’s sustainable economic development.10 This should be based on the principles put forward in the Millennium Ecosystem Assessment,11 which reports on 10 categories of ecosystems at the planetary level, including these seven categories that are relevant to Senegal:12

- **Marine environments** (ocean, with fish as the main change factor);
- **Coastal environments** (interface between marine and terrestrial environments, extending at sea to the environment of the continental shelf and on land in environments strongly influenced by marine environments);
- **Continental waters** (permanent water bodies located inland and where ecology and use are dominated by permanent, seasonal, or occasional flooding);
- **Forest environments** (environments dominated by the presence of trees, often used for wood cutting, fuel wood, or charcoal for non-wood forest products);
- **Dry environments** (where plant production is limited by water availability and where the dominant usage is for large herbivores, including grazing land and crops for livestock);

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9. The global action plan for the cluster for the period 2007-2010 is 56.4 billion FCFA of which 32 billion FCFA represent the cost of the Programme d’Ajustement des Capacités de la Pêche Maritime (PACPM) planned by the Ministère de l’Économie Maritime (MEMTMI). The major expected result is the medium-term restoration of natural productivity of the maritime fisheries sector and aquaculture production of 35,000 tonnes of fish (tilapia and silure) by 2015 (Republic of Senegal, 2007).

10. At present, Senegal is already divided into six eco-geographic zones that are relatively homogenous from the point of view of potentialities and problems linked to natural resources management. These are the Senegal River valley, the forest-pastoral zone, the Peanut basin, the Niayes zone, the Western Senegal zone, and the Southern forest zone (http://www.environnement.gouv.sn/article.php3?id_article=41).

11. This is an international research project spread over four years and aimed at assessing: (i) the condition of terrestrial ecosystems; (ii) potential impacts of the changes observed on ecosystem ability to meet human needs; and (iii) the policies, technologies, and tools required to improve ecosystem management by improving the quality of information used by decision makers and the public and institutional capacity — especially in developing countries — to undertake these assessments and act accordingly. This project will provide information on biological aspects of regulated and unregulated ecosystems as well as on the economic value of goods and services generated by these ecosystems and on the potential economic and health impacts of changes made to these ecosystems.

12. These categories are: marine environments, coastal environments, continental waters, forest environments, dry environments, insular environments, mountain environments, polar environments, cultivated environments, and urban environments. These are not ecosystems as such, but they contain a certain number of ecosystems. They are not mutually exclusive — their borders can overlap (for example, a humid environment in a coastal region can be considered in the assessment as a coastal system or a continental water system).
• **Cultivated environments** (dominated by domestic plant species, utilized and modified by crops, agroforestry, or aquaculture); and

• **Urban environments** (built environments with high human density).

66. **Analyzing main environmental issues.** In the framework of the current CEA, the main environmental issues affecting economic development in Senegal as well as the implementation of the PRSP were analyzed according to the ecosystem categories outlined above. As far as possible, the main change factors (including institutional issues) affecting these issues were identified, such as economic incentives, demographic pressure, access fees to natural resources, or land rights. Environmental trends are assessed in terms of their social and economic impact, including drops in production or economic productivity (agriculture, forest, fishing); threats to public health; human exposure to environmental risks (floods, drought, accidents); conflicts and security; impacts on poverty and vulnerable groups; sustainability of resources used; and cultural values.

67. **The main environmental issues affecting development in Senegal are:**

• Institutional framework for environmental management (Section 1.2);

• Sustainable management of terrestrial ecosystems, including sustainable land management and the management of forests and biodiversity (Section 1.3);

• Water resources management, including national and transboundary resources (Section 1.4);

• Fisheries management (Section 1.5); and

• Urban environmental management in Dakar (Section 1.6).

68. **The environmental issues in this report were chosen in agreement** with the Consultative Committee established by the Government for this CEA. At the time, environmental institutions, urban environmental management, and sustainable land management were retained as major topics. At the time of printing, however, there are other environmental issues — some of which are new — that have become equally important, and will need to be analyzed in the future.

69. **For example, the environmental issues in the Senegal River delta** are important. The Senegal River delta is already becoming an area of intensive development of irrigated agriculture. Known and existing environmental issues are likely to be exacerbated if mitigation measures are not put in place. This is one of the major environmental issues to be tackled to prevent further ecosystem and soil degradation, water pollution, invasion of diseases, and possibly even social conflicts.

70. **The Casamance ecosystem also has its problems.** The civil conflict there has had negative impacts on this historically rich and productive ecosystem because it has been managed by the local population without much input of best practices. Some observed effects include salinization of rice fields and the degradation of mangrove swamps and palm groves.
71. **Environmental issues in coastal areas could also benefit from further analysis** to set priorities for interventions. The coastal zone of Senegal from Saint-Louis to Capskiring is undergoing tremendous population pressure, translating into serious infrastructure problems as well as polluted bays and beaches.

72. **The extractive industries could become a major factor** affecting the environment if they are not dealt with in advance. The gold and iron mining opportunities in Kedoudou in Eastern Senegal could cause adverse environmental and social impacts, including site-specific (waste management, ecosystems degradation, habitat loss, altered landscapes) to large-scale impacts (increased erosion and siltation, spread of HIV/AIDS) limiting the ability of surrounding communities to sustain their livelihood. As the likelihood for increased mining activities becomes evident, Senegal will need to review its regulations and enforcement capacity on environmental issues. The institutional issues dealt with in detail in the CEA would help the country address systemic issues preventing sound environmental management related to extractive industries.

73. **The role of civil society in promoting transparency and accountability** in managing the environmental issues mentioned above is very important, and could be a topic that should be promoted to improve environmental management in Senegal.

### 1.2 Institutional Framework for Environmental Management

74. **Main environmental policies and strategies.** The first statement of environmental policy in Senegal was made public in 1972 when the government participated in the National Environment Commission at the United Nations Conference on the Environment in Stockholm. Nearly 10 years later, a Master Plan for Forestry Development (PDDF) and a Senegal Forestry Action Plan (PAFS) were completed in 1981 and 1992, respectively. An emergency Rural Water Supply Program (1981) addressed the multiple years of drought that had previously occurred. In 1994, a national Plan to Combat Desertification (PAN/LCD) was adopted to implement the Convention to Combat Desertification. Following the Rio Summit in 1991, a first version of the National Action Plan for the Environment (PNAE) was made public in 1995.

75. The **Conseil Supérieur des Ressources Naturelles et de l'Environnement** (CONSERE) was set up in 1993, under the office of the Prime Minister, to consider environmental aspects of the social and economic development strategies. CONSERE guided the development of the PAN/LCD and PNAE. The PNAE aimed to define a long-term strategy to integrate environmental, institutional, and macro-economic issues for sustainable development, but was not prepared on the basis of national consultations. A second version of the PNAE was made public in 1997.\(^{13}\) All the same, this plan was not applied. CONSERE, which was to coordinate PNAE implementation, was not operational from 1997 onwards (Republic of Senegal, 2004a).

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\(^{13}\) In addition to thematic studies carried out by experts from various technical departments, each administrative region developed a Regional Environmental Action Plan (PREA) in the PNAE process; the studies included various socio-professional groups (farmers, herders, craftspeople, etc.). The different documents on these works still exist.
76. **Major environment documents.** During the last 10 years, the main statements of policy, strategy documents, or programs about environmental management have been the General Plan for Land Management in 1997, the National Strategy for Biodiversity Conservation (SNCDB) in 1998, the National Strategy for the Implementation of the United Nations Framework of Climate Change (SNMO-UNFCC) in 1999, the Master Plan for Hazardous Waste Management (PDGDD) in 1999, the Strategy for the Sustainable Development of Fisheries and Aquaculture of 2001, and the National Strategy for Sustainable Development (SNDD) in 2005. The Poverty Reduction Strategy Papers I (2003-2005) and II (2006) and the New Partnership for African Development (NEPAD - 2001) also enabled the Government to reassert certain environmental priorities such as water supplies and water purification. However, besides the Long-Term Water Program (PELT) in 2001 and the National Program for Drinking Water and Decontamination for the Millennium (PEPAM) in 2005, which obtained tangible results, all these policy statements had little effect on environmental management in Senegal.

77. **Factors limiting the efficiency of environmental policies.** The few tangible results observed in the implementation of national environmental policies can be explained by several factors (Republic of Senegal, 2004a and 2005b):

- Small number of environmental assessments and the scattered nature of programs;
- Little qualitative monitoring policy and program efficiency to protect the environment and natural resources;
- Small number of environmental considerations integrated into sectoral programs besides those that are specifically related to the environment because of the lack of awareness about the contribution of ecosystems and natural resources to the economy, food security, and water supplies;
- Lack of financial, human, and logistical resources in the Ministry of the Environment (MEPNBRLA) and other ministries to carry out their roles and duties in the area of environmental management;
- Absence of appropriation by the national and other institutions responsible for laws, regulations, and conventions and the lack of will to implement them (CSE, 2005; United Nations, 1999);
- Strong dependency on international assistance and poor coordination of approaches and interventions among development partners, which leads to a lack of cohesion among sectoral policies (CSE, 2005; United Nations, 1999); and
- Shortcomings in basic infrastructure (roads, electricity) which hinder the efficiency water supplies, sanitation, and waste management services.

78. **Most of these factors were already identified** during the Country Environmental Analysis in 1994 (World Bank, 1994) and in the National Action Plan for the Environment (République du Sénégal, 1997a), even though little progress has been made since then.
79. **Main legislative tools.** The main recent regulatory instruments to manage the environment and natural resources are:

- **Law No. 2001 - 01 to 15 January, 2001 relative to an Environmental Code** as well as its application decree and clauses defining the principles of environmental assessment, the functioning terms for the Technical Committee and participation in public consultations, environmental norms for compliance in the areas of industrial emissions, vehicle exhaust emissions and effluent rejection, the consumption of ozone-depleting substances as well as the creation of protected marine areas.

- **Law 2004-16 of 2004 relative to an agriculture-forestry-pastoralism orientation** targeting economic efficiency, social equality, environmental sustainability, market economy, decentralization, participation of local communities, farmer professional organizations and the public, creation of a common market within the UEMOA and CEDEAO, solidarity, partnership, and subsidiarity.

- **Law No. 81-13 of June 1998 relative to a Water Code** as well as its decrees setting out the framework for water management, regulating the construction and use of works to capture and release water, and measures to combat water pollution.

- **Law No. 98-34 of 14 April 1998 relative to a Maritime Fisheries Code** and its provisions aimed at overseeing maritime fisheries activities and the organization of the Fisheries Department in charge of ensuring the management and surveillance of the exploitation of natural, maritime, and aquatic resources and maritime and continental waters.

- **Law No. 98-05 of 8 January 1998 relative to an Oil/Fuel Code** setting out provisions relating to the exploitation and transport of fuels and the obligations and rights associated with the exercise of oil operations.

- **Law No. 98/03 of 8 January 1998 relative to a Forestry Code** and provisions setting out the terms for managing forest resources.

- **Law No. 88-05 relative to an Urban Planning Code** sets out the urban planning and land planning regulations.

- **Law No. 86-04 of 1986 relative to a Hunting and Nature Protection Code** sets out the regulation of hunting activities.

80. **Decentralization texts**, especially Law No. 96-07 of 22 March 1996 for the transfer of authority to the regions, communes, and rural communities and its application provisions, especially decree no. 96-1134 of 27 December 1996 about the environment and management of natural resources, also feature among these regulatory tools. Moreover, the Hygiene Code is also part of the legislative texts in the field of environmental management.

81. **Effectiveness of regulations and their application.** Besides the Environmental Code, most of these codes date from the end of the 1990s and need to be updated. Few
regulations aim specifically at protecting ecosystems and their natural resources. The Forestry Code (law 98/03 of 8 January 1998) and its application decree ensure a certain protection of ecosystems and natural resources. Hence, the distinction between classified areas and protected areas is a major step in this direction. The registration of the national quota in managed zones sparing those areas that are most at risk is another example. The existence of a decree identifying fully or partially protected tree species is a biodiversity conservation measure.

82. **There are still large gaps in regulations aimed at protecting species** and their reproduction sites to ensure renewal of resources, especially fish stocks. The concepts of biodiversity protection, resource conservation, and renewal should be integrated and harmonized into all sectoral policies and regulations. The legislative bases of national park creation have not been reviewed for many years and do not integrate biodiversity protection efficiently.

83. **There is no emphasis on regulations to monitor pollution sources** and no penalty is outlined in the Environmental Code for people causing environmental damage. The consulted literature documents no case where the perpetrator of an environmental violation was taken to court. The favored conflict resolution mechanisms are mediation, conciliation, and information/awareness activities. Conflicts are generally resolved using administrative means or litigation at the level of the *Conseil d’État* (UNDP, 2005).

84. **Few or no financial or tax incentives have been used by the Government** to encourage compliance with environmental norms and standards for industries and projects that may affect the environment. Such incentives could have positive impacts on upgrading old industrial installations requiring large-scale work. Finally, the current regulations do not oblige industry to rehabilitate their sites at the closure stage (example: the quarries at Thiès). Intensive agricultural practices are not adequately framed by laws and regulations, especially measures to protect aquatic and underground water ecosystems (fertilizer and pesticide load, soil drainage that dries out grazing lands, etc.).

85. **Little progress has been made with the application of laws and regulations** since the last Country Environmental Analysis in 1994 and PNAE (1997). The lack of resources (especially in the regions) limits the technical capacity and motivation of institutions and their staff to implement these laws and regulations (Ngaido, 2002). The Environment, Forestry, and Mining Codes contain a number of contradictions about the terms and principles of environmental management, making the texts difficult to implement (UNDP, 2005). Other texts have few or no application decrees or do not take the local sociocultural context into account. Regulations aimed at controlling air emissions and effluents are relatively new (between 1999 and 2003) and have yet not been implemented effectively.

86. **MEPNBRLA should also make a greater effort** to explain in simple terms the socioeconomic and environmental benefits derived from the implementation, compliance, updating, and development of the main regulatory tools outlined above. The main targets
of this message are the population, the staff in charge of implementing the regulations, jurists, and industry.\textsuperscript{14}

1.3 \textbf{Sustainable Management of Terrestrial Ecosystems}

1.3.1 \textbf{Sustainable Land Management}

87. \textbf{General context.} Land and its products are essential to ensure food security and are important to life in Senegal, and as a result, local economic growth. Land degradation makes the country more vulnerable, a phenomenon caused by physical processes combined with unsustainable management practices — demographic pressure and random and insufficient rainfall for poor soils, especially in semi-arid to arid areas.

88. \textbf{Land use.} Senegal covers 19.5 million hectares, of which 19 percent are arable (3.8 million hectares); 32 percent (6.3 million hectares) are covered by forest, savannah, and protected zones; and the balance is shared between desert and unclassified brush and urban lands.\textsuperscript{15} About 65 percent of the arable land (2.4 million hectares) is used for rain-fed crops, nearly 3 percent for floodplain and irrigated crops (100,000 hectares), and the rest is uncultivated and mainly used for herding (1.3 million hectares). Terrestrial ecosystems make up 99.7 percent of the country’s natural capital (63 percent for crops and herding, 30 percent for forests, and 6 percent for protected areas) and 13 percent of total national wealth. Most of the population depends on these ecosystems and more than 60 percent make their living from farm production.\textsuperscript{16}

89. \textbf{Irrigation.} Major efforts have been made to increase irrigation where water sources are available. This includes the Irrigated Village Perimeter (PIV), rice producers in the Senegal River valley; the traditional marsh rice grown in Casamance, the Hydraulic Farming Developments (AHA), and horticultural projects distributed throughout the country. The number of irrigated zones grew between 1990 and 2000.\textsuperscript{17} There were only 69,000 hectares of irrigated land in 1996, mainly in the Senegal River valley, and there are today about 100,000 hectares.\textsuperscript{18} Given that irrigation is expanding in Senegal, it becomes increasingly important to ensure that humid highlands and their dependent agro-ecosystems function sustainably.

90. \textbf{Land exploitation.} The demographic growth of about 2.7 percent per year in Senegal has been a root cause of intensive land exploitation. Irrational land management methods, coupled with the impact of climate fluctuations, have exacerbated the degradation of the

\begin{itemize}
  \item \textsuperscript{14} Within the context of its public awareness campaign, the Ministry plans to explain the Environmental Code and its implementation to stakeholders.
  \item \textsuperscript{15} Documents from PGIES, Government of Senegal, 2005, section 3.1.1
  \item \textsuperscript{16} Senegal Land Action Plan (PAF), 1996
  \item \textsuperscript{17} National Senegal Report on the implementation of the CCD, September 2004.
  \item \textsuperscript{18} The hydro-agricultural developments are shared between the Senegal River valley (75,000 hectares), the lower and middle Casamance area (15,000 hectares safeguarded against saline intrusion), the water table at Niayes (10,000 hectares), Anambé valley (3,500 hectares), western Senegal (600 hectares), and the peanut basin.
\end{itemize}
main ecosystems in the country. The contribution of agriculture to GNP has dropped sharply from 17.3 percent in 1979 to 9 percent at present. This situation is definitely the result of economic diversification encouraged by the Government, but poor land management coupled with strong climate fluctuations have also contributed to the drop in income from the farming sector.

91. **Lost production.** The value of “lost production” (compared to potential production) in the primary sector (including agriculture, herding, and forestry) is estimated by the Government at 140 billion FCFA per year (nearly US$ 262 million), between 1990 and 2000, which corresponds to 4.5 percent of GNP in 2000. This occurred even as annual spending to combat land degradation increased from about US$ 28 million in the 1990s to about US$ 72 million during the last decade.

92. **Food production in the country increased only marginally** over the last four decades while the population tripled during the same period. This led to a per capita production that has practically been cut in half, resulting in a direct impact on food security. Senegal only produces one-half of its requirements (185 kilograms per person per year), and each year imports 350,000 tonnes of rice and 10,000 tonnes of wheat, leaving a deficit of about 35 kilograms per person per year.

93. **The livestock and herding sector has undergone a strong regression** for the same reasons. Grazing lands are subject to the combined effects of drought, brush, and crop fires. The limited nutritional knowledge of producers, persistence of pests, poor support for breeder associations, and absence of land rights are all obstacles that limit development. The forest estate has also been subject to widespread degradation. In fact, deforestation for herding or cropping activities as well as forest exploitation for charcoal has reduced wooded/forest zones by 45,000 hectares per year.

94. **Land degradation.** The nature and scale of land degradation in the country are widespread and reduce rural people’s ability to cope and thus contribute to an alarming poverty rate. The situation is so worrying that there is now large-scale migration to urban centers and to the remaining forested areas. Because of the high level of poverty in the Groundnut Basin, this zone in particular has witnessed a strong rate of migration to urban zones and Eastern Senegal to cultivate new lands of lesser quality. These migratory flows are also at the origin of land conflicts, particularly in the Senegal River valley along the border with Mauritania and in Casamance.

95. **Poverty and women.** Poverty affects 57.5 percent of rural households and 43.3 percent of households in urban zones except in Dakar, where documents indicate 42.0 percent and 33.6 percent, respectively. According to a survey carried out in 1995, 68 percent of the population in Senegal lives on less than US$ 2 per day and 26 percent with

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22. ESAM II quoted in PRSP II draft.
less than US$ 1 per day (based on spending). Nearly one-half of the population cannot read and the Gini Index at 41 indicates a significant level of inequality. Land degradation weakens the ability of rural people to overcome poverty. Women have very limited access to public information, training programs, or research. More than 71 percent of women were illiterate and in 1998, only 63 percent of women had completed their primary level schooling, compared to 70 percent of men. Women also have very little access to credit, commercial services, or technology sources. They often face difficult living conditions and face discrimination in several sectors. Women and unemployed youth are the most severely impacted by poverty (Winslow et al., 2004).

96. Consequences of drought. To adapt to the drought of the 1980s, farmers moved peanut crops to the south and worked pastoral lands. The return of rainy periods encouraged herders to gain land to the north, grazing on agricultural lands. The return of successive years of drought was thus catastrophic for both categories of stakeholders. Average temperatures are higher and the sea level is increasing, causing coastal lands to be lost at Rufisque along the southern coast of Senegal, and will in all likelihood increase the intrusion of salt water (Dennis et al., 1995). These changes will have more impact on water resources, food, health, and infrastructure, and are likely to reduce grain harvests and food security, and limit development.

<table>
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<th>Box 1. Adaptation to climate change in Senegal</th>
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| Adaptation capacity is the potential or capacity of a system, a region, or community to adapt to the effects or impacts of climate change (IPCC, 2001). The main characteristics that determine adaptation capacity are economic wealth, technology, information and skills, infrastructure, institutions, and fairness. In Senegal, the adaptation capacity of land-use systems is low because of poor soil quality and lack of economic resources and technology. There is high vulnerability to climate change in Senegal because of the strong dependence on rain-fed agriculture, frequent droughts and flooding, and widespread poverty in rural areas (Winslow et al., 2004).

The negative consequences of climate change cannot be eradicated without formal consideration of climate issues now and in the future through implementation of adaptation activities. Adaptation can be conceptualized as any activity or policy aimed at minimizing vulnerability to climate change. Adaptation activities can be preventive (development of drought- or flood-resistant crop varieties, development of early warning systems, improving water management) or reactive (erosion control, construction of dams for irrigation, changing agricultural practices). Links between Sustainable Land Management (SLM) and adaptation to climate change are numerous. SLM activities integrating climate change issues are an adaptation to climate change.


97. Scale of land degradation. Several analyses and studies have tried to evaluate the scale of land degradation in the country, but they lack reliable and relevant data and are subjective. This is one of the important challenges to increase economic and environmental prosperity in Senegal. The collection and analysis of relevant data on the natural environment and its productivity must be improved. Several factors have combined to degrade land in Senegal to a dangerous level. Poor soil quality, the lack of economic and technological resources, climate change and fluctuations, the country’s dependence on rain-fed agriculture, and the high and widespread level of poverty amplify the country’s vulnerability. We can confidently project further land degradation, thus

23. Earth Trends/WRI.
increasing the risk of infectious diseases and extinction of plant species, which will have a very negative impact on rural life, tourism, and genetic resources.

98. **Diagnostic.** In Senegal, 19 percent of the area of the country, or 3.8 million hectares, is agricultural land — Peanut Basin (57 percent), Casamance (20 percent), Eastern Senegal (10 percent), and the Senegal River valley (8 percent) (PROGERT, 2007). Land degradation has been observed for a number of decades. Today, it has grown to such an extent that it seriously compromises certain rural activities, especially those related to agricultural, forestry, and livestock production. Indeed, land degradation affects nearly 65 percent of total agricultural lands. This phenomenon is expressed in a number of ways. The different types of land degradation, their location and their importance can be summarized in four categories:

- **Reduced vegetative cover due to drought and deforestation.** Between 1980 and 1990, forest lands outside the national park system decreased at a rate of 80,000 hectares per year. Over the same period, wood potential decreased at a rate of 1.8 percent per year. In 1998, FAO estimated this decrease at 50,000 hectares per year and the decrease in wood potential at 0.7 percent per year (CSE, 2005).

- **Four types of water-related erosion that are related to the intensity of the process:** erosion due to rainfall, primary runoff, diffuse runoff, and concentrated runoff. Water-related erosion is mainly prevalent in the country’s southeastern regions (Casamance and Sénégal Oriental) that are characterized by soils with high iron content (Regosols). It has led to the degradation of 9,080,100 hectares, which represents 77 percent of total degraded soils (MEPN, 2005).

- **Wind erosion, which is particularly severe in the country’s northern regions** (Senegal River Valley, Centre-north, and the northern Peanut Basin) where soils are very sandy on the surface and are subjected to the harmattan seven to nine months per year. This erosion represents 3 percent of degraded soils and leads to the burial of water bodies and roads and the creation of mounds of sand (MEPN, 2005). This phenomenon is accelerated by soils that are for the most part highly sensitive to erosion because of their sandy composition and unstable structure.

- **Chemical degradation is present in two forms:** salinization and acidification. Salinization is caused by capillary upwelling from salty superficial water tables. It represents about 9 percent of degraded soils (MEPN, 2005). It occurs in the Senegal River delta, in Casamance, in the Saloum River delta, and in the lower reaches of the Gambia River. The area affected by salinization is estimated at 1,000,000 hectares, including 650,000 hectares in Lower Casamance, 225,000 hectares in the Senegal River delta, and 125,000 hectares in the Sine Saloum (PRONARES, 1997). This phenomenon has increased because of the frequent droughts observed over the last few decades.

99. **Drought has also been at the origin of the acidification of soils.** As long as they are submerged, soils are neutral to alkaline. When oxidized either through natural or human-caused processes, they are converted to acid sulfate soils whose acidity can prohibit all vegetative growth (*tannes vifs*). When waters recede, soil acidification occurs as calcium is lost in the soil from the uncompensated migration of mineral elements during harvests,
and the use of acidifying mineral fertilizers. The degradation of soils through acidification is particularly present in the Peanut Basin (Thies, Diourbel, Sine Saloum) where this phenomenon is linked to very poor soils chemistry (particularly in the superficial strata) because of the lack of compensation for losses of nutritive elements. This phenomenon is also observed in the Senegal River valley and in Casamance. According to 1987 estimates, acid soils or soils undergoing acidification cover about 1,600,000 hectares, among which are 925,000 hectares of submerged land and 675,000 hectares of non-submerged lands (PRONARES, 1997).

100. **Physical and chemical degradation is less apparent in intensity.** It is essentially man-made and exists in peanut monoculture zones.

<table>
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<tr>
<th>Table 1.1 Extent of soil degradation in Senegal according to the cause</th>
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<tr>
<td><strong>Cause of degradation</strong></td>
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<tr>
<td>Water-related erosion</td>
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<tr>
<td>Wind erosion</td>
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<td>Chemical degradation</td>
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<tr>
<td>Man-made erosion</td>
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<td>Non-degraded soils</td>
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*Source: DAT/USAID/RSI, 1985. These data from 1985 underestimate current conditions because the degradation process has since worsened.*

101. **Soil degradation has a number of causes:**

- **Persistent droughts** that have led to a southward migration of rainfall and to the extension of arid conditions.

- **Demographic growth at a rate of 2.9 percent per year** has led to an extension of cultivated lands and to increased pressure on forest resources due to high demand for charcoal in urban centers. Human pressure is at the source of 11 percent of degraded soils (PROGERT, 2007). In addition, poorly adapted methods of cultivation and livestock husbandry have had severe effects on the Peanut Basin.

- **Herds have also continually grown** as a result of improved livestock health through control of contagious diseases. This has increased livestock pressure on the land and led to the degradation of livestock corridors, especially in the forest-pastoral zone. In addition, the disappearance of grass cover and reduced forest cover due to human activities has accelerated wind and water-elated erosion and displaced sand dunes.

- **Remote monitoring of brush fires** between 1992 and 1998 revealed that burned areas varied between 180,000 hectares (in 1997) and 740,000 hectares (in 1994).24

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These fires were usually caused by human activities that are related to local land-use practices — forest clearing for slash and burn cultivation, hunting, honey collection, cooking, etc.

- **Other contributors to soil degradation.** In the Peanut Basin, extensive agriculture, the divorce between agriculture and animal husbandry, speculative production methods, population pressure, aging agroforestry parks, wind erosion, progressive abandonment of fallow lands, increased monoculture practices, and the disintegration of traditional land management systems are all factors that have strongly contributed to soil degradation.

102. **Consensus elements.** Despite the absence of relevant data, everyone agrees that on a *biophysical level*, plant cover in Senegal is impoverished — arable lands are already in use and most are degraded. In addition, there is a significant decline in the quality of farming soils and their production capacity and a deterioration in grain reserves. On a *social level*, land degradation has the effect of lowering the income of rural people and hence increasing poverty, immigration, marginalization of women and young people, as well as sharpening conflicts. On an *economic level*, land degradation in Senegal has a high cost, probably equal to 10 percent of its agricultural GDP. The direct annual cost of soil erosion is about US$ 10 to 100 million. The cost of deforestation is unknown, but the value of forest products (besides timber) harvested annually is about US$ 6 million for rural households that depend heavily, with many urban dwellers, on biofuels.

103. **Land degradation affects the entire Senegal economy,** especially zones prone to poverty — the Peanut Basin and the forest-pastoral zone in the west and the center of the country. The main consequences are a lessening of the financial margin generated by agricultural products, an increase in rural poverty that prevents farmers from mechanizing production or replacing worn equipment, a rural exodus reducing physical work capacity, and growing competition for land between agriculture, herding, and construction. These consequences are made worse by a lack of public investments in the rural sector and agriculture, weak logistic services, lack of technical support to farmers and herders, and the absence of any agricultural insurance or risk management policy to offer a safety net in the event of drought or other calamity. Climate change and fluctuations may well worsen these impacts and their consequences.

104. **By strengthening the principles of sustainable land management** in the different development sectors, it will be possible to take action against land degradation and other issues to increase soil productivity sustainably, and reduce poverty and conflicts linked to natural resources and migration. A national SLM investment framework is a necessary and suitable instrument to reach these goals.

1.3.2 **Management of Forests and Biodiversity**

105. **Regulatory framework.** In Senegal, forests mean all lands covered by a formation of trees, shrubs, or brush. According to the Forestry Code adopted in 1998, Senegal forests are either state domain (classified zones including classified forests, forest-pastoral reserves, reforestation and restoration perimeters, national parks, natural reserves, and special reserves) or protected domain (communal forests and community
forests). The classified domain covers 6,237,648 hectares (for 213 classified forests) to which we should add 1,613,790 hectares of national parks for a total of 7,851,438 hectares.

106. **The Forestry Code of 1998** integrates the principles of decentralization and regionalization adopted by the country in 1996, and for the first time, involves local people in the management of their forests.

107. **Forest management plans.** For forests under their authority, local communities develop forest management plans or have them prepared. These plans can be implemented by local communities or contracted to third parties. Communities also have the authority to hire forest rangers to watch the forests under their authority. In state domain forests, the management plans are prepared by the *Direction des Eaux et Forêts*, while in communal forests these plans have to be produced by a *Commission de gestion des ressources naturelles et de l’environnement* put in place by the rural Councils and then approved by the State Representative. In the state forest domain, exploitation is by cutting and selling and can be by direct or indirect control. Any forest operation in the state domain, except when exercising a usage fee, can only be done after obtaining an operating permit issued following the payment of the planned taxes and fees.

108. **Institutional framework.** Since 1993, the forestry sector has been managed by the Ministry of the Environment. The structures involved include (FAO, 2003a):

- *Direction des Eaux et Forêts, des Chasses et de la Conservation des Sols* (DEFCCS) reporting to the MEPNRLA and in charge of developing policies, identifying resources to implement various kinds of management programs for natural resources, and developing wildlife resources. Its fields of authority include forest management, reforestation, soil conservation, and management of hunting activity.

- *Inspections Régionales des Eaux, Forêts et de la Chasse* (IREF) is in charge of DEFCCS activity in the regions (11 IREF divided among the country’s administrative regions).

- *Secteurs forestiers* are in charge of IREF activity in the départements (35 Secteurs forestiers divided up across the country), while at a less concentrated level, the *Brigades Forestiers* and *Triages* are also involved in forest management. The Forestry Services (*Services Forestiers*) are putting considerable effort into restoring the forest ranger service. These field agents historically played an important role in protecting forest resources.

109. **Decentralization.** Over the last decade, the roles and duties of the IREF have increased following the decentralization policy adopted by the Government. This has led to more localized forest conservation actions which are also participatory at the community level. Nonetheless, other ministries and Government departments, including the Ministry of Agriculture, Rural Hydraulics, and Food Security (MAHS), implement

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25. For forests from 5 to 20 hectares, simple management plans are required.
policies that may impact the forestry sector (such as the expansion of agricultural perimeters into forest-pastoral areas).

110. **This institutional framework is completed by a network** of bilateral and multilateral cooperation agencies and national and international NGOs which intervene at various levels to promote the sustainable use of forest resources. These actions generally have a relatively local range and are not always well coordinated. Foreign NGOs do not report their work to forestry services, which does not enable any monitoring or evaluation of their results at the national level.

111. **Forest exploitation and state revenues and spending.** Exploitation of forest resources for energy use is the main forest operation and accounts for extraction of about 5,000,000 cubic meters of wood per year. The other main types of exploitation are:

- Timber, estimated at 1,300,000 cubic meters per year, which is increasing with the emergence of craft exports, mainly Djembé.
- Harvesting wild plants for food, cosmetic, or medicinal usage. There has been a revival of interest in recent years for juices or oils made from these products and marketed in large urban areas, an economic sector mainly occupied by women (FAO, 2003a).

112. **Revenue.** In 2000, the forest sector generated revenues of 1,272 million FCFA, of which 90 percent came from state domains and 10 percent came from fines and confiscation carried out by Forest Services (FAO, 2003a). Each year, 75 percent of the domain revenue is paid into the *Fonds Forestier National* (National Forestry Fund). In 2000, this fund of 700 million FCFA, managed by DEFCCS, contributed one-half to the State’s operating costs and one-half to the conservation and restoration of forest, fish, and wildlife resources.

113. **Forestry investments.** An analysis of investments made in the forestry sector from all programs shows that Senegal contributed nearly 25 percent of funding for the period 1997 to 2001. Most of the resources come from outside in the form of subsidies or donations (FAO, 2003a). The forestry sector has benefited little from private sector investments because of a rigid regulation cycle and the long gap between planting trees and their exploitation. Certain measures introduced in the Forestry Code in 1998 have helped to generate a more favorable investment climate, including lifting the ban on exploiting planted trees and the possibility for classified forests to revert to local communities.

114. **State of forest resources.** All forest and wooded areas covered about 32 percent of Senegal in 2000. Among these forests, the forests of the ‘dense’ type (80 percent of canopy closure) represented less than 3 percent of the country’s area. They include forests of the Sudano-Guinean type, and the gallery forests of lower Casamance as well as the river forests along the Senegal River valley (Tappan et al., 2004).
115. **Forest degradation.** Over the last 40 years, the forest and wooded resources in the country have experienced degradation linked to a combination of several factors, the most important of which are:

- Drought (drop in rainfall since the 1970s causing among other things, acidification and salinization of soils, especially on laterite and clay soils in the Ferlo region);
- Intensified agricultural activity. Agricultural areas grew from 17 percent to 21.4 percent of the land area between 1965 and 2000, an expansion to the detriment of savannahs and forests (Tappan et al., 2004);
- Multiplication of brush fires linked to human activity (slash and burn agriculture, hunting, honey collection); and
- Removal of wood resources, mainly to produce charcoal. This activity (wood and charcoal) is the main source of forest degradation in the center-east and southeast of the country (FAO, 2003a).

116. “As practiced at present, forest exploitation represents an important degradation factor for plant cover and a real threat to biodiversity” (Strategy and National Action plan for Biodiversity Conservation, 1998).

### 1.4 Water Resource Management

#### 1.4.1 Management of National Resources

117. **Senegal is not a poor country in terms of water.** The availability of renewable water resources is today evaluated at about 4,750 cubic meters per inhabitant per year, which is above the reference value for a water shortage, which is 1,000 cubic meters per inhabitant per year (Ministère de l’Hydraulique, 2006). In fact, the country has considerable underground and surface water resources (Figures 1.2 and 1.3). The underground waters include four water-bearing systems—surface water, intermediary water, deep water, and base water. The country’s total underground water resources are between 450 and 600 billion cubic meters of water, with an annual renewal capacity of between 3 and 4 million cubic meters (CSE, 2005). Surface water resources include the Senegalese hydrographic network, which is very unevenly distributed across the country. This network mainly includes the medium course of the Gambia River, the Sine Saloum River, the Casamance River, and the Senegal River. The surface water resources are assessed at 31 billion cubic meters per year (CSE, 2005).

118. **The problem of managing water resources in Senegal** is linked to spatial and temporal distribution. Underground water resources and especially surface resources are very unevenly distributed across the country and do not reach the widespread human settlements in sufficient quality and quantity, especially rural areas. Rainfall is also the object of large-scale geographical and seasonal disparities. Rainfall is concentrated over five months of the year in the south (May-October), but only three months in the north (July-September).

120. **Rains are more abundant in the south than the north** and have not stopped dropping since the beginning of the twentieth century. The average annual rainfall dropped from 968 millimeters per year between 1941 and 1950 to 828 millimeters per
year between 1961 and 1990 (CSE, 2005). Since the 1960s, all water management issues in Senegal have focused on managing existing water to bring it in sufficient quantities to the different users with the quality they need. Hence, large dams or retention basins were constructed on the Senegal River, in the Anambé valley, and in the Casamance region.

121. **The riparian depressions in the zone of Niayes are also under development.** Most of these works are associated with efforts to intensify and modernize agriculture. Underground water is exploited by traditional works such as uncemented wells and catch basins. Village wells and modern wells, as well as hydraulic drilling, have also been developed.

122. **Water delivery problems.** Recent efforts have been largely insufficient to address problems linked to supplying quality water to the different users in the country. Major problems remain to this day, including:

- Variation in surface water flow;
- Pollution and invasion of surface water by plants;
- Flooding;
- Drop in the level of underground water tables;
- Pollution and salinity of underground water layers;
- Costs for resource mobilization;
- Dangers to public health caused by certain hydraulic developments; and
- Obstruction and pollution of waterways from waste.

123. **Water management policies in the past** were not sufficiently based on the real needs of the population. The lack of dialogue and synergy between different water users was a major impediment to implementing efficient strategies to manage water resources at the country level (Ministère de l’Hydraulique, 2006).

1.4.2 Management of Transboundary Resources in the Senegal River Basin

124. **The Senegal River basin** (290,000 square kilometers) is shared among Senegal, Mauritania, and Guinea. The whole basin houses a population of about 3,500,000 people, including 85 percent living near the river (STUDI, SACI and GEDUR-SARL, 2006). Historically, the river produced a two-month flood, bringing life and water to the delta and river valley, which passes through a desertic and arid environment. This flood is caused by monsoon rains between April and October in the mountain area of the Fouta Djallon upstream from the basin.

125. **Historical background of OMVS.** In 1972, Senegal, Mali, and Mauritania created the *Organisation pour la Mise en Valeur du Fleuve Sénégal* (Senegal River Basin Organization, OMVS) with the goal of developing river resources for irrigation, electricity generation, and navigation.
126. In 1992, Guinea joined the organization as an observer. The major OMVS investments were construction of the dams at Diama and Manantali, both operational from 1988. The Diama dam at the head of the Senegal delta, 27 kilometers from the mouth of the river prevents upstream intrusion of salt water and supplies drinking water for cattle and the population of Dakar. The salt tongue can reach as far as 200 kilometers upstream in periods of low water. The Manantali dam is located in Mali on the Bafing River, one of the Senegal River’s major tributaries (it contributes one-half of the river flow at the level of Bakel). It was designed to regulate the river flow and supply water to develop irrigation farming and produce electricity. The total power production potential of the Senegal River basin is estimated at 1,200 MW. This dam also aimed at making navigation possible between Saint-Louis and Kayes, providing Mali with river access to the sea. Through lack of funding, the power generation capacity of Manantali took a long time to be installed.

127. These two dams helped develop irrigated farming, which has become a major economic force in the valley. In 1996, approximately 100,000 hectares were developed for irrigated farming. Further, fishing was developed in Mauritania and on the Manantali reservoir, with villages being set up around the reservoir basin. Diama dam has improved the fresh water supply in the lake of Guiers, which is used as a drinking water supply for Dakar, and other depression areas in Lake R’kiz.

128. Manantali dam. When the dam was completed at the end of the 1980s, it was planned that the dam would be used to continue supplying controlled flooding during a transitional period, but that artificial maintenance of the flood should be abolished following installation of the hydroelectric facilities. Subsequently it became apparent that the economic and environmental services contributed by the flood had been underestimated and that a certain artificial flood level had to be maintained (Salem-Murdock, Horowitz et al., 1994). Besides supporting the farming, herding, and fishing that underpin the riverside populations, the floods provided several environmental services such as recharging the groundwater, regeneration of woodlands and pastoral lands, and supporting biodiversity in the marshes downstream from the river and in the delta. From 1994, the Manantali dam was used to generate limited floods and maintain cropping and low watermark activity while allowing irrigated farming to develop. River navigation goals were nonetheless sacrificed. Installation of hydroelectric facilities raised the challenge of reconciling uses such as irrigation, power generation, and water level maintenance.

129. River management problems. Due the absence of an appropriate environmental impact assessment, construction of the anti-salt dam at Diama downstream and the hydroelectric dam at Manantali upstream altered the natural water level of the river, which led to environmental and social issues related to dam management. These issues include:

- Proliferation of invasive aquatic plants in the zones formerly affected by the salt tongue, which is one of the major impacts of the OMVS dams;
• Greater incidence of water-related diseases, which is the main impact of the dams on the human population;
• Reduced volume and duration of high water levels, reducing the recharge of underground water and weakening the ecosystems along the river downstream from Manantali;
• Reduced volume and duration of low water levels, modifying the foundation of traditional subsistence activities;
• Years without low water, causing significant loss of nutritive resources for rural people;
• Over-salinization of water downstream of the Diama dam, reducing the ecological productivity of habitats in the river estuary; and
• Use of agrochemicals in irrigated farming, causing a deterioration of water quality for human consumption.

1.5 Fisheries Management

130. The fisheries sector in Senegal includes three activities — maritime fisheries, continental fisheries, and aquaculture. The main fisheries activity is maritime, which has a dominant position in the national economy. This sector is confronted with a major drop in fish stocks caused mainly by over-exploitation. This ecological crisis threatens the perennial nature of the resource and revenue and other benefits.

131. Historical background of maritime fisheries. Since independence, the Senegalese Government strategy for maritime fisheries has been oriented to developing the sector and increasing fish production. This strategy was effective and spawned rapid growth. Maritime fish production multiplied by eight and there was a major increase in employment in rural areas and fish exports. While the Senegalese fisheries industry generated annual catches of 50,000 tonnes in the 1970s, it produced 450,000 tonnes at the beginning of the 2000s. This great success is mainly linked to the modernization of artisanal fishing which transformed from a seasonal activity to a well structured year-round activity managed by owners of motorized pirogues.

132. This strategy created critical over-exploitation of some species, especially demersal species that have strong commercial value (large bottom fish such as pageot, common grouper, and Nile perch). As an example, stocks of common grouper and Pageot dropped from 45 to 90 percent over the last 20 years. There remain no more than 5 percent of the common grouper in terms of biomass off the coast of Senegal. Since 2001, the production of demersal fish has declined rapidly, as well as related fish exports and fish revenue.

133. Lack of political will. Before 2001, even though the critical condition of the stocks was already well known, the political will and efforts to reorganize the fisheries sector were insufficient and difficult political decisions were put off (Stratégie du Secteur des Pêches, 2006). In the past, external donor assistance financed about 80 percent of action plans, which encouraged a tendency to rely on these funding sources, especially in
the industrial sub-sector. From 1997 to 2000, the fisheries sector benefited from an annual amount of about 8.7 billion FCFA in development assistance from Japan, France, and the European Union (FAO, 2004). Until the recent past, large-scale state assistance to artisanal fishing was considered as free and the same held for some industrial companies (FAO, 2004).

134. **Artisanal and industrial sectors.** The Senegalese fisheries sector includes artisanal and industrial activities. The artisanal sector is very efficient at catching demersal fish (crustaceans such as crab and white shrimps and fish such as grouper, gilt bass, sole) and small pelagic fish (sardines, pilchards). In 2005, the artisanal sector produced 85 percent of fish tonnage harvested by the industry in Senegal. In 2004, this sector supplied 60 percent of primary inputs for exporting companies.

135. **The artisanal sector** is characterized by the use of pirogues of four to 20 meters long and diverse catch methods (lines, nets, seines). This sector has widely benefited from outboard motors, wider fish nets, radio communication, and better fish preservation techniques. In 2000, this sector had about 12,000 pirogues, 90 percent of which were motorized. Following the drop in traditional fish resources, artisanal fishermen compensated by targeting fish of lesser value or by exploiting more distant zones. Over the last five years, Senegalese artisanal fishers have expanded their zones of activity by joining *ramasseurs*, industrial boats that do not fish themselves but which own processing plants to channel fish harvested by artisanal fishermen. This system enables them to operate from Mauritania to Namibia. Some estimates suggest that about 30 percent of fish caught by Senegalese artisanal fishermen come from outside Senegalese waters.

136. **Salaried workers.** Over the years, artisanal activity has become more concentrated in the hands of a pirogue owner class that loans its vessels to fishermen who then become salaried workers. These owners try to maintain lucrative activity and are a powerful pressure group that has opposed attempts to regulate the sector in the past (GEF, 2004).

137. **The Senegalese industrial fisheries fleet was started in the 1960s** and uses outdated equipment. Industrial fisheries concentrates on exports. Following objections from artisanal fishers to catching coastal pelagic species by industrial fishers, industrial fishing concentrated on demersal fish and tuna. In 2002, the industrial fleet had 175 trawlers, tuna ships, and sardine ships, including 100 with onboard refrigeration facilities, three-quarters of which supplied factories located outside Senegal (mainly in the European Union). Most industrial fishing of demersal fish is carried out by Senegalese vessels. Foreign vessels only accounted for 4 percent of demersal fish catches in Senegalese waters in 2000. Illegal fishing also takes place and the scale of this activity is unknown.

138. **Fish processing sector.** Fish processing includes both the artisanal and industrial sectors. Artisanal processing is 30 to 40 percent of artisanal fishing (mollusks, crustaceans, and fish), to which we add the unsold inventory of industrial fishers. It is a
sector mainly occupied by women. In 2002, nearly 28,375 tonnes of finished processed products were estimated. In Senegal, industrial processing involves four types of product:

- **Fresh products.** Thirty percent from artisanal fishing and the remainder from industrial ice fishing.

- **Frozen products.** About 30 enterprises are active. Freezing can be done on board trawlers with ice or on land in processing plants. These plants often have parallel activities (salting, drying, smoking). Fish can be frozen whole or processed (skin, topped, gutted, or in fillets).

- **Canned products.** In 2004, Senegal had four fish canning facilities in operation.

- **Fish meal.** In 2004, two factories for fish meal set up in Senegal and exported about 60 percent of their production, estimated at a little over 1,231 tonnes (FAO, 2004).

139. **Economic importance of the fisheries sector.** The Senegal fisheries sector has considerable economic importance. Fisheries contribute about 1 percent of Senegal state revenues. In 2002, the sector accounted for 2.3 percent of Senegal’s GNP and 25 to 30 percent of exports, which makes it the main source of export revenue. Demersal coastal fish account for more than 50 percent of the total value of fish exports. In 2002, Senegal exported 87,564 tonnes of fish worth 181 million FCFA. Europe absorbed 60 percent of Senegal fish exports while Africa took in 35 percent, Asia 5 percent, and America less than 1 percent (FAO, 2004). A recent study on the social and economic contribution of artisanal fishing revealed that this sector accounted for 4.08 percent of GNP in 2003, about 163 billion FCFA (Le Soleil, 2006).

140. **In 2001, the fisheries sector employed 600,000 people directly or indirectly** (about 17 percent of the active population), for about 380,000 tonnes of fish (FAO, 2004). Most of these jobs (52,000 full time) were created by the artisanal sector, while the national industrial fisheries employ 5,000 full-time people.

141. **Fish are important in the Senegalese diet.** According to official estimates, fish make up 70 percent of animal protein consumed in Senegal. Average fish consumption per inhabitant is estimated at 26 kilograms per year, but there is a wide variation in consumption between the coast and inland areas (FAO, 2004). We note the importance of biodiversity in Senegalese waters as crucial factor in the growth of ecotourism (GEF, 2004).

142. **Resource management problems.** A scientific symposium on maritime fisheries in West Africa held in Dakar in 200226 in the framework of a sub-regional project (SIAP) showed that some species (white grouper/common grouper, pagre, small Nile perch/tiekem, pageot) are over-exploited on the Senegalese continental shelf. From 1997 to 2002, demersal fish catches dropped by 50 percent. The symposium concluded that it

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was necessary to reduce fishing along the whole West African coast, especially for demersal species.

143. **Decline of demersal fish.** An FAO working group met in November 2007 in Banjul (Gambia) to update the condition of demersal stocks in countries of the Sub-regional Fisheries Commission (Gambia, Mauritania, and Senegal) and Morocco. They concluded there was further depletion of coastal demersal fish stocks between 2002 and 2007, as well as over-exploitation of deep demersal stocks and key marine bottom fish and estuary species along the coastal spine. The main working group recommendations were a strong reduction in fishing pressure on these threatened resources.

144. **Negative effects.** Over-exploitation of demersal resources has already negatively affected reproduction for pageot, common grouper, and small Nile perch. Demersal species have also been affected by the degradation of their reproduction areas along the coasts of Senegal and at the mouths of the main rivers. As an example, only 5 percent of the historical fry are now accessible in the Senegal delta. The only coral garden of the Senegalese coast, located not far from Gorée, is affected by regional pollution. A drop in stocks will affect hundreds of thousands of people who depend directly on fisheries as their main source of income. Slumping stocks will also reduce revenues from export markets or market share that have been built up over the years despite the structural difficulties of the companies involved.

145. **Protect to regenerate.** International experience shows that establishing protected marine areas accelerates the regeneration of overexploited fish. Senegal has five protected marine areas with a total of 1.5 million hectares, but these areas suffer from underfunding and are not equipped to successfully carry out their mission. In the past, the designation of protected marine areas gave rise to opposition from neighboring communities which benefited from those areas.

146. **Uncertainty.** Other factors of uncertainty call for caution in resource management, including a lack of scientific knowledge on the reproduction and renewal of certain species, the influence of climate change, and the effects of the decimation of numerous species across the oceans.

147. **State of marine ecosystems.** The country’s marine ecosystem has lost biodiversity due to human activities (fishing, pollution, civil engineering works) and to factors related to the physical and chemical environment and the climate (habitat destruction or degradation, unfavorable environmental conditions). In the particular case of Senegal, its Exclusive Economic Zone (EEZ) has been an intensively exploited area for fishing over the past decade. These activities not only deplete fish stocks, but also reduce the longevity of resources, change the growth and reproductive potential of fish stocks, and above all, exert selective pressure that modifies the structure of fish communities. The exploitation of local fishing also leads to weak ecosystems that

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27. The report of the FAO working group held in May 2006 on the evaluation of small pelagics off the coast of north-western Africa also concluded that round sardine stocks were overexploited and recommended a drop in fishing efforts for all small sardine fishing.
become more sensitive to eventual changes to the marine environment, thereby setting the conditions for biodiversity erosion.

148. **Establishing protected marine areas.** In the face of such pressures, Senegal has established five protected marine areas (PMA) by decree No. 2004-1408 of November 4, 2004. These protected areas are located at Saint-Louis, Kayar, Joal-Fadiouth, Abéné, and Bamboung (Figure 1.4). There is also a project to establish five new PMAs following a decision by the President of the Republic.

![Figure 1.4 Location of protected marine areas in Senegal](source: WWF, undated)

149. **A PMA is a conservation area** where efforts are made to establish favorable conditions to develop marine and coastal species, protect habitats, and preserve socioeconomic resources. It is part of a marine environment (most often associated with an adjacent coastal environment) that is designated by its owner or by persons, communities, or structures responsible for its management.

150. **PMAs aim to preserve:**

- Representative types of marine, coastal, river, or lake ecosystems of sufficient size to ensure their long-term sustainability and maintain biological diversity;
- Habitats that are in danger of disappearing;
- Habitats that are necessary for the survival, reproduction, and renewal of endangered, threatened, or endemic animal and plant species;
• Species protected by international conventions; and
• Sites that are of particular importance because of scientific, aesthetic, cultural, or educational interest.

151. **Management at a national level to establish PMAs** is coordinated by an Interministerial Technical Committee that includes the main ministries responsible for fisheries and the environment. Day-to-day operational management of the PMAs is ensured at the local level by a local management committee that includes people or agencies that have been selected for each PMA by the communities.

152. **Improve fish populations.** International experience indicates that establishment of PMAs accelerates the reconstitution of overexploited fish stocks, thus these commitments by Senegal should be commended. The five PMAs set up by the Government, however, suffer from underfunding and are ill-equipped to accomplish their mission. In the past, the creation of PMAs has been opposed by neighboring communities that previously benefited from these areas.

### 1.6 Urban Environmental Management in Dakar

153. **Expanding city attracts migrants.** The urban population in Senegal reached 3.5 million in 1996, was estimated to reach 5.38 million inhabitants in 2006, and grow to 8 to 9 million between now and 2021 (CSE, 2005). About 55 percent of the urban population in Senegal is concentrated in the greater Dakar area, which occupies only 0.3 percent of the country. The growth of cities is largely due to the migration of rural people attracted by the opportunities to improve their lives. Quality of life for city residents in Senegal depends largely on the quality of the habitat they have rights to and the quality of environmental services to which they have access. Cities also exercise pressure on the rural areas surrounding them in the form of regulation, extraction, or water pollution, extraction of forest or fish resources, or intensive exploitation of farming and pastoral lands. The main environmental and public health issues facing cities in Senegal are weak control of urban development and uncontrolled sprawl of unhygienic living areas, bad quality air and water, inadequate waste management and sanitation services, and pollution and industrial risks.

154. **Poor control of urban development.** The growth of the greater Dakar area has been among the most rapid of Senegal’s cities, especially since the 1980s. Dakar’s growth rate is 0.5 percent higher than the national growth rate and migration comes from rural zones and other urban centers (République du Sénégal, 2005b quoted in Iszatt et al., 2007). Surrounding municipalities such as Pikine and Guédiawaye saw their population grow from 170,000 in 1970 to 900,000 in 1995, overtaking the central area of Dakar (CSE, 2005). The municipality of Pikine now has a population estimated at 1 million, one-half of which live in ‘irregular villages’ or shanty towns. The physical confinement of Dakar on the Cap Vert peninsula, strong pressure from urban migration, and the absence of areas suitable for habitation has led to unsuitable areas being occupied (such as contaminated areas or those at risk for flooding) or poorly developed or unserved areas (such as those without drinking water, sanitation services, electricity, commerce, health,
or schools). In addition, there are at present no processes to facilitate the integration of service networks and infrastructures (Iszatt et al., 2007).

155. Metropolitan Dakar is characterized by a severe imbalance of infrastructure and urban services. There is an over-concentration of administrative, public, and commercial services in the main municipality of Dakar, particularly in the Plateau area at the far end of the peninsula, and the road network serving the greater area is clearly insufficient. Lack of control over development of the large unbuilt areas in Dakar, lack of clarity about land and occupancy rights, as well as real estate speculation, also contribute to worsening the imbalance of the greater Dakar area.

156. Controlled development zone. In 1992, the Government established a Zone d’Aménagement Concertée (ZAC) of 380 hectares to promote the controlled development of houses in Mbao, a part of town located halfway between the municipalities of Pikine and Rufisque. The ZAC was developed with adapted services for a population of 200,000 inhabitants. The success of this experiment and other similar experience helped control to a certain extent the expansion of ‘irregular zones’ in the Dakar region and led the Government to envision setting up ZACs in other regional towns. Certain urban development initiatives were initiated by the city of Dakar to improve living conditions in older parts of town such as Ouakam. All the same, the lack of financial and human resources at the municipal level and the limited ability of households to pay for services were identified as the main obstacles to implementing development programs.

157. Air and water quality. Poor air quality in big cities in Senegal is linked to the presence of high concentrations of particulate matter (particles of 10 micrograms or less per cubic meter or PM-10) or to fine particulate matter (particles of 2.5 micrograms or less per cubic meter or PM-2.5) in suspension. The growing number of vehicles linked to the rapid population increase, the presence of industry in urban centers, and the high levels of suspended matter are key factors in the emission of PM. In the absence of reliable data on urban air quality in Senegal, the estimates produced in 2004 by the World Bank show concentrations of PM-10 in large towns were about 68 in Dakar, 105 in Kaolack, 123 in Saint-Louis, 95 in Thiès, and 55 in Ziguinchor. By way of comparison, the PM-10 levels were estimated at 11 in Paris, 34 in Abidjan, and 69 in Conakry.28

158. Urban congestion. There are 63 cars per 1,000 residents in Dakar, while the national rate is 15 per 1,000. Most vehicles driven in the capital are more than 10 years old. These vehicles access Dakar through six north-south roads and three east-west roads, where capacity is regularly exceeded. Urban congestion has thus worsened the air quality problem. The presence of bare sandy soil and the infrequent rainfall are factors that contribute to the high levels of suspended particulate matter.

159. Limited clean water. Only 33 percent of residents in regional towns are served by drinking water. In Dakar, about 90 percent of households now have access to municipal drinking water thanks to the success of the PEPAM. In peripheral communes

of the built-up areas such as in Pikine, only 50 percent of residents access drinking water from public sources (an average of 2,800 users per fountain). The supply of drinking water in sections of Dakar at risk of flooding raises special problems (leaks into the drinking water supply can contaminate the network). Unhygienic drinking water sources such as dug wells that tap the superficial water table are still used in the urban periphery. The presence of urban market gardens near urban pollution sources and contaminated drainage water is especially worrying (examples include Pikine, Lac Mbeubeusse, and Patte d’Oie).

160. **Water pumped to Dakar.** In 1993, 80 percent of drinking water in Dakar came from underground sources on the Cap Vert peninsula, while the rest was channeled from a pumping station with a capacity of 60,000 cubic meters per day near Lake Guiers, 250 kilometers from Dakar. Dependence on underground water sources has lessened with the increase in capacity of the water source at Lake Guiers and the development of other sources. A new pumping and water processing plant with a capacity of 65,000 cubic meters per day was also built at Keur Momar Sarr and is now operational.

161. **Inadequate waste management and sanitation services.** In 2002, 53 percent of households in Dakar and Pikine had access to regular domestic waste management services, while peripheral areas were not served. In these areas, waste was left on public roads until the relevant authorities picked it up. Public waste collection services and public infrastructure maintenance have limited access to the ‘irregular areas’ because their access roads are too narrow.

162. **Domestic waste disposal.** The average quantity of domestic waste collected per day is about 1,250 tonnes, of which about 1,000 tonnes are collected only in Dakar (CSE, 2005). Since 1970, most waste collected in the region of Dakar is transferred to the disposal site at Mbeubeusse, which occupies 70 of 250 hectares of a dry lake bed located near the coast. The water table in this sector is at risk of contamination and the disposal site is a health risk for the surrounding population and the people who make their living from waste recycling. Several government attempts to involve the private sector in developing and operating a new Centre d’enfouissement technique (CET/Waste Disposal Site) have failed. Discussions are currently underway to develop a public-private partnership to recover and recycle waste in Dakar. While national deposits of hazardous materials have been reduced in recent years, the management of these wastes is also confronted by the absence of suitable disposal sites.

163. **Waste water disposal.** In 2002, about 32 percent of households in Dakar and Pikine used sewer piping to dispose of their domestic water (washing, cooking, and cleaning waters) while 29 percent of households disposed of their wastewater on the road (CSE, 2005). This cocktail of domestic waste, domestic water, drainage water, and often even wastewater (especially during the rainy season) and the lack of maintenance of the drainage networks contributes to the bad quality and stagnation of drainage water and associated health risks. This problem is particularly acute in the lower zones of Dakar at risk of flooding and often occupied by ‘irregular habitat.’ Several institutions are responsible to varying degrees for drinking water and sanitation services in Dakar.
(SONES, SDE, DGPRE-MAH, ONAS, MEPNBRLA, city of Dakar), thus programs lack cohesion and there is uncertainty in running and maintenance of the drainage networks.

164. **Waste water processing.** In a tropical context, the quality of urban sanitation services represents a major environmental and public health issue. Sanitation services in Dakar and the other large towns in the country come under the responsibility of ONAS. The only towns in the country that enjoy partial coverage by municipal sanitation services are Dakar and Saint-Louis, with a coverage rate of between 25 and 30 percent. Embryonic sanitation services are available at Louga, Thiès (in construction), Saly (to serve 30 hotels), and Kaolack. In 2004, 64 percent of households in the region of Dakar had access to a sanitation system, including 25 percent of households linked to the municipal networks and 39 percent linked to individual or semi-collective systems (République du Sénégal, 2006a). Only one of the three wastewater processing plants in the city of Dakar was operational. The station of Cambérène, which is still operational, only processes 20 percent of wastewater collected by municipal networks (CSE, 2005). Because of the high cost of building, operating, and maintaining municipal sanitation services, the Government is leaning more toward development of individual or semi-collective sanitation systems at users’ cost for the unserved areas in large towns across the country.

165. **Pollution and industrial risks.** About 90 percent of industry in Senegal is located in the Dakar region. Most of the industry in the metropolitan region is concentrated around the Baie de Hann and borders the south coast of the Cap Vert peninsula up to Rufisque. Only a small part of the industrial waste in the region is recycled or reused, but some contaminated waste such as textiles that may contain solvents is recovered. While most industrial waste is sent to the disposal site at Mbeubeusse, some industries bury or burn their waste on site. Such practices help to contaminate the water table in the Dakar region. As an important port and industrial area, the Baie de Hann has become a highly contaminated environment. About 95 percent of the industrial effluents sent to the sea by industry located along the edge of the bay are unprocessed (CSE, 2002). The industries involved are reluctant to invest in processing systems.29

166. **Polluted bay.** The slow circular currents in the bay do not help disperse pollutants at sea and the configuration of the bay tends to bring part of the effluents back to the beach. The high levels of industrial and domestic effluents in the bay have made ‘green tides’ emerge, linked to the drifting algae that are a nuisance for coastal populations. The industrial sector is not the only cause of pollution in the Baie de Hann, but by the nature of marine industrial waste and the risks of accidental spills, the Dakar-based industries “bring the heaviest and most immediate threat” to the marine ecosystem (ONUDI, 2004).

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29. According to information obtained from the Société Africaine de Raffinage in 2006, when the SAR installed a capture and processing system to stop effluent disposal at sea, it offered neighboring industries the chance to be integrated into the system based on cost sharing, but was turned down.
Through fishing and tourism, this ecosystem is a major source of foreign currency for the country.30

167. **Aging industries, pollution problems.** Industrial risks in Dakar are increased by growth of ‘irregular areas’ on the edge of industrial zones, and by the increase in the complexity of industrial activities (larger volumes and greater diversification of activities). The presence of aging industries near some residential zones in Dakar raises important risks of industrial accidents.31 The main risks of industrial accidents in Dakar are linked to fire and explosions, traffic and rail accidents, leakage of hazardous materials on main roads, gas leaks, and emission of steam and toxic gas (CSE, 2002).

168. **Potential for industrial accidents.** The impact of an industrial accident is increased by the absence of security measures, non-compliance with handling standards and norms for the transport of chemical and fuel products, absence of risk assessments related to each classified establishment, operational lack of rescue organizations, shortage of industrial equipment, and lack of security at work. A UNIDO mission concluded that the country is deficient in industrial risk control and rescue management. In this area, initiatives accompanied by concrete measures were virtually non-existent (UNIDO, 2004). When they do exist, emergency plans are often vulnerable because both industry and municipal institutions lack resources and suitable equipment. Resources and equipment to fight large-scale fires are completely insufficient. The zones *Potou-Bel-Air* and the *Baie de Hann*, where most of the fuel depots are located, are not adequately equipped with fire hydrants (IAGU-CUD-CNUEH-PGU, 1996).

169. **Promises but no action.** Senegal has environmental management norms for waste and hazardous materials set by the Direction de l’Environnement et des Établissements Classés (DEEC) and the Institut Sénégalais de la Normalisation (ISN).32 Despite requirements for full application of these norms and of the Environmental Code and associated texts, few measures to inventory and control polluting industries had begun as of 2004.33 The bodies in charge of monitoring and control were being strengthened and equipped (UNIDO, 2004). Analysis of the environmental situation in the urban and industrial context shows that regulatory and legislative provisions exist, analytical capacity is in place, the will of the industrial actors exists, and there is mobilization of the Government and international donor agencies, but there is a problem “with making practices, concrete measures and to a certain extent the resources allocated, coherent with stated intentions” (UNIDO, 2004).

30. In 2001, tourism generated income of 123 billion FCFA and it would appear that in terms of indirect revenue, it is the main source of foreign currency in the country.

31. Several industrial accidents have taken place in recent years in Dakar, the deadliest of which was the explosion in 1992 of an arsenic load transported by truck with a death toll of 140.

32. The ISN has nearly 60 environmental norms including two recent ones on industrial waste (NS 05-061 for wastewaters, adopted in March 2002, and NS 05-062 on atmospheric polluting waste, adopted in October 2003).

33. We should, however, still note that there is a database of Classified Installations in Senegal, a terminology bulletin of Classified Installations, and Sectoral Guides on environmental impact assessment studies.
170. **Action plan.** Senegal recently adopted an industrial redeployment policy and an Action Plan for industrial redeployment (PARI). The PARI, adopted in 2004, includes an environment, anti-pollution, and industrial risk component, which aims to be the meeting point of the country’s industrial and environmental policy.

171. **Goals to upgrade industry.** The main goals are to upgrade industry to national and international environmental norms and sustainable management of local natural resources. It includes three components — monitoring-evaluation and supervision of industrial pollutant waste; sustainable management of the natural environment (sustainable exploitation, pollution prevention, recycling, etc.); and management of industrial risks. This Action Plan recommends in particular development of adapted industrial norms, establishment of specifications, performing environmental and risk audits, performing EIA and environmental and risk management plans, and development of an environmental quality label.

172. **Five-year pilot program.** The Action Plan includes a five-year pilot program. Pilot projects implemented by industry and which may be funded by national or international partners (UNIDO, UNEP, and ONI) will, after assessment, be replicated in other similar industries (demonstration project). In the area of agro-industry, the selected pilot projects aim to reduce polluting marine waste based on ammonia and chemical products. It is planned that installation of pilot projects, acquisition of equipment, or undertaking research for more sustainable technology will be funded from an Environment and Industrial Depollution Fund. This fund will be financed by the State, international partners (UNIDO and others), industry, and local communities (for waste management).

1.7 **Other Environmental Issues**

173. The other environmental issues briefly tackled in this section include urban environmental management in the regions, waste management, management of coastal zones, and management of retention basins and artificial lakes.

1.7.1 **Urban Environmental Management in the Regions**

174. **Degraded living conditions.** The growth of urban areas and the reasons for this strong growth are covered in Section 1.6. The main environmental and health issues in the secondary urban centers of Senegal are related to degradation of living conditions because they lack adequate waste and sanitation services, which are exacerbated in certain towns by poor control over urban development.

175. **Inadequate waste and sanitation services.** Only 21.4 percent of the population of Senegal has access to private or public waste management services (including 47 percent in urban areas and 2 percent in rural areas). The absence of adapted waste disposal sites in the cities is a major constraint for waste management. According to the CSE (2005), most uncollected waste is buried in ditches or holes in the ground (32.2 percent), disposed of in nature (20.7 percent), buried in cisterns or abandoned wells (10 percent), thrown into drainage ditches (7.1 percent), or thrown into the street (1 percent).
176. **Access to sanitation.** A review of the situation (*Ministère de l'Agriculture et de l'Hydraulique*, 2004) revealed that in 2002, the rate of access to sanitation of urban households was:

- 64 percent in the region of Dakar, among which 25 percent were connected to a collective sanitation network;
- 39 percent in other serviced urban areas (Saint-Louis, Thiès, Kaolack, Louga, and Saly) had access to sanitation services, among which 4 percent were connected to a collective sanitation network; and
- 39 percent in other urban centers, only on the basis of unconnected sanitation services.

177. The *Programme d'Eau Potable et d'Assainissement du Millénaire* (PEPAM) aims to increase the coverage rate of sanitation services in urban areas to 78 percent in 2015 (PEPAM: www.pepam.gouv.sn).

178. **Rainwater drainage.** The management of rainwater drainage networks is also largely deficient in a number of locales, including neighborhoods in the periphery of Dakar. This problem is worsened by urban developments that are built in complete disregard of urban planning standards and that are exposed to flooding during the rainy season with related health risks such as malaria and diarrhea.

1.7.2 **Waste Management**

179. **Increasing amounts of waste.** As in most countries, Senegal is confronted with problems related to continual increases in the production of waste and the consequences that these increases have on their collection, disposal, and elimination. In rural areas, waste is generally agricultural or domestic. These are often disposed off by burning outdoors or burying them as agricultural fertilizer. In urban areas, solid waste is a major concern because there are inadequate disposal sites and volume continues to increase. As a result, uncontrolled waste disposal sites are present in all urban centers of Senegal. The situation is all the more alarming because these uncontrolled sites are used for disposal of industrial and medical wastes.

180. **Waste in Dakar vs other urban areas.** About 45 percent of the population of Senegal lives in urban centers, which are growing on average by 2.8 percent per year. The problems faced by city residents are quite different in Dakar than those in the numerous secondary urban centers. As the economic and social capital of the country, Dakar is densely populated (3,659 people per square kilometer compared to 178 in secondary urban centers), with a rate of growth estimated at 4.2 percent. Such high demographic growth adds pressure on the environment. This pressure is increased by difficulties observed in the collection, transport, and processing of urban solid waste, the disposal of which is one of the outstanding deficiencies of environmental services in the region of Dakar.
181. **Waste not treated.** As the only authorized waste disposal facility in the region of Dakar, Mbeubeuss receives 475,000 tonnes of waste per year that do not benefit from any treatment other than dumping after being weighed (IAGU, 2006). In the context of its program to improve sanitation services in the national capital, the Government contracted an international firm specializing in solid waste management. The program included development of a waste transfer station in the region of Dakar (in the Mbao forest) and a *Centre d’Enfouissement Technique* at Diass in the region of Thiès.

182. **Waste in smaller urban areas.** A study of solid waste management in the communes of Thiès, Saint-Louis, Kaolack, Ziguinchor, Tambacounda, Louga, Kolda, Rufisque, Mbour, Dagana, and Mboro provides a better understanding of the nature of the problem in secondary urban centers, despite a lack of information on the basic characteristics and appreciation of the quantities and qualities of the waste. On the basis of available data for eight of the 11 communes, the estimated quantities of domestic waste produced in the secondary urban centers of Senegal is less than 0.5 kilogram per person per day with a large proportion of organic waste (an average of nearly 50 percent with variations between 40 percent and 85 percent from one commune to another). Collection rates are estimated to be on the order of 35 percent on average with considerable difficulties to transfer waste to a final disposal site (Rouyat J. et al., 2004).

183. **Uncontrolled waste disposal.** The deficiencies in transferring waste combined with low collection rates result in a proliferation of uncontrolled waste disposal sites. In the majority of communes in Senegal, uncontrolled waste disposal sites lie at the entry and the exit to the town, and even within built-up areas. One also can observe a number of hazardous waste recycling practices. Such practices increase the importance of waste management issues for communes since the law on decentralization in 1996. The communes are, however, incapable of finding the important financial resources required to manage such issues in an effective and sustainable manner.

184. **Underlying causes.** The underlying causes of these problems were analyzed with the assistance of the *Agence pour la Propreté du Sénégal* (APROSEN), with 21 major issues identified on the basis of a participatory process. These issues include insufficient involvement of major players, limited knowledge about the types and quantities of wastes, deficiencies in planning, organization, and mobilization of the necessary resources, as well as an inadequate legal and regulatory framework (APROSEN, 2006).

185. **Six strategic actions.** Identification of these causes led to the definition of six strategic actions for sustainable solid waste management: (i) development of an adapted financing mechanism; (ii) development of an adapted legal and regulatory framework; (iii) harmonization of an institutional framework; (iv) design of an adapted and sustainable waste management system; (v) development of public communication and awareness programs on solid waste management; and (vi) reinforcing the capacity of actors involved in solid waste management.

186. **Sustainable approaches.** To develop sustainable approaches to solid waste management in Senegal, APROSEN (2008) initiated a number of studies and programs, including:
- Studies to develop sustainable waste management systems in the cities of Kaolack and Saint-Louis; similar studies are planned in Touba, Mbour, Tivaouane, Diourbel, Ziguinchor, and Matam in 2008.

- Studies to develop reuse and recycling activities related to domestic and inert industrial wastes (plastics and gravel in particular) to support development of small and medium enterprises in the waste management sector.

- The “one household-one garbage bin” program has allowed for distribution, at a reasonable cost, of 30,000 garbage bins to city residents.

- Emergence of social development programs known as écoquartiers and écovillages following an iterative and participatory process.

- A local community support program in the solid waste management sector with local initiatives specifically tailored toward religious cities.

- A program to develop appropriate community waste management infrastructure and services.

- Implementation of a communication and capacity reinforcement strategy for actors in solid waste management through the cellules écoquartiers community organizations.

187. **Constructing waste disposal sites.** In addition, the Ministry of the Environment has initiated a project to develop Class 2 solid waste disposal sites (Centres d’Enfouissement Technique [CET] de classe 2) in the regional capitals of Senegal (with the exception of Dakar) and the cities of Tivaouane and Touba. In addition to construction of waste disposal facilities, the project also provides support to develop waste management plans in each of these cities. Feasibility and engineering studies have been completed for all the cities and construction of some facilities started in Thiès in 2005 and Touba in 2006, and is starting in Saint-Louis.

1.7.3 **Coastal Zone Management**

188. **Transition areas.** Coastal zones are defined as transition areas between land and the sea. In Senegal the coast extends along 700 kilometers and is the maritime facade of seven administrative regions. It includes sandy coasts (about 300 kilometers), mangrove estuaries (about 234 kilometers), and rocky coasts (174 kilometers). Because of the favorable conditions that it offers, the coast has attracted a high population concentration and a numerous activities. However, in this interface where air, water, and land connect, the environment is very dynamic, producing continuous and sometimes dramatic changes to physical, biological, and chemical attributes that can modify coastal profiles.

189. **Coastal flooding.** A prospective study of the vulnerability of the low Senegalese coast shows that this mixture of sand and clay frequently floods and is affected by serious erosion, salinization of soils and water tables, degradation of plant cover, and depletion of fish stocks. In the region of Dakar, populations threatened by flooding and coastal erosion are estimated to number between 174,864 and 730,249, with a potential loss estimated at between 52 million and 129 million FCFA, according to a minimum
flooding scenario and a depreciation rate of 6 percent. Populations threatened by flooding and coastal erosion of the Saloum estuary (departments of Kaolack, Fatick, and Foundiougne) are estimated to number between 74,587 and 847,191, with a potential loss estimated between 30 and 117 millions FCFA (République du Sénégal, 2008b).

190. **Fighting coastal erosion.** With a goal of limiting encroachment of the sea along the coast, the Ministry of the Environment initiated a study to develop a National Program Against Coastal Erosion. The study of coastal erosion processes identified the main sources of the problem, the primary affected zones, as well as the constraints associated with an adequate management of these resources (République du Sénégal, 2008b).

191. **Causes of coastal erosion.** It appears that the main causes of coastal erosion are natural (rises in sea levels, sediment deficits, exceptional wave action or ‘tidal waves’, superficial runoff and poor coastal drainage, natural weakness of rocky coasts) and/or man-made (extraction of sand and other sediments along beaches, construction of buildings along beaches, construction of perpendicular structures along the shorelines). These causes are sustained by deficiencies: (i) political and institutional; (ii) legal and regulatory; (iii) technical (poor understanding of coastal erosion management processes); and (iv) coastal land-use planning and management (République du Sénégal, 2008b).

192. **Coastal erosion processes include:**

- Slow processes are mainly controlled by sediment movements that are perpendicular to the coast and related to sediment deficits (Rufisque, Cambérène);
- Rhythmic processes that translate into longitudinal displacement of erosion zones (Saint-Louis, Joal);
- Extremely rapid processes, generally due to exceptional wave action, associated with the opening of coastal inlets (Djiffere located on the Pointe de Sangomar);
- Slow rise in sea level related to climate change;
- Runoff processes related to poor drainage of continental waters toward the sea;
- Human activities such as the extraction of marine sediments; and
- Very slow but brutal processes affecting rocky coastal cliffs (such as the cliffs of Dakar).

193. **All coastal cities at risk.** Coastal erosion processes are observed in nearly all coastal cities (Saint-Louis, Cambérène, Yoff, Dakar, Rufisque, Joal), as well as in the area of Djiffere following the opening of a new inlet along the Pointe de Sangomar.

194. **The areas most threatened by coastal erosion include:** (i) Saint-Louis (Gokhou Mbatchie) and the Langue de Barbarie (an area that includes a beach that opened in 2004) and (ii) the Cap Vert peninsula where the main known erosion points are the areas of Cambérène-Yoff, the western and eastern cliffs of Dakar, and the greater Bay of Hann (from Hann to Rufisque), in addition to the area of the Mbeubeusse quarry that presents worrying signs of erosion. For the western and eastern cliffs, it is reported that from 1980
to 1997 the coast has lost between 0.45 and 2.7 meters per year. The most affected sector is located between the Pointe des Madeleines and the beach of Rebeuss.

195. **Gorée island.** The coast of the island of Gorée has also been affected by coastal erosion that has varied from place to place. Along the Mamelle cliff, the combination of runoff and the pounding surf have led to intense erosion. The Bay of Hann presents signs of coastal erosion, mainly at the levels of Thiaroye and Mbao.

196. **Known coastal erosion zone.** Rufisque has been known for a long time as a coastal erosion zone, and the area of the thermal power station of Cap des Biches-Diokoul is characterized by erosion of 0.9 meters per year on average. The phenomenon is especially pronounced at the southeast extremity of the city (Thiawléne zone), where erosion was recorded at a rate of 2.1 meters per year between 1976 and 1980.

197. **Along the Petite Côte,** the main coastal erosion zones are Joal and the area of Palmarin-Djiffere where the annual erosion between Joal and Sangomar is estimated to be 2 meters. Erosion processes have been observed at certain places near Saly, where coastal encroachment threatens some hotels. In Casamance, surveys conducted at the beginning of the 1980s indicated a reduction in the width of beaches.

198. **Multiple consequences of erosion.** Coastal erosion has led to a number of villages and tourism areas being abandoned. Particular meteorological events can result in the disappearance of beaches, damage to infrastructure (roads, railways, etc.), destruction of houses built close to the sea, collapse of cliffs and increased vulnerability of neighboring land uses, and the abandonment of villages and agricultural or tourism activities. Fish stocks can be affected by changes to the coastal environment. The salinization of water tables from marine intrusions can have negative effects on the availability of drinking water in certain localities. From an ecological standpoint, the modification and destruction of ecosystems (particularly in mangroves) is also a significant concern.

199. **Projects underway.** While the National Program Against Coastal Erosion awaits final approval, several projects are fighting coastal erosion in some of the most threatened areas: the Porte du Millénaire, and the areas of Mbao, Rufisque, and Popenguine.

### 1.7.4 Management of Retention Basins and Artificial Lakes

200. **Agricultural deficit.** Senegal is an agricultural country with a potential 3.8 million hectares of agricultural land, of which 2.5 million hectares are under cultivation. About 350,000 hectares can potentially be irrigated, but only 75,000 hectares are currently used for irrigated agriculture. Despite these advantages, agriculture does not provide sufficient income to cultivators and does not provide rural populations with the food security they require, let alone providing food security to the country as a whole or sustainably reducing the deficits in the national commercial accounts.

201. **Managing rainwater.** The management of water is a major constraining factor for agricultural development. Important quantities of rainwater are lost every year
through runoff. In this context the Project for the Construction and Upgrading of Water Retention Basins was initiated by the Ministry of the Environment to provide sustainable water supplies at a reasonable cost to rural communities. The project cost is estimated at about 218 billion FCFA, or US$ 437 million (République du Sénégal, 2007c). Presently, 150 retention basins have been completed. According to the Direction des Bassins de Rétention et Lacs Artificiels (DBRLA) that is responsible for its implementation, the project should be a sustainable mechanism to retain populations in rural areas, improve food security, and support agricultural intensification and modernization.

202. **The project aims to build and upgrade 3,240 water storage facilities** between 2008 and 2012, and pursues the following objectives:

- Develop, securitize, and diversify agricultural production;
- Create the conditions for sustainable development of family-based agriculture in Senegal and increase the incomes of rural producers;
- Recharge water tables, contribute to forest renewal, and development of intensive livestock husbandry;
- Develop aquaculture (fish, shrimp, oysters) and continental fishing;
- Improve the availability of watering holes for livestock; and
- Restore ecosystems and protect the environment.

203. **Further benefits.** In addition to the development of retention basins, the project aims to support: (i) development of irrigated perimeters (a total area of 90,000 hectares is planned around the basins); (ii) development of livestock perimeters (7,000 kilometers), and (iii) construction of storage and conservation facilities for agricultural products. In addition, the project includes as complementary measures reforestation actions, river basin protection, fish farming, and reinforcing the capacities of the beneficiaries.

204. **Increase irrigated area.** According to the DBRLA, this project could contribute to attaining the objectives of the Poverty Reduction Strategy by increasing the rate of areas under irrigation from 4 percent in 2005 to 10 percent by 2010, and then 15 percent by 2015 (République du Sénégal, 2007c). Indeed, the completion of 2,736 retention basins and 504 artificial lakes (for a total of 3,240 water storage facilities) should provide each region of the country with at least 10 facilities per rural community. The possibility of irrigating 90,000 hectares could lead to creation of over 200,000 permanent or seasonal jobs, thereby reducing the rural exodus toward the cities.

205. **Exploiting the landscape for water retention.** From a technical standpoint, these basins would be created by water retention and regulation structures that would mainly be installed in valleys (micro or large dams, artificial lakes), and in natural depressions as large natural or artificial ponds (*mares naturelles ou artificielles*). Their capacity could vary between 30,000 cubic meters and several tens of millions of cubic meters to be used mainly for irrigation, supplying water to livestock, fish farming, and recharging water tables.
Section 2 — Main Environmental Issues

2.1 Institutional Framework for Environmental Management

2.1.1 Environmental Management at the National Level

2.1.1.1 Functions and organization of the Ministry of the Environment

206. **Historical background.** The history of the Ministry illustrates the low importance given to the environment during its first years. It also indicates the institutional instability that created a lack of long-term vision and multiple policy changes linked to the different vocations of the Ministry. Following the creation of the State Secretariat of Nature Protection (Secrétariat d’État à la Protection de la Nature, MEPN) in 1973, a Ministry of Industrial Development and Environment (Ministère du Développement Industriel et de l’Environnement) started life in 1975. The first Ministry dedicated exclusively to the environment was the Ministry of Nature Protection (Ministère de la Protection de la Nature, MPN) (1983-1990), which grouped the Direction de l’Environnement and the Direction des Eaux et Forêts et Chasses, Parcs nationaux et de la Conservation des sols et du Reboisement (DEFCCS).

207. **Changing organization.** From 1990 to 1993, the MPN became the Ministry of Tourism and Nature Protection (Ministère du Tourisme et de la Protection de la Nature). In 1993, the MEPN grouped the Direction de l’Environnement, the DEFCCS, the Direction des Parcs Nationaux (DPN), and the Bureau des Établissements Classés. In 2001, MEPN broadened its jurisdiction and became the Ministère de la Jeunesse, de l’Environnement et de l’Hygiène publique until 2002, when it became the MEPN again, grouping the DPN, the Direction de l’Environnement et des Établissements Classés (DEEC), and DEFCCS. The Ministry was renamed MEPNBRLA in 2007 following the integration of the Direction des Bassins de Rétention et des Lacs artificiels (DBRLA).

208. **Orientation.** The MEPNBRLA has a mission to “promote a rational management of natural resources, to control surface waters for agriculture-forestry-pastoral ends and to work toward improving the living framework of the population in a perspective of sustainable development and poverty reduction.” This mission was reaffirmed through a sectoral policy letter (République du Sénégal, 2008).

209. **Sustainable socioeconomic development.** The Ministry wants to establish sustainable socioeconomic development. Environmental policy is divided into medium-term sectoral objectives (République du Sénégal, 2008a). These include:

- **Reducing the degradation of natural resources and the environment** by reversing the deforestation trend, developing methods and techniques to restore resources, and conserving and protecting forest resources, wildlife, and their habitat. We can add preservation of the marine and coastal environment and promotion of citizen behavior that favors the environment.

- **Contributing to the fight against poverty and improving living conditions,** especially for rural people whose survival is linked to production in zones that are...
sometimes marginal and ecologically fragile. Promoting and developing natural resources will strengthen their technical and institutional capacities to manage the environment. Important in these efforts is control of water by setting up and managing retention basins and artificial lakes, as well as protection and recovery of salty lands for production that will help reduce poverty. In addition, a special emphasis will be placed on waste management, compliance with environmental norms, and monitoring classified establishments.

- **Improving the quality of services by expanding the knowledge base of natural resources and the environment**, by the availability of information on the condition of natural resources and the environment, and strengthening operational, technical, and institutional capacities of the State and local communities to improve working conditions at the Ministry.

- **Contributing to the preservation of the global environment** by implementing national action plans stemming from multilateral environmental agreements by stronger integration of convention obligations in the implementation of environmental policy.

210. **MDF 7.** The Millennium Development Goals (MDG) and the PRSP-II in part guide the main strategic axes of ministerial intervention. The Ministry takes part in reaching MDG 7 aimed at “encouraging the reversal of the current trend of loss of environmental resources” at the national level through biodiversity management, desertification control, pollution and waste control, and the control of sources contributing to climate change (République du Sénégal, 2005b).

211. **Sectoral Action Plan.** MEPNBRLA formulated a Sectoral Action Plan (POS) to reduce poverty based on the PRSP-II that targets sustainable use of forest and wildlife resources, biodiversity conservation, improving the quality of life in urban and rural areas, strengthening management capacity for natural resources, and community management of protected areas. The Ministry has recently adopted a policy framework prepared for the medium and long term that is based on a sectoral policy letter for the environment (*Lettre de Politique sectorielle en environnement*), a *Cadre de Dépenses Sectorielles à Moyen Terme* (CDS-MT), and the implementation of a result-based management process.

212. **Functions.** According to Decree No. 2004-589 of 30 April 2004, MEPNBRLA ensures the following functions:

- Combating pollution and nuisances of all kinds;
- Preserving wildlife and flora;
- Rational utilization of forest potential and managing the forest economy;
- Managing surface waters;
- Recovering land invaded by salt;
- Protecting water courses against the invasion of aquatic plants;
• Protecting national parks and other protected areas;
• Protecting threatened plant and animal species;
• Preparing and implementing hunting legislation and regulations and overseeing the development of ecotourism;
• Combating brush fires, soil degradation, and desertification;
• Supporting local communities for collection and treatment of household waste;
• Promoting and developing environmental education; and
• Managing surveillance and monitoring mechanisms for climate change and modifications to the status of the environment.

213. **Complex sector.** These tasks illustrate the overlapping nature of the sector and justify the need to consider it in all socioeconomic activities so as to be effective in the fight against poverty and improve living conditions (République du Sénégal, 2008). The organization structure of the MEPNBRLA is presented Figure 2.1.34

214. **MEPNBRLA includes four departments** —Direction des Eaux et Forêts, Chasses et Conservation des Sols (DEFCCS); Direction de l’Environnement et des Établissements Classés (DEEC); Direction des Parcs Nationaux (DPN); and the new Direction des Bassins de Rétention et des Lacs Artificiels (DBRLA). Each department

34. In 2007, the Direction des Bassins de Rétention et des Lacs Artificiels was integrated into the Ministry (ref: La Réforme institutionnelle et organisationnelle du MEPN, 2007). Because it was set up only recently, this department was not analyzed in the present report.
has a director and deputy director reporting to the minister. Each department is divided into divisions managed by division heads. The Ministry also has services under the aegis of the MEPNBLRA. The minister’s Cabinet is directed by a chef de Cabinet, supported by an attaché de Cabinet, a chargé de mission, three technical advisors, two technical department advisors, a communication advisor, and a legal advisor. Finally, the Service de l’Administration Générale et l’Équipement (SAGE) and the Inspection des Affaires Administratives et Financières (IAAF) are attached to the Cabinet.

215. **The DEFCCS has a long history** — since 1973 — in the management of natural resources and the environment. It plays a key role for forest resources and has a vast network of Inspections Régionales des Eaux et Forêts (IREF) that is well established in all 11 regions under its authority. It operates mainly in the management of forests, wildlife, and soil conservation. Its main mission is to protect forest and wildlife resources (conservation of forest potential and ecological balances) and guarantee sustainable management and planning of these resources (meeting people’s needs for forest products). The DEFCCS has five divisions (Figure 2.2). The Centre forestier de recyclage in Thiès (Centre FoRet) is attached to the DEFCCS. Most DEFCCS operations involve reforestation, and more recently, biodiversity protection.

![Figure 2.2 Organizational structure of the DEFCCS](image)

Source: MEPN, 2006

216. The DEEC is in charge of implementing Government environmental policy, legislation and environmental regulations, environmental assessments, protection, monitoring, compliance, and surveillance aimed at ensuring that natural resources are managed rationally. In the past, the DEEC was also in charge of the technical supervision
of the *Commission Nationale sur le Développement Durable* (CNDD). This task is now carried out by the *Direction du Plan*. The DEEC is a relatively recent body compared to other MEPNBRLA institutions and has limited influence. An operational environmental code was only passed in 2001, and has only been implemented during the last few years. In 2006, the DEEC was structured into three divisions. The DEFFCS carried out DEEC functions in regions outside Dakar (Figures 2.3 and 2.4). Since the creation of 11 regional departments at the end of 2006, the DEFCCS is no longer in charge of these functions.

![Organizational structure of the DEEC](image)

Source: MEPN, 2006

217. **The DPN is in charge of managing classified areas and natural reserves**, safeguarding representative samples of the country’s natural ecosystems, and ensuring wildlife protection and development of ecotourism in these protected areas. The DPN includes five divisions (MEPN, 2006) — studies and development, humid zones and protected marine areas (AMP), training/communication, monitoring/evaluation (focal point CEPS), and natural community reserves (RNC) and peripheral zones. Each national park is managed by a conservator. The department is now trying a new approach to encourage the creation of private community areas that incorporate lands considered as biosphere reserves and involves the community as the main stakeholder. Unlike other departments of MEPNBRLA, DPN is not structured in regional departments. With various partners, DPN has developed a community management model for protected areas held up as an example by some NGOs. Figure 2.4 illustrates the type of links they recommend between the different stakeholders.
The Cellule d’Étude de Planification et de Suivi (CEPS) is a service (Figure 2.1) under the authority of the MEPNBRLA. It was created in 2003 thanks to, among others, the Appui Budgétaire Sectoriel (ABS/sectoral budgetary support) of the Netherlands. It aims to develop a planning and operational monitoring system to address broad national strategic guidelines and local environmental issues. It also prepares the Cadre de Dépenses Sectorielles à Moyen Terme (CDS-MT). The CEPS is a body for reflection and analysis, but also coordinates interventions and optimizes use of resources and the effectiveness of management activities to protect natural resources and the environment. It plans and prepares activity budgets within MEPNBRLA and evaluates implementation.

35. The CDS-MT is made operational through a Plan de Travail Annuel (PTA/annual work plan), which is a series of activities to be implemented to help reach sectoral goals and annual program performance measured using result/impact indicators targeted annually (République du Sénégal, 2008b).
The CEPS is under the authority of a coordinator and is divided into five units — Planning, Technical, Socioeconomic, Computer, Documentation, and the Division of Human Resources Management. It also has a computer center. Creation of CEPS has helped improve the administrative, financial, and monitoring capacities of MEPNBRLA programs as well as strengthen functional ties with the MEF (Van Der Linde, 2006).

219. The *Cellule d’Éducation et de Formation Environnementale* (CEFE), set up in 2002, is in charge of implementing the national environmental education strategy developed and validated by institutional and social stakeholders. It includes one representative from each technical department of MEPNBLRA, 10 representatives from other ministries, and three representatives from associations operating in environmental training and education. The CEFE is in charge of developing and implementing environmental awareness and education policy. It also helps develop studies and research into environmental education and the promotion of national, regional, and international partnerships. The secretariat of the CEFE is entrusted to a coordinator.

220. The *Centre de Suivi Écologique pour la Gestion des Ressources Naturelles* (CSE) is a public interest association attached to the MEPNBLRA. CSE is structured into four departments (MEPN, 2006) — Information/Training, Environmental Monitoring, Geographical Information and Natural Resource Management, and Environmental Assessments. CSE has a director general and a technical director, an administrative and financial director, and about 40 experts. The director general (DG) reports to the Chairman of the General Assembly of the CSE (Président de l’Assemblée Générale du CSE), which is currently the Minister of the Environment. The CSE concludes framework agreements with the various departments of the Ministry and these agreements set out the cooperation parameters between the parties. If required, addenda are finalized. The role of the CSE is to promote products and services to meet monitoring, surveillance, and inventory requirements for natural and agricultural resources.

221. **The different CSE disciplines** are the environment, remote detection, databases, cartography, and socioeconomics. Some projects (GIVACQUE, PREFER, POGV, PAPEL, PRODAM) sub-contract their monitoring activity to CSE.

222. The *Service de l’Administration Générale et de l’Équipement* (SAGE) is commissioned to prepare and implement the MEPNBLRA budget and manage the staff and material. SAGE is structured into offices — Management/Accounting, Markets, Staffing, Equipment, and Dispatch (MEPN, 2006). The recent establishment of SAGE and good collaboration with CEPS have helped strengthen MEPNBLRA and make it more effective (Van De Linde et al., 2006). All the same, disbursement procedures are still slow and there are often gaps between needs and available resources (Van Der Linde et al., 2006).

223. The *Inspection des Affaires Administratives et Financières* (IAAF) is in charge of the technical, administrative, and financial control of structures, projects, and programs under MEPNBLRA authority. It only has one person at present (MEPN, 2006). The principle of administrative and financial audits and checks is fairly recent in
MEPNBRLA and is beginning to be integrated into national programs such as PEPAM (République du Sénégal, 2005a).

224. **Main environmental management tools.** The main environmental management tools used by MEPNBRLA are environmental assessment (application of the Environmental Code of 2001), environmental audits applied to industrial installations and atmospheric emissions (2003), effluent quality (2001), and exhaust gases from land vehicles (1999). The various departments of MEPNBRLA also use indicators as environmental monitoring tools (Table 2.1).

225. **Land use information.** Further, various institutions, including CSE, use Geographic Information Systems (GIS) as management tools and for interpreting environmental and land use information. CSE publishes a yearbook on the environment and natural resources, as well as a report on the state of the environment in Senegal (Edition 2005), making it easy for various national institutions to access information. Other tools include environmental monitoring carried out by CSE (brush fires, plant production, farming). Several of these tools have only recently started to be used, and because there has been no monitoring of their effectiveness, only partial conclusions can be drawn about their effectiveness.

226. **Monitoring needs improvement.** It appears clear from interviews and documents that the monitoring mechanisms and tools do not enable stakeholders to have a holistic vision of the environment and the main priority zones and sectors for intervention. The absence of systematic updating of the database and return of information to local communities has created a situation where the information used in environmental management is limited and outdated. Further, mitigation and monitoring measures in impact studies are not implemented systematically. Finally, the norms developed as environmental management tools are not implemented and thus have limited effectiveness.

227. **Monitoring and information sharing in planning and setting priorities.** The Government of Senegal is currently formulating a monitoring framework for the Millennium Development Goals (MDG) to collect the information necessary to develop good policies for all sectors, identify priority intervention sectors, and concentrate on the main issues. The Commission Nationale du Développement Durable (CNDD) is in charge of monitoring Agenda 21 commitments.

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36. All the same, we can observe more rigor in the implementation of regulations. Several classified establishments at fault recently received fines. In addition, monitoring environmental management plans was selected as an indicator of the impact of economic activities on the environment.
Figure 2.5  Environmental management and support of national institutions

- **Ministère de l'Environnement et de la Protection de la Nature (MEPN)**
  - Direction des Eaux, Forêts, Chasse et de la Conservation des Solis (DEFCCS)
    - **Services déconcentrés**
      - Diorbel
      - Louga
      - Saint-Louis
      - Fatouk
      - Tamba
      - Matam
      - Kaolack
      - Dakar
      - Thies
      - Kolda
      - Ziguinchor
  - Direction de l'Environnement et des Établissements classés (DEEC)
    - **Services déconcentrés**
      - Thies
      - Saint-Louis
      - Ziguinchor
  - Direction des Parcs nationaux (DPN)
  - Direction de l'Urbanisme et de l'Architecture (DUA)

- **Ministère de l'Urbanisme et de l'Aménagement du Territoire (MUAT)**
  - Direction des Parcs nationaux (DPN)
  - Direction de l'Aménagement du Territoire (DAT)
  - Direction de l'Urbanisme et de l'Architecture (DUA)
  - Services déconcentrés

- **Ministère de l'Intérieur et des Collectivités locales (MICL)**
  - Direction des Affaires générales et de l'Administration territoriale (DAGAT)
  - Services déconcentrés

- **Agence régionale de Développement (ARD)**
  - Institutions nationales
  - Collectivités locales

- **Commission régionale d'urbanisme et d'environnement**

- **Région**
  - Commune
    - Autorisation de toute coupe et perception de la quote-part d'amendes prévues par le Code forestier
    - Reboisement et création de bois communaux
    - Gestion des déchets, lutte contre l'insalubrité, les pollutions et les nuisances
    - Protection des ressources en eaux souterraines et superficielles
    - Plan communal d’action en environnement
  - Collectivités locales
    - Gestion, protection, entretien et création de forêts, sites protégés et naturels d’intérêt régional ou national
    - Gestion des eaux continentales, sauf celles à statut international ou national
    - Lutte contre les feux de brousse et intervention en cas d’atteinte à l’environnement (ex. braconnage)
    - Plans d’intervention d’urgence et de gestion de risques, plan régional d’action en environnement
  - Communauté rurale
    - Gestion des forêts (zones de territoire)
    - Autorisations de toute coupe, de défrichement et d’amodiation des zones de chasse et perception de la quote-part d’amendes prévues par le Code forestier
    - Gestion de sites naturels d’intérêt local et création de bois et d’aires protégées
    - Gestion des déchets et lutte contre l’insalubrité
    - Plan local d’action en environnement

- **État**
  - Agences de coopération internationales

- **ONG environnementales et organisations communautaires de base**
  - Direction des Parcs nationaux (DPN)
  - Pool des conservateurs régionaux
228. **Monitoring framework.** MEPNBRLA is developing a national monitoring framework with operational environmental and socioeconomic indicators to quantitatively assess the state of the environment and pressure on natural resources. This framework is articulated around nine strategic priorities (MEPNBRLA, 2008): (i) management of forest and wildlife potential; (ii) promotion of good citizen behavior for the environment; (iii) preservation of the marine and coastal environment; (iv) promotion of popular participation and involvement of the private sector and local communities in managing natural resources and the environment; (v) improving the knowledge base of natural resources and the environment; (vi) strengthening the technical and institutional capacities of the State and local communities; (vii) contributing to conserving the global environment; (viii) controlling surface waters to improve agriculture-forestry-pastoralism and fish production; and (ix) control and operation of the CDS-MT. For each of these priorities, a reference condition is summarized, objectives and proposed actions are detailed, and indicators are listed.

229. **Monitoring indicators.** Table 2.1 illustrates the monitoring indicators used by MEPNBRLA and other national institutions. These indicators were used to prepare recent plans such as the DPN Action Plan (2006), le PAFR (2005), the environmental management framework for MDG 7 (2006), and others. The necessary administrative procedures to make a formal request for data from the relevant authorities are often bottlenecks that limit the capacity for information exchange among institutions (République du Sénégal, 2005a). In addition, the absence of systematic updating of the database, associated with a lack of human and financial resources, limits the quality of the information (République du Sénégal, 2005a). Despite the fact that each ministerial technical department has a monitoring cell, the CSE is identified by most respondents as one of the main sources of environmental data and is always seeking funding for its operations.

2.1.1.2 **Main gaps at the structure level**

230. The main gaps include:

- Poor level of authority and influence of MEPNBRLA over sectoral policy of other ministries (such as those related to fishing and water management);
- Limited integration of a global vision of the broad issues and natural resource protection priorities into State action;
- Insufficient and ineffective assumption of certain important environmental issues such as protection and renewal of natural resources (fishing, water, species), management of rainwater in urban areas, and waste management in rural areas;
- Insufficient structure and will to implement current environmental regulations (absence of a suitable litigation service, few cases initiated, poor DEEC representation in the regions); and
- Weakness of staff in the technical departments linked to problems in hiring qualified staff to renew the workforce.
<table>
<thead>
<tr>
<th>Ministère</th>
<th>Direction ou Agence</th>
<th>Principaux indicateurs de suivi</th>
<th>Couvertures Spatiales</th>
<th>Organisme responsable de la collecte</th>
<th>Source de financement pour la collecte</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE, DEFCCS</td>
<td>1</td>
<td>Indice de Végétation de la Différence Normalisée (NDVI)</td>
<td>Nationale</td>
<td>CSE, DEFCCS</td>
<td>Etat du Sénégal, Projets</td>
</tr>
<tr>
<td>CSE, DA, DIREL</td>
<td>2</td>
<td>NTCC (Indice de croissance végétale normalisé)</td>
<td>Nationale</td>
<td>CSE, DEFCCS</td>
<td>Etat du Sénégal, Projets</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Indice de productivité</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Indice d'abondance kilométrique (grande et moyenne faune)</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Redaction du nombre d'espèces menacées de disparition</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Nombre d'espèces disparues</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Capacité et fonctionnalité des AMF</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td>DPN</td>
<td>8</td>
<td>Proportion d'endérides par espace d'eaux</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal, Wet Land, GFMPO, UNCCD, etc.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Taux de couverture national en eaux protégées</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Superficie de mangroves et de milieux restants</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Superficie de mares et de lagunes aménagées et protégées</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Nombre de personnes formées à ces techniques</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Nombre de personnes interdites sur les lieux qui posent les zéth et leur impact</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Disponibilité d'un plan national de gestion des ZH</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Superficie des AMF fonctionnels dans le taux de couverture</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Niveau d'harmonisation des approches et stratégies de gestion</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>Livestock reboisement and regeneration of forests</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>Existence de protocole d'accord avec les pays dans le cadre de la conservation de la biodiversité</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>Niveau d'harmonisation des interventions des partenaires au développement</td>
<td>National</td>
<td>DPN</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td>Ministère de l'Environnement et de la Protection de la nature</td>
<td>DEFCCS</td>
<td>Ratio reboisement et surboisement des forêts</td>
<td>Nationale</td>
<td>DEFCCS (Division reboisement et conservation des sols)</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>Taux de survie des plantes</td>
<td>Nationale</td>
<td>DEFCCS (Division reboisement et conservation des sols)</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>Quotas national d'exploitation des charbons</td>
<td>Nationale</td>
<td>DEFCCS (Division exploitation des charbons)</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>Nivel d'harmonisation des interventions des partenaires au développement</td>
<td>Nationale</td>
<td>DEFCCS (Division exploitation des charbons)</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>Number of plants produced for the campaign national de reboisement</td>
<td>Nationale</td>
<td>DEFCCS (Division reboisement et conservation des sols)</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>Existence et fonctionnalité du cadre juridique et institutionnel</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>Capacité et fonctionnalité du laboratoire de contrôle et de suivi</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>Nivel d'harmonisation des interventions des partenaires au développement</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>Nivel d'harmonisation des interventions des partenaires au développement</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>Existence et fonctionnalité des AMF fonctionnels</td>
<td>National</td>
<td>DEFCCS</td>
<td>Etat du Sénégal / Partenaires</td>
</tr>
</tbody>
</table>
### Table 2.1 Main environmental indicators followed by national institutions (continued)

<table>
<thead>
<tr>
<th>Ministère</th>
<th>Direction ou Agence</th>
<th>Principaux indicateurs de suivi</th>
<th>Couvertures Spatiales</th>
<th>Organisme responsable de la collecte</th>
<th>Source de financement pour la collecte</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ministère de l'Énergie</strong></td>
<td>DIREL</td>
<td>Taux de conversion énergétique des combustibles fossiles</td>
<td>Nationale</td>
<td>DIREL</td>
<td>État (BCI)</td>
</tr>
<tr>
<td>Ministère de la Protection, de l'Urbanisme et de l’Aménagement</td>
<td>PAPEL/DIREL</td>
<td>Taux d'accès des populations à l'eau potable</td>
<td>Nationale</td>
<td>PAPEL</td>
<td>État (BCI)</td>
</tr>
<tr>
<td>Ministère de l'Agriculture, de l'Elevage et des Aliments</td>
<td>DAHU</td>
<td>Taux d'accès des populations aux services sanitaires</td>
<td>Nationale</td>
<td>DAHU</td>
<td>État (BCI)</td>
</tr>
<tr>
<td>Ministère de l’Économie et des Finances</td>
<td>DPM</td>
<td>Taux d'incidence de la pauvreté</td>
<td>Nationale</td>
<td>DPM</td>
<td>État (BCI)</td>
</tr>
<tr>
<td>Ministère de l’Économie et des Finances</td>
<td>DPN</td>
<td>Nombre d'infrastructures insuffisantes dans le cadre des extensions</td>
<td>Locaux</td>
<td>DPN</td>
<td>État (BCI)</td>
</tr>
<tr>
<td>Ministère de l’Économie et des Finances</td>
<td>DUH</td>
<td>Taux de croissance de la population</td>
<td>Nationale</td>
<td>DUH</td>
<td>État (BCI)</td>
</tr>
</tbody>
</table>

**SIGLES ET ABBREVIATIONS**
- ASP: Aides Matières Premières
- AMD: Aménagement de l'Eau
- BCI: Budget Consultatif d’Investissement
- CFT: Centre des Foires et Expositions
- CGT: Centre Général des Territoires et des Collectivités
- DAB: Direction de l’Assainissement et de la Récupération des États
- DAPC: Direction de l’Aménagement et du Planificateur des Ressources en Eau
- DAS: Direction des Affaires Spéciales
- DBC: Direction de l’Électricité et de l’Energie
- DECC: Direction de l’Économie et des Collectivités Communes
- DDP: Direction des Domaines et de la Planification des Ressources en Eau
- DHR: Direction de l’Habitation
- DPLG: Direction de l’Hydraulique et de la Gestion des Eaux
- DPM: Direction des Pompes Ménagères
- DPN: Direction des Pompes Nationales
- DPNH: Direction des Pompes Hydrauliques

Source: CSE (2006)

231. **Lack of influence.** The scant influence that MEPNBRLA has over the **Ministère de l’Économie et des Finances** and the sectoral policy of other relevant ministries contributes to the fact that environmental considerations are not always taken into account as priorities in sectoral policies. As a result, these policies put pressure on the environment by unsustainable exploitation of natural resources. The accelerated growth

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37. Projects submitted to the MEF by MEPNBRLA are examined by a selection Committee based on criteria relating to economic profitability, their effects on the national collectivity, the environment, regional equilibrium and, on public finances (MEPN, 2006).
strategy of the Government of Senegal relies, among other things, on farming and fisheries. Unless political will at several levels is established and effectively finances the protection and renewal of natural resources in economic development policy, those natural resources that the population depends on are at risk.

232. **Diluted programs.** Lack of coordination among national institutions and other environmental partners (bilateral and multilateral donors, NGOs) dilutes efforts and programs. This situation has lasted for decades (*Plan National d'Action pour l'Environnement*, 1997; *Country Environmental Analysis*, 1994). Both the CEA in 1994 and the PNAE in 1997 recommended setting up an interministerial environmental agency reporting to the Prime Minister to exercise greater influence on the policies of other sectors likely to put pressure on the environment.\(^{38}\) There is a real need for coordination at the ministerial level with political authorities, technical support, and the required funding to effectively recognize environmental considerations in all sectors. Alternatively, an institutional framework where MEPNBRLA has more resources to protect natural resources and greater decision-making power over the sectoral policies and programs of other ministries (veto rights) might be another avenue to explore.

233. **Global vision.** Nonetheless, we can observe the emergence of a global vision of the broad issues and natural resource protection priorities within the MEPNBRLA. We should remember that the Ministry formulated a sectoral operations plan (POS) to reduce poverty based on CSRP II. The Ministry is also equipped with a political framework prepared for the medium and long term based on a *Lettre de Politique sectorielle en environnement*, a *Cadre de Dépenses Sectorielles à Moyen Terme* (CDS-MT), and the installation of a management method based on results from checking operational monitoring indicators. Geographic information systems are still hardly used in environmental management. There is little connection between broad environmental issues as identified by local experts and the allocation of funds to these priorities.

234. **Recognizing responsibilities.** Moreover, it seems that the responsibilities of MEPNBRLA structures to achieve the goals of the *Cadre de Dépenses à Moyen Terme* (CDMT) of the Government are not clearly set out, contributing to the absence of recognition (MEPN, 2006). **Not recognizing natural resource protection responsibilities** is particularly evident for water, wildlife, fish resources, waste management, and water purification. Water is so fundamental for sustaining life that a special effort should be made to clarify responsibilities in this sector and ensure effective recognition of protection and conservation functions. In Dakar, management of rainwater drainage appears to be a priority.

235. **The DEFCCS has historically operated in forestry** and exploitation of forest resources, but little effort has been made for biodiversity conservation. The respective responsibilities of DEFCCS, DPN, and MEMTMI should be clarified in relation to the protection and development of national parks and protected areas.

\(^{38}\) In both cases, it was suggested to envisage a modification of the CONSERE statute to make it an effective supra-ministerial environmental agency.
Clarifying management is necessary. The management model and financing mechanisms for parks and protected areas have not been reviewed for years. Further, there are gaps and duplication in the appointment and jurisdictions of certain agencies such as DPN and DEFCS for hunting and wildlife management and DEFCCS and DEEC for pollution control, nuisance control, and classified establishments (MEPN, 2006). The absence of a strong functional link and dialogue between MEPNBRLA and MEMTMI limits the effectiveness of marine and coastal resource protection, marine biodiversity conservation, and management of protected areas.

Local communities on their own. In rural areas, local communities are left to their own devices for waste management and water purification and need technical and financial support from national institutions. NGOs operating in this sector in the regions will be encouraged by incentives the government has started.

The absence of a legal services within the DEEC limits its ability to prosecute violators of environmental regulations.\(^{39}\) The few available resources and legal mechanisms to implement regulations, as well as a lack of influence by the DEEC on the sectoral programs of other institutions, produce a lack of will to control pollution sources and reduce pressure on natural resources. Fortunately, since 2006, all regions of Senegal have a service Régional de l’Environnement et des Établissements Classés. These new structures should enable CL to be well supervised, ensure effective implementation of regulations, and promote environmental awareness for CL and the population.

SAGE is facing a serious staff renewal problem in MEPNBRLA since more than one-third of the DEFCCS managers are on the verge of retirement (DEFCCS, 2006). DPN also faces hiring problems.

2.1.1.3 Budget

Limited funds. Despite the importance of environmental problems in Senegal, (i) a small portion of the Government budget is allocated to MEPNBRLA and most of the funds come from outside sources; (ii) a good percentage of the available resources are allocated to administration or dispersed to various programs that are not always directly linked to the broad environmental issues affecting the population; and (iii) DEEC and DPN, which both have important responsibilities for pollution control and the renewal of natural resources, have few resources to carry out their duties.

Origin of the budget. The MEPNBRLA budget comes from the Programme Triennal d’Investissements Publics (PTIP)\(^{40}\) 2006-2008 of the Government of Senegal, with 62 percent from outside resources. The Government budget in the PTIP 2006-2008 totals 1,641,582 million FCFA for the period 2006-2008. Creation and execution of the budget are based on legal and technical rules (MEPN, 2006). Unlike the PTIP, which includes MEF technicians and sectoral ministries, the CDMT of MEPNBRLA should be

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\(^{39}\) Note the proposal in the framework of the project to reorganize the DEEC to create a division for monitoring/evaluation and legal affairs.

\(^{40}\) The PTIP is a law program that authorizes public investments over a three-year duration, revised and voted each year at the same time as the finance law (MEPN, 2006).
designed and implemented according to a participatory process involving all stakeholders involved in sectoral policy implementation (ministries, local communities, development partners). The MEPNBRALA budget in its CDMT (2005-2007) represents 4 percent of the PTIP budget for the same period.

242. **The MEPNBRALA 2006 budget** was 25,379 million FCFA (US$ 51 million) with 46 percent from outside sources (Van Der Linde, 2006). The 2006 budget (Table 2.2) represented only 1.87 percent of the state budget, illustrating the limited influence of MEPNBRALA with the Ministère de l’Économie et des Finances (MEF).

243. **Improving relationship.** The functional relations between MEPNBRALA and MEF seem to be improving; the functional budget of MEPNBRALA in 2006 increased by 25 percent compared to 2005, thanks in part to the Appui Budgétaire Sectoriel (ABS) from the Netherlands. The portion of the investment budget of MEPNBRALA financed by state resources went from 17 percent in 2005 to 41 percent in 2006 (Van Der Linde et al., 2006).

244. **MEPNBRALA does not use economic instruments for sustainable financing of programs** such as taxation, license fees on the utilization of natural resources (forest and wildlife resources), violations of environmental regulations, etc. Further, the Government makes no appeals for subsidies or incentives from the private sector to promote their participation in environmental management. The strong dependence of MEPNBRALA on international aid and multiple sources of financing creates a situation where the degree of involvement in programs often relies on financing duration.

245. **MEPNBRALA budget.** The MEPNBRALA budget is currently divided into several sectoral environmental programs that rely strongly on financing from development institutions, and consequently is closely linked to the portfolios and priorities of these institutions. The broad environmental issues affecting the population are not always reflected and clearly identified in budgets because when the budget is being prepared, there is little consideration of the needs expressed at other levels such as regions, departments, or rural communities (MEPN, 2006).

<table>
<thead>
<tr>
<th>Category</th>
<th>FY 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government budget</td>
<td>1,360,537</td>
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<tr>
<td><strong>MEPNBRALA budget</strong></td>
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<tr>
<td>Personnel</td>
<td>2,286</td>
</tr>
<tr>
<td>Functioning</td>
<td>2,573</td>
</tr>
<tr>
<td>Current transfers</td>
<td>20</td>
</tr>
<tr>
<td>Investment by the State</td>
<td>7,483</td>
</tr>
<tr>
<td>Capital transfers</td>
<td>1,174</td>
</tr>
<tr>
<td>External resources</td>
<td>11,843</td>
</tr>
<tr>
<td>Total</td>
<td>25,379</td>
</tr>
<tr>
<td>MEPNBRALA/Government budget</td>
<td>1.87%</td>
</tr>
</tbody>
</table>

*Source: Van Der Linde et al. (2006)*
246. **Budget allocation by sector.** While more than 60 percent of the population in Senegal lives in rural areas and depends on the land and subsistence activities, a low percentage of MEPNBRLA resources is allocated to protecting ecosystems and natural resources and their renewal. Based on questionnaire interviews carried out in 2006 with representatives from agencies involved in Senegal, the main environmental issues in rural areas are access to water (especially drinking water), ecosystem protection (especially soil quality), water purification and hygiene (e.g., domestic wastewater and waste), and the control of agricultural development. In urban areas, the main issues identified by respondents are flood control and control of urban development, waste management, air quality, and water purification.

247. A small portion of the MEPNBRLA budget is allocated to protecting the environment and pollution control even though this is a priority for urban populations. In 2006, MEPNBRLA allocated only 7.3 percent of its budget to environmental protection and pollution control (Table 2.3). Water management and hydraulic works at the heart of community needs only received 5.5 percent of the MEPNBRLA budget. Fortunately, the budgets of other ministries such as MAH, MEMTMI, and MTTA complement the budget of MEPNBRLA even though they are not specifically dedicated to protecting and conserving resources. In Dakar, flooding problems, pulmonary disease linked to air quality, as well as low water quality, collectively affect the productivity of a large part of the population and thus their active participation in the economy.

<table>
<thead>
<tr>
<th>Intervention sector</th>
<th>Budget 2005-2007 (FCFA)</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration expenses (buildings, operations, staff, transfer)</td>
<td>16,437,467,408</td>
<td>23</td>
</tr>
<tr>
<td>Vegetation, biodiversity, ecosystems</td>
<td>15,100,571,000</td>
<td>21</td>
</tr>
<tr>
<td>Technical reinforcement</td>
<td>12,178,128,360</td>
<td>17</td>
</tr>
<tr>
<td>Management of marine and coastal resources, control of coastal erosion, pollution clean-up, and rehabilitation of the Baie de Hann</td>
<td>7,016,836,070</td>
<td>9.6</td>
</tr>
<tr>
<td>Education, training, awareness, and ecotourism</td>
<td>6,264,866,950</td>
<td>8.6</td>
</tr>
<tr>
<td>Natural resources management</td>
<td>5,792,810,000</td>
<td>7.9</td>
</tr>
<tr>
<td>Environmental protection (pollution control)</td>
<td>5,333,749,000</td>
<td>7.3</td>
</tr>
<tr>
<td>Hydraulic works (water management)</td>
<td>4,000,000,000</td>
<td>5.5</td>
</tr>
<tr>
<td>Environmental monitoring and information systems</td>
<td>912,942,000</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>73,037,370,788</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>


248. **Budget allocation for natural resources.** A small proportion of the MEPNBRLA budget is allocated directly to the protection and renewal of natural resources on which most of the population in Senegal depends. MEPNBRLA allocated 9.6 percent of its budget in 2006 (Table 2.3) to the protection and rehabilitation of marine and coastal environments (including reducing pollution and rehabilitating the **Baie de Hann**) and 7.9 percent to managing natural resources.
Limited access to quality water. The collapse of fish stocks, poor soils, and the limited access of rural people to quality water limit their productivity and contribute to an exodus. Access to drinking water is an important issue for rural populations. The long distances women have to travel to access water, which is sometimes of doubtful quality, limits the time they could be spending on essential tasks such as farming and herding. In the same way, stagnant water near rural communities and municipalities allows disease vectors to develop and thus hampers participation of the population in the economy.

Priority environmental issues. The CDS-MT 2008-2010 provides a better marriage between priority environmental issues in Senegal and budget allocations (operating and investment budgets). The budget preparation process places more emphasis on improving sectoral performance by achieving objectives and indicators (République du Sénégal, 2008).

Budget allocation to MEPNBRLA institutions. More than one-half of the ministerial budget in 2006 was allocated to the DEFCCS and the Service de l’Administration Générale et l’Équipement (SAGE). Because of its seniority and influence, the DEFCCS held 31 percent of the ministerial budget (Table 2.4) while 23 percent went to SAGE. DEEC and DPN, which have large responsibilities in the management of natural resources and pollution control, only received 18 percent and 7 percent of the ministerial budget, respectively, which seems low to carry out their respective tasks.

Table 2.4 Summary of MEPNBRLA budget projected in the CDMT plan, 2005-2007, by department

<table>
<thead>
<tr>
<th>MEPNBRLA department</th>
<th>2005-2007 budget (FCFA)</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFCCS</td>
<td>22,360,950,000</td>
<td>31</td>
</tr>
<tr>
<td>SAGE/MEPNBRLA</td>
<td>16,437,467,408</td>
<td>23</td>
</tr>
<tr>
<td>DEEC</td>
<td>13,503,414,060</td>
<td>18</td>
</tr>
<tr>
<td>CEPS / CABINET</td>
<td>9,973,251,000</td>
<td>14</td>
</tr>
<tr>
<td>DPN</td>
<td>5,352,721,370</td>
<td>7</td>
</tr>
<tr>
<td>CEFE</td>
<td>4,162,626,950</td>
<td>6</td>
</tr>
<tr>
<td>CSE</td>
<td>763,050,000</td>
<td>1</td>
</tr>
<tr>
<td>CNTEFCPN Djibélor Zuguichor</td>
<td>483,890,000</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>73,037,370,788</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>


Environmental monitoring. Ministerial efforts for awareness and environmental education were 6 percent of the budget allocated to CEFE. The CEPS/Cabinet and the CSE respectively received 14 percent and 1 percent of the budget to ensure planning and monitoring activities even though there is still no national environmental monitoring framework. It is possible that a part of the Cabinet budget in 2006 was linked to certain projects attached to the Cabinet that should normally be attached to the technical departments (MEPN, 2006).
2.1.1.4 Available resources

253. Human resources. SAGE is facing a serious staff renewal problem at MEPNBRLA as more than one-third of the DEFFCS managers are about to retire (DEFCCS, 2006). DPN also has hiring problems. There is also a need to reinforce internal inspection manpower because none exists outside of IAAF (MEPN, 2006). To bridge the gap between qualified staffing requirements and the qualifications available inside the Ministry, MEPNBRLA is carrying out an inventory of human resources inside the Ministry (Van Der Linde et al., 2006). This census will be used to formulate a human resources management and training policy.

254. Decentralized services. DEFCCS has a well-established network of regional offices (present in 11 regions) inside MEPNBRLA. DEEC is today also represented in all regions. This enables it to carry out its functions in each region and especially to provide better assistance to local communities.

255. Available resources. MEPNBRLA’s capacity to fully carry out its duties and achieve its strategic goals is limited by its low level of financing (4 percent of the PTIP) and because its resources are not used optimally.

256. DEEC has none of its own resources to monitor water pollution and has certified laboratories to carry out this task (MEPN, 2006). For air pollution, it has a laboratory truck. The lack of financial resources, qualified staff, equipment, and logistics hampers effective implementation of a monitoring plan for air quality and atmospheric emission control (Iczatt et al., 2007). Based on questionnaire interviews held in 2006 with representatives from agencies involved in Senegal, staff from the various departments do not have the necessary financial and logistical resources to carry out regular field visits to become familiar with local issues and support local communities in managing the environment and natural resources.

257. Funding gaps. These gaps have broad negative ramifications on the ability of agencies to meet the population’s needs through sustainable exploitation of natural resources. For example, the absence of sustainable financing mechanisms for national parks and protected areas and their underfunding limit the ability of the DPN to invest in biodiversity protection. Usage fees from national parks are not sufficient to ensure program financing and anticipated revenue from ecotourism has not materialized. For DEEC and DEFCCS, the absence of significant revenue from natural resource exploitation limits their ability to invest in resource protection and conservation.

258. Lack of resources. Given the scale of the problems linked to natural resource conservation, MEPNBRLA does not have the resources to alone cope with ecosystem degradation and needs the support of other ministries involved in natural resource management. In the current institutional context, MEPNBRLA’s low level of authority within the Government and the little influence it has over the orientation and sectoral programs of other ministries (such as MAHS, MAT, MEF, MEMTMI, and MAH) are important obstacles to overcome.
2.1.1.5 Environmental assessment and authorization process

259. The first Environmental Code (1983) had no enforcement order and did not define requirements for environmental evaluation in the framework of the authorization process. Decree No. 5295 (2 August 1999) aimed at coordinating the environmental approval process. Ministerial decree No. 1986 MH establishes a *Cellule de Suivi des Impacts environnementaux du Projet Sectoriel Eau* (a unit to monitor the environmental impacts of the water sector project). Eighteen years after the first code, the new Environmental Code and its enforcement orders make impact studies obligatory and set out their scope and content as well as the public consultation process. Projects are classified into two categories:

- **Category 1.** Installations or activities representing a danger to public health and safety, hygiene, nature, and the environment in general, or a nuisance for neighboring communities (projects likely to have considerable impact).
- **Category 2.** Installations or activities that do not cause such damage for the issues outlined above (projects with limited impacts which can be mitigated).

260. **Automatic EIA.** Category 1 projects are automatically subject to an Environmental Impact Assessment (EIA) and public consultations while Category 2 projects are subject to a declaration backed up by relevant documentation. The environmental assessment process is linked to the authorization process and the scope, content, and acceptability of the EIA are under the authority of the DEEC.

261. **Effectiveness of the environmental assessment process.** In 2002, right at the beginning of the new Environmental Code, some projects were not subjected to the environmental assessment process (Ngaido, 2002), but with time, the process was applied more systematically. According to a census carried out in MEPNBRLA in 2006, 94 impact studies were submitted to MEPNBRLA between 2003 and 2006. Most (57) were submitted in the period 2005-2006. The structure and content of the EIAs generally comply with good practice.

262. **EIA participants.** More than two-thirds of the interview participants in 2006 from concerned agency representatives in Senegal were familiar with or had participated in an environmental assessment process. National and regional institutions, cooperating agencies, NGOs, and the private sector all take part in such processes. Nonetheless, their degree of participation was limited by the time allocated to supply comments on the sometimes voluminous documentation and by their availability.

263. **Comments after completion.** Based on these interviews, it appears that participation of the different stakeholders is often restricted to providing comments on the impact study once it has been completed. As a result, their level of influence on project design (before the publication of the EIA) and the implementation of the proposed measures in the environmental management plan of the EIA is poor or non-existent.

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41. The number of EIAs registered at the Ministry has since increased considerably.
264. **DEEC sets up technical committees** to validate the EIA of each project but does not have resources to motivate the participation of committee members. Moreover, the members of these technical committees do not always have the required technical expertise to provide objective opinions (MEPN, 2006).

265. **Not an effective tool.** As implemented at present, the environmental assessment process is viewed more as an administrative requirement rather than an effective tool to optimize projects by considering community concerns. Several problems with coordination and administrative efficiency of the process have been reported (delays in sending out the impact study reports for comments, heavy administrative process, and long delays in certifying environmental assessment practitioners). The implementation process is still not transparent. There is still no registry of the impact studies carried out or obligation for authorities or promoters to distribute related information.

266. **Weak points in the process.** Based on interviews carried out in 2006 with concerned agency representatives in Senegal, the weak points of the process are: (i) absence of public project notice; (ii) site selection process; (iii) poor quantification of impacts; (iv) absence of cumulative effects assessment; and (v) absence of monitoring during the construction, operation, and closure phases. According to respondents, once the EIA was completed, the environmental management plan and monitoring plan were not implemented systematically. Public consultation and participation were also identified as weak points in the process.

2.1.1.6 **Environmental monitoring**

267. **The absence of a strategic monitoring framework** limits the ability of institutions and donors to measure the effectiveness of policies and programs that aim to improve the state of the environment (République du Sénégal, 2004a; 2005a). There is also an absence of measurement tables in the CEPS to ensure the strategic monitoring of the CDMT and provide an information and decision-assistance system at MEPNBRLA (MEPN, 2006).

268. **No environmental monitoring framework.** The absence of an operational national environmental monitoring framework and the limited extent of applied environmental research (limited mainly to the work of the Institut des Sciences de l’Environnement) constrain decision making for institutions dealing with environmental and natural resource management. The monitoring indicators measured by MEPNBRLA do not enable any national quantitative measurement of the state of the environment and the pressure put on natural resources. This observation has endured since the last Country Environmental Analysis in 1994, which already highlighted this gap. Nonetheless, the CEPS is currently in the process of starting such monitoring in collaboration with the CSE and is setting up a strategic monitoring framework for the Ministry of the Environment’s programs (Van Der Linde et al., 2006).42

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42. A workshop took place in April 2006 to harmonize the CDMT monitoring and evaluation systems formulated by CEPS and CSE.
269. **Several indicators are not measured** systematically in temporal and spatial terms (République du Sénégal, 2005a). In addition, the spatial and temporal coverage varies considerably according to the indicators.

270. **Conditions not easily monitored.** Several relevant indicators of condition or impact are not monitored or easily accessible (such as ambient noise in urban areas and quality of domestic effluents, quantity and characterization of waste, soil quality, land use, air quality, and quality of marine sediment). To tackle the considerable air quality problems in Dakar, an air quality monitoring program has been set up by CETUD. This program entered an operational phase with the purchase of an air quality measurement vehicle in Dakar.

271. **Limited ability to use data.** The administrative procedures to access data and the absence of systematic updating of the databases limit the ability to transmit and use data among institutions (République du Sénégal, 2005a) as well as their ability to obtain a common and global vision of the main environmental issues and priorities.

### 2.1.1.7 Consultation process

272. **Public consultation and participation** in the environmental assessment process is an integral part of the regulatory framework as set out in Decree No. 9468 MJEHP-DEEC of 28 November 2001. Public participation includes three main activities — information, consultation, and public hearings. The public hearings are chaired by the ministry involved in the activity subject to the environmental assessment, with the vice chair from CL and the secretariat from DEEC. The goal of the public hearings is to summarize the impact study and collect comments from the main actors. Public information is the responsibility of the promoter and involves the technical committee, the CL, and the promoter. The technical committee prepares a report one week after the hearings based on the EIS, and the promoter has two weeks to incorporate the concerns of the public in the report and resubmit it to the committee.

273. **Effectiveness of the consultation process.** Information, consultation, and public participation were identified by several respondents as weak points in the environmental assessment process. The decree does not set out the terms of participation, so there is no information, consultation, and effective public participation upstream of the impact study when there is maximum potential to influence the project at least cost. Information is the purview of the promoter, and several respondents noted that the promoters deliberately limited distribution of information on projects for fear of receiving compensation requests during the public hearings. Furthermore, the hearings are chaired by the ministry whose activities are being evaluated, so there is a potential for conflict of interest that can harm consultation outcomes.

274. **More public participation.** As for public participation in formulating policies and programs, the CSE recommended in 1999 that local communities be more actively involved in the decision-making process for policy and program formulation (CSE, 1999). Inefficient communication tools and the lack of motivation of government representatives were identified as a weakness in the *Plan National d’Action pour*
l'Environnement (PNAE). The creation of the CEFE and the participatory approach adopted by the Government will possibly help to improve the situation.

2.1.1.8 Political interference and corruption

275. **Political decisions favor growth over the environment.** In a context of growing poverty and short-term political mandates, there is strong potential to make political decisions that favor accelerated economic development (agriculture, fishing) to the detriment of natural resource sustainability. The lack of regulatory supervision over certain resource consumption trends reflects a lack of political will to protect natural resources upon which a large portion of the population depends. In addition, a lack of quantitative resource monitoring means that decision makers are not always aware of the serious consequences their actions may have on resources.

276. There are more and more efforts to provide integrated management policies for resources. One example in the fisheries sector is the *Programme de Gestion Intégrée des Ressources Marines et Côtières* (Programme GIRMaC) which should be implemented shortly (the preparatory phase is planned between 2004 and 2008). The global objective of this program is to *“promote the sustainable growth of fisheries in Senegal while preserving important natural habitats for biodiversity and to meet the socioeconomic needs of the actors involved, especially local communities.”*[^43]

277. According to the TI 2005 Global Corruption Barometer of the NGO Transparency International, corruption is present in the legal and judicial system of Senegal as well as the permit and registry services. Nonetheless, based on interviews held in 2006 with agency representatives involved in Senegal, implementation of environmental regulations and acquisition of permits are subject to little political interference.

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**Box 2. Corruption in Senegal in 2005**

The Transparency International Global Corruption Barometer appraises the level of corruption in more than 150 countries using opinion surveys. According to the 2005 report, corruption in Senegal mainly affects these institutions — the police (3.7 out of 5), political parties (3.6 out of 5), and the legal and judicial system (3.2 out of 5).

When asked how the level of corruption in Senegal has changed over the last three years, 23 percent of respondents mentioned that it had stayed the same and 27 percent think the level of corruption should go down slightly in the next few years.

**Source:** Transparency International (2005); World Bank (2005)

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2.1.1.9 Governance

278. **Recent significant improvements.** While there are some important gaps, there have been recent significant improvements in MEPNBRJA planning and program monitoring, as well as classifying and monitoring cases (Van Der Linde et al., 2006). Following a recommendation made in a review of the public finance management system, the Government decided in 2005 to experiment with three-year budget planning in MEPNBRJA using the *Cadre de Dépenses sectorielles à Moyen Terme* (CDS-MT) 2005-2007 (République du Sénégal, 2005b). The CDS-MT is now well established and helps translate government priorities over a three-year horizon and allocate specific

[^43]: http://www.girmac.sn/article.php3?id_article=3
budgets and objectives to priority action sectors (Van Der Linde et al., 2006). The CDS-MT enables the Ministry to prepare *Plans de Travail Annuel* (PTA/annual work plans).

279. **Information system.** The Ministry is in the process of setting up an operational and strategic information system (SISO) aimed at following activities by administrative structure, result indicators, financing levels, and relationships between achievements and spending. Nonetheless, there are certain gaps such as the not-yet operational nature of the SISO and the lack of command by users of the informatics tool (MEPN, 2006). Among the gaps noted, MEPNBRLA should become more effective in selecting, preparing, and carrying out these investment projects (Van Der Linde, 2006). The decision-making processes are rarely documented. Furthermore, the Ministry should involve the actors more actively in formulating the CDMT (MEPN, 2006). The officers in charge in the Ministry are well aware of this because they actively collaborated in setting up 11 regional environmental action plans (PAER) with the general goal of ensuring CDMT implementation and taking into account the concerns specific to each region.

280. **More to be strengthened.** MEPNBRLA should also strengthen the logical framework of CDS-MT (objectives, anticipated results, activities, result indicators, indicators of effects and impacts, and links between these components) (Van Der Linde et al., 2006). Finally, the administrative and financial management capacity of these projects should also be strengthened. The budgetary nomenclature was not classified by activity, which did not make it easy to impute and evaluate activity costs (MEPN, 2006), but this defect was resolved in 2007, when classification and budgeting by activity were applied (République du Sénégal, 2008).

281. **Eliminating delays.** Delays were observed in some CDS-MT spending linked to the complex and over-centralized procedures that can slow and damage activity implementation. This slowness has now virtually disappeared as a Contrôleur des Opérations Financières (COF) and an Ordonnateur Délégué (OD) were delegated to the Ministry, which sped up financial procedures. For instance, progress made in the Programme d'Eau Potable et d'Assainissement du Millénaire (PEPAM) 2015 can be monitored because it incorporates several measures to improve governance (République du Sénégal, 2005a).

282. **Stability within MEPNBRLA.** The many institutional and leadership changes within MEPNBRLA (five ministers in 10 years) have definitely hindered the implementation of environmental policy and staff motivation. Most of this period was characterized by a lack of long-term vision and few tangible decisions.

### 2.1.2 Environmental Management Below the National Level

#### 2.1.2.1 Structures and functions

283. **Local communities.** Structures below the national level include three types of local communities (CL) — the region, commune, and rural community, each operating at

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44. All the same efforts were made to remedy these gaps. Thus, all MEPNBRLA staff took computer training and all offices are now equipped with computers.
various levels and whose responsibilities are set out in Law No. 96-07 of 22 March 1996 on the transfer of authority to these local communities (Figure 2.4). This law transfers authority to local communities in nine fields — management of the environment and natural resources; land management; urban and habitat planning; the public domain; health, population, and social services; youth, sport, and recreational activity; culture; education, literacy, and promotion of national languages; and planning (Ngaido, 2002).


285. The *Code des collectivités locales* also transfers to the CL responsibility for preparing the master plans for urban and land development (MUAT, 2003). The *Plans Détailles d’Urbanisme* (PUD) and the *Schémas Directeurs d’Aménagement et d’Urbanisme* (SDAU) are prepared by the communes in compliance with the TOR prepared by each rural community. They are both implemented following the resolution of the *Président du Conseil Régional* (regional council chairman) and approval by the state representative. The *Plans Directeurs d’Urbanisme* (PDU) are prepared by the communes and implemented following the decree issued by MUAT.

286. **Decentralization laws** do not provide sufficient political and economic authority to local governments to develop their planning capacity and fill their role in environmental and natural resource management (Iszatt et al., 2007).

### 2.1.2.2 Support and coordination with national institutions

287. **Lack of coordination.** There is a lack of coordination between the city of Dakar and other governmental institutions, especially long-term planning for water purification. The lack of planning linked to water management causes coordination gaps between investments, programs, and monitoring. The *Ministère de l’Intérieur et des Collectivités locales*, with help from the World Bank, is currently studying this problem.

288. **Support for local communities.** In rural areas, national institutions support the CL through decentralized services (Figure 2.4), the *Commissions régionales de l’urbanisme et de l’environnement* and the *Agences Régionales de Développement* (ARD, created in 1998), which are independent structures. The ARDs coordinate and harmonize development activities in regional areas by supporting decentralized technical structures, especially the technical committee to appropriate local development plans (MEPN, 2006; UNDP, 2005; Nagaido, 2002).

289. **ARD structure.** The ARD has an executive board, office, agency director, and technical committee (MEPN, 2006). The executive board decides the general policy of the agency and approves all acts, agreements, reports, and annual programs of the agency. The office is able to take decisions on the technical missions of the agency, however, it can delegate this function to the agency director. The agency director is the budget organizer — he implements all agency actions and contracts and directs agency operations.
activity in the framework of general guidelines. The technical committee is made up of regional officers from State decentralized services. The committee has a consultative role over all agency missions. The ARDs receive resources from contributions from local communities which must be set each year by the Minister of Finance, as well as subsidies, reimbursement of fees for services, and earnings on behalf of public bodies (MEPN, 2006).

290. **Supporting local communities.** In the framework of natural resources and environmental management, MEPNBRLA supports local communities, especially through:

- Support for implementing and monitoring regulations (DEEC, DEFCCS, DPN).
- Production and management of natural resources (DEFCCS: production and management of forest products; CSE: formulation of decision-making tools using geo-information systems).
- Protection of natural areas and lifestyle management (DEFCCS: management of forests in protected areas, management of classified forests bordering CL, forest and wildlife potential; DPN: creation of protected marine areas and community natural reserves; DEEC: extraction of marine sand without a stranglehold on decisions for granting permits, pollution, and nuisances; CSE: formulation of decision-making tools using geomatics).
- Information, education, training (DEFCCS, DEEC, DPN, CEFE, CSE, and CNFTEFPN).

291. **Weak functional links.** Even though the national institutions are represented within the Commissions régionales de l’urbanisme et de l’environnement and the ARD, the functional links between these and the regional institutions are weak. According to the Union des Associations des Élus Locaux (UAEL), the need for technical and training support in local communities is vast and poor representation of national institutions in the region and a lack of resources means that support is limited. For UAEL, the main obstacles limiting effectiveness of environmental management at the regional level are absence of clear support strategies to the CL, lack of qualified resources, board management of interventions, absence of implementation regulations, and lack of coordination among stakeholders (UAEL, 2006; Van Der Linde et al., 2006; UNDP, 2005).

292. **Limited effectiveness.** Different perceptions of land development, absence of effective dialogue with national institutions, and a certain degree of mistrust damages dialogue and limits the ability of environmental programs to provide tangible results (CSE, 2005, 1999). The resources used by Government to consult the population are not adapted to obtain the opinion of the most vulnerable groups (women, youth, herders, and subsistence fishers), which are an important part of the population. CEPS recently organized field missions aimed at implementing the programs linked to CDMT 2006-2008 and PTA 2006 with regional officers. This initiative should be replicated on a regular basis in the framework of MEPNBRLA operations and should help formulate the PAER (regional environmental action plans).
Providing technical support. Following decentralization, the DEFCCS was one of the pioneering departments of MEPNBRLA to provide technical strengthening and support to the CL in the form of financial assistance, support for developing plans and managing natural resources, technical training, and raising awareness (UNDP, 2005). Other MEPNBRLA departments or other ministries could benefit from this experience to strengthen their functional ties with the CL.

2.1.2.3 Financing sources

Most of CL financial resources come from revenues (local taxes, indirect taxes on electricity, water, gas, etc.), private and public revenue sources, transfer payments from the state, and contributions to the decentralization fund. Other resources come directly from bilateral international aid to the CL (UNDP, 2005).

Box 3. Support to local communities for environmental management

The Projet de Développement Agricole de Matam Phase 2 (PRODAM II) (2004-2011) program aims to reduce poverty in rural areas in the region of Matam. The main elements of this program funded by the West African Development Bank (WADB), the International Fund for Agricultural Development (IFAD), and the Government of Senegal aim to support local communities (Organisation Paysannes et Collectivités Locales) by developing their capacity to manage socioeconomic activity, improve agropastoral activities, facilitate access to financial services, and ensure follow-up. PRODAM is characterized by a participatory approach for local communities in project design and the development of partnerships with the private sector and public institutions for project implementation. As an example, a Geographic Information System (GIS) was developed at Matam to facilitate land management. The needs to be addressed by this system were outlined by the local community while training and data were provided by various government institutions, NGOs, and the private sector. This GIS was developed so that local actors could use it.

Source: FIDAfrique (2006); PRODAM (2006)

Tax payments. CLs face a low rate of tax payments (UNDP, 2005; MED, 2002), linked to, among other things, the willingness and capacity of rural households to pay (République du Sénégal, 2005a). The state also exercises control over the fiscal chain through taxes and fees paid locally for natural resource exploitation (UNDP, 2005). Thus CLs have difficult access to the necessary resources to carry out their tasks in the environmental domain. There are also large disparities in the financial support granted to local communities — the Dakar region receives about 20 billion FCFA per year, the wealthy regions of the country (Kaolack, Thiès) receive about 1 billion FCFA per year, while the poorer regions (Kolda, Fatick, Tambacounda) only receive 300-350 million FCFA per year (UNDP, 2005).

2.1.2.4 Available resources

CLs lack resources. The human, technical, financial, and logistical resources allocated to the decentralized services of national institutions are insufficient to provide effective support to the CLs (République du Sénégal, 2005a; IUCN, 2006; CSE, 2005; UNDP, 2005; MED, 2002; Ngaido, 2002; CSE, 1999). National institutions have not provided the capacity and decision-making autonomy to ensure an operational transfer of

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45. However, there has been recent progress concerning CL access to resources to carry out their tasks in environmental areas. The illustration is provided by the Conseil régional de Thiès, which signed a protocol with MEPNBRLA to finance the development of the Thiès plateau.
tasks and skills. The CLs still depend on state funding and international cooperation programs to implement their policies (CSE, 1999). This lack of resources and their lack of training may partially explain why local elected officials do not fulfill their responsibilities for environmental protection and natural resource management.

297. **Little support for waste management.** Waste management illustrates the lack of CL resources to carry out tasks. Limited financial resources and the high cost of waste management projects lead to the use of unqualified volunteers (UAEL, 2006). The CLs have little support for waste management services and often technical solutions are not adapted to local conditions (UAEL, 2006). The lack of resources also means that local communities are not in a position to provide effective services (Iszatt et al., 2007). Investments are necessary to provide waste management services (Box 4).

298. **Strengthening requirements.** There are many capacity-building requirements for the CL in the areas of environmental and natural resource management (UAEL, 2006; MEPN, 2006; CSE, 2005; République du Sénégal, 2004a, 2005a; UNDP, 2005). The Cellule d’Appui aux Élus locaux of the Union des Associations des Élus Locaux identifies certain priority requirements for the environment and other general skills required to fully carry out their responsibilities:

- **Priority needs for the environment.** Waste management (the first priority according to UAEL, 2006); wastewater treatment; responsible use of agricultural chemicals; land management and sustainable land management; evaluation and environmental regulation; rehabilitation and management of plant cover; brush fire control; sustainable management of wildlife and natural resources; health aspects linked to the environment; and the role of women and youth in the environment.

- **More general needs.** Organizational, administrative, and financial management; commercialization and processing of natural resources; hygiene; cattle management; and functional literacy campaigns (UAEL, 2006; CSE, 2005; UNDP, 2005).

2.1.2.5 **Governance**

299. **Local communities have the basic skills** required to ensure good administrative and financial management of the few resources at their disposal. These resources are not always allocated to priority actions that may benefit the environment.

300. **Investing in the urban environment.** As an example, the 2003-2006 summary of investments made by the urban Direction de l’Aménagement in Dakar indicates a small portion of investments were allocated to the main environmental priorities of the city. About 45 percent of investments are allocated to maintenance and development of the public lighting system; 5 percent are provided to clean the streets, drainage ditches, markets and roadside stations, and improve the rainwater drainage system; 3 percent are allocated to developing and maintaining the urban green zones; and 1.5 percent are allocated to studying urban development.
Box 4. Community participation in the search for adapted solutions

With support from UNDP and FAO, the government of Senegal set up a project Développement agro-sylvopastoral intégré dans quatre villages pilote et une zone d'élevage. One of the initiatives developed in this framework involves the coastal village of Kayar, a fisher village located 50 kilometers north of Dakar. During the high fishing season, its population doubles following seasonal immigration of farmers from inland areas. In the absence of appropriate sanitary infrastructure, the seasonal increase in the population of Kayar causes sanitary and environmental problems that are especially visible on the beach.

The global project approach is mainly based on the contractual participation of local people. The initiative set up in Kayar was managed by a GIE (economic interest group), which was also the main actor in the educational and awareness component of the population. Women, who are the main actors in fish processing on the beach, were invited to participate in formulation of solutions to environmental problems caused by fish processing. The project provides technical and material resources (217 counters, 217 salters, public toilets, etc.) to improve the environmental performance of fish processing. In response, the GIE invested in environmental promotion activity. Since then, another GIE has been set up by young people interested in economic opportunities linked to processing domestic waste and fish processing residue into compost.

Source: OECD, 1993

2.1.2.6 Environmental monitoring

301. Environmental data. The CLs do not have the necessary resources, skills, and tools to carry out monitoring themselves. These data are collected by national institutions and sometimes the CLs do not even have access to the environmental data collected from their territory (UNDP, 2005). The expertise of the CEPS and CSE should be put to good use to provide the CLs with the data collected in their territory.

2.1.2.7 Political interference and corruption

302. At a sub-national level, the lack of resources and capacity has created a situation where rules and processes are not clearly defined and are more prone to political interference or corruption.

2.1.3 Intersectoral Coordination

2.1.3.1 Other actors involved in environmental management

303. The other national institutions involved in environmental management are:

- Ministère de l’Agriculture, de l’Hydraulique rurale et de la Sécurité alimentaire (MAHS);
- Ministère de l’Intérieur et des Collectivités Locales (MICL);
- Ministère de l’Aménagement du Territoire et de l’Urbanisme (MAT);
- Ministère de l’Économie Maritime et des Transports maritimes internationaux (MEMTM); 
- Ministère de la prévention, de l’hygiène publique, de l’Assainissement et de l’Hydraulique urbaine (MAH);
- Ministère de la Santé et de la Prévention médicale (MSP); and
- Ministère de l’Économie et des Finances (MEF).
Box 5. Statements from the Forum Civil on natural resource management in Senegal

Forum Civil, the Senegalese chapter of the organization Transparency International, carried out research in 2005-2006 on governance and corruption in natural resource management, which led to a mixed statement. On the one hand, the organization noted that the environment has gone from having a peripheral status to being the focus of several policies adopted over recent years. Further, Senegal has ratified almost all international accords on the environment. The organization also observed improved management of public finance in general and the environmental sector in particular.

Environmental governance is nonetheless handicapped by numerous internal and external constraints. Among the internal constraints, the Forum mentions weakness of the judicial system such as the absence of environmental clauses in the public market codes and the mass of legislative codes and texts that favor a gap between rules and practice. At an institutional level, the Forum noted that the hesitant transfer of natural resources management skills from the state to local communities damages sustainable resource management. The absence of dynamic scientific research is also a constraint.

Among external constraints, the Forum underlined international commitments underwritten by Senegal such as the fisheries agreements that have contributed to a deterioration of maritime resources and the WTO accords, which, by liberalizing trade, have reduced the value of Senegal’s exports on European markets and increased pressure on natural resources. The Forum also noted that because Senegal shares its ecosystem with neighboring countries, the management of cross-border resources is necessary, but still at an embryonic stage.

The Forum noted four dominant factors that hamper good environmental management by the Government:

- Disarticulation of the regulatory and legislative framework and the weakness of control resources;
- Free access to natural resources and absence of a sense of responsibility;
- Low use of scientific and technical knowledge to help the State the condition of its resources; and
- Dependence of the State on outside partners to manage natural resources and the environment.

In this framework, it appears that it is not the multiple sectoral policies, even those that are participatory, or the ratified agreements which bring about better environmental management, but rather better coordination of the different sectoral policies and greater control over the various actors. Corruption hampers the sustainable management of natural resources, and increases pressure on resources while the natural balance in some sectors is being broken. Further, corruption brings about enormous losses for local people, communities, and the state. The Forum identified three forms of corruption in natural resource management:

- Non-compliance with regulations, especially respecting quotas in exchange for commissions paid for by special arrangements;
- Authorized favors to affiliates following an abuse of discretionary authority by officers in charge; and
- Procurement of situational profits or illicit monies by officers in charge.

Corruption was observed among several categories of actors, but the guilty are mainly technical agents and local administrators who manipulate the various institutional and regulatory dysfunction, as well as operators in the forest, marine, and mining resource sectors. The Forum underlines the ineffectiveness of control devices and the lack of knowledge about the strategies employed by corrupt parties. Among the factors favoring corruption, the Forum emphasized the lack of an exemplary model, abuse of discretionary authority, lack of democratization at the level of local commissions, and lack of transparency in income management. The Forum noted that the participatory approach favored by Senegal in natural resource management is a positive factor to combat corruption and institute better resource management. Participatory management is still not generalized, but offers considerable sustainability potential.

As an example, the effect of a regulation to deter poaching can be amplified by setting up effective joint management that will stimulate better surveillance from local people. The recommendations formulated by the Forum aim to promote a higher level of natural resource management by local communities in a co-regulatory framework. The priorities include:

- Greater consideration of corrupt players’ strategies to identify gray zones and gaps in regulations;
- Better articulation between regulations and local participatory practices for resource management, especially through a better judicial anchoring of local accords in natural resource management;
- Completion of the decentralization process by strengthening the weight of local communities, better distribution of revenues from the exploitation of natural resources and strengthening the capacity of local elected officials;
- Strengthening control mechanisms for regulation through additional human and equipment resources;
- Greater consideration of the ecosystem nature of the resources, thus promoting coordination between sub-regional bodies and international negotiations; and
304. **The national and international NGOs** and *Organisations Communautaires de Base* (OCB) are well developed and active in the field of environmental management in Senegal. Public advice/consulting and decision-assistance bodies such as the *Agence pour la Propreté de Dakar* (APRODAK) and the *Agence pour la Propreté du Sénégal* (APROSEN) also play an important role.

305. **Agency financing.** For their part, the cooperation agencies (bilateral and multilateral) provide most of the financing for natural resource management and the environment in Senegal. Their intervention covers financial, technical, and material assistance to the state, local communities, NGOs, and OCB (MEPNBRLA, 2006). We should point out the important role played by the Netherlands cooperation agency, thanks specially to their sectoral budgetary support (*Appui Budgétaire Sectoriel*/ABS), which represents a major part of MEPNBRILA’s operating budget (Van Der Linde, 2006).46

306. **The local communities** (CL) have much of the responsibility without having the means to carry out their duties. Finally, the private sector at present plays a limited but important role because it supports the Government in certain key sectors such as water and waste management.

### 2.1.3.2 Transversal structures

307. The *Conseil Supérieur des Ressources Naturelles et de l'Environnement* (CONSERE) has the mandate to integrate environmental considerations harmoniously into Senegal’s socioeconomic development. It is organized around the following structure (MEPN, 2006):

- **Conseil Interministériel** (CI), a decision-making body chaired by the Prime Minister and grouping the technical ministries involved in managing natural resources. The CI studies and provides directives on all questions relative to policy in the management of natural resources and the environment in general.

- **Comité Permanent**, a monitoring body chaired by the minister for the environment and grouping the technical ministries, public, NGOs, development partners, etc. It assists the Secretariat of CONSERE in its design and boosting role and follows the implementation of CI directives and decisions. It meets three times a year.

- **Secrétariat Permanent**, an implementation body. Under the authority of the minister for the environment, the SP/CONSERE has the mission, for the *Conseil Interministériel*, of:

46. The volume of aid to Senegal from the Netherlands during the period 1990-2002 was US$ 10.85 million per year on average, with most of the aid granted to the environment sector. The Netherlands is the largest contributor to the environment sector in Senegal (Van Der Linde, 2006).
Analyzing the coherence of current or upcoming policies in the area of GRNE and proposing measures to be carried out;

Analyzing the relevance of different institutions and the legislation governing them;

Proposing regional or thematic GRNE programs; and

Developing information and consultation among the various socioeconomic partners involved in GRNE.

308. **Following the abandonment of PNAE implementation in 1997, CONSERE became inactive. In 1998, CSE was appointed to ensure the continuity of CONSERE’s mission. In November 2000, SP/CONSERE was brought to the cabinet level of the Ministry of the Environment. As for supervision staff, the team of the Secrétariat Permanent at present includes the Coordinator and a secretary. The Secretariat only functions in sporadic fashion because it lacks staff and resources. The comité interministériel has only met once to validate the PNAE while the comité permanent has only met two to three times since being set up instead of the three projected annual meetings.**

309. **The National Commission for Sustainable Development (CNDD) was set up in 1995. Its mission is to formulate action plans in the area of sustainable development and ensure Agenda 21 monitoring. It comprises three sub-commissions (MEPN, 2006):**

- Orientation, under the chairmanship of the Prime Minister’s office, which defines the major axes of global policy in the area of sustainable development;
- Monitoring and evaluation, chaired by the Direction de l’environnement et des établissements classés, with a mandate to monitor and evaluate the recommendations from the Rio Conference; and
- Project study, under the authority of the Ministère de l’Économie et des Finances, is mandated to pre-select projects submitted for funding before transmission to development partners.

310. **The Secretariat of the CNDD is carried out by the Secrétariat Permanent of CONSERE. In 1999, it was entrusted to the Direction de l’environnement at the time. Since the creation of the MPDD in 2002, CNDD is chaired by it.**

### 2.1.3.3 Roles and responsibilities

311. **Duplicate responsibilities.** There is some duplication of responsibilities for management of water, water purification, and natural resource management. Several institutions have responsibilities for water and water purification (SONES, SDE, DGPRE-MAHS, ONAS, MEPNBRLA, City of Dakar), so that programs are not coordinated and lack leadership in assumption of responsibilities. For example, the management of running water receives little attention even though flood control is a priority (public health, damage to infrastructure, transport). Water purification is not considered in the context of decentralization (Iszatt et al., 2007). In addition, the management of mud from waste treatment is not included in the codes for water, the environment, and hygiene. Moreover, there are only three treatment plants in the Dakar
region. Given the lack of treatment infrastructure, some independent operators have thrown the waste directly into the collective sewer network.

312. **Sanitation Code.** The future “Law on public services for drinking water and collective wastewater treatment” and the future Sanitation Code (*Code de l’Assainissement*) should clarify the roles and responsibilities in these sectors (République du Sénégal, 2004). The future Sanitation Code should also merge applicable provisions from the Environment, Water and Urban Planning Codes (République du Sénégal, 2000). In addition, it is expected that the *Plan Stratégique de l’Assainissement* (PSA) will encourage authorities to act strategically and improve coordination between the national and infra-national levels of government (Mbaye, 2007, quoted in Iszatt et al., 2007).

313. **Shared responsibilities.** Some responsibilities in the area of natural resource management are shared (soil fertility under MAH and soil conservation under MEPNBRLA). In other cases, certain responsibilities under the jurisdiction of MEPNBRLA could possibly be better carried out by MAH (soil conservation, agroforestry, community management of natural resources). The management and creation of protected marine areas could be more effective if the respective roles and responsibilities of DPM and the DEFCCS were clarified.

314. **Air quality.** The legislative framework clearly defines the individual mandates of public sector agencies for air quality (Iszatt et al., 2007). Nonetheless, this framework is relatively recent so the overlaps and gaps have not yet been identified. The immediate concern is to procure equipment and create infrastructure so that authorities can develop a system for monitoring and managing air quality.

### 2.1.3.4 Coordination between sectors

315. **Lack of coordination in the Ministry.** Coordination problems between sectors seem to be greater between MEPNBRLA and other ministries than inside the departments of the Ministry. Inside the Ministry, the CEPS helps to improve planning, coordination, and strategic monitoring of national environmental policies and programs to optimize resource use and the effectiveness of interventions. The building of a new headquarters for MEPNBRLA, where all departments will be assembled, will also help improve coordination (République du Sénégal, 2005b).

316. **At the national level, several ministries formulate policies and programs** that also involve bilateral and multilateral cooperation agencies, as well as international NGOs, each with their project portfolios and priorities to defend. Resultant actions are not often coordinated, leading to poor utilization of available resources. Better coordination is particularly needed between MEPNBRLA, MAHS, MAT, MAH, MEMTMI, and MEF as well as between national institutions, NGOs, and international cooperation agencies. While cooperation bodies and international NGOs have good financial resources, their actions are concentrated at a local level and they find it difficult to coordinate their interventions and ensure that they are complementary. Control of atmospheric emissions, for example, lacks coordination and mechanisms to ensure synergy among the various actors and hampers the installation of effective measures.
(Iszatt et al., 2007). The efforts and energy of the various partners should be coordinated to ensure optimal utilization of resources and with a maximum impact on the environment. The actions of cooperation agencies should be coordinated by a central national institution.

317. **Lack of coordination.** Within Senegal, insufficient contacts and lack of coordination among MEPNBRLA, MICL, decentralized services, and the CL creates among other things a lack of dialogue and support to the CL (UAEL, 2006; Van Der Linde et al., 2006). We note, however, that relations between MEPNBRLA and the CL have recently improved as proof of the formulation of the 11 PAER.

318. **At the regional level, initiatives such as TerrAfrica** (October 2005) provide an opportunity to realign and coordinate the financing of sustainable land management among Sahel countries in consultation with the World Bank, NEPAD, MG-CNULD, and a vast array of other actors.

**2.1.3.5 Budget allocations by sector**

319. In total, 34.8 percent of the PTIP is allocated to urban management issues (transport, planning, habitat, decentralization, water supplies, and water purification); 16.2 percent to farming and agropastoral issues (agriculture, herding, rural and agricultural water); 11.7 percent to social development, education, and training; and 11 percent to technical and institutional strengthening. The water and forest sectors (3.7 percent) and fisheries (2.0 percent), which should ensure protection of natural resources, receive a fairly slim part of the PTIP budget.

**2.1.3.6 Integration of environmental considerations into sectoral policies**

320. **The poor integration of environmental considerations into sectoral policies** other than the environment is a major issue to limit conflicts among the objectives targeted for national institutions (République du Sénégal, 2005b). The incorporation of environmental issues in the policies and programs of other sectors such as agriculture, herding, education, water, industry, transport, energy, mines, urban planning, and trade, as well as economic, health, and social programs at national level, is not always systematic (MEPN, 2006).

321. **Limited effects.** These conflicts have a considerable impact on the perennial nature of ecosystems and natural resources for future generations. The lack of integration and cohesion among sectoral policies limits the effectiveness of policies, especially the lack of strategic and operational planning and the scattered nature of initiatives (Van Der Linde, 2006; République du Sénégal, 2005b; CSE, 2005; United Nations, 1999; République du Sénégal, 1997a). The fact that MEPNBRLA is a ministry with the same status as others limits its influence over other sectors, especially if they are ministries with an economic portfolio.
2.1.4 Role of NGOs and Society

322. **Changing role for NGOs.** Until the end of the 1980s, the State, CLs, NGOs, and *Organisations Communautaires de Base* (OCB) worked independently and with little interaction (CSE, 1999). The State was the main manager of international aid. Since the end of the 1980s, the roles and positioning of these institutions have gradually changed and the NGOs occupy a greater place in the financing and implementation of environmental measures. The *Conseil des Organisations Non Gouvernementales d'Appui au Développement* (CONGAD) set up in 1982 now includes 166 national and international NGOs. Decree 96-103 set out the intervention procedures of CONGAD and established a dialogue and exchange framework between the Government and society.

323. **NGOs are particularly active in Senegal** and bring positive changes to the environment. The role of civil society has also been especially important to force improved air quality (Iszatt et al., 2007). The environmental NGOs operate in biodiversity conservation, creation and management of protected areas (IUCN, WWF), water supply (Plan International, CARITAS, Eau vive), and water purification and domestic waste management (ENDA, CARITAS, Aide Action).

324. **Important role for NGOs.** NGOs and user associations such as the *Associations d’usagers de forages* (ASUFOR) are now recognized as key actors for water supplies and water purification. NGOs are also undeniable actors in natural resource management — they support CLs by promoting sustainable management of natural resources, directly financing regional development and income generating activities, and facilitating access to microcredit (UNDP, 2005).

325. **NGOs and environmental issues.** In the absence of formal project advisory processes, NGOs inform the CLs of environmental issues linked to projects. They promote participation in the environmental evaluation process, favor awareness and environmental education, and contribute to development of functional literacy, education, health, and hygiene (UNDP, 2005). UICN also promotes raising environmental awareness among parliament representatives, local elected officials, and jurists (IUCN, 2006).

2.1.5 Role of the Private Sector

326. **Larger role.** With the institutional reforms of 1996, the private sector started to become a partner of the Government in the provision of environmental services. This role of partner is relatively limited, but the Government is determined to make space for the private sector, especially for water supplies (treatment, production, drilling, maintenance), waste management, and water purification. At present, in rural zones 10 percent of drilling maintenance is the responsibility of the private sector. The financial sector is interested in increasing this percentage (République du Sénégal, 2005a). For water purification, the private sector provides limited support to the *Office National d’Assainissement du Sénégal* (ONAS). Besides forest exploitation, the role of the private sector in managing natural resources is relatively limited, although there is a still timid
evolution of the privatization of management rights for protected areas and the creation of animal reserves (MEPN, 2006).

2.2 Sustainable Management of Terrestrial Ecosystems

2.2.1 Sustainable Land Management

327. **Sustainable land management implements rigorous practices** to prevent, mitigate, and reverse the effects of land degradation to ensure both better protection of terrestrial ecosystems as well as the sustainability of these ecosystems for beneficiaries and users.

328. **The main practices promoted to counter land degradation** are those that assign management authority to local populations and farmers. They are centered on simplicity and command of techniques such as agroforestry, light plowing, market access, water recovery, small-scale irrigation, and reforestation. However, barriers on several levels (financial, technical, institutional, and political) prevent these practices from being amplified, despite Government efforts, even though the Government has adopted several laws, issued new policies, and prepared strategies, programs, and projects to favor improved land management.

329. **Fighting poverty and desertification.** Several sectoral initiatives have also been launched by the national program to combat poverty and desertification. They identify strategies to combat land degradation and promote sustainable agricultural and forestry development as a means to fight poverty.

330. **SLM actors fight against land degradation.** The following section summarizes the various SLM actors and partners and their fight against land degradation in Senegal, as well as their activities and resources. This analysis used Government files such as national reports from meetings of the Conference of the Parties of UNCCD, the national action plan for the environment, etc., as well as projects and programs of the World Bank, other multilateral agencies, and other institutions such as the World Resources Institute (WRI). In Chapter 3, we examine the recommendations to reduce barriers that constrain SLM in the country.

2.2.1.1 Experience to date

331. **The fight against land degradation** has been undertaken in Senegal since the 1970s. It includes a series of reforestation and corrective measures against the exploitation of forest resources. Apart from a few limited successes, the evaluation of this phase showed a lack of comprehension of the process. During the 1990s, several NRM projects totaling about US$ 1 billion were carried out, targeting agriculture, energy, forestry, water supplies, training, information, and education. More recently, structural activities have focused on strengthening capacity in sectors such as planting (21 percent) and socioeconomic activity (16 percent), including income-generating activities, access to credit, and basic social services. The other activities (12 percent) included research into the domestication of indigenous tree species and creation of conservation areas. Compared to larger-scale and hierarchical projects, the small-scale activities of NGOs are
among the rare ones that produce good results, thanks to their proximity to reality and their direct contact with local people.

332. **The Senegalese fight against desertification** (LCD) has raised awareness among decision makers and the public about the importance of land degradation and the need for common actions to better manage the country’s natural resources. Several projects and programs have strengthened local capacity, promoted problem identification and participation in solutions, and established dynamic partnership agreements with local people, NGOs, the State, and development partners.

333. **LCD has not reduced the pressure on natural resources** or mitigated the impacts of land degradation. In fact, the small sums allocated to environmental priorities in sectoral and national budgets, lack of coordination between the various environmental conventions, an inability of the agencies in charge of environmental management — especially the Ministry of the Environment — to coordinate interventions, and the absence of an effective system of surveillance and evaluation, have slowed LCD implementation. A national coordination plan for anti-desertification activity, as well as a framework to collect and distribute environmental information, are absent. The analysis of LCD carried out by the Government in 2004 indicates that all planned desertification control activities were implemented but with limited success.

2.2.1.2 **SLM stakeholders**

334. **The main actors active in sustainable management** and combating land degradation in Senegal represent different sectors — the State, local communities, producer groups, grassroots community organizations (women, youth), NGOs, development partners, the network of environmental journalists, the environmental policy network, religious and civil leaders, and the private sector.

335. **National policy for environmental and natural resource management** is the responsibility of the *Ministre de l’Environnement et de la Protection de la Nature* (MEPNBRLA). This Ministry is equipped with several technical departments — water, forests, hunting, and soil conservation (DEFCCS); National Parks (DPN); and the environment and classified sites (DEEC). MEPNBRLA is officially responsible for several programs and projects aimed at reducing desertification and poverty.

336. **Other ministries actively participate** in this objective, including the *Ministère de l’Agriculture et de l’Hydraulique*, the *Ministère de l’Élevage de la gestion des terres et de la décentralisation*, the *Ministère de la Coopération décentralisée et de la planification régionale*, as well as the ministry in charge of local community groups. Several other institutions operating at national and/or local levels actively contribute to the fight against land degradation and eradicating poverty, including national departments for planning, managing land and rural expansion, departmental services to support local development such as the *Centres d’expansion rurale polyvalents*, the center for ecological surveillance in charge of collecting and surveying data on natural resources, and the division for the restoration and improvement of soil fertility in charge of soil analysis.
Training and research institutes are also involved, especially ISRA (Institut de recherches agricoles attached to the Ministry of Agriculture) and the IRD (Institut français de recherche scientifique). More than 100 civil, national, and international organizations operate in the management of natural resources in Senegal and assist local bodies. In addition to these institutions, the government has created other bodies to ensure coordination and cooperation of NRM-related activities:

- **The Conseil supérieur de l’environnement et des ressources naturelles** (CONSERE) was set up in 1993 as an interministerial forum managed by the Prime Minister. Its objectives are to discuss and harmonize policy, ensure the integration of environmental issues in the various sectoral activities, ensure synergy between the three Rio Conventions, and supervise the activities of the Commission nationale du développement durable (CNDD). This structure has not really operated and is a failure.

- **Le Groupe national de partenariat.** Recently set up with the support of the global mechanism to combat desertification and poverty, this group involves all key players under the aegis of the ministries of the environment, planning, economy, and finances.

- **Institut national de pédologie.** Set up in 2004, under the Ministère de l’Agriculture et de l’Hydraulique, this institute has a mandate to improve the productivity of land in the framework of the Government strategy to reduce rural poverty.

- **Conseil national pour la coopération rurale (CNCR).** This council groups the main representatives of the rural sector. The CNCR and the Association des présidents des communautés rurales (APCR) created the Association sénégalaise pour la promotion des petits projets de développement local (ASPRODEB), which supports the implementation of the Programme des services agricoles et d’appui aux organisations de producteurs (PSAOP) and the PSSA.

Many institutions, many problems. By setting up so many institutions active in land management, Senegal like many other countries in the region, has provided an institutional response to the problems of land degradation and poverty. The multiple institutions, overlapping roles, missions, and functions; their contradictory responsibilities; lack of leadership and adequate financing; absence of clear orientation and incentive measures — these factors have not enabled an effective fight against land degradation and poverty. On the contrary, these factors actually increased difficulties and consolidated barriers against the spread of sustainable land management in the country. SLM success cannot be carried out without a large reorganization of these many institutions and responsibilities. A simplified policy is necessary, with environmental programs and SLM integrated into the sectoral political agendas of the main parties involved.
2.2.1.3 **Regulations or laws governing SLM**

339. Faced with alarming land degradation and to address the great drought of the 1970s, the Government installed large-scale financial, legal, and institutional measures in favor of rural areas to manage degraded lands. These measures include:

- Ratification of three environmental conventions from the Rio process, and formulation of action plans for their implementation.
- Defining five major axes to reduce poverty (main government priority), including one related to wealth creation in the primary sector, especially in agriculture.
- Formulation and implementation of the PRSP since 2004, which gives a central stage to natural resource management. Priority measures envisioned for rural zones include control of land degradation, sustainable land management, and environmental protection. PRSP-II highlights these activities even more.
- Decentralization and transfer of nine sectors of competency, including the management of natural resources to local communities.
- Adoption in 2004 of the *Loi agro-sylvo-pastorale* (LOASP), which promotes sustainable development of natural resources and is the basis for the PNDA launch (*Programme national de développement de l’agriculture*), and the launches of the PNDE (*Programme national de développement de l’élevage*), and the PAF (*Plan d’action forestier*).
- Publication of a *Lettre de politique* on the decentralization of rural development and a detailed operational program of decentralization of the development process to local communities, with grassroots support.
- Publication of a *Lettre de politique sectorielle de l’environnement* in 2005 describing the responsibilities and objectives of the Ministry of the Environment and providing a detailed list of programs and activities.

340. **Difficult implementation.** These important Government initiatives created duplication and overlap among institutions. Most of the laws and proposals that were adopted were formulated in French and were not translated into the official languages, making them difficult to implement. In addition, inadequate resources of the regulatory institutions have made it difficult to implement and foster these programs at the local and national levels. The complexity of decentralization and its very slow progression also make it difficult and confuse the local implementation of regulations, which sometimes has a twisted impact and is an obstacle to investment. It is crucial to promote synergy among these initiatives by establishing, for example, solid and clear connections between SLM principles and PRSP-II objectives. Senegal has also made little use of its economic instruments to promote SLM, such as taxes, subsidies, incentives, or payment for environmental services. On the contrary, certain economic measures at the national level such as control of prices, fees, and import taxes have deterred effects at the local level.

341. **Effective implementation of policies and programs** for natural resource management and implementation of laws and regulations cannot be done by decree alone. They require the complete and active involvement of local and national elected
assemblies, as well as participation of all parties as full partners, along with their technical, logistical, and financial support.

### 2.2.1.4 Barriers to SLM

342. **The situation in Senegal is hardly favorable to SLM.** Barriers related to governance, politics, institutions, laws, the economy, finances, and growth slow the integration of SLM-related strategies and activities. Local people, mainly farmers and herders, face obstacles related to ownership and land-use rights, negative economic factors, heavy taxes, unreasonable pricing, disproportionate transport and transaction costs, lack of access to market information, and absence of technical and institutional support. These deterrents should disappear and be replaced by incentives suited to the intentions of these actors and rural communities to ensure their involvement in SLM.

343. **On the governance level,** the main barriers to SLM are:

- Overlap and confusion in the role, responsibilities, and functions of the four ministries in charge of SLM and their respective administrations;
- Limited financial resources available, most of which come from development partners;
- Lack of coordination among projects that have been undertaken; the CONSERE failed and recent efforts to improve coordination have not been very successful;
- Low technical, logistical, and financial capacities of administrators involved at all levels, notably local administrators, who suffer from a lack of capacity building;
- Lack of a shared vision among government officials, rural populations, NGOs, and other authorities;
- Mistrust of Government by local actors;
- Lack of efficient coordination and cooperation between NGOs;
- Lack of risk assessment and management system for agricultural production; and
- Lack of incentives to motivate agents in charge of rural poverty programs.

344. **On the political and legislative level,** the main barriers are:

- Contradictions and difficulties in applying laws and regulations governing the various sectors;
- Lack of translation and distribution of legal texts in national languages to the local population;
- Unsettled land tenure issues with the advent of the *Loi du Domaine National*;
- Lack of recognition of pastoralism by authorities as an appropriate and sustainable use of land; and
- Implementation of economic policies that are not compatible with sustainable land management.
Box 6. Alternatives envisioned to reform the Law on National Domain

The Law on the National Domain of 1964 (law 64-46 and its enforcement orders) suppressed the customary rights of lineage and families over land to replace them with a State regime. Approximately 95 percent of rural land is subject to this regime. State lands are owned by the State and are characterized by:

- Free access to the land which cannot be subject to any transaction.
- Access to the land is linked to community belonging, and in a logical aspect of development, to proof of development capacity. The person who enjoys the right to cultivate the land cannot see this right withdrawn unless in the general interest of the community or if the land is not developed.
- The management of the national domain depends on a zone concept where each zone benefits from a legal regime adapted to its characteristics. For example, land located in zones (farm, pastoral, or rural lands) is administered by the rural councils under State authority (represented by the Préfet).
- The privatization of national lands must go through registration in the name of the State for reason of public utility and then requires legislators to cede these lands to a private individual.

The main problems associated with the National Domain regime are:

- Terms for implementing the Loi sur le Domaine National were never defined in a precise fashion. For example, the concept of “implementation” was never exactly specified. Further, 40 years after the law was adopted, no rural community has housing or land registry. This state of affairs has led to corruption and land conflicts that are growing in number. This translates into a situation of insecurity and uncertainty which does not favor investment but leads to a sense of injustice and dispossession among rural people (CNCR, 2004).
- In its current form, the land regime hampers development of large investments in farming because there is no recourse for mortgage-type credit, no chance for a third party to invest, and no chance for intervention by actors outside the community.
- The development conditions do not take into account environmental protection or the sustainable management of all natural resources, which may, for example, impose fallow periods.

The decentralization law of 1996 brought some modifications to the land regime. While giving greater space to rural communities in land management, this reform strengthens the state’s ability to remove land from this type of management. Various land reforms were considered. The Senegal Plan d’Action foncier (land action plan) prepared in 1996 at the instigation of the Government proposed three alternatives to address the issues raised by the question of domain lands:

- Maintaining current legislation in its full form, including the decentralization laws of 1996.
- Liberalization of land regimes with privatization of lands in the national domain. Any occupant who has invested can request registration.
- A mixed option that would allocate authority to rural communities to cede land while maintaining land allocation power. This option has three variants:
  - The national domain is set up in the private area of communities. These receive the authority to allocate land as property and for rent (on a decision of the rural council and State advice) and conserves the power to allocate usage rights.
  - The state registers all national domains in its name. The decision to allocate property can be given to communities or can be kept by the State which will act on the advice of the rural Council.
  - The state registers in its name only the specific areas already equipped or to be equipped while the other spaces are set up in the private domain of communities.

The status quo option appears difficult to accept because of its economic and environmental counter-performance and is today acclaimed by nobody (CNCR, 2004). Options 2 and 3 have no measures aimed at ensuring sustainable land management even through mechanisms could be attached (environmental specifications, more restrictive environmental laws). To know which of these two options has the most potential for sustainable land management means determining which of the State or rural communities is best at controlling and ensuring sustainable land management.

Source: Panaudit - Senegal, 1996. and CNCR, 2004
There are also a number of barriers to knowledge development and dissemination:

- Serious lack of reliable and up-to-date information on land degradation and its potential link to poverty reduction;
- Lack of economic data on the link between land management practices and the impact of land degradation on production, farmer income, and poverty; and
- Poor communication with users. The dearth of public information on the impact of climatic variations and changes in Senegal’s adaptation strategies, along with a lack of resources to help the population adapt to these changes, are additional barriers that are exacerbated by the very limited knowledge of farmers and the poor condition of farm equipment.

The inadequate financial resources of regulatory authorities and implementing institutions make it difficult to undertake the work, slow progress, and hamper effective delivery of government programs and projects at the local and national levels. Government investment remains very low, with most resources coming from development partners. This results in stiff competition among institutions for available funding. In addition, there are technical and financial partners that often have complex procedures but lack capacity to develop financing proposals and manage acquired resources. There is also an absence of guarantees to obtain bank advances or loans. All these elements significantly impede SLM.

Other barriers. The LCD implementation process helped identify other barriers:

- Slow and difficult disbursement;
- Significant gaps between needs and available resources;
- Approach to forestry that established large plantations on community lands (with a deficit of 5 million hectares to recover in order to be comparable with the 1980 level of 550,000 hectares to be rehabilitated before 2015);
- Unmotivated staff, particularly Government agents, which combined with the lack of resources, perpetuates the low level of interest and involvement by local administrations;
- Weak participation by key actors, producer associations, and village groups in NRM and especially SLM;
- Lack of cohesion of rural communities;
- Low technical skills of rural people for sustainable intensive agriculture, land restoration, and ecosystem rehabilitation;
- Social and economic isolation of unemployed women and young people who can be instrumental in reducing land degradation;
- Lack of coordination among projects undertaken by international development partners; and
• Low mobilization and incentives for local actors due to poor communication between land managers (farmers/stockbreeders) and central and local governments during the budget cycle; local government inability to adequately plan and efficiently manage resource allocations; and the uncertainty created by the multiple management systems of the country’s public finances which undermine credibility of the budgeting process.

2.2.1.5 Chances of SLM in Senegal

348. Sustainable land management is a process that seeks to achieve a balance among agricultural, economic, environmental, and social benefits. It is a fairly new approach in the productive use of land, water, and biological resources. It seeks to integrate production (crop production, breeding, and forest products) and environmental management so that the combined social and economic benefits exceed the sole benefits arising from production.

349. The land degradation situation in Senegal is critical and recognized by all stakeholders. Top priority must be given to development of a coherent and integrated approach to sustainable land management. The recent adjustments made by the various actors demonstrate their willingness to move in this direction. Such is the case with the agriculture-forestry-pastoralism law, the decentralization process, and the recent political letters that open several doors to improvements in the environment and primary sector administration.

350. On the institutional level, the various measures taken by the Government or other stakeholders have not yielded the expected results because a shared vision and communication and resources are lacking. The following adjustments are required:

• Establish a multisectoral operational framework that involves all stakeholders, and guarantee its long-term operation. This framework will help promote financing by Government or SLM project partners.
• Establish an effective interministerial coordination mechanism with adequate resources and political support for the successful implementation of SLM.
• Clarify the budget formulation process and make it more transparent and participatory.
• Strengthen the capacities of national institutions, beginning with the Ministry of the Environment and Protection of Nature.
• Strengthen the capacities of local actors. Concurrent with the decentralization process, the capacities of local actors must be strengthened to enable them to make informed decisions and guarantee their long-term commitment to SLM.
• Establish a coordination mechanism for development partners. Aid from bilateral/multilateral partnerships must be provided within a context of objectives, responsibilities, and joint work plans that are accepted by all. Frameworks such as those from TerrAfrica should be used to strengthen all cooperative actions in line with the objectives, goals, and principles of SLM.
• Provide increased support to CONGAD and NGOs to encourage broader participation by civil society and community organizations in the efforts of Government and donors.

• Offer an insurance of last resort to farmers and stockbreeders so they can be better protected from environmental and economic threats.

351. **On the legislative level,** the recent introduction of a new law supporting the rural development sector will be followed by the review and removal of incompatible or contradictory legislative texts. The key measures required are:

• Improvement of **land status** to guarantee better land security for farmers. The first effect will be a significant increase in primary production. The new agriculture-forestry-pastoralism law provides opportunities to improve the land situation. Its full implementation could also improve relationships between Government and stockbreeders, who would be recognized as legitimate land users.

• Introduction of **incentives** to encourage farmers and stockbreeders to improve their land, such as getting help to safeguard or obtain seeds, access to credit, ready access to markets at a manageable price, as well as access to health facilities and water supplies.

• Abolition of **barriers** in the form of oppressive taxes, subsidies, and price and market controls.

• Introduction of specific **incentives** for Government employees.

• Capitalize on the **strengths of all stakeholders,** particularly the local population, farmers, stockbreeders, and civil society, with the support and encouragement of authorities. Recent efforts by farmer associations and community groups should be strengthened, particularly raising awareness and focusing on women first. They must be encouraged, and above all, trained, so they can acquire the necessary authority, technical abilities, and logistics to promote SLM at the local level.

352. **On the financial level,** the recent review of public expenditures revealed an imbalance between partner and Government financing in programs that address land degradation. Projects implemented between 1992 and 2007 that address land degradation had a total budget of about US$ 643 million, or about US$ 42.8 million per year. However, annual investments during the last decade were higher at more than US$ 70 million, and it is expected that this amount will increase. The share of the investment raised by 116 NGOs between 1996 and 2000 was estimated at US$ 94 million.

353. **Financial focus in urban areas.** Financial institutions in Senegal tend to focus their efforts in urban areas. Their involvement in rural issues is limited almost exclusively to horticultural marketing or agroindustry. It is estimated that less than 4 percent of all credits go to rural projects. The *Caisse Nationale de Crédit Agricole du Sénégal* (CNCAS) is the main source of rural credit, having lent approximately 13 billion FCFA in 2004-2005.
More investments in rural areas. The Government should increase its financial commitment toward its own rural population to show that it is serious about reversing land degradation and setting up sustainable land management practices. The first measure would be to encourage greater Government investment in NRM and ensure that investment from partners is in step with Government commitments and funding, thus meeting the Maputo Declaration targets which stipulate that the Government must devote at least 10 percent of its budget to the primary sector. It is also essential to better target investments and make them available on a priority basis at the right time to those who work and manage the land. In a similar vein, it is essential to strengthen weak market structures to allow farmers and stockbreeders to respond quickly to local and international market signals while adhering to SLM principles. Lastly, the Government should abandon its preference for intensive farming and focus on more diversified investments, which would benefit a greater number of farmers and stockbreeders and pave the way to a significant increase in primary production.

Box 7. Review of public expenditures

By taking into account the completion rate of about 65 percent, the review of public expenditures estimates that US$ 377 million were spent during the period in question to generate a direct impact (8 percent of the total BCI), and US$ 391 million to generate an indirect impact (8 percent of the total BCI). The Government share was US$ 109 million to generate direct impacts and US$ 99 million to generate indirect impacts. The partners thus invested US$ 277 million to generate direct impacts and US$ 298 million to generate indirect impacts, which is on average 2.5 times greater than the Government.

The proportion of funds used to generate impacts in agricultural sub-sectors and rural irrigation show a downward trend, while breeding and technical and outreach services show a slight upward trend. The trend in the water and forestry sub-sectors is generally stable.

Infrastructure development also gets the lion’s share in the geographical distribution of funds. Areas in the groundnut basin (Diourbel, Fatick, Kaolack, Louga, and Thiès), where land degradation is regarded as a serious problem by primary users, received only 1 to 3 percent of the impact-generating funds.

Source: PER (Public Expenditure Review), World Bank, 2006

On the technical level, it is very important to collect data, and monitor and assess programs aimed at reversing land degradation and its impact on recipients, hence the need for a national follow-up and assessment system. This system was developed by the PAN/LCD but no framework has been established for the systematic collection, analysis, and dissemination of information, and there is no diagnostic base from which to monitor and assess changes. Moreover, there is virtually no compilation of economic data nor a cost-benefit analysis of programs, and there is no standardized approach for to monitor and assess systems.

The dissemination of information is crucial because it must be done in a form and a language accessible to everyone who needs it. Under TerrAfrica, the emphasis placed on establishing regional monitoring and assessment efforts provides a good opportunity to expand these efforts throughout the country by using the results from the LADA program and work done by the CSE (Ecological Monitoring Centre). Senegal is one of the test countries for the LADA program (Land Degradation Assessment in Drylands) which is currently evaluating a monitoring approach in two pilot areas (Kaffrine and Kaolak). Results should help devise a system that is able to monitor and assess the degradation process and the impact of measures taken to alleviate them. A wide variety of new programs is being implemented in this field, so it would be advisable
to harmonize the proposed monitoring and follow-up approaches as soon as possible to avoid needless duplication and conflicts.

357. **All stakeholders realize the value of collecting reliable data** to measure and monitor the biophysical extent of land degradation and its impact, but also to quantify the social and economic benefits of better management and the efforts necessary to alleviate poverty. Data on climate and climate change must also be integrated to determine the appropriate measures for adapting rural production systems. This body of knowledge on sustainable land management should be made available under a national system that monitors change, reviews successes, and manages knowledge so that decision makers and other stakeholders have access.

358. **The vast majority of development partners** are clearly very active in the battle against land degradation. Among the bilateral partners, the most active are France, USAID, Germany, Italy, Canada, the European Union, the Netherlands, and Japan. The UNDP, FAO, IFAD, UEMOA, UNESCO, UNICEF, and the World Bank are among the most active multilateral partners, with the support of other funds and groups including FEM, UNCCD, Global Mechanism, and CILSS.

359. **Active multilateral partners.** These partners, coordinated by GTZ, are active in several fields. IFAD supports farmer and stockbreeder associations, while the European Union, CIDA, GTZ, USAID, and the Netherlands are setting up financial management and governance improvement projects. The World Bank has been supporting agricultural or rural development for many years. Reorganization of the agricultural sector, including the Department of Agriculture, along with establishing the *Agence Nationale de Conseil Agricole et Rural* (ANCAR) and strengthening ISRA, is funded by the PSAOP with considerable support from the World Bank.

360. **Bank support for rural infrastructure.** Together with IFAD, ADB, and OPEC, the Bank also supports the national rural infrastructure project (PNIR) with a total of US$ 319 million, with the first phase at US$ 42.9. The small rural project program is funded by the World Bank and IFAD, and was primarily designed to help rebuild small irrigation projects, while mid-size and large irrigation in the departments of Matam, Dagana, and Podor are supported by other donors. Canada and Belgium support irrigated horticultural development in the Niayes region.

361. **Long-term support for SLM.** This Senegal Country Environmental Analysis, the revised Country Assistance Strategy, and the Poverty Reduction Strategy document are also actively supported by the World Bank. Through the partnership with TerrAfrica, the Bank and its partners can form a long-term coalition around a shared vision and complementary investments to support SLM in Senegal. For example, the partnership could help Senegal benefit from new emerging mechanisms to provide an additional source of income for farmers and stockbreeders, which would also help alleviate rural poverty.

362. **Emerging international environmental markets** such as carbon trading provide new economic opportunities for farmers and offer innovative solutions to finance services
and environmental benefits with investments from the corporate sector. Other forms of “payment for environmental services” can provide additional funding sources to improve the lives of poor farmers. These forms of payment have proven successful in South America and elsewhere but have not yet made significant inroads in Africa.

363. **Strategic approach.** Support from partners is an asset for Senegal, however, such support cannot be competitive and productive without a strategic approach negotiated between governments and partners, and a renewable decadal action plan. The TerrAfrica partnership offers a unique opportunity and access in a manner that is coordinated with financing of sustainable land management.

### 2.2.1.6 Lessons learned

364. **Sustainable Land Management (SLM) can contribute to the economic growth of Senegal.** It requires, however, consistent governing with advantageous laws and policies, clear and efficient operational structures, and measures that give all stakeholders the means to see themselves as players and partners in the fight against soil deterioration and poverty. This is how social, economic, and environmental benefits will emerge when the SLM approach has been integrated into the governing framework via committed government leadership.

365. **Integrated SLM approach.** Various donor initiatives, the Millennium Development Goals, the FEM-SIP program, NEPAD with its agricultural and environmental programs, and new initiatives such as international coal trade or green credits for water and the TerrAfrica partnership for SLM amplification, are all opportunities to create and finance an integrated SLM approach in Senegal.

### 2.2.2 Management of Forests and Biodiversity

#### 2.2.2.1 State of forest resources

366. **Forests and wooded areas covered approximately 32 percent of Senegal** in 2000. Among the forest crops, the “dense” type of forests (with 80 percent canopy cover) were less than 3 percent of the country’s area. They included Sudanese-Guinean type forests and the fringing forests of lower Casamance, as well as the riparian forests along the Senegal River delta and valley (Tappan et al., 2004).

367. **Decreasing area of dense forests.** Corona and Landsat satellite images of soil usage from 1965 to 2000 indicate that the dense forests which occupied 4.4 percent of soils in 1965 dropped to 2.6 percent in 2000 (Figure 2.6), a decrease of approximately one-half of their area (Tappan et al, 2004). Hypothesizing a linear trend indicates a reduction of approximately 333 square kilometers per year for the dense forest cover, which is smaller than the FAO estimate produced in 1995 of 520 square kilometers per year.

368. **Reduced biodiversity.** Monitoring of the Senegal forest cover also reveals deterioration in terms of quality (biodiversity), which does not necessarily translate into a decrease of the forest area as such. Between 1965 and 1992, the area covered by black
locust riparian forests along the middle valley of Senegal (from Bakel to Dagana) decreased approximately 77 percent. Expanded irrigated farming is the main cause of forest degradation.

369. **Expanded farming reduces forest area.** Forest coverage and forest biodiversity have especially deteriorated in the eastern half of Casamance due to coal production and expanded farming following the migration of farming populations from the Saloum region. In 1999, 4.6 percent of the Guimara Reserved Forest and 28.8 percent of the Pata Reserved Forest had been converted to farming, which caused tensions between the local agricultural/pastoral populations and migrants (Tappan et al., 2004). According to the FAO (2003), the overall forest and wooded area of Senegal diminished by 0.7 percent between 1990 and 2000 (Table 2.5).

<table>
<thead>
<tr>
<th>Forest and wooded area</th>
<th>1990</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural forests</td>
<td>n/a</td>
<td>5,942</td>
</tr>
<tr>
<td>Plantations</td>
<td>n/a</td>
<td>263</td>
</tr>
<tr>
<td>Total</td>
<td>6,250</td>
<td>6,205</td>
</tr>
<tr>
<td>Percentage of the total area</td>
<td>32.4</td>
<td>32.2</td>
</tr>
</tbody>
</table>

**Source:** FAO, 2003

370. **Deterioration of the country’s overall forest and wooded resources** is linked to a combination of several factors, among which the most important are:

- **Drought.** Decrease in rainfall since the 1970s causes, among other things, soil acidification and salinization, especially on lateritic and clay soils in the Ferlo region.
- **Development of farming activity.** Farming area expanded from 17 percent to 21.4 percent between 1965 and 2000, an expansion at the expense of the savannahs and forests (Figure 2.6).
- **Multiplication of bush fires caused by humans.**
- **Charcoal production is the most important cause deterioration for the Central-East and Southeast forests of the country (FAO, 2003).**

### 2.2.2.2 Logging problems

371. **Annual harvesting of wood for energy needs cleared 30,000 hectares,** of which the majority was used for charcoal production (FAO, 2003). The official statistics, which do not include non-controlled samplings from rural households, demonstrate an annual harvest of 5 million cubic meters of fuelwood and 100,000 tonnes of charcoal (FAO, 2003).
372. **Charcoal production.** An aerial survey conducted in 1994 indicated that 28 percent of savannah woodlands were moderately or severely deteriorated due to charcoal production (Tappan et al., 2004). Charcoal production has been criticized by local populations that do not benefit much from the economic benefits of this activity, but are affected by depletion of wood resources, especially deadwood. Charcoal production is an important economic activity in the Tambacounda regions (Kaolack-Tabacounda center) and Kolda regions (Vélingara-Kolda center), but the main economic benefits from this activity revert to the loggers (“masters”) and charcoal wholesalers in urban regions (Ribot, 1998). The national demand for charcoal is restricted to a certain extent by an increase in butane gas use for cooking in large cities. This increase is partly due to Government efforts to promote the country’s “butanization”.

373. **Decentralizing Government management.** Throughout the 1990s, Senegal adopted several reforms aimed at decentralizing Government management. These included the Local Communities Code (*Code des collectivités locales*) in 1996, which established the transfer of some responsibilities from the Government to the farm and
village Councils, including management of natural resources and the environment. The 1998 Forestry Code decentralized forestry management.

374. **Quota system to be eliminated.** In the new Forestry Code, it was planned that in 2001 the quota system would be eliminated and replaced by working plans that were to be prepared for all forests over 20 hectares. In Government-owned areas, the working plans were to be prepared by the Direction des Eaux et Forêts, while in municipal forests, these plans were to be produced by a natural resource and environmental management board, and implemented at the farm and village Council level and then approved by the Government representative. The quantities were to be determined locally in relation to the biological potential of each forest. The farm and village Councils would determine who would have the right to operate in the municipal forests, but granting permits and licenses would remain the Ministry’s responsibility.

375. **Few forest plans.** Since the adoption of the 1998 Forestry Code, only a few communities have been able to implement their forest working plans. The quota system continues to be used in communities where the DEFCCS has implemented controlled production zones (ZPC). Forestry sectors determine management plans instead of farming communities, and allocate quotas and zones to be exploited in accordance with a system similar to the one that prevailed before 1998. In zones deemed temporary and transient while awaiting a community working plan, quotas are allocated by the MEPNBRLA in accordance with the decentralized services of the DEFCCS and approved by a national commission. A regional quota allocation commission is in charge of determining the specific zones to be exploited. It should be noted, however, that forest management and localization of quotas in managed forests is an ongoing process that has been in progress for a few years. In 2007, 57 percent of the annual quota (50,000 tonnes) is supplied by managed forests. The PROGEDE, along with decentralized DEFCCS structures, contributes to the supply of household domestic fuels in a stable and sustainable manner, while still preserving the environment. Currently, 230,000 hectares of forests are under management in the program’s intervention zone.

376. **Other projects,** such as PAEFK, Wula Nafaa, PERACOD, and the *Projet d’aménagement de la bande de filao de la Grande Côte Nord* are conducting similar actions in forestry management to enrich forestry product channels to benefit the population and local communities (DEFCCS, 2007).

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47. For forests that are 5 to 20 hectares, simple management plans are required.

48. The PROGEDE’s *Volet Offre* aims to guarantee a sustainable supply of fuelwood to households on the basis of participatory forest development. During the first phase of the program (completed December 31, 2004), the forests of Néétéboulou and Missira/Kothiary in the Tambacounda region and those of Saré Gardi and Thiéwal in the Kolda region have approved working plans and have been in the execution phase since 2004. The new plans for forests such as Koar in Tambacounda and Kandiator, Fafakourou, Bonkonto, and Guiamara in the Kolda region are complete but have not yet been approved, except for Koar. This procedure began in 2005 for these forests that have a total area of 267,494 hectares. The PROGEDE is combined with approval and implementation of these working plans. Moreover, in Kolda and Tambacounda, exploitation of forest products is implemented more and more on the basis of inventories conducted on over 800,000 hectares. Finalization of the Ecological and Forestry Information System (SIEF) made it possible to produce digital plans based on aerial photography of more than 1,300,000 hectares (DEFCCS, 2007).
Box 8. Types of energy used for cooking in Senegal

According to a study based on an analysis from the Enquête Démographique et de Santé conducted in Senegal in 2005, 40 percent of Senegal households use butane gas for cooking (it should be noted that Senegal households use, in a lesser amount, charcoal for other activities such as ironing, incense, and fighting off mosquitoes). Less than 10 percent of households use charcoal, while 45 percent use wood or straw and only 2 percent use dried dung from livestock. Butane gas is used for cooking by more than 75 percent of households in urban areas (95 percent in Dakar), which represents one of the highest rates in Africa, while wood and straw are used in 75 percent of rural environments. A strong correlation evolves in urban environments between household living standards and the type of energy used for cooking — the more affluent households mainly use butane or electricity for cooking while the less affluent ones fall back on charcoal.

Source: Larsen, 2007

2.2.2.3 Impact of forestry on biodiversity

377. The deterioration of forest area has affected wildlife habitats. Drought and human pressure have produced a notable decrease of certain species and shifted the distribution of other species. According to Mullié (FAO, 2007), distribution of species such as termites and birds in the northern regions of the country are most affected by drought. Bird species identified in desert environments have appeared in the northern part of the country. Human pressure in the central part of the country has led to the gradual disappearance, since the 1980s, of predatory species such as vultures in Tivaouane and Louga. Senegal is one of the rare West African countries that has an important protected area of land (Table 2.6).

378. Senegal’s national parks and reserves play an important role in protection of the country’s biodiversity. Senegal has strived to maintain its national parks and wildlife reserves and promote ecotourism and hunting to justify their maintenance. These efforts made it possible to maintain certain biodiversity features that previously characterized the country, but the integrity of these protected areas is being strongly challenged by many factors such as poaching and bush fires, as well as a lack of financial and labor resources. These protected areas did not attract enough tourists to finance the maintenance of equipment and services for wildlife conservation. Inadequate financing for these protected areas also reflects the absence of a true commitment from the Government to ensure the maintenance and integrity of these wildlife habitats.

379. A Strategy and National Action Plan for the Conservation of Biodiversity was adopted in 1999. The plan anticipated:

- Implementation of a coordination and monitoring structure;
- Endorsements by regional Councils to develop biodiversity conservation strategies and action plans;
- Promotion of education and awareness about biodiversity and sustainable development;
- A primary inventory of biodiversity, emphasizing the least known components; and
- Encouragement of biodiversity conservation initiatives, including local initiatives.
Table 2.6 Protected land areas in Senegal

<table>
<thead>
<tr>
<th>Name</th>
<th>Area (ha)</th>
<th>Specific status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parc National de Niokolo Koba (Sénégal Oriental)</td>
<td>913,000</td>
<td>World Heritage Site and Reserve of Man and the Biosphere (UNESCO)</td>
</tr>
<tr>
<td>Parc National de la Basse Casamance</td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td>Parc National des Oiseaux du Djoudj</td>
<td>16,000</td>
<td>Ramsar Site</td>
</tr>
<tr>
<td>Parc National de la Langue de Barbarie</td>
<td>2,000</td>
<td></td>
</tr>
<tr>
<td>Parc National des Îles de la Madeleine</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>Parc National du Delta du Saloum</td>
<td>73,000</td>
<td>Reserve of Man and the Biosphere (UNESCO) et Ramsar Site</td>
</tr>
<tr>
<td>Réserve Ornithologique de Ndial</td>
<td>46,550</td>
<td>Ramsar Site</td>
</tr>
<tr>
<td>Réserve de Faune du Ferlo Nord</td>
<td>487,000</td>
<td></td>
</tr>
<tr>
<td>Réserve de Faune du Ferlo Sud</td>
<td>663,700</td>
<td></td>
</tr>
<tr>
<td>Réserve de Popenguine</td>
<td>1,009</td>
<td></td>
</tr>
<tr>
<td>Réserve de Gueumbeul</td>
<td>720</td>
<td>Ramsar Site</td>
</tr>
<tr>
<td>Réserve de Kalissaye</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Réserve de Kassel</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Réserve de Djovol</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,208 022</strong></td>
<td></td>
</tr>
</tbody>
</table>


380. **The plan also anticipated strategies for the national parks and reserves** such as poaching prevention by encouraging substitute economic activities in the communities (beekeeping, animal husbandry); control of bush fires by involving the local population; development of a working plan and fire management; and study of the ecology of plant species to be harnessed and preserved for an ecological reforestation approach. In the case of reserved forests, the National Action Plan proposed studies to determine the most appropriate status of each forest for its sustainable exploitation; evaluation of hunting reserve impacts; and promotion of “wildlife fallows”. Very little information is available on the efficacy of the implementation of the National Action Plan.

381. **Sustainable management to conserve biodiversity is a fundamental concern** for the authorities of the MEPNBRLA. Work is in progress by the DFCCS and the DPN, with support of the UICN, on the National Strategy for the Participatory Management of Protected Areas (reserved forests, parks, reserves, community forests, sacred groves, natural community reserves, etc.). A review of the legal and regulatory framework for biodiversity and preservation of protected areas will reinforce legal instruments while considering the strong mutations that environments and habitats undergo, biological resources, and socioeconomic and cultural issues. It will also be necessary to clarify the various texts about conservation and sustainable use of biodiversity.
Problems in hunting reserves

382. **Hunting rights have been leased in hunting reserves since the late 1980s.** Hunting rights are leased for seven years to citizens or to foreigners having resident status for at least five years. They pay fees and taxes and must fill out a logbook. Limits are set for the number of animals killed per species and per day. The lessees or guides guarantee the civil liability of tourist hunters. This system fulfills the objectives of “meeting the socioeconomic needs of rural populations and preserving animal species by a controlled sampling and the preservation of ecosystems.”

383. **In 2002, there were 64 hunting reserves for tourist hunting** in five regions of the country, covering 2,416,969 hectares or 12 percent of Senegal (IRG, 2003). Two other zones were leased for hunting by Senegal residents. A reserve with low human density is dedicated to large game hunting, the Zone d’Intérêt Cinégétique (ZIC) of the Falémé in the southeast. This ZIC is a buffer zone between the national park of Niokolo-Koba and the cultivated area of eastern Senegal. The Government developed eight camps inside the ZIC of the Falémé where the lessees can bring their clients who wish to try their hand at large game hunting.

384. **Hunters from outside the zones** in question (nationals from urban regions or foreign tourists) hunt in the reserves. In some cases, the foreign tourists are transported directly by plane from Europe to the hunting reserve. Based on DEFCCS statistics, the number of tourist hunters registered for the 2001-2002 hunting season was 2,272 compared to 284 resident hunters. Tourist hunting has several financial risks but has strong revenue potential (Table 2.7).

385. **The revenue from tourists hunting** in the reserves benefits the lessees and the Government, as well as the local communities that benefit from employment, mainly temporary, as well as other economic benefits.

386. **Local communities are actively involved in managing hunting activities**, as well as development and monitoring of working plans such as evaluating implementation of lessee specifications. Regional Council representatives preside over the boards in charge of developing and monitoring the PTAs, as well as evaluating specification status during the intermediate and final evaluations. This integrated approach is maintained at least under two formats:

- **An institutional approach** through annual meetings of the Conseil Supérieur de la Chasse et de la Protection de la Faune (Superior Hunting and Wildlife Protection Council), in which the representatives from various Government departments, representatives from Regional Councils, and lessee representatives take part.

- **A vicinity approach** through preparatory meetings during each hunting season, which are organized annually at the regional level. These meetings provide opportunities for exchange between representatives of the Regional Council, the presidents of the affected rural Councils, and the decentralized Government
services such as the departments for Water and Forestry, Land Use Planning, Tourism, Planning, and National Parks.

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of hunting reserves</th>
<th>Local economic benefits a (FCFA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tambacounda</td>
<td>25</td>
<td>281,500 000</td>
</tr>
<tr>
<td>Kolda</td>
<td>15</td>
<td>168,900 000</td>
</tr>
<tr>
<td>Fatick</td>
<td>10</td>
<td>112,600 000</td>
</tr>
<tr>
<td>Kaolack</td>
<td>5</td>
<td>56,300 000</td>
</tr>
<tr>
<td>Saint-Louis</td>
<td>9</td>
<td>101,340 000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>64</strong></td>
<td><strong>720,640 000</strong></td>
</tr>
</tbody>
</table>

a. Includes expenses for chiefs, locations, salaries, returns in donations and game, impact on infrastructure, medical and medical evacuation support, purchase of local residences, and hiring local troops for cultural events.

*Source:* IRG, 2003

387. Local communities have participated in workshops (Special Work Groups implemented by the MEPNBRLA about hunting problems) about improving the efficiency of certain management parameters. These include adaptation of specifications in a biodiversity context, the socioeconomic realities of regions open to hunting, monitoring wildlife dynamics, effective involvement of local communities in the overall farm leasing process, fair and equal sharing of benefits that are produced by hunting activities, and eligibility of a zone for a hunting concession. All these initiatives help the collaborative discussion among the various stakeholders in hunting.

388. **Kill limits and daily quotas are determined by analysis of information** from enumeration and inventory operations, as well as observations and testimony gathered from the population and various forest users. However, the absence of structured wildlife inventories within the hunting reserves limits an evaluation of the effects of hunting on wildlife and its growth potential. Some have claimed a decrease in wildlife in these zones, but there is no proof that this is solely the result of hunting. There is very little monitoring of lessee activities, particularly those located in remote areas. In 2002, the MEPNBRLA evaluated lessee efforts. Out of 64 hunting reserves, seven concession contracts had to be cancelled due to insufficient efforts and 21 had to be maintained under conditions (IRG, 2003). The contracts to be cancelled were all located in the regions of Tambacounda and Kolda.

389. **A structured inventory of birds is technically difficult**, but there are initiatives. During the 2005-2006 hunting season, 12 of 15 zones in the Kolda region were almost entirely inventoried. Each year during January, waterfowl are counted in collaboration with the *Office National de la Chasse et de la Faune de la France*. Besides the option of a systemized inventory of the hunting reserves, one focuses being considered is a monitoring system for wildlife dynamics.
Limited management capacity. Beyond the mobility of animals, the capacity of lessees to manage wildlife resources is limited because they are merely active players in the zone and their activity is seasonal. There is little collaboration between lessees and local communities to ensure the year-round “exploitation” of the resource, but this presents an interesting economic potential for development of the regions.

Concession hunting rights. In matters of concession hunting rights, Article 26 from Decree 96-1134 of 27 December 1996 about application of the law related to transfer of skills to the regions, community pastures, rural communities, and the management of natural resources stipulates: “... the region has jurisdiction over the lands of its territory for the authorization of farming out hunting rights after considerations from the interested regional council(s). The decision that ensues is made by the President of the Regional Council. It is submitted for approval to the Government Representative.” Despite legislative innovations in matters of decentralization, the Government revenues (taxes and permits) from concession hunting go to the National Treasury Department and are not returned to local communities. There is no coherence between the responsibilities assigned to the regions and the fact that they do not benefit from the revenue generated by exploiting the territory of which they are in charge. The Senegal Government is currently reviewing the statutory framework surrounding hunting in hunting reserves.

Brush fire management problems

Human-caused fires. An increase in brush fires of human origin has contributed to the deterioration of forests in Senegal. The DEFCCS strategy to manage brush fires is mainly based on prevention and active campaigns. The prevention campaign focuses on building awareness, organization, and mobilization of players.

Building awareness is mainly intended for forest users — breeders, foresters, farmers, hunters, beekeepers, women groups, craftsmen, campers, etc. Public communication efforts are aimed at the general public, notably travelers, smokers, women in rural areas, Sunday tourists, etc. Approximately 10,000 fire fighting committees have been created and a large portion of these are equipped with small tools to maintain firebreaks and combat fires.

Active campaigns focus on detection and abatement of reported fires, thanks to the efficiency of local people. This is why the DEFCCS wants to equip itself with fire fighting apparatus. This has made possible a reduction from 1,000,000 burned hectares in the 1980s and 1990s to approximately 200,000 hectares today.

Fire is a fire management tool. In fact, before plants reach a certain level of desiccation, it is possible to light controlled fires so as to later control the effects of late fires that can be more severe. Early burning must be done during a period determined by the President of the Regional Council (Article R 57 of decree 98/164 of 20 February 1998). Early fires can be lit after notifying and under the supervision of the Water and

49. Each year the State receives about 80,000,000 FCFA from farm concessions for hunting rights, to which can be added funds from the sale of permits and the kill taxes paid by hunters.
Forest Department in zones where the vegetation allows it. The early burning period (Article R 58) is based on a proposal from the Chief of Regional Water and Forest Department using objective and scientific criteria to prevent any fire spillovers. The conditions for fire use in national parks are specified by the internal regulations of each national park.

### 2.2.2.6 New forestry policy

396. **Within the context of the national decentralization policy, a new Forestry Policy (PFS) was adopted in 2005** by all players in the management of natural resources and environment (MEPN, 2005). Faced with regression of forest potential that is thinned out daily by weather events and strong pressure from people, this new policy demonstrates the desire of the Senegalese Government to manage its national forestry resources in a sustainable and planned manner.

397. **Regional Forestry Action Plan.** The PFS involves all the country’s administrative regions by allowing them to have a Regional Forestry Action Plan (PAFR). The PAFR is based on an environmental diagnostic using the Strategic Environmental Analysis (SEA) method. The PAFR identifies factors that interfere with the non-consumptive management of natural resources and proposes relevant priorities and a medium-term action plan. The objectives of this policy are:

- Restructuring the forestry field on the basis of a participatory strategy for the forestry zones with involvement by all affected players;
- Rationalizing forest resource exploitation by systemizing implementation of sustainable working plans for forests in which people occupy a central position, promote soil conservation and restoration, and promote certification of forest produce;
- Ensuring better conservation of biological diversity in all ecosystems and restoring production capacity of agrarian and agroforestry systems;
- Promoting public forestry based on management of protected areas and council support, community forestry which includes urban forestry that promotes NRM via local communities, and private forestry that creates added value;
- Reinforcing the technical skills of Government agents, local elected representatives, and basic community organizations, as well as developing their management and organizational capabilities; and
- Seeking a relationship between the various national development policies by coordinating forestry programs with other public operational programs such as the management of parks and reserves, the *Programme National de Développement Agricole* (PNDA), the *Programme National de Développement de l’Élevage* (PNDE), the *Politique de Développement Agro-sylvo-pastoral*, the *Lettre de Politique du sous-secteur de l’Energie*, the Poverty Reduction Strategy Paper (PRSP), Land-use Planning, Urban Planning, Hydraulics, Tourism, and others.

398. **Creating strategies.** The development of PAFRs supported by SEAs has made it possible for the concerns about natural resource management of several regional players
to emerge. Consolidation and synthesis of ideas has identified the following strategies and priority topics:

399. **Strategy 1 — Development, non-consumptive use, and management of forestry and wildlife resources.** This strategy combines actions linked to deforestation, water and soil conservation, forest protection, forest management, and wildlife management. Its goal is to encourage the non-consumptive use of fuelwood, forest resources (wildlife and other products), and pastoral resources based on forest management plans or simple agriculture-forestry-pastoralism management plans developed in a participatory manner. The strategy considers forest management, non-consumptive use of forests, wildlife management and biodiversity conservation.

400. **Strategy 2 — Reinforce local community and OCB skills.** Transfer of skills in the management of natural resources and the environment must naturally be accompanied by technical, financial, organizational, and institutional measures to enable local communities, the OCB, and the ONG to fully play their roles.

401. **Strategy 3 — Reinforce the forestry department’s intervention capabilities.** This strategy aims to repair infrastructure, provide more equipment for the forestry department, improve tree quality and production potential of quality tree seeds, improve human capital, and promote action programs (PAFS and PAFR).

402. **Strategy 4 — Develop private forestry.** This strategy aims to support forest management by forestry cooperatives, GIE, associations, forestry companies, women’s groups, youth groups, and others that have become specialized in such areas as fuelwood, timber, handicraft or construction wood, sheets, bark, fruits, oils, honey, tannin, gum, and animal products. Management of protected areas by private concerns, hunting concessions, ecotourism development, and creation of animal parks also offer realistic opportunities.

403. **Strategy 5 — Develop urban and peri-urban forestry.** This strategy is linked to the difficulties of managing forest resources within urban and peri-urban environments, specifically in large cities such as Dakar. With the demographic explosion in metropolitan cities due to poverty-linked rural migration, urban and peri-urban wooded areas are shrinking at an alarming rate.

**2.2.2.7 Lessons learned**

404. **Sustainable management resource efforts.** Certain initiatives from the Senegalese Government have contributed to slowing the deterioration of forest resources, notably:

- Fighting brush fires;
- Reforestation (the Government’s reforestation efforts do not, however, prevent the several-decade-long decline of forest resources);
- Banning exploitation of woody resources in areas that have already been exploited;
• Building awareness, educating, and consulting local communities about reforestation, fighting brush fires, and managing hunting activities and parks; and
• Promoting alternative energy, specifically butane, and creating the domestic fuels observatory.

405. **Despite these efforts, Senegal lacks sustainable management of resources that could stop forest degradation and ensure conservation of forest ecosystems.** According to the 1998 Forestry Code, working plans must consider ecological and socioeconomic conditions and include regeneration, improvement, thinning, inventory, protection, reforestation, and sanitary treatment actions. In practice, management of the forestry sector mainly focuses on the need for wood and charcoal in cities and rural communities, with very few mechanisms that ensure regeneration and conservation of biodiversity. The estimate of areas to be exploited does not rely on any scientific system that would ensure resource regeneration. Reforestation contractors are not expected to maintain or guarantee the success of reforestation programs.

406. **Decentralization of the forestry resource.** The decentralization of forestry management is challenged by:

• Lack of human and financial resources at the local level to prepare adequate working plans;
• Public institutions that wish to preserve a certain amount of control;
• Local institutions that are not well educated about their rights and responsibilities and are influenced by the controlling political bodies; and
• Local institutional management problems (financial crisis, political conflict, lack of clarity).

407. **Biodiversity conservation.** Senegal has made extensive efforts to develop a national park and wildlife reserve network and promote ecotourism and hunting activities to justify their preservation. These protected areas have not attracted enough tourists to finance equipment maintenance and services related to wildlife conservation. They are characterized by continuous lack of financing and scientific resources. Preservation of protected areas will only be able to count on support from foreign donors in areas where biodiversity is not too deteriorated and tourism is viable. It is a priority to preserve biodiversity in protected areas and break the current cycle of resource deterioration.

408. **Hunting in reserves presents opportunities** to preserve ecosystems and biodiversity that have not been fully realized because joint action between rural communities, lessees, and the Government is lacking. Better monitoring of hunting activities is necessary to ensure the sustainability of the resource.

409. **Two management issues.** Overall, the management of forest resources and biodiversity is faced with two issues: (i) lack of knowledge about the resources, which is necessary for efficient monitoring of their exploitation; and (ii) local populations that do not participate and thus do not share the benefits from exploiting forest resources and
biodiversity. There are several opportunities available for the rural population, whether it is exploiting non-timber forest products or ecotourism.

**Box 9. The Wula Nafaa project (the benefits of the forest)**

The Wula Nafaa project, financed by USAID, is based on existing relations between nature, wealth, and power, and on this paradigm: If the local population truly benefits from the natural wealth of which it is in charge and if people can efficiently exercise their right to manage those resources, they will be even more capable of ensuring sustainability through sustainable management. This project, started in 2003, has contributed to increasing local production and distribution of non-traditional forest or farming products (mbep gum, madd fruit, baobab fruit, palm oil). It has also contributed forestry working plans for dozens of forests in the regions of Tambacounda, Kolda, and Ziguinchor and in the adoption of formal agreements between the Forestry Department and local communities to implement these working plans and increase local income derived from forest produce. The Wula Nafaa project offered technical support and training in reforestation, grazing prohibition, and fighting bush fires in approximately 400 villages.

The project conducted an evaluation of the Hunting Interest Zone of Falémé (ZIC) in the southeastern region of Senegal. This study highlighted deterioration of the ZIC environment caused by bush fires, expanded farming, and poaching, and that this deterioration has had negative effects on the chimpanzee and eland populations in Derby. The study also concluded that there are opportunities to implement land management plans that would reduce pressure on wildlife, notably by encouraging bush fires early in the season to limit their damage.

*Source: USAID/Sénégal et al., 2006; USDA Forest Services, 2006 (transmitted by B. Winterbottom, IRG)*

**Box 10. Potential additional income available from Parc national des oiseaux du Djoudj**

An investigation carried out in 2003 concluded that visitors to the Parc national des oiseaux du Djoudj were on average ready to pay substantially more than the 2,000 FCFA required for an entrance fee. This investigation was based on a survey of 647 visitors. The multiple choice answers to questions about the price revealed a median value of 12,000 FCFA, while the answers to open questions revealed an average value of 6,442 FCFA. Even taking into account a drop in the number of visitors following a price hike, the study concluded that an increase in entry price as suggested by the survey would substantially increase the park’s annual income. It is, however, important to note that the visitors wanted improved services offered by the park. Improved facilities and services could encourage visitors to stay longer and spend more in this park that is mainly visited by foreigners.

*Source: UICN, 2006b*

**Box 11. Economic value of non-timber forestry resources**

Research on the economic value of non-timber forest resources (food, medicinal, or cosmetic plants), wild animal resources, and freshwater fishing was recently conducted in Senegal. The added value of these products is not considered in official economic statistics. Their economic significance varies from one geographic region to another and also varies by consumer demand. One analysis indicates that the primary producers of these products receive approximately 50 percent of the product's final value. The exploitation of non-timber forest and wild animal resources could be up to 50 percent of the annual income of a poor household. The overall added value from these resources is conservatively estimated at 14 billion FCFA (US$ 19 million) and could reach 25 billion FCFA (US$ 35 million).

The exploitation of non-timber forest resources in two main regions of Senegal would add at least 1.4 billion FCFA per year to the national income, while throughout the country the estimate is between 3.5 and 11.1 billion FCFA. This excludes the value of fuel wood, timber, and coal.

The added value from sport hunting, wildlife tourism, and exploitation of living animals is estimated at 1 million FCFA per year.

The value of freshwater fishing, in two of the three regions where this activity is practiced, was estimated at 9.2 billion FCFA per year. This represents an added value from production to wholesalers but excludes retail sales. Considering of home consumption and the added value (up to the wholesaler) in the other regions of the country could add between 10.2 and 14 billion FCFA. This would give a total added value of an estimated 14.5 to 19.6 billion FCFA, or the equivalent of 19 to 26 percent of added value from maritime fisheries in 2000 (54.7 billion FCFA).

*Source: UICN, 2006a*
Box 12. Wealth and sustainability in Senegal — the economic case for natural resource management

Economic policy is in many ways a process of portfolio management, where the assets to be managed include infrastructure, land, forests, fishing, and human resources. This box describes Senegal’s comprehensive wealth composition and outlines the important implications of considering the environment and natural resources as part of a country’s economic assets.

Wealth of Senegal

According to the publication *Where is the Wealth of Nations?* (World Bank, 2006), the average Senegalese has a total wealth of roughly US$10,000 (table below). This not only includes assets such as buildings and machinery, but also natural wealth in the form of land, forests, and subsoil assets, as well as intangible capital such as human resources and institutions. A quick glance at the wealth composition for Senegal shows that natural capital is a relatively important component. Natural capital constitutes 13 percent of total wealth; produced capital accounts for 10 percent, and intangible capital for 78 percent. While intangible capital is by far the largest share of wealth, natural capital is an important component of tangible wealth, one that is greater than produced capital. This pattern is qualitatively similar to that of other sub-Saharan African countries.

### Wealth estimates for Senegal (US$ per capita, 2000)

<table>
<thead>
<tr>
<th>Asset type</th>
<th>US$ per capita (2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsoil assets</td>
<td>4</td>
</tr>
<tr>
<td>Timber resources</td>
<td>238</td>
</tr>
<tr>
<td>Non-timber forest resources</td>
<td>147</td>
</tr>
<tr>
<td>Protected areas</td>
<td>78</td>
</tr>
<tr>
<td>Crop land</td>
<td>608</td>
</tr>
<tr>
<td>Pasture land</td>
<td>196</td>
</tr>
<tr>
<td><strong>Natural capital</strong></td>
<td><strong>1,272</strong></td>
</tr>
<tr>
<td>Produced capital + Urban land</td>
<td>975</td>
</tr>
<tr>
<td>Intangible capital</td>
<td>7,920</td>
</tr>
<tr>
<td><strong>Total wealth</strong></td>
<td><strong>10,167</strong></td>
</tr>
<tr>
<td>Share of natural capital</td>
<td>13%</td>
</tr>
<tr>
<td>Share of produced capital</td>
<td>10%</td>
</tr>
<tr>
<td>Share of intangible capital</td>
<td>78%</td>
</tr>
</tbody>
</table>

*Source: World Bank, 2006, Where is the Wealth of Nations?, Washington DC; Author’s calculations*

A breakdown of the different types of natural capital — including crop land and pasture land, timber and non-timber forest resources, and protected areas — shows the critical importance of soil for Senegal. Agricultural land accounts for 63 percent of natural wealth. Forest assets, including timber and non-timber resources, are another 30 percent. The remaining 7 percent is related to protected areas, which are valued at their opportunity cost, a conservative estimate. The wealth estimates do not include fish stocks. Fishing can yield sustainable profits or rents if properly managed (see text further below). In the presence of overfishing and illegal fishing, rents are likely to be dissipated.

Sustainability in Senegal

To develop policies for sustainable development, composition of wealth and changes in its value must be examined. A growing — or at least not declining — stock of wealth is a necessary condition so that well-being does not decline. This requires a comprehensive measure of wealth. Senegal’s adjusted net saving rate for 2004 was 6.6 percent of GNI, 9 percentage points below the gross savings rate usually referred to by decision makers. The estimates take into account depreciation of produced capital as traditionally measured by economists, but also consider investments in human capital; health damage from local air pollution; lack of adequate water, sanitation, and hygiene; improper water resource management; depletion of natural resources (including soils and fish); and damage caused by CO₂ emissions.
## Measures of saving in Senegal (percent of GNI, 2004)

<table>
<thead>
<tr>
<th>National accounting aggregates, 2004</th>
<th>Percent of GNI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross saving</td>
<td>15.19</td>
</tr>
<tr>
<td>Consumption of fixed capital</td>
<td>8.85</td>
</tr>
<tr>
<td><strong>Net saving</strong></td>
<td><strong>6.34</strong></td>
</tr>
<tr>
<td>Education expenditures</td>
<td>3.78</td>
</tr>
<tr>
<td><strong>Net saving plus education expenditure</strong></td>
<td><strong>10.12</strong></td>
</tr>
</tbody>
</table>

### Environmental health damages\(^a\)

- Malaria (based on this CEA, Dakar only) \(0.84\)
- Lack of water, sanitation and hygiene (based on this CEA, Dakar only) \(0.31\)
- Urban air pollution (based on this CEA, Dakar only) \(0.46\)

### Net depletion of renewable resources

- Agricultural land (back of the envelope estimates by authors – further analysis required) \(0.70\)
- Fisheries (back of the envelope estimates by authors – further analysis required) \(0.80\)
- Forests \(0.00\)

### Depletion of non-renewable resources

- Energy \(0.02\)
- Minerals \(0.00\)
- \(\text{CO}_2\) damage \(0.40\)

### Adjusted net saving \(6.59\)

\(^a\) Environmental health damages are estimated in Section 2.5 but are limited to greater Dakar.

\(^b\) Agricultural land degradation estimates are based on annual loss of 1-10 percent (average used) of agricultural GDP as found in a review of studies from African countries (Africa’s Vision for SLM (draft), TerrAfrica 2008).

\(^c\) Fish depletion is estimated assuming the recorded decline in value added between 1996 and 2002 continued until 2006 and assuming no decline in value added thereafter.

*Source:* World Bank, 2008, World Development Indicators, unless otherwise noted

The estimates of health damage from poor environmental management are described in detail in the text of the CEA in Section 2.5. Poor environmental conditions in Senegal severely affect health and quality of life. The cost of malaria, urban air pollution, and inadequate water and sanitation in urban greater Dakar are on the order of US$ 155 to 215 million per year in 2004. The cost of malaria alone is estimated at US$ 82 million per year. With a growing urban population, the problem is likely to become more acute in the next few years.

These figures in the table above include very rough estimates of soil depletion. Senegal depends heavily on agricultural land resources. Recent African studies show a range of estimates for soil erosion from less than 1.0 to more than 5.0 percent of annual agricultural GDP. If salinization and waterlogging are included, the estimates range from 1.0 to over 10.0 percent of agricultural GDP (see Africa’s Vision for SLM [draft], TerrAfrica, 2008).

The depletion figures also include very rough estimates for fisheries. The decline in demersal catches has had a major impact on the economic performance of industrial fisheries, which target demersals. Artisanal fishermen have also been heavily affected, although the impact has been dampened by the artisanal sector’s diversification and involvement with small pelagic production, which so far has not been affected by over-exploitation. The economic impact of the declining demersal catches on domestic value added is difficult to estimate because there are no recent sector studies. Detailed cost and earnings data of specific artisanal and industrial fisheries, various processing activities, and even the
tuna canning industry are limited. These fisheries statistics are largely based on rough assumptions, and should be further refined in the future.

Economic case for environmental management
A crucial issue is that natural wealth is a potentially large resource that can be sustainably channeled to create capital. How natural capital is transformed into other forms of capital is crucial for Senegal’s development strategy, an issue that cannot be ignored, especially because the poorest households are likely to be the most dependent on natural resources.

Moreover, further analysis shows that environmental management makes economic sense. This CEA clearly makes this point for urban areas. A number of remediation activities — such as malaria control, targeting mothers and caretakers of young children to promote hand washing, and household point-of-use drinking water purification programs — have been shown to have a high benefit-cost ratio under standard assumptions.

While this study does not dwell on the issues of land management, regional calculations show that selected, low-cost agronomic techniques have benefit-cost ratios greater than one, i.e., they produce a discounted stream of benefits that is greater than their costs. Likewise, economic sector work on Senegalese fisheries suggests that current value added could be doubled if the fish stock is well managed. Similar increases may be possible for a well-managed processing industry. This CEA suggests that economic analysis can provide important insights for decision makers, strongly supporting an extension of the work done here to other sectors on environmental health issues.

Source: G. Ruta, et al., World Bank, 2008

2.3 Water Resource Management

2.3.1 Management of National Water Resources

2.3.1.1 Status of water management

Water resource management in Senegal is shared by a large number of institutions. At the Government level, the following departments are directly involved in management of water resources (Ministère de l’Hydraulique, 2006):

- The Ministère de l’Hydraulique et du réseau hydrographique national, which ensures that water resources are available over the entire territory for all populations;
- The Conseil Supérieur de l’Eau, which is under the authority of the Prime Minister and certain statutes and decides significant management options; and
- The Comité Technique de l’Eau, which is in charge of studying all issues related to water management at the request of the Conseil Supérieur.

Other departments also conduct actions that can influence water resource management, such as MEPNBRLA, the Ministère de la Santé et de la Prévention Médicale and the Ministère des Collectivités locales et de la décentralisation. In the past, this fragmentation has led to a lack of coordination and integration of water resource matters, which produce legal, institutional, and technical constraints. At this time,

development of policies and an Integrated Water Resources Management Action Plan (PAGIRE) in Senegal is necessary.

412. **Integrated Water Resources Management (IWRM) was adopted** for the first time during the International Conference on Water and Sustainable Development, which was held in Dublin in 1992. This is a “process which encourages enhancement and coordinated management of water, lands and related resources for the purpose of maximizing the economic and social well being which derives from it in an equitable manner, without being detrimental to life-sustaining ecosystem sustainability.” From a practical point of view, this approach involves significant institutional changes with the intent to create new partnerships and ensure that all players involved in the management and use of water resources work together to develop and implement policies customized to the needs of the population and the environment.

413. **Adoption of the IWRM approach is an absolute necessity** because until recently many failures in the country’s water resource management can be associated with a lack of coordination and consensus among institutions and water users.

### 2.3.1.2 Development and implementation of PEPAM 2015

414. **The first step in the implementation of IWRM on a national scale** was reached in 2004 with the start of the *Programme d'Eau Potable et d'Assainissement du Millénaire* (PEPAM 2015). This program, designed to contribute to Senegal’s Millennium Development Goals for poverty reduction, rests entirely on the principle that “only the addition of the efforts from the Government, civil partnerships, local communities, NGOs, private sector and from the partners in development will make it possible to firmly achieve the Millennium Development Goals.”

415. **Letter of sectoral policy.** Its implementation is overseen by a letter of sectoral policy for water and sanitation in urban and rural environments, which is a combined effort of the Ministère de l’Agriculture, the Ministère de l’Hydraulique, the Ministère l’Urbanisme et Habitat, the Ministère de l’Économie et des Finances, the Ministère de la Prévention, the l’Hygiène Publique and the Assainissement, as well as the Ministère du Plan et du Développement Durable. This letter was developed through a process designed to reach MDGs for drinking water and sanitation. It considered several major strategic frameworks — the Millennium Development Goals, the Poverty Reduction Strategy, and IWRM. This process was conducted during 2004 and completed in January 2005 with a strategy and investment plan validated by all players. The letter of sectoral policy is the formalization of the results from this process and presents actions in the water resources sector (including water resource management and rural and urban water supplies) and the sanitation field (rural and urban sanitation). These directions can be summarized as follows:

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416. **Managing water resources** to supply drinking water to both urban and rural communities (financing provided in the urban and rural PEPAM program) includes:

- Implement a management plan and institutional framework for Lake Guiers;
- Identify and implement technical solutions to improve water quality in the peanut basin zone;
- Effectively mobilize alternative water resources on behalf of truck farmers of the Niayes zone;
- Model building and quantitative and qualitative monitoring of the country’s underground water resources thanks to a reliable piezometer; and
- Reinforce DGPRE’s human, financial, and material resources to make possible its monitoring role, policing, and regulation of water.

417. **The rural water supply** will follow a strategy that is narrowly linked to the rural sanitation strategy. It will be based on three main elements:

- National implementation of an integrated intervention framework;
- Institutional reforms that will lead to a public drinking water system in the rural environment; and
- Implementation of tools and sustainable financing systems to ensure mobilization of public and private resources needed to maintain and expand drinking water and sanitation services.

418. **Development of the urban water supply** will depend on a four-point strategy:

- Evolution of the an organizational and institutional framework with a law on drinking water and public sanitation services;
- Consolidation and reinforcement of technical infrastructure;
- Preservation of the financial sector’s balance; and
- Implementation of actions to target poverty.

419. **For rural sanitation**, the development strategy will be based on:

- Implementation of an integrated intervention framework that will propose a coordinated framework and exchange of experience;
- Implementation of a proximity proposal for sanitation in rural environments and prescribed standards for implementation; and
- Implementation of tools and sustainable financing.

420. **The development of urban sanitation** will be executed using a four-step strategy:
• Evolution of an organizational and institutional framework that will notably include a sanitation code which combines provisions previously contained in the Environmental, Water, and Urban Planning Codes;
• Reinforcement and consolidation of technical infrastructure to deal with increasing demand, improving service quality, and expanding services;
• Progression toward a financial balance for the sanitation sub-sector; and
• Actions to target poverty.

421. **Local plans.** To reach its objectives, PEPAM also plans to develop the Local Hydraulics and Sanitation Plans (PLHA) thanks to close collaboration between rural communities and those in charge of water and sanitation. These local plans will be the counterparts of local sanitation plans that already exist in certain urban areas.

422. **Measuring progress.** An evaluation system based on indicators has been developed to measure advancements. It is managed by the PEPAM coordination unit. Lastly, a sectoral expense framework has been designed to mobilize needed resources and manage them in relation to the data provided by the evaluation. From an institutional point of view, the four branches of the PEPAM will rely on the following departments of the Ministère de l’Hydraulique and on the national hydrographic network:

- **Direction de l’hydraulique rurale (DHR)** is responsible for the planning, construction, and monitoring of new water supplies in rural environments.
- **Directions de l’assainissement et de l’hydraulique urbaine (DAHU)** are in charge of the planning, construction, and monitoring of waste water treatment sub-programs in rural environments. It is also jointly in charge of, with the SONES and ONAS, the planning and implementation of urban hydraulics and sanitation sub-programs.
- **Direction de l’exploitation et de la maintenance (DEM)** is in charge of the technical support for user associations and management committees, the implementation of transfer processes for the private sector of rural drilling, operational maintenance, and monitoring and regulation of public drinking water services in rural environments.
- **Direction de la gestion et de la planification des ressources en eau (DGPRE)** is responsible for underground waterworks intake, modeling and monitoring of quantitative underground water resources, and implementation of the management plan for Lac de Guiers.

423. **Urban water and sanitation.** The Société nationale des eaux du Sénégal (SONES) is in charge of implementation of the urban water component, while the Office national de l’assainissement du Sénégal (ONAS) is in charge of implementation of the urban sanitation component. The Unité de coordination du PEPAM (UCP) was created.

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55. [http://www.dhrsen.net/](http://www.dhrsen.net/)
Its mission is to coordinate activities of various executing agencies, ensure coordination of interventions by PEPAM funding parties, and monitor proper performance of the

**Box 13. Sanitation improvement program for the peri-urban neighborhoods of Dakar (PAQPUD)**

The sanitation improvement program for the peri-urban neighborhoods of Dakar (PAQPUD) was launched by the Senegalese Government in 2001. This six-year program is financed by the World Bank via the Long-Term Water Project (PLT). The objective of the PAQPUD is to provide adequate sanitation services in neighborhoods where urbanization has already occurred and a conventional sewer system is not possible. This project is notably based on the experience of the ONG ENDA in the semi-collective sanitation of Rufisque. The PAQPUD finances the construction of a large number of individual sanitation works (sump basin, sump shower, various types of latrines) or semi-collection (collection, small diameter sewer system). At the end of 2005, the PAQPUD had surpassed its objectives by building more than 63,548 individual sanitation works, 16 public toilets, and 76 comfort stations in school environments. More than one-half of the two pilot collection sanitation projects in Ngor and Cité Ousmane Fall (Thiaroye sur mer) were complete.

The success of the PAQPUD is based on people and includes an important "social marketing" component called the information, education, and communication strategy that was implemented from project onset and that aims to promote hygiene and sanitation and various alternatives. This allows people to become familiar with the technologies and stimulates a demand for sanitary facilities. The residents, who finance between 20 and 50 percent of installation costs, request a sanitation system and sign a construction contract with a craftsman trained in this field or a small-to-medium private certified company.

One of the strengths of the PAQPUD is participation by various players whose actions are focused on their specialty fields. ONGs or OCBs (Basic Community Organizations) are hired to conduct training, education, and communication activities. The residents participate in evaluation of the installation upon completion. The PAQPUD success rests on clear mandates, determined by contracts, for each of the organizations involved.

One of the program’s other strengths is the presence of pilot committees subsidized by the Government that act as an interface between people and the PAQPUD. These committees include mayors and neighborhood delegates, ONGs, religious leaders, craftsmen, and youth and women representatives. These committees are implemented from the onset of the project and are involved in project promotion. These committees are viewed as a symbol of solidarity. Lessons to be learned from implementation of this program include:

- Better coordination with health programs to assess the effects of the sanitation facility on the health of the population.
- Treatment of waste sludge is a component of individual sanitation systems that has not yet been entirely mastered. The ONAS should implement committees for manual collection of waste sludge and train them to increase their knowledge about its environmental impact. These committees have collaborate with the waste sludge treatment facilities.
- Informal agreements have been completed by ONGs so the poorest households are able to spread out their payments, but this displeases other players because it affects project finances.
- According to the ONAs, the number of players and steps between the program and beneficiaries should be reduced.


424. **Monitoring quality.** Local communities and consumer associations directly monitor the quality of public service. They are also closely linked to the implementation of social programs. An interdepartmental monitoring committee assigned by the decree is in charge of the contractual regulation of water and sanitation sectors in urban environments.

425. **Too early to declare success.** It is still too early to tell whether the letter of sectoral policy for water and sanitation in urban and rural environments and its implementation in the PEPAM framework will be successful, but it certainly represents a step in the right direction. It is hoped that sufficient water resources can be correctly routed, in sufficient quantity and quality, to all users, and that water is subsequently
collected and reprocessed under conditions that will ensure the sustainability of water resources.

2.3.1.3 Development and implementation of the PAGIRE

426. Water resources are the heart of essential assets needed by Senegal to overcome the challenges of water access for everyone, food security, public health, and the preservation of ecosystems. In accordance with the Integrated Water Resources Management Action Plan (PAGIRE) recently adopted by the Senegal government, “...the country must face continuous growth in the capital’s water demand, today estimated at 4.5 percent per year, keeping in mind the demand by other internal central business districts as well as the 13,000 villages that make up the rural environment and its numerous herds, for which sustainable solutions for drinking water have to be created. The development of irrigated farming, large water consumption and pollution sources, has significantly been reinforced under the drive of public powers and the private sector, with expansion of interventions in the Niayes zone, the entire Senegal River valley, Casamance, the Ananbé basin, as well as the river edges of Gambia” (Ministère de l’Hydraulique, DGPRE, 2007. PAGIRE. Plaquette d’information, p. 2).

427. Still below expectations. “As impressive as they may be, the achievements in the drinking water and sanitation sectors are still below expectations, taking into account the structural gaps to be filled and the ever increasing water demands. Moreover, the sectoral approach centered on the priority resolution of drinking water problems has made it so that other sectors linked to water are receiving little attention. Therefore, we are forced to recognize that much still needs to be done, notably development of irrigated or market garden farming, water for livestock, protection of the aquatic environment, water for industry and tourism, treatment and evacuation of wastewater, etc. Water resource management is faced with problems such as: aquifer salinization, blooming water plants, costly investments, high fees, resource scarcity, diverse interveners with often conflicting interests, industrial pollution, non-practiced or adapted laws, etc.” (Ministère de l’Hydraulique, DGPRE, 2007. PAGIRE. Partie II – Stratégies, Programmes d’actions prioritaires, Coordination et Financement, p. 14).

428. Water is a fundamental life-sustaining resource, and efforts to clarify responsibilities have been developed. The PAGIRE proposes institutional, legal, and organizational framework reform to improve the protection and technical and financial management of water resources by involving all sectors. These reforms are centered on five major organizations that make it possible to implement the four IWRM principles (Table 2.8). Implementation of the 2008-2015 Priority Action Program by the PAGIRE is significant leverage toward overcoming these challenges:

429. Project 1 — Development of an IRWM charter. To facilitate the compliance of all players in the GIRE process, it is anticipated that an IRWM charter will be developed in a consensual manner with participation by all players in the sector related to water.

430. Project 2 — Reinforcement of the water resource planning and information system. This project includes two sub-projects: (i) reinforcement of the material and human materials for structures in charge of water resource management; and (ii)
implementation of an integrated water information and knowledge system (*Mise en place d’un Système intégré d’informations et de connaissances sur l’eau*, SIE).

431. **Project 3 — Institutional and legal reforms.** This project involves (i) clarifying legal, regulatory, and organizational documents; and (ii) reforming the water resource management framework to make it consistent with the Water Code.

432. **Project 4 — Reinforcing participation by women and other disadvantaged social categories in integrated water resource management.** This project involves determining the baseline case at a national level, gender issues in water management, and integration of gender and water issues in national policies and those governing transboundary water.

433. **Project 5 — Development and implementation of an education, communication, and sensitization program about water.** This project involves the development of information, education, and sensitization tools.

434. **Project 6 — Monitoring water resources and management of at-risk areas.** This project includes two sub-projects: (i) reinforcement of water resource monitoring, and (ii) a management plan for at-risk areas.

### 2.3.2 Management of Transboundary Resources in the Senegal River Basin

435. **One aspect of IWRM is management of transboundary resources.** Integrated water resource management has been in progress for a few years in the Senegal River basin within the scope of OMVS programs. However, some problems remain that are at the heart of specific water resource management difficulties.

#### 2.3.2.1 Environmental and social issues related to dam management

436. Construction of the Diama dam downstream on the Senegal River and the upstream hydropower dam in Manantali has altered the river’s flow, which has contributed to environmental and social issues related to dam management. These issues include:

- **Invasive aquatic plants** in zones once affected by salt spits are one of the main OMVS dam impacts. In addition to the destructive effect they have on the overall ecosystem, these plants reduce water flow, and consequently, increase the prevalence of malaria and schistosomiasis vectors, affect fish breeding, and complicate fisher access to the river. The major threats originate from *Thypha australis* which must be mechanically removed and *Salvinia molesta*, a non-native water fern accidentally introduced in 1998 but sensitive to biological control via the introduction of *Cyrtobagous salviniae* (STUDI, SACI and GEDUR SARL, 2006).
Table 2.8 PAGIRE — Integrated water resource management (IWRM) strategies

<table>
<thead>
<tr>
<th>Handicaps in the management of the Senegal water sector</th>
<th>Recommended strategies for reform of water resource management</th>
<th>Relevant IWRM principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient knowledge of the water resource</td>
<td>Improve water resource planning by reinforcing work methods and improving protection, follow-up/evaluation, and management system of demands</td>
<td>Principle 1</td>
</tr>
<tr>
<td>Planning framework for water resource usage that is not adequate for the needs of users</td>
<td></td>
<td>Fresh water is a limited at-risk resource</td>
</tr>
<tr>
<td>Deficiencies in water resource prevention and protection systems</td>
<td>Improve negotiation frameworks between all players and their strong participation in the process of decision making and water resource management</td>
<td>Principle 2</td>
</tr>
<tr>
<td>Insufficient material and human means</td>
<td>Reinforce equality in access, contributory capabilities, and strong participation from all stakeholders involved in the mobilization, exploitation, and protection of the water resource</td>
<td>Principle 3</td>
</tr>
<tr>
<td>An institutional framework that is not conducive to negotiations between various players</td>
<td></td>
<td>Principle 4</td>
</tr>
<tr>
<td>Poor involvement from local players and users in development of policies and water management</td>
<td>Promoting and applying the GIRE principles in political and legal instruments related to water</td>
<td>Water’s economic aspect</td>
</tr>
<tr>
<td>Insufficient budgetary allocations from the Government and poor capability of mobilizing financial resources for the GIRE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor exposure of mobilization systems and water resource management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of agreement between sectoral policies and absence of integrated mobilization and water resource management plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate and poor application of legal, regulatory, and organizational water documents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insufficient operational communication, information, awareness, and education strategies about water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source: Ministère de l’Hydraulique, 2007, p. 15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **An increase in the prevalence waterborne diseases** is the main effect of dams on the human population. In addition to an increasing risk of malaria and schistosomiasis in the Senegal Valley, the filling of the Manantali reservoir has caused an epidemic of Rift Valley fever and a greater incidence of malaria and schistosomiasis in the reservoir’s riparian populations. In the Senegal River valley, malaria has gone from a seasonal disease to a disease present throughout the year. National public health campaigns were launched in Senegal and Mauritania to limit malaria and schistosomiasis infections (STUDI, SACI and GEDUR SARL, 2006).

- **Decreased volume and duration of high water** has reduced underground water recharge and weakened ecosystems along the river downstream of the Manantali.
Parks have been created in Senegal River estuaries and Mauritania to preserve wetlands and habitats important to preserve migratory birds and fish.

- **Decrease in volume and duration of high water has altered the foundation of traditional subsistence activities.** The areas adapted for recession farming have been reduced, and irrigated farming (mainly for rice) has developed at the expense of fishing and animal husbandry. The decrease in water resources has led to greater competition for access to water. Development of irrigated farming was not conducted in an optimal manner in the middle valley of the Senegal River because high water is not retained long enough in the flood plain. There is a lot of evaporation and soil permeability in certain zones (notably the **diery soils**). Although the per-hectare irrigated farming yield is greater than the recession farming yield, irrigated farming requires a greater financial and labor investment and has experienced a decline following the decrease in subsidies that supported this sector. A certain proportion of irrigated perimeters are currently unused and a portion of the coastal population has reported a preference for recession farming. A decrease in farming, animal husbandry, and fishing productivity has been recorded compared to the five years following the implementation of dams (STUDI, SACI and GEDUR SARL, 2006). Consequently, the emigration of men searching for employment, a pre-existing phenomenon that had been alleviated by the expansion of irrigated farming, still prevails. Economic alternatives such as market gardening have been developed (Alam and Dione, 2004).

- **The years without recession farming cause significant losses in nutritive resources for rural populations.** There is no notification system for farmers about the possible discharge from Manantali that would enable better planning (Lautze, 2006).

- **High salinization of water downstream from the Diama dam** has reduced the ecological productivity of habitats in the river estuary.

- **Use of agrochemicals in irrigated farming has lowered water quality** for human consumption and affected coastal populations that are not served by water treatment plants (STUDI, SACI and GEDUR SARL, 2006).

- **Priority conservation of wetlands for waterfowl,** (for example, the Ndialé in the Senegal River flood plain is an area registered with the Ramsar Convention as an internationally significant wetland, as well as with the Montreux Record, of Ramsar at-risk areas)

### 2.3.2.2 Recent interventions improve management of river resources

**Regional hydroelectric development project.** In 1997, the World Bank implemented the Project to develop a 200 megawatt net capacity at the Manantali dam. The installation of turbines in Manantali (executed in 2001) depends on retaining recession waters long enough to generate electricity. This project included the *Programme d’Atténuation et de Suivi des Impacts Environnementaux* (PASIE) that sought to diminish environmental problems resulting from recession monitoring in Manantali and support optimal water management. This led to development of an Environmental Code for the OMVS and a Water Charter.
438. **Senegal River Water Charter.** In 2002, Senegal, Mauritania, and Mali signed a charter that gives a new operational framework for the OMVS and ensures maintenance of recession farming. This charter’s objective is to ensure 50,000 hectares of recession farming and between 100,000 and 375,000 hectares of irrigated farming while also producing 800 gigawatts of electricity per year. This charter also predicts that there will be enough water for domestic use, regional fishing, pastoral activities, and protected areas.

439. **Objectives not met.** Unfortunately, available water for most years did not make it possible to achieve all these objectives. In 2003, various water allocation scenarios were planned with six cost-benefit analyses. The analyses concluded that the scenario emphasizing irrigation of 200,000 hectares was the most appropriate, while a multi-criteria analysis placed less emphasis on irrigated farming and more on environmental protection and maintaining navigation. In 2004 and 2005, no water was released from Manantali because of hydroelectric production requirements. In 2005, the other Senegal tributaries ensured a sufficient quantity of water to maintain 50,000 hectares of recession crops, which was not the case in 2004 (Lautze, 2006).

440. **Water and Environment Management Project.** In 2004, the Global Environment Facility supported implementation of a project to assist the OMVS in developing a water management framework that would determine a final high-water regimen for Manantali. This project was implemented by the World Bank and UNDP and should be completed in 2007. Guinea joined the OMVS on March 16, 2006. The World Bank approved the *Programme de Gestion Intégrée des Ressources en Eau et de Développement des Usages à Buts Multiples dans le Bassin du Fleuve* in 2006. This program includes:

- Consolidation and modernization of the OMVS to expand its institutional capabilities and modifications to its legal framework to include Guinea;
- Local development of multiple-use activities, including development of small infrastructures and activities to improve traditional fishing, protect water resources, and reduce malaria and schistosomiasis; and
- Development and planning of work with multiple goals, preparation of development plans, and management of basin water resources. This component includes completion of additional studies for the hydroelectric project of Gouina and feasibility studies for works at four sites.

441. **A transboundary analysis of the environmental management** of the river basin was conducted in 2006 for each member country. The analysis examined each country’s National Environmental Action Plans (the PNAE was produced by Senegal in 1997). It evaluated the relevance of these plans and examined in what way these plans affect transboundary issues. The analysis will be used to develop a strategic action plan for environmental management of transboundary basin resources, which is planned for 2007. It is contemplated that a similar regional approach will also be implemented by the *Organisation de Mise en Valeur du fleuve Gambie* (OMVG), to which Senegal also belongs. Intended targets have already been agreed upon between the OMVS members.
for a phase two of this program, which would include implementation of planned dams. One of these objectives is Guinea’s commitment to continue cooperating with the OMVS (World Bank, 2006a).

2.3.3 Lessons Learned

442. **Flood recession cropping and traditional fishing** in the Senegal River valley has always been practiced by coastal populations living in the flood plain, along with subsistence activities that have little environmental impact. However, the Société d’Aménagement des Eaux du Delta (SAED) has for many years supported development of large agricultural development areas which today represent 75,000 hectares in the Senegal River valley. This intense farming contributes nutrients to the Senegal River while the Government is investing significant sums of money to: (i) treat water in the lac de Guiers (a major drinking water source for Dakar); (ii) monitor the blossoming of aquatic plants in the lac de Guiers and at the Diama dam (MEPNBRLA, SOGED); and (iii) protect wetlands and ecosystems in the Senegal River that are essential to maintain inland fishing for rural communities that are among the poorest in the country. The regulations do not encompass fertilizer fees, intense farming activities, and run-off close to the lac de Guiers or the Senegal River.

443. **Integrating environmental factors.** For the farming sector, it is necessary to integrate environmental factors and ensure that all sectors target natural resource sustainability in a coordinated manner. Various partners must support a common national action to ensure optimal use of resources to have an impact. Still to be determined are the institutional responsibilities to manage transboundary environmental issues. This role is currently the responsibility of the OMVS, which is a national organization that seems inefficient at integrating environmental factors.

2.4 Fisheries Management

2.4.1 Resource Management Problems

444. **An important scientific symposium on maritime fisheries in West Africa** held in Dakar in 2002 concluded that the maritime fisheries sector in Senegal was in crisis and that this crisis was mainly affecting coastal demersal fish, notably the majority of exports such as grouper, bream, shrimp, octopus, and cuttlefish. From 1997 to 2002, there was a 50 percent decline in the demersal fish catch, which affected economic performance (Table 2.9). The symposium concluded that it was necessary to reduce fisheries efforts on the entire West African coast, specifically for demersal fish.

445. **The Senegal-Gambia marine ecosystem simulations** produced using the ECOSIM model indicated that the continual expansion of traditional and industrial fisheries would reduce the biomass of demersal fish by one-half and increase the risk that many of these species would no longer be capable of breeding efficiently (Samb et

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Mendy, 2002). In the scope of ECOSIM simulations produced in 2002, two capture reduction scenarios were tested: (i) freezing industrial fishing and a 50 percent reduction of traditional fishing; and (ii) freezing traditional fishing and a 50 percent reduction of industrial fishing.

Table 2.9  Volume of traditional and industrial maritime fisheries and exports

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Industrial fishing</td>
<td>n/a</td>
<td>92</td>
<td>89</td>
<td>110</td>
<td>84</td>
<td>81</td>
<td>52</td>
<td>59</td>
<td>47</td>
</tr>
<tr>
<td>Senegal trawlers</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Foreign vessels</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>15</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Tuna boats</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>13</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Traditional fishing</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>290</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Total fishing</td>
<td>50</td>
<td>353</td>
<td>416</td>
<td>463</td>
<td>409</td>
<td>395</td>
<td>393</td>
<td>370</td>
<td>355</td>
</tr>
<tr>
<td>Exports</td>
<td>n/a</td>
<td>91</td>
<td>99</td>
<td>103</td>
<td>101</td>
<td>119</td>
<td>83</td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>

n/a = not available

Source: DPM in Global Environment Fund (GEF, 2004)

446. The second scenario was the most likely to quickly regenerate fish stocks and the authors concluded that it was essential to reduce the fishing, notably traditional fishing, to avoid collapse, and possibly extinction of certain demersal fish species. A continual decline of coastal demersal fish resources would severely affect the country's economy and threaten the subsistence of numerous coastal communities.

447. An FAO workshop held in 2007 in Banjul, Gambia of the Sub-Regional Fisheries Commission (Gambia, Mauritania, and Senegal) and Morocco, concluded that in-shore demersal fish stocks in Senegal deteriorated between 2002 and 2007, along with deep demersal stocks and key species from sea bottoms and estuaries for in-shore shrimp. Major recommendations from the workshop were directed at massive reductions of overfishing of these endangered resources.

448. Over-exploitation of demersal resources has already negatively affected reproduction of Red Sea bream, thiophene, and lesser African threadfin. Demersal species have also been affected by degradation of reproductive areas along the coasts of Senegal and at the mouth of large rivers. For example, only 5 percent of historic fish spawning areas are accessible today in the Senegal delta. The only coral reef of the Senegalese coast, located close to Gorée, is affected by pollution in the area. Various factors call for caution in resource management —lack of scientific knowledge about reproduction and preservation of some species, the influence of climate change, and the effect of the decimated reproductive biomass for numerous species across the oceans.

449. Depletion of these stocks would affect hundreds of thousands of people who directly depend on fishing as their main source of revenue. Depletion would also reduce revenue from export markets where market share was garnered throughout many years.

450. Development of protected areas accelerates regeneration of overexploited stocks. Senegal has 12 protected coastal areas for a total of 1.5 million hectares, however,
these areas suffer from underfunding and lack of equipment. In the past, setting up protected marine areas brought opposition from the local populace that benefits from these areas.

2.4.2 State of the Marine Ecosystem (Biodiversity and Critical Habitats)

451. **Deterioration of major stocks.** Between 2002 and 2007, deterioration of major stocks demonstrates the inefficiency of fisheries management systems implemented over the last few years. In general, fisheries management systems have not integrated (outside of the GIRMaC program and GIRMaC+ project) the numerous environmental questions encountered while exploiting resources and which affect the marine ecosystem:

- Direct impacts on targeted species and sub-species (decreased abundance, medium-sized catches) which are characteristic of overfishing.
- Direct (or indirect) physical effects on marine demersal species (rocky shelters, grass beds, algae prairies) from using certain fishing techniques. Intensive trawling, for example, largely contributes to destruction of demersal habitats.
- Direct effects on non-targeted species. Fishing grounds generally target species of commercial interest, but also pull in high numbers of fish with no commercial interest. In Senegal, trawler fishing for shrimp brings in four times the shrimp tonnage in non-targeted fish species, most of which are thrown back. Notably, the rejected species are often fish sought by small-scale or industrial fishers.

452. **These disturbances of the marine ecosystem and biodiversity are also found in local fishing** where non-selective or drag nets are used. Effects on resources and natural habitats and the ensuing erosion of marine biodiversity, along with overfishing, are a threat to the survival and long-term economic viability of fishing.

453. **Depleted fish stocks and habitats.** The intermediary beds of the Senegalese continental shelf, including shrimp beds, have depleted their large-size fish stocks and habitats. These beds are between Kyarr and Saint Louis in the north, and between Pointe de Sangamor and the northern frontier of Gambia and Casamance in the south. For the Cap Vert peninsula, rocky habitats and biomass which were still relatively untouched have now deteriorated mostly because of intense industrial trawling, illegal fishing practices, or fishing with non-selective nets. Numerous fishing beds, notably rocky beds, are littered with lost nets, waste materials, and garbage that affect fish habitat.

454. **The underwater cliffs of the Petite Côte are highly damaged by trawling** and fishing with long lines, jigs, various nets, etc. Fish reproduction is still closely linked to certain types of habitats because some species need support to attach their eggs, such as the cephalopods (for example, seiche) which explains the large concentrations observed during reproduction times in grass areas and algae prairie areas of the Petite Côte.

455. **Fishing methods harm habitats.** Without a regulatory system, fishermen develop methods that are more and more efficient, but also harmful to aquatic habitats and their biodiversity (net fishing in rocky habitats, underwater fishing in critical areas,
laying long lines or nets in mangrove swamps, fishing with explosives, and proliferation of gillnets made of monofilament).

456. Environmental factors affecting fishing include:

- Rocky beds located around the Cap Vert peninsula (Hann Bay, harbor area, Mbao) are polluted by many sources, destroying the breeding bottoms and nurseries for numerous coastal demersal species.
- Deforestation of mangrove swamps in the Saloum Delta and Casamance.
- Construction such as dikes and dams has entirely changed the seasonal system of floods and falls of the Senegal River and stopped the flow of the estuary that carries spawning fish or fry in the dry season. Decrease of flooded areas and the river flow have a direct impact on shrimp productivity.
- Proliferation of aquatic vegetation and silting of river beds.

2.4.3 Adaptation Efforts in the Fisheries Sector

457. More sustainable management. The first effort of the fisheries sector to move toward more sustainable management was undertaken in 1998 with the passage of a new fisheries law that introduced management plans for fishing of every kind, including calculation of total authorized catches (TPA) and calculation of an optimal fishing state, but there has not been any plan made since the adoption of this law (GEF, 2004). This law also introduced a consultation approach to fisheries management by setting up consultation groups that would involve stakeholders on a local and national level. This law had no specific measure for managing local fisheries activities.

458. Reorganized ministry. The Ministry of Maritime Economy and International Maritime Transports (MEMTMI) was reorganized in 2000 and again in 2004. In 2001, the Ministry announced a Strategy for Sustainable Development of Fisheries and Aquaculture. This strategy reoriented the Ministry by favoring management of resources as opposed to growth of the fisheries sector. It included measures to decrease the real capacity of marine fisheries and measures to promote aquaculture and continental fisheries. Numerous aspects of this strategy were transposed into an action plan, 2001-2007. This plan contemplated development of a continental aquaculture capable of producing 100,000 tonnes of fish per year to sustain communities because they live off continental fisheries. Production of fish on the Senegal River is in decline because of drought and water and agricultural development in the Senegal River valley.

459. In 2002, the Senegalese Government set up two working groups:

- One to define which fishing rights system should be considered; and
- Another to define how the local co-management boards should operate.

460. The Senegalese working group on fishing rights produced a final report in 2004 that suggested a two-tier system. Industrial fisheries would be managed by a central
agency that would use permits and some form of quotas. Local fishing would be co-managed by groups with local interests and be geographically defined.

461. **The working group on local boards** also issued recommendations in 2004 but they were not in accord with opinions expressed by the working group on fishing rights. The recommendations of this group did not take into account the prerequisites of a local co-management system within the board’s operations. The Senegalese Government did not complete its own evaluation of costs and benefits or the political feasibility of the group’s recommendations. Two management approaches were considered by the Ministry:

- A resource management approach aimed at reducing and normalizing fishing capacities and quotas, with one centralized top-down management system that would issue quotas for catches of industrial and local activities; and
- Another approach with two different systems for artisanal and local fishing as described by the Senegalese work group on fishing rights.

462. **For the Ministry, there are at least two implications:**

- If local people are involved, the potential for acceptance increases, but the power of intervention by the Ministry is reduced; and
- Over time, local co-management may increase the share of marine resources allocated to local fishing.

463. **International support.** The Senegalese Government policy on adaptation of the fisheries sector was supported by international development agencies. In 2002, an Integrated Framework for Technical Assistance for Trade Development in Least Developed Countries (IF) concluded that maritime fisheries management spawned overcapacity in the industrial and artisanal fisheries fleet. It proposed a presidential commission to negotiate future reforms to reduce fisheries quotas. This commission had a much more restricted mandate than the one foreseen by the IF, was limited to finding ways to reduce fisheries quotas, and concluded its work in 2005.

464. **FAO started a technical assistance program** aimed at transposing the 2001 Strategy and IF recommendations into specific components of a structural adjustment program, initially with funding from the African Development Bank and the French International Development Agency. Japan also started a program for testing co-management of local fishing. An assistance program funded by Danish Cooperation will test the feasibility of different types of local co-management boards.

465. **GIRMaC Project.** The Government of Senegal, the World Bank, and the Global Environment Facility (FEM) started a pilot project in 2004 known as the GIRMaC (integrated marine and coastal resource management) Project. The aim of the GIRMaC Project is to improve marine and coastal parks and test approaches for joint management of artisanal resources in connection with the management of protected maritime areas in three locations that are considered as critical ecosystems along the Senegalese coast (the Senegal delta, the Sine-Saloum delta, and the Cap Vert peninsula). The project is in line
with the priorities identified in the National Biodiversity Strategy and the National Environmental Action Plan. The specific objectives of the project are to:

- Conserve critical habitats and species and improve management of the Senegalese network of protected coastal areas;
- Develop and implement participatory fisheries management systems (local joint management) that are sustainable;
- Improve the capacity for protecting and conserving coastal and marine biodiversity;
- Establish a coherent institutional framework involving all stakeholders;
- Develop and promote the required scientific, technical, and administrative capabilities; and
- Improve the regulatory framework for the management of coastal zones.

466. Test areas. This project proposes using protected areas to design and test approaches that integrate biodiversity conservation and resource usage with the aim to reduce poverty and boost socioeconomic development. The financing is intended to support efforts of the Direction des Parcs Nationaux for sustainable management of the network of protected coastal areas using an ecosystem-based approach. If the joint management pilot project proves to be a success, it could be repeated elsewhere in Senegal.

2.4.4 Fisheries Sector Strategy (2006)

467. The new Fisheries Sector Strategy (MEMTMI, 2006) recommends that maritime fishing be reduced until stocks are renewed, and that they be authorized thereafter with a slight reduction in catches. The two options for reducing fishing that were identified during the 2002 symposium are:

- Reducing the capacity of industrial fishing by 50 percent and a freeze on the number of pirogues; or
- Reducing the capacity of artisanal fishing by 50 percent and a freeze on the number of industrial fishing boats.

468. Protecting fish stocks. The strategy recognizes that the more effective option to protect stocks would be reducing the capacity of artisanal fishing by 50 percent and freezing the number of industrial fishing boats. Nevertheless, taking into account the political and economic importance of the artisanal sector, the first solution, in combination with a temporary expansion of artisanal fishing in international waters (associated with a renegotiation of international treaties), is considered to be the only one that is politically feasible. Nonetheless, the Strategy aims to reduce the migration of fishermen in the long term through a gradual process of instituting permits for traveling fishermen. The migration of fishermen who catch small pelagic fish will be excluded from all restrictions. A boat buyback program might be considered only if the other
conditions for controlling fishing capacity (permits, quotas, and monitoring activities) are in place and operational.

469. **Artisanal and industrial fisheries must subsequently be managed sustainably.** The Strategy recommends that these two sectors be managed differently:

- **Industrial fishing.** The Fishing Rights Working Group recommends that industrial fishing must be managed through a permit system. Once the follow-up, checking, and monitoring system for this sector is operational and running effectively, a quota system could be applied.

- **Artisanal fishing.** The artisanal sector should be the object of joint management involving local Fishing Councils. The Fishing Councils could represent either all species or species selected according to the situation and the need for coordinating with protected marine areas. The initiatives of the Fishing Councils will be sent once per year to the local Councils, who will transform them into annual management plans and request approval from the Ministry. This measure should be combined with measures to improve protection for protected marine areas, which will require more cooperation between the MEMTMI and the MEPNBRLA. Given Senegal’s lack of experience in joint management and the uncertain implications on the sociopolitical and institutional levels, a pilot approach would be most appropriate for developing and testing such a system.

470. **Introducing two systems.** The strategy recommends that a number of parallel actions be considered for introducing these two systems:

- Creating annual management plans for industrial fishing that would incorporate a two-step approach (permits and quotas) and measures to reduce and restructure the fishing fleet, which would possibly include compensation schemes such as the ones planned by the GIRMaC Project.

- Adjusting the legal and regulatory framework to allow Local Committees to operate effectively and legally. Past experience with local management of fishing at Kayar and Fass Boye ran into administrative and legal problems.57

- Developing fishing research capacity both nationally and along the coasts, and improving coordination between the Cellule d’Étude et de Planification du MEMTMI (CEP) and the Centre de Recherches Océanographiques de Dakar, Thiaroye (CRODT).

- Coordinating with international donor agencies to achieve consensus for planning aid from the World Bank and the FEM (GIRMaC), the African Development Bank, DFID, Japan, France, and other initiatives that support the introduction of local joint management.

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57. At Kayar, the activities of a local fishing committee aiming to protect the resources of one sector and block other fishermen was the object of a legal remedy by industrial fishermen. The court decided that such activities were illegal.
• Introducing a long-term program to improve the effectiveness of fishing, landing, transformation, market launch, and exportation of artisanal fishing.

• Retraining artisanal and industrial fishermen through existing social programs and institutions as a pilot project.

471. **Quota system.** The strategy presupposes that implementation of a quota system will be more likely to succeed if it is based on participation by the various concerned actors. It proposes various measures to encourage participation, including strengthening the role of the *Conseil National Consultatif pour les Pêches Maritime* (CNCPM) regarding the MEMTMI and professional organizations.

472. **Quotas and permits.** The strategy suggests that granting quotas and permits be led by an independent organization according to a plan approved by the Department. Moreover, a Fisheries Management Fund could be set up to ensure that the “critical functions of fisheries management” that benefit the private sector would be financed regularly. These include routine fisheries research such as the preparation of annual management plans and follow-up, checking, and monitoring functions.

473. **Exploiting sustainable products.** In the long term, the Strategy suggests that development of a sustainable artisanal industry might find a niche in international markets, where “sustainable” products benefit from added value. Fish processing should be studied to reorient its activities to the needs of global markets that have changed over the past 30 years (a preference for fresh and frozen over tinned food, vertical integration of the industry).

### 2.4.5 Letter of Sectoral Policy on Fisheries and Aquaculture (2007)

474. **Rethinking fisheries development.** The new Letter of Sectoral Policy on Fisheries and Aquaculture (MEMTMI, 2007) moves toward reevaluating development options, promoting fish farming, and improving the transformation of fish products. This new policy is based on the need to adapt to the economic and socioeconomic crisis that is affecting the fisheries sector, communities, and the national economy.

475. **The observed reduction in fish catches** (demersals in particular) and exports of fish products is mainly linked to poor fisheries practices and overcapacity that have led to overfishing and a reduction in fish stocks (MEMTMI, 2007). Constraints in the fisheries sector are linked to a number of factors, including:

- Problems related to sustainable management and restoration of fish stocks;
- Low capacity for regulation in the sector;
- Satisfying the needs of people, industry, and external markets for fish products without increasing pressure on existing resources;
- Problems related to optimal transformation of resources;
- Weaknesses in organization, analysis, and decision making of professionals in the sector;
• Lack of communication between actors in the sector; and
• Absence of an appropriate funding mechanism for sector activities.

476. **Urgent reforms needed.** The sum of these constraints illustrates the need for urgent reforms to the fisheries sector. The government’s objective is “to ensure a sustainable management of fisheries by prioritizing the restoration of fish stocks in order to restore the value added that has been largely dissipated” and stimulate and promote development of fish farming (MEMTMI, 2007). The application of this new policy is mainly based upon six strategic objectives:

• Ensure sustainable development and restoration of fish stocks while maintaining their economic viability.
• Satisfy national demand for fish products by promoting continental fishing and fish farming and reducing post-capture losses.
• Improve transformation of fish products and modernize artisanal fishing by developing fish processing facilities and improving commercialization and product marketing. The government intends to bring industrial fishing companies up to standards, upgrade and restructure the industry, promote redevelopment of the industrial sector, provide incentives for unloading catches, and redevelop the tuna sub-sector.
• Promote higher professional standards and qualifications among all actors by initiating training programs related to sustainable management of fish stocks, responsible fishing practices, safety, managing hygiene and quality of fish products, and acquiring the necessary knowledge base for each of the professions involved.
• Improve funding mechanisms for fishing and fish farming by providing sector professionals with adapted financial instruments, including the use of microcredit for artisanal fishing and longer-term credit for the industrial sector.
• Reinforce regional and sub-regional cooperation in the fisheries sector.

2.4.6 **Recently Introduced Reforms**

477. **The Senegalese Government has been introducing reforms** since 2005 to reorient the sector and promote resource renewal. These reforms are centered on:

• Freezing industrial fisheries licenses for demersal coastal resources and freezing the licensing of foreign boats. In 2005, 160 ships were authorized to fish in the Senegalese Exclusive Economic Zone (EEZ), and 121 of these were Senegalese (Birame Sene, 2006).
• Introduction of temporary bans on the basis of the CRODT's recommendations (temporary ban periods were observed by industrial trawler fishing to allow certain species to recover).
• Introduction of an artisanal fishing permit in October 2006 with the participation of professional organizations (Zantou, 2005).

• Retraining fishermen wanting to leave the sector. In 2005, a study by the African Development Bank drew up a training plan for fishermen aimed at the commercial, agricultural, and market gardening sectors (Zantou, 2005).

• Increase EEZ monitoring capacity (purchase of speedboats and an aircraft).

• Measures to reduce capacity and modernize industrial processing. In 2005, 57 industrial businesses were surveyed, of which 11 were suspended for non-compliance with sanitation regulations or termination of activity (Birame Sene, 2006).

• Measures to promote artisanal processing with local co-management and proper sanitation (introduce fish processing and sale centers managed by local communities).

• Promotion of aquaculture and continental fishing.

• Introduction of artificial reefs.

478. **Balance in the fisheries sector.** In 2005, the MEMTMI issued an Action Plan for Continental Fisheries and Aquaculture covering 2005-2010. Evaluation of efforts to promote the sector started in 2001 and identified these problems: (i) lack of technical follow-up for aquaculture projects; (ii) organizational difficulties with artisanal actors and continental fishermen; and (iii) a lack of incentives for industrial aquaculture. The status report indicated that the main aquaculture species were tilapia and mangrove oyster, and the industry produced 150,000 tons of fish per year. The 2005-2010 Action Plan integrates the policy for sustainable management of natural resources defined by the NEPAD and aims for sustainable development of continental fisheries and artisanal, semi-industrial, and industrial aquaculture. From now until 2010, Senegal foresees the development of 7,500 fish ponds, and some development work has recently begun. The 2005-2010 Action Plan identified the need for diversified aquaculture practices such as the development of marine aquaculture. Further studies are necessary, and development of a marine aquaculture station was planned for 2006.

479. **Network of protected marine areas.** In addition, a presidential decree in 2005 established a network of protected marine areas to help replenish stocks (World Bank, 2006). In 2006, the Senegalese Government was engaged in renegotiating its fisheries agreements with the European Community.

**2.4.7 Lessons Learned**

480. **Balance in the fisheries sector.** Through its Fisheries Sector Strategy and its Letter of Sectoral Policy on Fisheries and Aquaculture, the MEMTMI is seeking to strike a balance between avoiding a collapse of the country’s maritime fish stocks and a consensus from the main actors in the national fisheries industry. Unfortunately, questions can be raised on the effectiveness of the solutions considered in the Strategy.
and the Policy for slowing the decline of fish stocks. Though many of the measures are a step in the right direction, their scope remains modest. The measures introduced since 2005 to reorient the sector seem even more centered on modernizing infrastructure and promoting the artisanal sector than reducing fisheries efforts.

481. **Create an appropriate strategy.** In this context, the only option to avoid a crisis is to forget old attitudes and behaviors and commit to a path of sustainable development in a sector where sociopolitical costs are the major constraint. The main challenge is to reconcile ecosystem-related concerns with the social and economic effectiveness of fisheries activities using an appropriate strategy based on a fisheries management system. The priority should be to attack overfishing and over-capacity, which appear to be the main causes of problems with the Senegalese marine environment. Indeed, management and conservation strategies can be effective only when fishing capacity and access to resources are controlled and managed effectively.

482. **The solution is to adopt effective management and conservation approaches** based on participation and increased responsibility by fishing communities, as well as models for joint resource management, planning development, and adopting ecosystem-based management to integrate the principles of sustainable management and conservation. Wherever possible, the use of protected marine areas and other measures (such as artificial reefs) will be encouraged to preserve fish breeding, growth, and nursery sites by restricting fishing in specific zones or seasons.

483. **Management tools.** National and local fisheries development plans will provide tools to manage fisheries capacity and conserve critical marine and coastal habitats. These plans should balance fisheries capacity and exploited resources, and allow management through targeted permits and licenses for industrial and artisanal fishing.

484. **Joint management system.** The integration of sustainable resource management and conservation of coastal marine ecosystems could likewise be done through a local joint management system based on granting access and usage rights. The global management system that will be implemented through this approach will encourage actions that aim for better conservation of the marine ecosystem (eco-labels on products, responsible fisheries technologies and practices, etc.).

485. **New framework.** This management system will require a new administrative institutional framework, cooperation, and sector management. The same applies for promulgation of new legal frameworks (adaptation of the Maritime Fisheries Code, development of a Framework Law on Biodiversity, etc.). This requires clarification of responsibilities of the relevant ministries (*Ministère de l’Environnement, Ministère de l’Économie Maritime*). The ministries and other organizations must additionally place a priority on rehabilitating the ecology of the Senegal River delta, in particular flood phenomena, to increase fishing productivity by protecting and expanding reproduction and nursery zones for numerous species of fish and shrimp.

486. **Aquaculture development.** Marine and continental aquaculture development is the other current priority of the *Ministère chargé de la pêche*, Key environmental
considerations that might accompany aquaculture projects (salinization, chemical fertilizers, hormone-based food additives, antibiotics, etc.) will encourage responsible and sustainable models that respect aquatic and soil environments.

487. **Intensive aquaculture is destructive to coastal marine zones**, including mangrove forests. It is strongly recommended that all aquaculture project studies consider sustainable development and preservation of the environment. Models that study species introduction must consider ecological risk and the long-term consequences. It is of utmost priority for Senegal, whose aquaculture development is still in its infancy, to develop a code of good aquaculture practices based on lessons learned from broad experience in Asia and South America.

### 2.5 Public Health and Environmental Degradation in Dakar

#### 2.5.1 Public Health Costs of Environmental Degradation

488. **Major health threats.** Urban air pollution, inadequate potable water and sanitation, and water management that increases the risk of malaria are three major health threats related to environmental conditions in urban areas of Senegal and Dakar in particular. Health data on children under five-years-old indicate that the incidence of some of the diseases related to these environmental conditions is higher in greater Dakar than in urban areas as a whole and in Senegal. The Senegal DHS 2005 survey showed that the two-week prevalence of ARI was 21 percent in Dakar, 16.3 percent in urban areas (including greater Dakar) and 13.2 percent for Senegal as a whole. Prevalence of diarrheal diseases was 27.9 percent in greater Dakar, 22.2 percent in urban areas, and 22.3 percent for Senegal as a whole. The survey also shows the prevalence of fever with convulsions to be 34.7 percent for Dakar, 30.4 percent for urban areas, and 29.8 percent for Senegal as a whole (although such symptoms include malaria, they also include a broader spectrum of diseases). Survey results thus point out the negative health effects of living in an urban area, an impact which is more severe in Senegal’s largest city.

#### 2.5.1.1 Urban air pollution

489. **Health concerns about air pollution.** The WHO World Health Report 2002 states that “recent epidemiological studies, using sensitive designs and analyses, have identified serious health effects of combustion-derived air pollution even at the low ambient concentrations typical of Western European and North American cities. At the same time, the populations of the rapidly expanding mega-cities of Asia, Africa and Latin America are increasingly exposed to levels of ambient air pollution that rival and often exceed those experienced in industrialized countries in the first half of the 20th century.” The World Health Report explains that urban air pollution is the result of the combustion of fossil fuels for transport, industry, power generation, and other human activities, producing a mixture of pollutants that “comprises both primary emissions, such as diesel soot particles and lead, and the products of atmospheric transformation, such as ozone and sulfate particles formed from the burning of sulfur-containing fuel.” Air pollution is measured by ambient particulate matter (PM) emitted by industry and transportation or
resulting from the reaction of SO$_2$ and NO$_x$ with other pollutants (Senegal has been using lead-free gasoline since 2005).

490. **Death from air pollution.** The WHO report says that globally, ambient air pollution causes about 5 percent of tracheal, bronchial, and lung cancer; 2 percent of cardiopulmonary deaths; and about 1 percent of respiratory infection deaths. These percentages, especially for cardiopulmonary deaths, are much higher in urban areas and in cities with above average pollution levels.

491. **Effects of particulate matter.** The 2002 National Census showed that greater Dakar had 53 percent of the urban population of Senegal. Besides greater Dakar, Senegal has four urban centers (population over 100,000) with high levels of urban air pollution — Kaolack (250,000), Saint-Louis (256,000), Thies (562,000), and Ziguinchor (192,000). Table 2.10 shows the level of ambient concentration of PM10. Particulate matter of less than 10 microns (PM10) has the most important health effects because it is small enough to be inhaled into the lungs. Within that category, particulate matter of less than 2.5 microns (PM2.5) has even more serious health effects. The WHO report uses estimates from World Bank modeling of ambient air pollution in world cities with populations of more than 100,000 people (http://www.worldbank.org/nipr/Atrium/mapping.html). The modeling is based on energy consumption, atmospheric and geographic factors, city and national population density, local urban population density, local intensity of economic activity, and other factors (Ostro, 2004).

![Figure 2.7 Concentration of PM10 (micrograms/m$^3$) in Senegal cities, 2004](http://www.worldbank.org/nipr/Atrium/mapping.html)

492. **Particulate matter in Dakar.** For 2004, the model estimates the ambient concentration of PM10 at 68 micrograms per cubic meter in Dakar. Based on a conversion factor of 0.5, a PM10 level of 68 is equivalent to a PM2.5 level of 34. In estimates of health effects, a background level or lower threshold level of 7.5 is assumed for PM2.5 (Ostro, 2004).

493. **Actual measurements.** The on-going CÉTUD-NILU project (Sivertsen et al., 2005) will provide the ambient concentration of PM10 based on actual measurements. This project has already provided on-site measurements at different points and different times in Dakar, but the project has not yet provided final results. There is a high range between the different measurements taken so far (short-duration measurements taken in
different zones of Dakar between October 2005 and January 2006 vary from 160 to 300 micrograms per cubic meter) and in the absence of a single representative value for Dakar, the estimate of the World Bank will be used.

DOSE-RESPONSE COEFFICIENTS

494. The impact on morbidity and mortality of ambient air pollution is estimated through a set of dose-response coefficients that have been estimated by scientific analysis in recent years. Pope et al. (2002) measured the impact of the ambient level of PM2.5 on cardiopulmonary and lung cancer deaths. Dose response coefficients from Ostro (1994) and Abbey et al. (1995) have been applied for morbidity effects, linking the ambient level of PM10 to chronic bronchitis among adults (Abbey et al., 1995); respiratory hospital admissions, emergency room visits, restricted activity days, lower respiratory illness in children, and respiratory symptoms among adults (Ostro, 1994). All these health endpoints have an impact for on-going years except chronic bronchitis, whose impact is on average over a period of 20 years.58 The dose-response coefficients for mortality and morbidity impacts of air pollution are given in Table 2.10.

<table>
<thead>
<tr>
<th>Annual health effects</th>
<th>Dose-response coefficient</th>
<th>Per 1 µg/m³ ambient concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (percent change in cardiopulmonary and lung cancer mortality, age 30+)</td>
<td>0.80% PM 2.5</td>
<td></td>
</tr>
<tr>
<td>Chronic bronchitis (percent change in annual incidence, age 30+)</td>
<td>0.90% PM 10</td>
<td></td>
</tr>
<tr>
<td>Respiratory hospital admissions (per 100,000 population)</td>
<td>1.2 PM 10</td>
<td></td>
</tr>
<tr>
<td>Emergency room visits (per 100,000 population)</td>
<td>24 PM 10</td>
<td></td>
</tr>
<tr>
<td>Restricted activity days (per 100,000 adults, age 15+)</td>
<td>5750 PM 10</td>
<td></td>
</tr>
<tr>
<td>Lower respiratory illness in children (per 100,000 children)</td>
<td>169 PM 10</td>
<td></td>
</tr>
<tr>
<td>Respiratory symptoms (per 100,000 adults)</td>
<td>18,300 PM 10</td>
<td></td>
</tr>
</tbody>
</table>

Source: Pope et al. (2002) for the mortality coefficient; Ostro (1994) and Abbey et al. (1995) for the morbidity coefficients.

IMPACT ON MORTALITY

495. Estimates of the impact of ambient PM2.5 on cardiopulmonary and lung cancer mortality were based on these estimates:

- Population by age groups in greater Dakar by using the age distribution in urban Senegal from the Senegal DHS, 2005.
- Number of deaths in greater Dakar per age group by using the death rate by age group according to WHO life tables for Senegal.

58. For morbidity, it must be noted that “compared to the mortality findings, there is a greater degree of uncertainty when morbidity findings are extrapolated to developing countries, since estimation requires both a concentration-response function and a baseline incidence rate” (Ostro, 2004).
Number of deaths in greater Dakar due to CP and LC (cardiopulmonary diseases and lung cancer) by applying to the total number of deaths the proportion of CP and LC deaths by age group in the WHO “AFRO D” sub-region (countries with high mortality of children and adults), to which Senegal belongs.

Applying the PM2.5 levels in greater Dakar and the dose-response coefficient to the number of deaths due to CP and LC gives an estimate for the number of those deaths due to ambient PM2.5 in Dakar, nearly 1,100 deaths per year in 2004 (Table 2.11).

IMPACT ON MORBIDITY

Chronic bronchitis. The impact of ambient PM10 on the incidence of chronic bronchitis is measured by applying the dose-response coefficient to the incidence of chronic bronchitis as estimated by the incidence rates for AFRO D countries given in Shibuya et al. (2001). They estimated incidence rate by age group over 30, for both sexes. These incidence rates were applied to the age groups of the Dakar population over 30 in 2004 for a total of 794 cases. Applying the dose-response coefficient of 0.9 percent per 1 microgram per cubic meter to the present level of 68 micrograms per cubic meter of PM10 (Abbey et al., 1995) gives a total of 300 cases of chronic bronchitis per year attributable to urban air pollution in Dakar.

<table>
<thead>
<tr>
<th>Health end-points</th>
<th>Cases caused by urban air pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature mortality (age 30 +)</td>
<td>1,060</td>
</tr>
<tr>
<td>Chronic bronchitis (age 30 +)</td>
<td>300</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>1,900</td>
</tr>
<tr>
<td>Emergency room and outpatient hospital visits</td>
<td>38,000</td>
</tr>
<tr>
<td>Restricted activity days (age 15 +)</td>
<td>5,644,690</td>
</tr>
<tr>
<td>Lower respiratory illness in children (under age 15)</td>
<td>101,688</td>
</tr>
<tr>
<td>Respiratory symptoms (age 15 +)</td>
<td>17,964,839</td>
</tr>
</tbody>
</table>

Hospital admissions. Medical research has also linked the number of hospital admissions (for all age categories) to ambient PM10. A dose-response coefficient of 1.2 (Ostro, 1994) for each 100,000 population has been estimated for each microgram per cubic meter of PM10. Thus the estimated level of 68 micrograms per cubic meter of PM10 in Dakar would account for 1,900 hospital admissions per year.

Emergency room and outpatient hospital visits. The number is related to urban air pollution through a dose-response coefficient of 24 per 100,000 population (Ostro, 1994), which is equivalent to 38,000 such visits per year for the population of Dakar in 2004.

Restricted activity days. The number of restricted activity days is related to urban air pollution through a dose-response coefficient of 5,750 per 100,000 adults (age 15 +) (Ostro, 1994), which is equivalent to 5.6 million days for the population of Dakar in 2004.
501. **Lower respiratory illness in children.** Lower respiratory illness in children (under 15) caused by ambient air pollution is estimated at 169 cases per 100,000 population, equivalent to about 100,000 cases in 2004 for Dakar.

502. **Respiratory symptoms.** Respiratory symptoms among adults (age 15 +) caused by ambient air pollution is estimated at 18,300 per 100,000 population, equivalent to about 18 million cases in 2004 for Dakar.

**COST OF HEALTH IMPACT**

503. The health effects of urban air pollution are an economic loss for Senegal, either through lost contributions from people who die or from willingness to pay to reduce the risk of death, as well as the cost of morbidity. The cost of morbidity includes medical treatment, value of time losses, and a measure of the willingness to pay to avoid the disease. Willingness to pay to avoid disease includes a monetary measure of the effect on people of pain, suffering, and inconvenience. In the absence of a measure of willingness to pay to avoid disease in Senegal, the report uses the indicator of burden of disease used by WHO, the Disability Adjusted Life Year (DALY), valued at GDP per capita, as an indication of the cost of pain, suffering, and inconvenience (Table 2.12). The DALY takes into account factors such as age, duration of the disease, and the level of disability.

504. **Cost of mortality.** Two approaches are used to value a person’s premature death:

- The Human Capital Approach (HCA), based on the present value of what a person would have normally produced if her life had not been taken by disease; and
- The Value of Statistical Life (VSL) which is based on the valuation of mortality risk.

<table>
<thead>
<tr>
<th>Annual health effect</th>
<th>Disability weight</th>
<th>Number</th>
<th>Unit</th>
<th>DALYs/10,000 cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic bronchitis</td>
<td>0.2</td>
<td>20</td>
<td>years</td>
<td>32,536</td>
</tr>
<tr>
<td>Respiratory hospital admissions</td>
<td>0.4</td>
<td>14</td>
<td>days</td>
<td>234</td>
</tr>
<tr>
<td>Emergency room visits</td>
<td>0.3</td>
<td>5</td>
<td>days</td>
<td>63</td>
</tr>
<tr>
<td>Restricted activity days</td>
<td>0.1</td>
<td>1</td>
<td>days</td>
<td>4</td>
</tr>
<tr>
<td>Lower respiratory illness in children</td>
<td>0.28</td>
<td>10</td>
<td>days</td>
<td>85</td>
</tr>
<tr>
<td>Respiratory symptoms</td>
<td>0.05</td>
<td>0.5</td>
<td>days</td>
<td>1</td>
</tr>
</tbody>
</table>

a. DALYs are calculated using age weighting for relevant age interval

*Source:* Disability weights and duration are from Larsen and Strukova (2005)
<table>
<thead>
<tr>
<th>Cost data for all health end-points</th>
<th>Baseline</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic cost of hospitalization (FCFA per day)</td>
<td>62,500</td>
<td>a</td>
</tr>
<tr>
<td>Economic cost of emergency visit (FCFA) – urban</td>
<td>25,000</td>
<td>a</td>
</tr>
<tr>
<td>Economic cost of doctor visit (FCFA) (mainly private doctors) – urban</td>
<td>16,000</td>
<td>a</td>
</tr>
<tr>
<td>Value of time lost to illness (FCFA per month)</td>
<td>44,000</td>
<td>75 percent average monthly labor income in Dakar, 58,000 FCFA for 2001-2002 according to UEMOA, adjusted for inflation</td>
</tr>
<tr>
<td>Value of time lost to illness (FCFA per day)</td>
<td>2,031</td>
<td>44 000 / number of work days</td>
</tr>
<tr>
<td>GDP (billion FCFA)</td>
<td>3,815</td>
<td>b</td>
</tr>
<tr>
<td>Population - Senegal</td>
<td>10,564,303</td>
<td>Annuaire statistique 2004, Ministère de la Santé</td>
</tr>
<tr>
<td>GDP per capita (FCFA)</td>
<td>361,160</td>
<td>GDP / population</td>
</tr>
<tr>
<td>Rate of exchange (FCFA/USD)</td>
<td>528</td>
<td>Based on a fixed rate of 655.96 FCFA/euro and average rate of exchange for euro in 2004 (<a href="http://fxtop.com/fr/historates.php3">http://fxtop.com/fr/historates.php3</a>)</td>
</tr>
<tr>
<td>GDP per capita (USD)</td>
<td>684</td>
<td></td>
</tr>
<tr>
<td>Rate of increase, real income per capita</td>
<td>2.4%</td>
<td>b</td>
</tr>
<tr>
<td>Chronic bronchitis (CB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average duration of Illness (years)</td>
<td>20</td>
<td>Based on Shibuya et al. (2001)</td>
</tr>
<tr>
<td>Percent of CB patients being hospitalized per year</td>
<td>1.5%</td>
<td>c</td>
</tr>
<tr>
<td>Average length of hospitalization (days)</td>
<td>10</td>
<td>c</td>
</tr>
<tr>
<td>Average number of doctor visits per CB patient per year</td>
<td>1</td>
<td>c</td>
</tr>
<tr>
<td>Percent of CB patients with an emergency doctor/hospital outpatient visit per year</td>
<td>15%</td>
<td>c</td>
</tr>
<tr>
<td>Estimated lost work days (including household workdays) per year per CB patient</td>
<td>2.6</td>
<td>Estimated based on frequency of doctor visits, emergency visits, and hospitalization</td>
</tr>
<tr>
<td>Annual real increases in economic cost of health services and value of time (real wages)</td>
<td>2%</td>
<td>Estimate</td>
</tr>
<tr>
<td>Annual discount rate</td>
<td>3%</td>
<td>Applied by WHO for health effects</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average length of hospitalization (days)</td>
<td>6</td>
<td>Survey of Dakar hospitals</td>
</tr>
<tr>
<td>Average number of days lost to illness (after hospitalization)</td>
<td>4</td>
<td>Survey of Dakar hospitals</td>
</tr>
<tr>
<td>Emergency room visits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average number of days lost to illness</td>
<td>2</td>
<td>Larsen and Strukova (2005).</td>
</tr>
<tr>
<td>Restricted activity days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average number days of illness (per 10 cases)</td>
<td>2.5</td>
<td>Larsen and Strukova (2005).</td>
</tr>
</tbody>
</table>
Table 2.13 Baseline data for cost estimates (continued)

<table>
<thead>
<tr>
<th>Cost data for all health end-points</th>
<th>Baseline</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower respiratory illness in children</td>
<td>1</td>
<td>Survey of Dakar hospitals</td>
</tr>
<tr>
<td>Number of doctor visits</td>
<td>1</td>
<td>Larsen and Strukova (2005).</td>
</tr>
<tr>
<td>Total time of care giving by adult (days)</td>
<td>1</td>
<td>Larsen and Strukova (2005).</td>
</tr>
</tbody>
</table>

a. Per consultations with medical service providers, and health authorities. This cost is weighted to take into account that according to Annuaire statistique du Ministère de la Santé (2004), in Dakar hospitals revenue covers 24 percent of costs.

b. BAD - Document de Stratégie par Pays (Axé sur les Résultats) 2005-2009

c. From Schulman et al. (2001) and Niederman et al (1999) (study on North America and Europe)

505. **Human Capital Approach.** The HCA approach gives a lower bound to the estimate of the value of a person’s life, while the VSL approach gives an upper bound. The following formula defines the average loss of economic contribution for each death:

\[
P V_0 (I) = \sum_{i=k}^{n} \frac{I_0 (1 + g)^i}{(1 + r)^i}
\]

506. where \( PV_0 (I) \) is the present value of income (I) in year 0 (year of death), \( g \) is annual growth rate of real income, and \( r \) is the discount rate (rate of time preference). As can be seen from (1), the equation allows for income to start from year \( k \), and ending in year \( n \).

507. **Cost of deaths.** In Dakar, the estimated average number of years lost to CP and LC is 11.6 years (based on WHO life tables for Senegal), real growth income estimated at 2 percent, a discount rate of 3 percent, and income measured as GDP per capita of 360,160 FCFA. The annual cost of mortality due to CP and LC caused by urban air pollution in Dakar estimated with HCA is 4.0 million FCFA per case. If based on HCA, the cost for the 1,057 cases due to urban air pollution is 4.2 billion FCFA.

508. **Value of Statistical Life.** VSL is based on revealed preference for avoiding the risk of losing one’s life. It has been estimated at US$ 1.5 and 2.5 million in high income countries (Larsen and Strukova, 2005). This kind of revealed preference has not been measured for Senegal, so a proxy is used by assuming VSL will be proportionate to the income level. The average GDP per capita in high income countries is estimated at US$ 30,000, while it is 361,160 FCFA in Senegal, based on an exchange rate of 528 FCFA per 1 dollar and assuming an income elasticity of one, VSL in Senegal is estimated at between 18 and 30 million FCFA, averaged at 24 million FCFA per case. Based on VSL, the cost for the 1,057 cases due to urban air pollution is 25.4 billion FCFA.

**COST OF MORBIDITY**

509. **Chronic bronchitis** has an average duration of 20 years during which each year the patient will have one visit to the doctor, 15 percent of patients will have an emergency doctor/hospital outpatient visit, and 1.5 percent of patients will be
hospitalized for an average period of 10 days. Time losses related to medical treatment are estimated at an average of 2.6 lost work days per CB patient per year. Based on the unit costs explained in the baseline data table for cost estimates, each new case of chronic bronchitis represents an annualized cost of 600,000 FCFA. If the disease burden has a disability weight of 0.2 over a period of 20 years, each new case represents 3.25 DALY, for a cost of 1.2 million FCFA. Thus, the cost of morbidity related to the 300 cases of chronic bronchitis caused by urban air pollution is estimated to be 546 million FCFA.

510. **Hospital admissions** caused by urban air pollution last an average of six days. In addition to the cost of treatment, each hospitalization is a loss of four days in addition to the days of hospitalization. The cost is thus measured at 0.4 million FCFA per case. With a disability weight of 0.4 and an average duration of 14 days, the disease burden for hospitalization is 234 DALYs per 10,000 cases, estimated at 8,438 FCFA per case. Thus, the cost of morbidity related to 1,900 cases of hospital admissions caused by urban air pollution is estimated to be 767 million FCFA.

511. **Emergency room visits and outpatient hospital visits** have a treatment cost of 25,000 FCFA and an average time loss of two days, equivalent to a cost-of-illness per case of 29,000 FCFA. With a disability weight of 0.3 and an average duration of illness of five days, the disease burden is measured as 63 DALYs per 10,000 cases, valued as 2,261 FCFA. Thus the total cost of 38,001 cases related to urban air pollution is estimated at 1,189 million FCFA.

512. **Restricted activity days (RAD)** due to urban air pollution have been estimated to 2.5 days per 10 cases. The estimated 5,644,690 cases of RAD is 2,866 million FCFA. With a disability weight of 0.1, the disease burden of 5,644,690 RAD is valued at 763 million FCFA. Total cost of RAD is 3,629 million FCFA.

513. **Lower respiratory illness in children under 15.** For the reference year, it is estimated that urban air pollution caused 101,688 cases of lower respiratory illness in children under 15. Each case is expected to require an average of one visit to the doctor per year, at a cost of 16,000 FCFA, for a total treatment cost of 1,627 million FCFA. The time loss is estimated at one day per year, for a total cost of 204 million FCFA. With a disability weight of 0.28 and average duration of 10 days, each case of lower respiratory illness in children represents 85 / 10,000 of DALY. The disease burden of 101,688 cases of lower respiratory illness in children is thus valued at 311 million FCFA and the total cost at 2,142 million FCFA.

514. **Respiratory symptoms (15 +).** Urban air pollution in Dakar is said to be responsible for a total of 18 million cases of respiratory symptoms among adults (15 +). Neither cost for treatment nor cost for time losses is associated to these symptoms. With a disability weight of 0.05 and average duration of 0.5 days, each case of respiratory symptoms in adults represents 1/10,000 of DALY. The disease burden (and total) cost of 18 million cases of respiratory symptoms in adults is thus valued at 607 million FCFA.

515. **Total cost of morbidity.** Table 2.14 sums up the cost of morbidity related to urban air pollution for different health end-points. The total cost of morbidity is 8.9
billion FCFA per year. Restricted activity days and lower respiratory illness in children are the two highest costs due to the high number of cases, and for lower respiratory illness in children, the cost of treatment is also high. The cost of illness, including treatment and time lost, is 76 percent of the health cost and the disease burden is 24 percent.

**TOTAL HEALTH COST**

Adding the cost of morbidity to the cost of mortality attributable to urban air pollution yields a total annual cost of 13 billion FCFA when mortality is valued using the human capital value, or 34 billion FCFA when mortality is valued using value of statistical life (Table 2.15). With the minimum (HCA) approach, the cost of mortality is 32 percent of the total. With the maximum (VSL) approach, the cost of mortality is 74 percent of the total.

<table>
<thead>
<tr>
<th>Table 2.14 Cost of morbidity caused by urban air pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health end-points</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Chronic bronchitis (age 30+)</td>
</tr>
<tr>
<td>Hospital admissions</td>
</tr>
<tr>
<td>Emergency room and outpatient hospital visits</td>
</tr>
<tr>
<td>Restricted activity days (age 15+)</td>
</tr>
<tr>
<td>Lower respiratory illness in children (under 15)</td>
</tr>
<tr>
<td>Respiratory symptoms (age 15+)</td>
</tr>
<tr>
<td>Total cost of morbidity (million FCFA)</td>
</tr>
<tr>
<td>Cost of illness and disease burden (percent of total)</td>
</tr>
</tbody>
</table>

*a. DALYs per case valued at GDP per capita.*

<table>
<thead>
<tr>
<th>Table 2.15 Total health cost of urban air pollution (billion FCFA)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health end-point</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Mortality</td>
</tr>
<tr>
<td>Morbidity</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

*a. Cost of mortality is estimated using HCA. b. Cost of mortality is estimated using VSL.*
IMPACT OF URBAN AIR POLLUTION ON OTHER SENEGALESE URBAN CENTERS

517. The impact of urban air pollution on health costs estimated for Dakar can be used to estimate the health impact in other Senegalese urban centers to the extent that the parameters of the cost of illness and disease burden are similar. This impact in other Senegalese urban centers would be proportional to their population and their ambient level of PM10.

2.5.1.2 Water supply, sanitation, and hygiene

518. Lack of an adequate water supply, sanitation, and hygiene are responsible for most cases of diarrheal morbidity and mortality (Pruss et al., 2002). Diarrheal diseases are not the only illnesses caused by these problems, but they are the most widespread. Children under the age of five are particularly vulnerable to diarrheal diseases.

519. Among 11 regions in Senegal, greater Dakar has the second highest incidence of diarrhea in children under five, with 27.9 percent of children having had a diarrheal episode during the two-week period preceding the survey, while Kolda, Thiès, and Ziguinchor had the lowest incidence with rates between 16 and 17 percent (Senegal DHS, 2005).

520. Morbidity and mortality are considered in the cost assessment of diarrheal diseases related to urban environmental risk factors. According to WHO statistics, about 90 percent of diarrheal disease and diarrheal mortality in children under five is from inadequate water, sanitation, and hygiene in AFRO D countries. Health effects are considered for the mortality and morbidity of children under five, morbidity for children five to 14, and morbidity for the population 15 and older.

IMPACT ON MORTALITY

521. In 2005, in greater Dakar an estimated 4,360 children under five died. This is based on an under-five child mortality rate of 69 per 1,000 live births. Applying the 14.8 percent of children under five who died due to diarrheal diseases in WHO AFRO D countries, the number of under-five deaths due to diarrheal diseases in greater Dakar for that year was 646. Applying the WHO percentage of 90 percent of diarrheal illness due to an unsafe water supply, poor sanitation, or insufficient hygiene, there were 582 deaths.

IMPACT ON MORBIDITY

522. Impact on morbidity is based on two sources — the Senegal DHS 2005 survey, which covers the percentage of children under five with episodes of diarrhea, and the Senegal MoH report for 2004, which gives the number of diarrhea cases treated at health

59. The Senegal DHS 2005 reports under-five child mortality rates in each region of Senegal for the preceding 10-year period. These figures were adjusted to arrive at an estimated under-five child mortality rate in greater Dakar in 2005.

60. It is assumed that the number of cases reported for the two-week period prior to the DHS survey includes episodes that started earlier and ended later than the survey period, and that the number of cases during that period was 26 percent higher than during the rest of the year based on an analysis of DHS household data.
facilities in greater Dakar by age groups and the number of under-five cases treated with ATB (35 percent) — the most serious cases. It has been assumed that 35 percent of children under five taken to health centers for diarrheal episodes were hospitalized.

523. **Four treatment categories.** The number of cases of children under five with diarrheal episodes has been divided into four categories:

- Given ORS or other medication;
- Taken to health centers;
- Hospitalized; and
- Others.

524. Table 2.16 presents cases of diarrheal disease related to unsafe water, inadequate sanitation, and improper hygiene for children. It is assumed that these cases represent 90 percent of all diarrheal cases.

525. **Children under five.** The total number of cases of diarrheal illness among under-five Dakar children in 2005 was estimated at 1.5 million based on the following parameters: Dakar region population (MoH, 2005), percentage of children under five in urban areas (DHS 2005), and the percentage of Dakar under-five children who had diarrhea (DHS, 2005), taking into account seasonal factors. Applying the WHO percentage of 90 percent gives a total of 1.4 million cases attributable to water, sanitation, and hygiene.

526. **Population over five years.** Estimates of morbidity for the over-five population is based on the ratio of over-five to under-five in the number of cases of diarrheal diseases reported in 2004 to Dakar health institutions. Applying this ratio (0.58) to the number of cases for under five gives an estimate of 0.9 million cases for the over-five population, with 0.8 million attributable to water, sanitation, and hygiene. Similar to children under five, the estimated number of diarrheal cases in the over-five population is a multiple of the number of cases reported to health institutions.

**COST OF HEALTH IMPACTS**

527. Health impact includes the cost of mortality of children under five, and the cost of morbidity for children under five and the population of five and older. The cost of morbidity is defined as in Section 2.5.2.2. In this case, the cost of treatment includes medication taken at home, consultation and treatment at health centers (simple cases), and hospitalization (acute cases), as well as the value of time lost.

528. **Cost of mortality.** Only the mortality of children under five is accounted for here with the HCA method. The parameters are that the average age of the child is 2.3 years, and that he or she would make a contribution to society from age 20 to 65 at a value equivalent to the GDP per capita in 2004 of 361,000 FCFA per year. With an assumed growth rate of 2 percent and a discount rate of 3 percent, the value of child mortality is 11 million FCFA. Thus the total cost of mortality for children under five due to diarrheal
attributable to inadequate water, sanitation, and hygiene is estimated at 6,471 million FCFA.

Table 2.16 Morbidity cases attributable to inadequate water supply, sanitation, and hygiene

<table>
<thead>
<tr>
<th>Health end-points</th>
<th>Number of cases</th>
<th>DALYs per 100,000 cases</th>
<th>Total DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children under 5</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines (ORS, etc.)</td>
<td>982,017</td>
<td>31</td>
<td>309</td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>335,697</td>
<td>42</td>
<td>141</td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>8,357</td>
<td>74</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>66,861</td>
<td>31</td>
<td>21</td>
</tr>
<tr>
<td>Sub-total</td>
<td>1,392,932</td>
<td></td>
<td>477</td>
</tr>
<tr>
<td><strong>Children 5 – 14</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines (ORS, etc.)</td>
<td>243,043</td>
<td>101</td>
<td>245</td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>83,083</td>
<td>134</td>
<td>111</td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>2,068</td>
<td>235</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>16,548</td>
<td>101</td>
<td>17</td>
</tr>
<tr>
<td>Sub-total</td>
<td>344,741</td>
<td></td>
<td>378</td>
</tr>
<tr>
<td><strong>Population 15+</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines (ORS, etc.)</td>
<td>332,472</td>
<td>130</td>
<td>433</td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>113,653</td>
<td>174</td>
<td>197</td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>2,829</td>
<td>304</td>
<td>9</td>
</tr>
<tr>
<td>Other</td>
<td>22,637</td>
<td>130</td>
<td>30</td>
</tr>
<tr>
<td>Sub-total</td>
<td>471,591</td>
<td></td>
<td>669</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,209,264</td>
<td></td>
<td>1524</td>
</tr>
</tbody>
</table>

529. **Cost of morbidity.** The cost of treatment for children under five used the Senegal DHS survey of 2005 — 24.1 percent of cases were treated at medical facilities (excluding pharmacies, shops, and traditional healers), and 70.5 percent were treated with medicines (ORS, pills, syrup, injection, home treatment). The proportion of those hospitalized is estimated at 0.6 percent based on the number of children under five treated with ATB in Dakar health institutions. Less than 5 percent of cases (“other”) did not receive treatment. Cases are assumed to last for three days and four for cases taken to health facilities with three additional days for cases of hospitalization. For diarrheal cases in children, time lost for adult caretakers was equivalent to two hours per day, and four hours per day of hospitalization. Time loss per adult diarrheal case was two hours per day and a full day for each day of hospitalization.

530. **Cost of home treatment.** The cost of ORS (or other medication) at home is 400 FCFA. A consultation at a health center costs 6,500 FCFA. The cost of hospitalization is estimated at 12,500 FCFA per day for children 0–14, and at 20,800 FCFA for adults. Other cost parameters appear in Table 2.17. The cost of treatment at home (ORS or other medicines), is added to the cost of treatment at a medical center or hospitalization, which assumes that children are first treated with medication prior to being taken to health centers.
Table 2.17 Baseline data for cost estimates of inadequate water, improper sanitation, and unsafe hygiene

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dakar – Percentage of diarrheal cases treated at medical facilities (under 5)</td>
<td>24.1 percent</td>
<td>EDS, 2005</td>
</tr>
<tr>
<td>Percentage of diarrheal cases treated with ORS or other medication (under 5)</td>
<td>70.5 percent</td>
<td>EDS, 2005</td>
</tr>
<tr>
<td>Average cost of doctor visits (FCFA)</td>
<td>6,500</td>
<td>a</td>
</tr>
<tr>
<td>Average cost of medicines for treatment of diarrhea (FCFA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 15 years, simple case</td>
<td>6,900</td>
<td>b</td>
</tr>
<tr>
<td>Under 15 years, acute case</td>
<td>15,500</td>
<td>b</td>
</tr>
<tr>
<td>Adult 15 + years, simple case</td>
<td>4,100</td>
<td>b</td>
</tr>
<tr>
<td>Adult 15 + years, acute case</td>
<td>32,700</td>
<td>b</td>
</tr>
<tr>
<td>Average cost of ORS per diarrheal case in children (FCFA/.)</td>
<td>400</td>
<td>Brigs et al. (2002)</td>
</tr>
<tr>
<td>Average duration of diarrheal illness in days (children and adults)</td>
<td>3 – 4</td>
<td>Larsen and Strukova (2005).</td>
</tr>
<tr>
<td>Hours per day of care per case of diarrhea in children</td>
<td>2</td>
<td>Larsen and Strukova (2005).</td>
</tr>
<tr>
<td>Hours per day lost to illness per case of diarrhea in adults</td>
<td>2</td>
<td>Larsen and Strukova (2005).</td>
</tr>
<tr>
<td>Value of time lost to illness (FCFA per month)</td>
<td>43,500</td>
<td>c</td>
</tr>
<tr>
<td>Value of time for adults (care giving and ill adults) – FCFA/day</td>
<td>2,008</td>
<td>c</td>
</tr>
<tr>
<td>Value of time for adults (care giving and ill adults) – FCFA/hour</td>
<td>251</td>
<td>c</td>
</tr>
<tr>
<td>GDP per capita (FCFA)</td>
<td>361,160</td>
<td>Year 2004</td>
</tr>
<tr>
<td>Hospitalization rate (percent of all diarrheal cases) – children under 5 years</td>
<td>0.60 percent</td>
<td>Based on percentage of cases brought to health centers and treated with ATB</td>
</tr>
<tr>
<td>Average length of hospitalization (days)</td>
<td>3</td>
<td>Consultation with Dakar hospitals</td>
</tr>
<tr>
<td>Time spent on visits (hours per day)</td>
<td>4</td>
<td>Assumption</td>
</tr>
<tr>
<td>Average cost of hospitalization, children 0 – 14 years, (FCFA per day)</td>
<td>12,500</td>
<td>Consultation with Dakar hospitals</td>
</tr>
<tr>
<td>Average cost of hospitalization, 15 + years (FCFA per day)</td>
<td>20,800</td>
<td>Consultation with Dakar hospitals</td>
</tr>
<tr>
<td>Percent of diarrheal cases attributable to water, sanitation, and hygiene</td>
<td>90 percent</td>
<td>(WHO 2002b)</td>
</tr>
</tbody>
</table>

a. Cost of consulting at private hospital - Hôpital principal de Dakar (other hospitals vary between 2,500 and 6,000 FCFA)
b. Average of Dakar public hospitals surveyed, assumed cost to patient
c. Based on 75 percent average labor income in Dakar, 58,000 FCFA according to UEMOA
### Table 2.18 Cost of morbidity attributed to inadequate water, improper sanitation, and unsafe hygiene

<table>
<thead>
<tr>
<th>Health end-points</th>
<th>Number of cases</th>
<th>Cost of illness</th>
<th>Cost of burden of disease</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cost per case (FCFA)</td>
<td>Total cost (million FCFA)</td>
<td>Cost per case (FCFA)</td>
</tr>
<tr>
<td><strong>Children under 5</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines (ORS, etc..)</td>
<td>982,017</td>
<td>1,906</td>
<td>1,871</td>
<td>114</td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>335,697</td>
<td>15,808</td>
<td>5,307</td>
<td>152</td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>8,357</td>
<td>64,919</td>
<td>543</td>
<td>266</td>
</tr>
<tr>
<td>Other</td>
<td>66,861</td>
<td>1,506</td>
<td>101</td>
<td>114</td>
</tr>
<tr>
<td>Sub-total</td>
<td>1,392,932</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Children 5 – 14</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines (ORS, etc..)</td>
<td>243,043</td>
<td>1,906</td>
<td>463</td>
<td>364</td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>83,083</td>
<td>15,408</td>
<td>1,280</td>
<td>485</td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>2,068</td>
<td>64,519</td>
<td>133</td>
<td>850</td>
</tr>
<tr>
<td>Other</td>
<td>16,548</td>
<td>1,506</td>
<td>25</td>
<td>364</td>
</tr>
<tr>
<td>Sub-total</td>
<td>344,741</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Population 15 +</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines (ORS, etc..)</td>
<td>332,472</td>
<td>1,906</td>
<td>634</td>
<td>471</td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>113,653</td>
<td>12,608</td>
<td>1,433</td>
<td>628</td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>2,829</td>
<td>109,631</td>
<td>310</td>
<td>1,098</td>
</tr>
<tr>
<td>Other</td>
<td>22,637</td>
<td>1,506</td>
<td>34</td>
<td>471</td>
</tr>
<tr>
<td>Sub-total</td>
<td>471,591</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total cost of morbidity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of illness and disease burden (percent)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2.19 Total health cost of water supply, sanitation, and hygiene (billion FCFA)

<table>
<thead>
<tr>
<th>Health end-point</th>
<th>Health cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Billion FCFA</td>
</tr>
<tr>
<td>Mortality</td>
<td>6.5</td>
</tr>
<tr>
<td>Morbidity</td>
<td>12.7</td>
</tr>
<tr>
<td>Total</td>
<td>19.2</td>
</tr>
</tbody>
</table>
The total cost of morbidity of diarrheal cases in the Dakar region attributed to inadequate water, sanitation, and hygiene is estimated at 12 billion FCFA. Children under five account for 63 percent of this total at 8 billion FCFA.

Total health cost. Total annual cost of diarrheal illnesses related to water, sanitation, and hygiene in Dakar is 19 billion FCFA, with 34 percent of this amount related to mortality of children under five and 66 percent to morbidity in a population of all age groups (Tables 2.18 and 2.19).

2.5.1.3 Malaria

A WHO malaria study estimated 1.04 malaria episodes per person per year in urban areas while it is 0.6 for highly endemic rural areas (Korenromp, 2005). Malaria is thus an important factor of morbidity and mortality in greater Dakar and other Senegalese urban areas. The DHS survey of 2005 has shown that 34.7 percent of under-five children in the Dakar region had an episode of fever and convulsions in the two-week period preceding the survey. Using these DHS findings as a basis to measure the incidence of malaria would, however, lead to an overestimate because malaria is not the only cause of fever and convulsions. It was therefore preferred to refer to the incidence reported in a WHO study covering all countries (Korenromp, 2005).

This study gives incidence rates for the three age categories used in this report — under five, 5-14, and over 15. These rates were used to estimate the cost of morbidity, which includes the cost of illness (cost of treatment and value of time lost) and the cost of disease burden. The cost of mortality for under five has been measured because 90 percent of malaria deaths are children in this age group.

IMPACT ON MORTALITY

As seen in previous sections, a total of 4,360 children under five in the Dakar region died in 2005. Applying the WHO AFRO D countries figure of 23.5 percent deaths of children under five due to malaria, the number of malaria deaths in Dakar for that year is estimated at 1,025.

IMPACT ON MORBIDITY

Impact on morbidity is based on the findings of the WHO study on malaria incidence (Korenromp, 2005). The incidence rate is 1.04 episodes per year for children under five in urban areas, 0.59 for children 5–14, and 0.117 for the rest of the population (Table 2.20).

Estimates of DALYs are based on the median of an age group, a disability weight of 0.2, and an episode duration of seven days for simple cases and 12.5 days for severe cases. For each age group, the total number of cases was split into four groups (Table 2.20).
Table 2.20 Morbidity of malaria, Dakar, 2005.

<table>
<thead>
<tr>
<th>Health end-points</th>
<th>Number of cases</th>
<th>DALYs per 10,000 cases</th>
<th>Total DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children under 5</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines only</td>
<td>123,660</td>
<td>127</td>
<td>157</td>
</tr>
<tr>
<td>Cases taken to a medical center - simple</td>
<td>65,604</td>
<td>127</td>
<td>83</td>
</tr>
<tr>
<td>Cases with hospitalization - acute</td>
<td>4,809</td>
<td>227</td>
<td>11</td>
</tr>
<tr>
<td>Other</td>
<td>134,811</td>
<td>127</td>
<td>171</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td>328,884</td>
<td></td>
<td>422</td>
</tr>
<tr>
<td><strong>Children 5 – 14</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines only</td>
<td>125,348</td>
<td>428</td>
<td>536</td>
</tr>
<tr>
<td>Cases taken to a medical center - simple</td>
<td>62,890</td>
<td>428</td>
<td>269</td>
</tr>
<tr>
<td>Cases with hospitalization - acute</td>
<td>4,099</td>
<td>764</td>
<td>31</td>
</tr>
<tr>
<td>Other</td>
<td>141,035</td>
<td>428</td>
<td>603</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td>333,372</td>
<td></td>
<td>1,440</td>
</tr>
<tr>
<td><strong>Population 15 +</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases treated with medicines only</td>
<td>849</td>
<td>553</td>
<td>5</td>
</tr>
<tr>
<td>Cases taken to a medical center - simple</td>
<td>157,135</td>
<td>553</td>
<td>869</td>
</tr>
<tr>
<td>Cases with hospitalization - acute</td>
<td>10,962</td>
<td>987</td>
<td>108</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>553</td>
<td>0</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td>168,946</td>
<td></td>
<td>981</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>831,202</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

538. **Children treated at home.** The percentage of cases treated with medicine at home was estimated on the basis of Dakar region under-five children with fever and convulsions who were treated with anti-malaria medication, which was 37.6 percent (Senegal DHS, 2005).

539. **Malaria in Dakar.** The simple cases treated at health centers and severe cases (hospitalized) were taken from MoH statistics for 2004. The “other” category is a residual. Because of the high number of over-15 cases (simple or acute) taken to the hospital, the number of cases treated at home is the residual value, and the “other” category becomes zero. An estimated 831,202 cases of malaria occurred in Dakar, of which three-quarters were children (0–14).

**COST OF MORTALITY**

540. The HCA method was applied for the cost of mortality of children under five. The parameters include 2.2 as the average age of the child at death, that he or she would make a contribution to society from age 20 to 65 at a value equivalent to the GDP per capita of 361,160 FCFA in 2004. With an assumed growth rate of 2 percent and a discount rate of 3 percent, the value of child mortality is 11 million FCFA. Thus the total cost of mortality for children under five due to malaria was valued at 11.4 billion FCFA.
COST OF MORBIDITY

541. **For all age groups**, cost of morbidity includes a treatment cost for all cases not referred to health centers, estimated at 53 FCFA (Clarke et al., 2003). A cost for medicine of 6,700 FCFA is added for children (5–14) with malaria taken to a health center who are judged to have simple cases. The cost of medicines was 13,900 FCFA for children taken to a health center and judged to have severe cases (hospitalized).

542. **For adults**, the cost of medicines for cases taken to health centers was 4,500 FCFA for simple cases and 10,700 FCFA for severe cases. The (economic) cost of hospitalization was 12,500 FCFA per day for children (0–14) and 20,800 FCFA for adults. Average time of hospitalization was 12.5 days (baseline data are presented in Annexes 1 and 2). The value of time lost was based on two parameters:

- For children, two days of care for cases not hospitalized and four hours per day for each day of hospitalization; and
- For adults, three days lost per case, plus two days for a caretaker for cases not hospitalized; time lost being hospitalized plus four hours of visit time per day for cases of hospitalization.

543. The total cost of morbidity for malaria in the Dakar region was 23 billion FCFA (Table 2.21). One important element is the cost for adults because of time lost.

TOTAL HEALTH COST

544. Total annual cost of malaria in Dakar was 34.5 billion FCFA, with 33 percent of this amount related to mortality of children under five and 67 percent to morbidity in all age groups (Table 2.22).

545. It thus appears that out of the three types of health problems related to urban environmental degradation, malaria bears the highest economic cost, followed by inadequate water supply, sanitation, and hygiene if mortality is valued using the human capital approach (HCA). If mortality is valued using the value of statistical life (VSL) for adults, then the estimated cost of malaria and urban air pollution is the same.

2.5.2 Cost-Benefit Analysis of Certain Policy Options in Dakar

546. A cost-benefit analysis (CBA) of potential environmental interventions to improve public health can help establish priorities and guide resource allocation. Both cost of interventions and benefits from such interventions are, however, often difficult to accurately quantify. It is therefore useful to provide a range of estimates with transparent assumptions that reflect diverse situations in order for such estimates to be of value and guide decision makers.
### Table 2.21 Cost of morbidity attributed to malaria

<table>
<thead>
<tr>
<th>Children under 5</th>
<th>Cost of-illness</th>
<th>Cost of burden of disease</th>
<th>Total cost</th>
<th>Cost per case (FCFA)</th>
<th>Total cost (million FCFA)</th>
<th>Cost per case (FCFA)</th>
<th>Total cost (million FCFA)</th>
<th>Million FCFA</th>
<th>Percent of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases treated at home with anti-malaria medication</td>
<td>123,660</td>
<td>4,068</td>
<td>503</td>
<td>4,577</td>
<td>566</td>
<td>1,069</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>65,604</td>
<td>17,268</td>
<td>1,133</td>
<td>4,577</td>
<td>300</td>
<td>1,433</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>4,809</td>
<td>189,251</td>
<td>910</td>
<td>8,197</td>
<td>39</td>
<td>950</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>134,811</td>
<td>4,015</td>
<td>541</td>
<td>4,577</td>
<td>617</td>
<td>1,158</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-total</td>
<td>328,884</td>
<td>3,087</td>
<td>1,523</td>
<td>4,610</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Children 5 – 14</th>
<th>Cost of-illness</th>
<th>Cost of burden of disease</th>
<th>Total cost</th>
<th>Cost per case (FCFA)</th>
<th>Total cost (million FCFA)</th>
<th>Cost per case (FCFA)</th>
<th>Total cost (million FCFA)</th>
<th>Million FCFA</th>
<th>Percent of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases treated at home with anti-malaria medication</td>
<td>125,348</td>
<td>4,068</td>
<td>510</td>
<td>15,448</td>
<td>1,936</td>
<td>2,446</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>62,890</td>
<td>17,268</td>
<td>1,086</td>
<td>15,448</td>
<td>971</td>
<td>2,057</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>4,099</td>
<td>189,251</td>
<td>776</td>
<td>27,591</td>
<td>113</td>
<td>889</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>141,035</td>
<td>4,015</td>
<td>566</td>
<td>15,448</td>
<td>2,179</td>
<td>2,745</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-total</td>
<td>333,372</td>
<td>2,938</td>
<td>5,200</td>
<td>8,138</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Population 15 +</th>
<th>Cost of-illness</th>
<th>Cost of burden of disease</th>
<th>Total cost</th>
<th>Cost per case (FCFA)</th>
<th>Total cost (million FCFA)</th>
<th>Cost per case (FCFA)</th>
<th>Total cost (million FCFA)</th>
<th>Million FCFA</th>
<th>Percent of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases treated at home with anti-malaria medication</td>
<td>849</td>
<td>10,091</td>
<td>9</td>
<td>19,963</td>
<td>17</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases taken to a medical center</td>
<td>157,135</td>
<td>21,038</td>
<td>3,306</td>
<td>19,963</td>
<td>3,137</td>
<td>6,443</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases with hospitalization</td>
<td>10,962</td>
<td>314,897</td>
<td>3,452</td>
<td>35,637</td>
<td>391</td>
<td>3,843</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>10,038</td>
<td>0</td>
<td>19,963</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-total</td>
<td>168,946</td>
<td>6,766</td>
<td>3,545</td>
<td>10,311</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total cost of morbidity (million FCFA) | 12,792 | 10,267 | 23,058 |

| Morbidity attributed to malaria (percent) | 55 | 45 |

### Table 2.22 Total health cost of malaria (billion FCFA)

<table>
<thead>
<tr>
<th>Health end-point</th>
<th>Billion FCFA</th>
<th>Cost (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>11.4</td>
<td>33</td>
</tr>
<tr>
<td>Morbidity</td>
<td>23.1</td>
<td>67</td>
</tr>
<tr>
<td>Total</td>
<td>34.5</td>
<td>100</td>
</tr>
</tbody>
</table>
547. A number of environmental interventions are analyzed:

- Options to control particulate emissions from vehicles to improve urban air quality;
- Investments to improve household water supply and sanitation, and programs to promote hand washing; and
- Interventions to control the malaria vector.

548. The purpose of the analysis is to illustrate the use of CBA for environmental health protection. The areas for analysis were selected based on the estimated social cost of the current situation in greater Dakar. Several programs are related to water, sanitation, and hygiene, and malaria prevention and treatment. Policies, investments, and programs to control urban air pollution are, however, in their initial stages. A special emphasis is therefore placed on the analysis of cleaner diesel fuels because this is a critical intervention to control particulate emissions from road vehicles that are a major source of urban air pollution. A technical annex presents more detailed information on the CBA analysis of the options to control urban particulate emissions.

**2.5.2.1 Options to control PM emissions from road vehicles**

549. Cost of air pollution. Urban air pollution in greater Dakar imposes a significant social and economic cost in terms of premature mortality and morbidity, estimated at 13-34 billion FCFA per year depending on valuation method of health effects.61

550. The benefits of reducing urban air pollution are potentially substantial and an analysis of interventions can help government authorities prioritize interventions.62 The focus is on particulate emissions (PM2.5) because this pollutant is found in studies around the world to cause greater health effects.

551. Dakar population. Greater urban Dakar (Figure 2.8) has a population of over 2.3 million and includes four main urban areas. CA Dakar with a population of about 830,000 is located on the Cap Vert peninsula. To the northeast are Pikine and Guediawaye with a population of about 910,000 and 435,000, respectively. Across the bay, east of CA Dakar and southeast of Pikine and Guediawaye, is Rufisque with a population of 160,000.

552. Management options for health benefits. To estimate the potential health benefits of management options, the complex chain of events that links emission sources to ambient pollutant concentrations and health effects must be considered (Figure 2.9). Control options are typically designed to reduce emissions, but emissions do not

61. The low bound reflects valuation of mortality at 4 million FCFA per death (human capital value). The high bound reflects valuation of mortality at 24 million FCFA per death (value of statistical life). The cost of illness (COI) approach is used in both the low and high bound for morbidity.

62. Cost-benefit analysis (CBA) is a very data intensive exercise and involves a complex process of assessing emission sources and their contribution to ambient pollution concentrations. Not all needed data is currently available for Senegal. The CBA presented in this section therefore represents orders of magnitude, and is limited to controlling emissions from road vehicles because they are the largest contributor to ambient PM concentrations.
necessarily lead to health effects. Health is affected by the ambient concentration of particulates in the air that in turn is a function of (i) primary emissions (such as those from vehicles and power plants), (ii) secondary emissions (such as particulates formed in the atmosphere from gaseous emissions), and (iii) fugitive emissions (such as particulates from fields and deserts, and particulates that were deposited and then re-emerge, for example, as a consequence of traffic). The extent to which emissions contribute to ambient particulate concentrations depends on the city’s layout, population distribution, climate (including wind patterns), traffic patterns, and location of industry and other emission sources. These factors all affect population exposure to pollutants.

553. **Total emissions of PM2.5 in greater urban Dakar** are estimated at 2,400 tonnes per year, of which 1,700 tonnes are estimated to contribute to ambient concentrations and 700 tonnes are disbursed to the sea and over rural areas (Figure 2.10).63

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63. These estimates represent the mid-point of estimated emissions (2,000-2,900 tonnes) and contribution to ambient concentrations (1,400-2,100 tonnes). The estimates are very tentative. Improved estimates should be based on emission disbursement modeling and select emission monitoring.
Road transport makes the largest contribution of primary emissions to ambient concentrations (596 tonnes per year, 34 percent), the cement industry (147 tonnes per year, 8 percent) and solid waste burning (141 tonnes per year, 8 percent). Power plants and industry are estimated to contribute only about 80 tonnes per year to ambient concentrations (less than 5 percent).

Winds disperse emissions. The location of cement and power plants and prevailing winds allow a major portion of emissions from these sources to disperse away from the urban areas. Secondary PM2.5 emissions, formed mainly from gaseous emissions (NOx, SO2) from road transport and power plants burning heavy fuel oil, contribute 23 percent to ambient concentrations. Fugitive emissions (from paved and unpaved roads, fields, and background desert areas) are estimated to contribute 22 percent.

Controlling emissions from road transport is a major element in the efforts to reduce PM2.5 ambient concentrations. Three interventions are assessed:

- Reducing the sulfur content of road transport diesel from 500 to 50 parts per million;
- Particle control technology on diesel vehicles (retrofitting vehicles); and
- Replacing old buses.

The first two interventions were selected because diesel engines are so important in Senegalese road transport. The environment can benefit from the evolution of diesel vehicle PM emission standards and improved diesel fuel now used in the developed world, and some developing countries. The last intervention was selected because there are so many old vehicles in Senegal.

Sulfur content is the most important characteristic of diesel in terms of PM emissions in developing countries. Sulfur causes higher particulate emissions and contributes to secondary particulate formation in the atmosphere. Low-sulfur content is needed for the particulate control technology on modern vehicles to function effectively. Replacement programs and proper maintenance are also important. The European Union has implemented progressively more stringent emission limits for road vehicles during the last 15 years. A large share of vehicles in the EU are diesel, as in Senegal. This means that Senegal could potentially benefit from these developments. Table 2.23 presents estimated benefit-cost ratios of the different control options.

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South Africa has been moving to 500 parts per million (ppm) sulfur in diesel and is planning to limit the sulfur content to 50 ppm in 2010. Botswana, Lesotho, Namibia, and Swaziland are also using 500 ppm sulfur diesel imported from South Africa. Mexico, Bolivia, Chile, and metropolitan areas of Brazil are using < 500 ppm sulfur diesel. Many Asian developing countries have mandated 500 ppm diesel fuel, including China, India, Malaysia, the Philippines, Thailand, and Vietnam, and some are moving to 50 ppm sulfur diesel (UNEP, 2006; ADB, 2003).
Table 2.23 Benefit-cost ratios of different emission control options

<table>
<thead>
<tr>
<th>Control option</th>
<th>Detail</th>
<th>HCA</th>
<th>VSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing sulfur content of diesel</td>
<td>From &gt;2,000 ppm to 500 ppm Light vehicles</td>
<td>0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Buses and trucks</td>
<td>0.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>From 500 ppm to 50 ppm Light vehicles</td>
<td>0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Buses and trucks</td>
<td>0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>PM control technology used for vehicles</td>
<td>Diesel oxidation catalyst (life: 5 years)</td>
<td>0.15</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>Buses (emissions: 0.5 g/km) – Usage: 35,000 km/year</td>
<td>0.47</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>Diesel oxidation catalyst (life: 10 years)</td>
<td>0.24</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>Buses (emissions: 0.5 g/km) – Usage: 35,000 km/year</td>
<td>0.76</td>
<td>2.86</td>
</tr>
<tr>
<td></td>
<td>Diesel particulate filter (life: 5 years)</td>
<td>0.06</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>Buses (emissions: 0.5 g/km) – Usage: 35,000 km/year</td>
<td>0.20</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>Taxis (emissions: 0.24 g/km – Usage: 35,000 km/year)</td>
<td>0.18</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>Buses (emissions: 0.8 g/km) – Usage: 70,000 km/year</td>
<td>0.36</td>
<td>1.34</td>
</tr>
<tr>
<td></td>
<td>Taxis (emissions: 0.24 g/km – Usage: 70,000 km/year)</td>
<td>0.29</td>
<td>1.08</td>
</tr>
<tr>
<td></td>
<td>Buses (emissions: 0.8 g/km) – Usage: 70,000 km/year</td>
<td>0.33</td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td>Taxis (emissions: 0.24 g/km – Usage: 35,000 km/year)</td>
<td>0.20</td>
<td>0.76</td>
</tr>
</tbody>
</table>

a. Assumes medium cost of providing low and ultra-low-sulfur diesel.

Note: HCA: 4 million FCFA per death. VSL: 24 million FCFA per death. HCA refers to health benefits of emission reductions valued by using the HCA for premature mortality. VSL refers to health benefits of emission reductions valued by using VSL for premature mortality. Morbidity is valued using the cost-of-illness (COI) approach in both cases.


559. **Two levels of benefits.** A benefit-cost ratio greater than one indicates that benefits are estimated to be higher than the costs. The benefit-cost ratios are based on two levels of benefits. HCA refers to valuation of health benefits (premature mortality) using the human capital approach. VSL refers to valuation of mortality using the value of statistical life.

560. **Two technologies lower emissions.** Estimated benefit-cost ratios of low-sulfur diesel (500 parts per million) for use in light vehicles, buses, and trucks used predominantly in urban areas are greater than one when the health benefits (premature mortality) are valued using the VSL approach, but lower than one when the HCA is used. The situation is the same for ultra-low diesel (50 ppm). Technical options to substantially reduce PM emissions from diesel vehicles are available after low- and ultra-low-sulfur diesel are made available on the market. Two options are considered here — diesel
oxidation catalysts (DOC) and diesel particulate filters (DPF). DOCs are effective with low-sulfur diesel (500 ppm) and DPFs are effective with ultra-low-sulfur diesel (50 ppm).

561. **Benefits depend on usage and technology.** Benefit-cost ratios are less than one for DOC and DPF when the HCA is used for valuing health benefits (premature mortality). When the VSL approach is used, the benefit-cost ratios are larger than one for DOC for high-usage large buses (emissions of 0.8 grams per kilometer with usage of 70,000 kilometers per year), but not for low-usage buses (35,000 kilometers per year).65 The benefit-cost ratio for DPF is only larger than one for taxis and high-usage large buses if the DPF has a useful life of 10 years and health benefits are valued using the VSL approach.

562. **Retiring old vehicles.** Vehicle replacement programs in several countries retire old, highly polluting vehicles. Improved safety and noise reduction are also motivation for vehicle replacement. Greater urban Dakar implemented a replacement program for minibuses (*cars rapides*) several years ago. The program provided financing at favorable interest rates to vehicle operators, subject to turning in the old vehicle (World Bank, 2000).

563. **Estimated annual benefits of replacing old diesel minibuses** (light vehicles, class 3 more than 1760 kilograms) are presented in Table 2.24. Benefits are presented for minibuses with an annual usage of 35,000 and 70,000 kilometers per year. Benefits in the absence of low- or ultra-low-sulfur diesel (Pre-Euro-1) are only one-half of the benefits if such fuels are available (Euro-1 to Euro-4). This is because old buses cannot be replaced by buses that meet Euro emission standards if low- or ultra-low-sulfur fuels are not available. If lower sulfur diesel is available, then the benefits of replacement vehicles meeting Euro-1 to Euro-4 are quite similar. This is because lowering sulfur content provides progressively larger benefits irrespective of whether the vehicle technology meets Euro-1 or Euro-4 standards.

<table>
<thead>
<tr>
<th>Value health benefits of emission reductions</th>
<th>HCA</th>
<th>VSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual vehicle usage (km)</td>
<td>35,000</td>
<td>70,000</td>
</tr>
<tr>
<td>Technology of replacement buses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Euro-1 (US$)</td>
<td>48</td>
<td>97</td>
</tr>
<tr>
<td>Euro-1 to Euro-4 (US$)</td>
<td>80-110</td>
<td>160-220</td>
</tr>
<tr>
<td></td>
<td>300-400</td>
<td>600-800</td>
</tr>
</tbody>
</table>

**Note:** Replacement of light diesel vehicles, class 3 (> 1760 kg). HCA: 4 FCFA million per death. VSL: 24 FCFA million per death. 

**Source:** ECON 2007.

564. **Replacing buses is more beneficial.** Provided that low-sulfur diesel is available, the estimated benefits per vehicle of replacing old minibuses with vehicles that meet Euro

---

65. Current PM emissions from buses are 0.5 to 0.8 grams per kilometer, reflecting buses of different sizes. Current emissions from diesel taxis are 0.24 grams per kilometer. These emission coefficients are for pre-Euro-1 standards, reflecting the general old age of vehicles in Senegal.
emission standards are about twice as high as the benefits per vehicle of installing a DOC. The cost of the DOC is about US$ 1,000, so vehicle replacement would be favorable if it could be achieved at less than US$ 2,000 per vehicle, provided that the vehicles to be scrapped would otherwise have similar remaining life on the road as the useful life of a DOC.

565. **Require low-sulfur diesel.** A first priority for Senegal would be to provide and require that urban buses (and trucks used predominantly in greater Dakar) use low-sulfur diesel regardless of their age. Options should also be explored to provide such fuel to diesel taxis and passenger cars used predominantly in greater Dakar. If, however, the low-sulfur diesel is used for other purposes or largely for rural driving, then the benefits would likely not exceed the additional costs of this fuel.

566. **Ultra-low-sulfur diesel should also be considered for urban diesel vehicles.** If its additional cost is more than US$ 6 per barrel compared to the cost of high-sulfur diesel (more than 2,000 parts per million) or less than US$ 3 per barrel compared to the cost of low-sulfur diesel, then ultra-low-sulfur diesel should be considered for these urban vehicles. As low-sulfur diesel is secured for the urban market in greater Dakar, a first priority could be to install DOCs on large, high-usage buses used exclusively in the urban area. When ultra-low-sulfur diesel is available, DPFs can be installed on high-usage taxis with pre-Euro technology, provided that these taxis will remain on the road for at least five additional years.

567. **Target part of the bus fleet.** Even before low- or ultra-low-sulfur diesel is widely available in the market, one option could be to secure these fuels for a centralized bus fleet that uses a few fuel stations and start equipping these buses with DOC. Priority could be given to buses operating in, for instance, downtown areas of CA Dakar and other polluted areas of greater urban Dakar. Alternative programs should also be evaluated and compared with the benefits and costs of a replacement program. This includes an inspection and maintenance (I&M) program.

### 2.5.2.2 Water supply, sanitation, and hygiene

568. **The annual cost of diarrheal illness and mortality** from an unsafe water supply, inadequate sanitation, and improper hygiene in urban greater Dakar was estimated at 19.2 billion FCFA in 2005. About 14.5 billion FCFA of this cost is illness and mortality in children under five years of age and 4.7 billion FCFA is illness in the population over five years of age.66

569. A cost-benefit analysis of potential interventions to improve water, sanitation, and hygiene, both quality and coverage, can help establish priorities and guide allocation of resources. Both costs and benefits of interventions are often difficult to comprehensively and accurately quantify. It is therefore useful to provide a range of estimates, with transparent assumptions, to guide decision makers (Table 2.25).

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66. The human capital value was used for valuation of child mortality (11 million FCFA per death). The cost of illness (COI) was used for valuation of morbidity.
Table 2.25 Components of costs and benefits of sanitation interventions

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Costs</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved water supply and sanitation</td>
<td>Construction (capital cost); operation and maintenance</td>
<td>Reduction in disease and mortality; household time savings</td>
</tr>
<tr>
<td>Hand washing promotion program (protection of child health and adult health)</td>
<td>Program promotion; soap and water</td>
<td>Reduced disease and mortality</td>
</tr>
<tr>
<td>Program to promote drinking water purification</td>
<td>Program promotion; energy for boiling water</td>
<td>Reduced disease and mortality</td>
</tr>
</tbody>
</table>

570. **Effectiveness of interventions.** Fewtrell et al. (2005) provide a meta-analysis of studies of the effectiveness of interventions in water supply, sanitation, and hygiene in reducing diarrheal illness (Table 2.26). The health benefit of an improved water supply and sanitation facilities is roughly in line with Esrey et al. (1991). The single most effective hygiene intervention, particularly for mothers or caretakers of young children, is hand washing after defecation, after cleaning a child, before preparing meals, and before eating. The health benefit of hand washing found by Fewtrell et al. (2005) is similar to the finding by Curtis and Cairncross (2003). The studies of source water treatment reviewed by Fewtrell et al. (2005) are not conclusive, suggesting a mean reduction in diarrheal illness of 11 percent but with no statistical significance. In contrast, household point-of-use drinking water treatment was found very effective to reduce diarrheal illness.

**WATER SUPPLY AND SANITATION IMPROVEMENTS**

571. About 60 percent of the population in urban greater Dakar has a piped water supply in their dwelling and another 23 percent has a tap in their yard or compound. About 72 percent has a flush toilet (Senegal DHS, 2005). Peri-urban areas are, however, still in need of water and sanitation improvements where households still rely on public stand pipes and have inadequate toilet facilities, often shared by several households.

Table 2.26 Effectiveness of interventions to reduce diarrheal illness

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Relative risk of diarrheal illness</th>
<th>Reduction in diarrheal illness (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand-washing with soap</td>
<td>0.56</td>
<td>44</td>
</tr>
<tr>
<td>Improved toilet facilities</td>
<td>0.68</td>
<td>32</td>
</tr>
<tr>
<td>Improved water supply</td>
<td>0.75</td>
<td>25</td>
</tr>
<tr>
<td>Household water treatment (urban/peri-urban)</td>
<td>0.74</td>
<td>26</td>
</tr>
<tr>
<td>Water treatment at source</td>
<td>0.89</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: Summarized from Fewtrell et al. (2005)

67. Improved water supply refers to a house connection, standpipes, boreholes, protected wells or springs, and collected rain water. Unimproved water supply includes unprotected wells or springs, open surface water and rivers, and water provided by a vendor or tanker trucks. Improved sanitation refers to facilities for safe and hygienic removal of excreta, such as flush toilets, pour-flush latrines, ventilated improved pit latrines (VIP), and simple pit latrines. Unimproved sanitation is open pit latrines, public latrines, service or bucket latrines, and the absence of any facilities.
**Conventional sewage systems often too expensive.** Conventional sewage systems with large-scale networks and wastewater treatment plants are often found to be prohibitively expensive in peri-urban communities in developing countries. Senegal is therefore implementing on-site sanitation solutions in many of these communities. These can include: (i) a water basin with soakway (*Bac à laver puisard* or BALP), a small gravel bed that allows the gray water to infiltrate into the soil; (ii) a pour-flush toilet (*Toilette à chasse manuelle* or TCM), which depending on the soil characteristics, is connected to a pit that is regularly emptied or to septic tank where the wastewater decomposes biologically before partially infiltrating the soil. The on-site sanitation solutions can also include: (iii) a shower with soakway, or (iv) a shower connected to the TCM pit or septic tank.

**The risk of disease from water and sanitation conditions** in many peri-urban areas is likely to vary depending on the specific situation. Evaluation of benefits and costs of interventions in this report therefore only focuses on improved water supply and toilet facilities, and in particular on a water basin with soakway and pour-flush toilets connected to a pit.

**Benefits and costs of improved water supply.** Table 2.27 presents the parameters applied to estimate benefits and costs. The average household size in urban greater Dakar is 7.1 (Senegal DHS, 2005). Household size is larger in the peri-urban areas, with an average size of nine. Most households already have some form of “improved” water supply and toilet facilities. Reduction in diarrheal disease may therefore be smaller than presented in Fewtrell et al. (2005).

**Cost of investments** is from the World Bank on-site sanitation project documents. The costs do not include a septic tank that is needed for households in some locations. Benefits of reducing diarrheal disease are based on a 15-20 percentage reduction in disease and the estimated cost of diarrheal disease in urban greater Dakar.

**Time increases benefits.** The benefit-cost ratios are less than one if only health benefits are included in the estimate, but the ratios are larger than one if time benefits are included. If, however, reduced diarrheal disease would be 25 and 32 percent as in Fewtrell et al. (2005), the benefit-cost ratio with health benefits only (no time benefits) would be 1.6 and 1.3 for water supply and pour-flush toilets, respectively.

**HYGIENE PROGRAMS**

**Promoting hand washing.** The evaluation of benefits and costs of improved hygiene focuses on hand washing. A hand washing promotion program is now being implemented in Senegal. It is thus premature to provide an economic evaluation of the program, but an estimate of the benefits and costs can be based on results from other countries.

**Benefits depend on multiple factors.** This involves an assessment of several key parameters and outcomes such as the cost of programs to promote hand washing, the private or household cost of hand washing (soap and water), and the health benefits of
hand washing (Table 2.28). The most uncertain and critical parameter is changing household and individual behavior, and the lasting effect of changed behavior (sustainability). This likely depends on several dimensions and will vary from country to country. It will also depend on the design, duration, and overall magnitude of the hand washing program.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Water basin with soakway (BALP)</th>
<th>Pour-flush toilet (TCM) connected to pit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average household size</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Reduction in diarrheal disease</td>
<td>15 percent</td>
<td>20 percent</td>
</tr>
<tr>
<td>Net time benefits (minutes/household/day) &quot;low&quot;</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>Net time benefits (minutes/household/day) &quot;high&quot;</td>
<td>20</td>
<td>45</td>
</tr>
<tr>
<td>Annual discount rate of benefits and costs</td>
<td>10 percent</td>
<td>10 percent</td>
</tr>
<tr>
<td>Useful life of investments (years)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost (US$ per household)</td>
<td>340</td>
<td>550</td>
</tr>
<tr>
<td>Cost (FCFA per household)</td>
<td>164,560</td>
<td>266,200</td>
</tr>
<tr>
<td>Annualized cost (FCFA per household) b</td>
<td>15,869</td>
<td>25,671</td>
</tr>
<tr>
<td>Annual benefits of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease reduction (FCFA per household)</td>
<td>14,090</td>
<td>19,247</td>
</tr>
<tr>
<td>Time savings (FCFA per household) &quot;low&quot;</td>
<td>15,036</td>
<td>13,532</td>
</tr>
<tr>
<td>Time savings (FCFA per household) &quot;high&quot;</td>
<td>30,071</td>
<td>33,830</td>
</tr>
<tr>
<td>Benefit-cost ratios</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health benefits only</td>
<td>0.89</td>
<td>0.75</td>
</tr>
<tr>
<td>Health benefits and time savings (&quot;low&quot;)</td>
<td>1.84</td>
<td>1.28</td>
</tr>
<tr>
<td>Health benefits and time savings (&quot;high&quot;)</td>
<td>2.78</td>
<td>2.07</td>
</tr>
</tbody>
</table>

a. “Low” and “high” net time benefits of pour-flush toilets are 2 and 5 minutes per day per household member

b. Annualized cost is calculated using the discount rate of 10 percent over the 30-year useful life of investment.

Source: ECON 2007.

579. **Three hand washing programs** that provide program costs and behavioral change are presented in Table 2.29. Behavioral change ranges from 10 to 18 percent of target households. Program cost ranges from around US$ 0.4 to US$ 5 per target household, and from US$ 3.5 to US$ 28 per household with behavior change.

580. **Projected cost.** Based on about 320,000 children under five in urban greater Dakar, total program cost to achieve a 10 percent behavioral change would be about US$ 0.13 million, or about US$ 1.6 million to achieve 18 percent behavioral change. While the studies are too few to draw a definite conclusion, the results may suggest that program cost per person or household increases substantially if the objective is behavioral change in a large percentage of targeted households. This issue may therefore have major
impact on the overall cost of hygiene programs that aim to achieve substantial reductions in the overall number of cases of diarrheal illness in a country.

Table 2.28  Key parameters and outcomes in a benefit-cost analysis of hand washing

<table>
<thead>
<tr>
<th>Key parameters</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program cost</td>
<td>Overall cost of hand washing program</td>
</tr>
<tr>
<td>Program effectiveness</td>
<td>Percent of target population that improves or starts regular hand washing</td>
</tr>
<tr>
<td>Program sustainability</td>
<td>Lasting effect of the program</td>
</tr>
<tr>
<td>Private cost</td>
<td>Costs of hand washing in the group with behavioral change (increased water and soap expenditures)</td>
</tr>
<tr>
<td>Program benefits</td>
<td>Percent reduction in diarrheal illness from hand washing in group with behavioral change, and monetized benefits of reduced diarrheal illness</td>
</tr>
</tbody>
</table>

Table 2.29  A review of costs and effectiveness of hand-washing programs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guatemala</th>
<th>Thailand</th>
<th>Burkina Faso</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target area</td>
<td>National</td>
<td>Rural villages</td>
<td>One city</td>
</tr>
<tr>
<td>Targeted households</td>
<td>With children under 5</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Number of targeted households</td>
<td>1,570,000</td>
<td>10,000</td>
<td>6,550</td>
</tr>
<tr>
<td>Duration of program implementation</td>
<td>1 year</td>
<td>3-4 months</td>
<td>3-4 months</td>
</tr>
<tr>
<td>Behavioral change (percent of target population)a</td>
<td>10 percent</td>
<td>11 percent</td>
<td>16 percent</td>
</tr>
<tr>
<td>Program cost ('000 US$)</td>
<td>560</td>
<td>6</td>
<td>7.7</td>
</tr>
<tr>
<td>Program cost per target household (US$)</td>
<td>0.4</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Program cost per target household with behavioral change (US$)</td>
<td>3.6</td>
<td>5.4</td>
<td>7.4</td>
</tr>
</tbody>
</table>

a. Behavioral change refers to improved hand washing practices.


581. Benefits and costs of a hand washing promotion program in urban greater Dakar are presented in Table 2.30. The primary target of the program is mothers (or caretakers) in households with young children. Three scenarios are evaluated, with a range of improved hand washing from 10 to 20 percent of all mothers with young children.

582. Estimated of the program cost is US$ 3.8 million, which includes public relations and mass media campaigns, media communications support, direct contact with households, and monitoring and evaluation. If the cost for greater Dakar is proportionate to the population, then the cost in greater Dakar is about US$ 0.85 million, or around 400 billion FCFA.

583. Private cost is estimated at about 5,000 FCFA per child and mother per year, and is almost entirely the cost of soap or hygiene products for hand washing before cooking, eating, feeding a child, and after going to the toilet and cleaning a child. Program benefits are a reduction in diarrheal disease and mortality in children under five, estimated at 700-1,400 million FCFA per year.
Table 2.30 Benefits and costs of a hand-washing program in urban greater Dakar for households with children under 5-years-old

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Low^a</th>
<th>Medium^a</th>
<th>High^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program effectiveness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program target (million children)</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
</tr>
<tr>
<td>Program response (percent of households with behavioral change)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent reduction in diarrheal illness per child (Fewtrell et al. 2005)</td>
<td>10</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>Program cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total program cost (million FCFA)</td>
<td>400.0</td>
<td>400.0</td>
<td>400.0</td>
</tr>
<tr>
<td>Private cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of water per child per year (FCFA)</td>
<td>219.0</td>
<td>219.0</td>
<td>219.0</td>
</tr>
<tr>
<td>Cost of hygiene products per child and mother per year (FCFA)^a</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
</tr>
<tr>
<td>Total private cost per year (million FCFA)</td>
<td>158.7</td>
<td>238.1</td>
<td>317.4</td>
</tr>
<tr>
<td>Program benefits — reduction in health effects per year (million FCFA)</td>
<td>707</td>
<td>1,061</td>
<td>1,414</td>
</tr>
<tr>
<td>Benefit-cost ratios</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low — If behavioral change lasts 1 year</td>
<td>1.3</td>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Medium — If behavioral change lasts 2 years^b</td>
<td>1.9</td>
<td>2.4</td>
<td>2.7</td>
</tr>
<tr>
<td>High — If behavioral change lasts 3 years^b</td>
<td>2.3</td>
<td>2.8</td>
<td>3.1</td>
</tr>
</tbody>
</table>

^a. Two soaps per child and mother per month at a cost of 200 FCFA per soap.
^b. Benefits and costs in the second and third years are discounted at an annual rate of 10 percent.

Source: ECON 2007

584. **Benefits relative to costs are estimated at 1.3** if only 10 percent of mothers or caretakers of young children improve their hand washing practices and this improvement only lasts for one year. If, however, 20 percent of mothers or caretakers improve their hand washing practices and this improvement lasts for three years, then the benefit-cost ratio is estimated at 3.1.

585. **Response rate in Senegal.** If household response rate in relation to program cost per household in Table 2.30 is an indication of the response rate in Senegal, then the magnitude of cost of the hand washing promotion program would suggest a 15 to 20 percent response rate for improved hand washing practices. In this case, the benefit-cost ratios range from 1.7 to 3.1.

586. **The benefit-cost ratios are also sensitive to unit price** and level of soap consumption. If the cost of soap consumption is 2,400 FCFA per child per year, then the benefit-cost ratios range from 2.0 to 4.5 for a response rate in the range of 15 to 20 percent.
DRINKING WATER PURIFICATION PROGRAMS

587. Wells and municipal distribution networks are at risk of contamination. Fewtrell et al. (2005) report from their meta-analysis that household purification of drinking water at point-of-use on average reduces diarrheal illness by 26 percent in urban and peri-urban areas.

588. **Benefits and costs of a household drinking water purification program** in urban greater Dakar are presented in Table 2.31. Purification is by boiling. Other options such as chemicals are likely to be less expensive than boiling. Three scenarios are evaluated, with a range of 10 to 20 percent of the population purifying their drinking water as a result of the program. There are no estimates of program costs to promote water purification at point-of-use. The program costs and behavioral change rates in Table 2.30 are therefore applied. Over 95 percent of the population in urban greater Dakar uses LPG for cooking (Senegal DHS, 2005). Private cost to boil drinking water with LPG is estimated at nearly 1,300 FCFA per person per year. Total health benefits are estimated at 550 to 1,100 million FCFA per year.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program effectiveness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target urban population (millions)</td>
<td>2.33</td>
<td>2.33</td>
<td>2.33</td>
</tr>
<tr>
<td>Program response (percent of population with behavioral change)</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Percent reduction in diarrheal illness per person (Fewtrell et al. 2005)</td>
<td>26%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>Total program cost (million FCFA)</td>
<td>60</td>
<td>179</td>
<td>747</td>
</tr>
<tr>
<td><strong>Private Costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of boiling drinking water/person/year (FCFA)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1,282</td>
<td>1,282</td>
<td>1282</td>
</tr>
<tr>
<td>Total cost of boiling drinking water per year for individuals with behavioral change (million FCFA)</td>
<td>298</td>
<td>447</td>
<td>596</td>
</tr>
<tr>
<td><strong>Program benefits</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction in health effects/year (million FCFA)</td>
<td>553</td>
<td>830</td>
<td>1,107</td>
</tr>
<tr>
<td><strong>Benefit-cost ratios</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low — If behavioral change lasts 1 year</td>
<td>1.5</td>
<td>1.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Medium — If behavioral change lasts 2 years&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.7</td>
<td>1.5</td>
<td>1.1</td>
</tr>
<tr>
<td>High — If behavioral change lasts 3 years&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.7</td>
<td>1.6</td>
<td>1.3</td>
</tr>
</tbody>
</table>

<sup>a</sup> Estimated based on 50 percent efficiency of LPG stoves, cost of LPG (US$ 15 per million Btu), and per person water consumption of 0.75 liters per day.

<sup>b</sup> Benefits and costs in the second and third years are discounted at an annual rate of 10 percent.

*Source: ECON 2007*

589. The benefit-cost ratio for the central estimate is 1.5, corresponding to a 15 percent program response rate with drinking water purification sustained for two years. The benefits are lower than cost only for a program that aims at a 20 percent behavioral response rate and where behavioral change lasts for only one year. This is because of the
high program cost applied in this scenario from Table 2.30 to achieve a 20 percent response rate.

**2.5.2.3 Malaria vector control**

590. **Annual cost of malaria morbidity and mortality in urban greater Dakar** is estimated at 34.4 billion FCFA per year. About 16 billion FCFA of this cost is illness and mortality in children under five years of age and 18.4 billion FCFA is illness in the population over five years of age.\(^{68}\)

591. **A malaria control program** may include vector control and case management, as well as surveillance, monitoring, and evaluation. Vector control may include insecticide-treated bed nets (ITN), indoor residual spraying (IRS), prophylactics, water management (proper drainage, etc.), and larvae control. Case management may include malaria case detection (diagnostic tests) and treatment.

592. **A roll-back malaria program is currently being implemented in Senegal** with focus on IRS, ITN, and case management. A survey on use of ITN was conducted in 2004 (NetMark, 2004). Several studies in Africa have evaluated the effectiveness of vector control in terms of reduced malaria incidence and mortality. Recent studies include a malaria program evaluation in Eritrea (Nyarango et al., 2006 and Mufunda et al., 2007), an assessment of the effectiveness of IRS and ITN in South Africa (Goodman et al., 2001).

593. **Malaria control studies.** Several studies have also estimated the cost effectiveness of malaria control (cost per death or case averted). Goodman and Mills (1999) provide a review of 14 studies of the cost effectiveness of malaria prevention and treatment in Africa. Hanson et al. (2003) evaluate the cost effectiveness of ITN in Tanzania. Morel et al. (2005) present a cost effectiveness analysis of strategies to combat malaria in developing countries. The potential benefits and costs of malaria control in urban greater Dakar, an analysis of vector control (ITN and IRS) is presented in Table 2.32.

594. A 40 to 60 percent reduction in malaria incidence in all age groups and malaria mortality in children under five is applied.\(^{69}\) This may be conservative — WHO reports studies indicating such a reduction from ITN alone (Kiszewski et al., 2007). Cost of malaria vector controls are from Kiszewski et al. (2007), Guyatt et al. (2002), and Conteh et al. (2004). A useful life of ITN of three years and a 60 to 80 percent utilization rate is applied (Kiszewski et al., 2007).

595. **Estimated benefits are a cost reduction of the health burden of malaria** estimated for urban greater Dakar, which is 40-60 percent of 34 billion FCFA per year.

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\(^{68}\) The human capital value was used for valuation of child mortality (11 million FCFA per death). The cost of illness was used for valuation of morbidity.

\(^{69}\) Proper case management (early malaria detection and treatment) will reduce child mortality by a greater percentage, in addition to the vector control benefits.
divided by the population of 2.3 million, and adjusted by the ITN utilization rate.\textsuperscript{70} The result of the analysis indicates a benefit-cost ratio of 2.6 to 3.7.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average household size</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Reduction in malaria incidence and mortality (percent)</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Annual discount rate of benefits and costs (percent)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Useful life of ITBN (years)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ITN utilization rate (percent)</td>
<td>60</td>
<td>80</td>
</tr>
</tbody>
</table>

\textit{Cost of malaria vector control}

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of ITBN (US$/net)</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Cost of ITBN (US$/person)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Cost of insecticides for IRS (US$/ household/year)</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Program cost (US$/person)</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Annualized cost (FCFA/person)</td>
<td>1,354</td>
<td>1,948</td>
</tr>
<tr>
<td>Annual benefits of malaria reduction (FCFA/person)</td>
<td>3,557</td>
<td>7,113</td>
</tr>
<tr>
<td>Benefit-cost ratios</td>
<td>2.6</td>
<td>3.7</td>
</tr>
</tbody>
</table>

\textit{Source:} ECON 2007

### 2.5.3 Lessons Learned

596. A number of remediation activities have shown a high benefit-cost ratio under median assumptions. Examples include:

- **Malaria control.** Benefits are estimated to be over three times greater than costs if: (i) 70 percent of the population starts using insecticide-treated bed nets (ITBN); and (ii) indoor residual spraying (IRS) is conducted regularly. As a result of these actions, malaria incidence and mortality are reduced by 50 percent.

- **Hand washing program targeting mothers and caretakers of young children.** Benefits are estimated to be nearly 2.5 times greater than costs if 15 percent of mothers and caretakers improve their hand washing behavior for at least two years at critical times such as: (i) before cooking and feeding the child; and (ii) after cleaning the child and going to the toilet. As a result, diarrheal illness in children is reduced by about 45 percent. Main costs included in this analysis are program costs and soap.

- **Program to promote household point-of-use drinking water purification.** Benefits are estimated to be about 1.5 times greater than costs, if only 15 percent of households start and continue for at least two years. In such a case, the reduction in diarrheal illness would be about 25 percent. Main costs included in this analysis are program costs and boiling water.

\textsuperscript{70} This is a conservative estimate of benefits because households fully benefit from IRS even though some household members may not consistently use ITN.
Assumptions for other activities. A benefit-cost ratio greater than one under median assumptions depends on the type of benefits and the monetary value given to mortality. Examples include:

- **Household provision of a water basin with soakway (BALP) and a pour-flush toilet (TCM) connected to a pit.** The benefits of these interventions include health improvements — reduced diarrheal illness and time benefits from not having to fetch water at a distance from the dwelling or going to a community toilet. Reductions in diarrheal illness from BALP and TCM may be on the order of 15 and 20 percent, respectively. If so, the health benefits are estimated to be less than the costs of providing BALP and TCM. However, with time benefits included — about 15 minutes per household per day for a BALP and 30 minutes per household per day for a TCM — benefits are about 2.3 and 1.7 times greater than costs for a BALP and TCM, respectively.

- **Provision of diesel with sulfur content at a maximum of 500 ppm in greater Dakar to both heavy and light diesel vehicles.** Benefits are estimated at 2 to 2.5 times the incremental cost of 500 ppm diesel if reduced mortality from air pollution improvements is valued by using a value of statistical life of 24 million FCFA per death. If reduced mortality is valued using the human capital approach — 4 million FCFA per death — benefits are lower than the costs of lower sulfur diesel.

- **Moving from 500 to 50 ppm diesel.** The benefits of this extra measure are estimated at 1.5 times or more than the cost if the value of statistical life is used. If, however, the human capital value is used, benefits are below the costs.

- **Installing diesel oxidation catalysts (DOC) and diesel particulate filters (DPF) on some types of vehicles.** Benefits are also estimated to be greater than the costs of these particulate control technologies. If reduced mortality is valued at the human capital value, benefits are lower than the costs of particulate control technologies.

### 2.6 Environmental Policies — Lessons from Other Countries

This section provides some examples of environmental policies from other countries. Such examples are useful to feed discussions among Senegalese stakeholders about how to improve environmental management, and to identify roles and responsibilities of industry, civil society, and the Government, particularly where market and policy failures are strongly linked to environmental problems.

- **A variety of mechanisms help control environmental degradation,** including: (i) environmental impact assessment, (ii) direct regulation by Government or “command-and-control” measures; (iii) economic- and market-based instruments; (iv) public disclosure, and (v) legal actions.

- **Economic instruments are more efficient** to tackle priority environmental problems, however, command and control instruments have been found easier to design and implement and thus more effective for environmental management.
2.6.1 Environmental Impact Assessments

601. The Peru Country Environmental Analysis (CEA) concluded that Environmental Impact Assessments (EIA) were being used as the main instruments to manage the environment sector in Peru. If EIA was to be used as an environmental planning tool, however, it was important to recognize its limitations (World Bank, 2006e).

602. Conflicting conceptions of the Peru EIA turned the instrument into a bureaucratic obstacle for projects with minimal environmental impacts, while constraining its use as a decision-making tool for managing and resolving complex environmental and social issues.

603. Limitations of EIAs include: (i) lack of standardization and uniformity in the content and scope of EIAs across and within sectoral ministries; (ii) the concept of public participation as events for information sharing rather than to receive critical input; and (iii) weak enforcement of EIA commitments.

604. No EIA when risk is minimal. Given inconsistency in the approach, content, timing, and requirements of the EIA legal and regulatory process in Peru — which lacked standardization and uniformity in project planning and the approval process — minimizing the need for an EIA for projects that posed no environmental threat or risk was suggested.

605. Carrying out fewer EIAs by concentrating on mega-projects that could potentially exert significant negative environmental impacts (with regional, precedent-setting impacts) would greatly improve the quality of EIAs and increase opportunities for meaningful public consultation and community participation.

606. Market and policy failures. The Peru CEA also concluded that if an EIA is to be used as an environmental planning tool, it is inefficient and ineffective where market and policy failures are strongly linked to environmental problems. Consequently, clear and specific regulations that are targeted to specific environmental problems would need to be developed.

2.6.2 Command and Control Instruments

607. Analytical work in Peru, Colombia, and other countries found that command and control measures including environmental standards — such as for air pollution, PM2.5, and drinking water quality standards — could be promoted and aligned with the country context and conditions.

608. Command and control regulations as an environmental management tool focus on preventing environmental problems by specifying how a company will manage a pollution-generating process. This approach generally relies on detailed regulations followed up by an ongoing inspection program. Reducing the incidence of waterborne diseases, for instance, could be achieved through measures based on command and control instruments such as setting and enforcing strict standards for drinking water
quality, particularly for substances such as fecal coliform, and setting water standards for uses that could impair human health, including irrigation and recreation.

609. **For agricultural uses**, a command and control standard could prohibit vegetable irrigation with wastewater containing more than 2,000 NMP of fecal coliform per 100 milliliters. Other command and control instruments such as effluent standards are the instruments commonly used to control water pollution. Typically, limits have been established and regulated for primary pollutants such as Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), total suspended solids, Ph, temperature, odor, color, and taste. These limits are primarily of aesthetic and ecological significance and have a bearing on water use for recreational purposes or for agriculture and industry (Sanchez-Triana et al., 2007).

610. **For air pollution control**, command and control measures include ambient standards, emission standards, and technology- and performance-based standards. For example, several countries set ambient air primary standards for particulate matter (PM2.5) at an annual average of 14 micrograms per cubic meter, and 35 micrograms per cubic meter for a 24-hour average. Command and control instruments also include technological standards to reduce sulfur content in diesel to 500 ppm in the short term, and to 15 ppm in the medium term. Other technological standards might include requiring retrofit particle control technology for diesel vehicles, and banning used car imports.

611. **Voluntary agreements.** Command and control instruments are complemented by voluntary agreements in two cases in Colombia (World Bank, 2007). Negotiations with polluters for clean production agreements target either specific sectors (for example, transportation or agriculture) or specific regions. The agreement involves a quid pro quo — polluters pledge to improve environmental performance over a specified period; in exchange, the regulator provides a grace period to allow the polluter to achieve compliance. The purpose of such agreements is to mitigate the problem of chronic noncompliance in certain sectors and regions by building consensus among polluters on the need for compliance and giving them guidance on how to comply.

612. **An alternative to the clean production agreement** is Performance Oriented Regulations. Specific environmental performance goals — such as a reduction in the amount of pollution associated with a process — is specified by a regulation and each facility is left to determine the best method to achieve this goal (Morgenstern et al.). The concern with this approach is that it tends to be much more difficult to enforce because it requires an intimate understanding of the process and alternatives to the process (Environmental Information Coalition and National Council for Science and the Environment, 2007).

613. **The design and implementation of voluntary agreements in Colombia** was very ineffective. These findings agree with research findings in the United States of America and the European Union, where voluntary agreements “may represent a shift in emphasis from the worst polluters to those most willing to abate on their own initiative. However, some see voluntary programs as a distraction from the real work of taking mandatory action” (Morgenstern and Pizer, 2007).
2.6.3 Economic Instruments

614. Market-based instruments such as taxes or pricing policies could be more effective as tools to redress existing markets and policies and transform them to improved environmental outcomes.

615. Economic instruments are based on the polluter pays principle where the polluting party pays for damage done to the natural environment. For example, experience in many countries indicates that economic instruments and command and control regulations are far more efficient and effective than an EIA to control air pollution.

616. Economic or market-based instruments aim to modify behavior by providing incentives. Economic instruments include tax differentiation, pollution charges, and tradable permits. In some countries tax differentiation has been used to reduce vehicle-related emissions by encouraging motorists to switch from leaded to unleaded gasoline, high-sulfur to low-sulfur diesel, and by encouraging clean cars. Many European countries assess differentiated taxes and fees on vehicles according to cylinder capacity, age, fuel efficiency, and other environmentally relevant aspects. A strong system of enforcement and monitoring is required to enhance the effectiveness of tax differentiation systems (Sanchez-Triana et al., 2007).

<table>
<thead>
<tr>
<th>Fuel type</th>
<th>PM 2.5</th>
<th>SOx</th>
<th>NOx</th>
<th>VOCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Methanol</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Gasoline</td>
<td>L</td>
<td>M</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>Kerosene</td>
<td>M</td>
<td>H</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Diesel (low-sulfur)</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Diesel (high sulfur)</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Fuel oil</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Crude oil</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Coal (low-sulfur)</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Coal (high sulfur)</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Fuelwood</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

L = low concentration of atmospheric emissions  
M = medium concentration of atmospheric emissions  
H = high concentration of atmospheric emissions; Blanks indicate no atmospheric emission  
PM2.5 Particulate matter; SOx, Sulfur oxides; NOx, Nitrogen oxides; VOC, Volatile.  
Source: Sanchez-Triana et al. (2007)
617. **Fuel types vary in their potential to produce emissions** that pollute the environment (Table 2.33). In Peru, fuel taxes could be designed to promote a shift from using dirty fuels such as fuel and diesel to clean fuels such as gas. In any given country, the government might consider the timing of such taxes according to fuel prices. If, for example, fuel prices decline, the government could not reduce pump prices immediately. This approach might incur less resistance than instituting a new tax. In addition fuel tax revenues can help subsidize gas consumption by households in rural areas. Furthermore, increased fuel revenues would provide additional resources that could be used to finance the investments required for state-owned refineries to shift to production of cleaner fuel (Sanchez-Triana et al., 2007).

2.6.4 **Legal Actions**

618. **Campaign to enforce regulations.** Two fairly elitist NGOs in India, the Indian Council for Enviro-Legal Action and the Centre for Science and Environment (CSE), brought public interest lawsuits and generated a fact-based, high-profile publicity campaign that compelled the Government to enforce legal regulations on air pollution (World Bank, 2005b). The key actors were the Supreme Court of India, civil society, and the media. But for the new environmental standards to be imposed successfully, several necessary conditions had to be in place. The Government could have evaded the Supreme Court’s orders at several points, for instance by declaring polluting diesel to be an officially “clean” fuel, but it chose not to do so.

2.6.5 **Public Disclosure**

619. **Promoting accountability.** Mechanisms to disseminate information in a manner that is easily interpretable can allow communities to function as informal regulators. Such mechanisms also promote accountability on the part of those being regulated. An example is the pioneering public disclosure scheme in Indonesia (PROPER), which encouraged firms to clean up their air and water pollution. In a second phase of the program, the Government made the disclosure program compulsory (Ahmed and Sanchez-Triana, 2008).

620. **Other examples of accountability mechanisms** include actions implemented by the Government in the Mexico Programmatic Environment Structural Adjustment Loan. These include public disclosure of funds returned to municipalities for water treatment investment programs that encourage greater scrutiny and accountability on the part of the public and a requirement to post on the Internet the processing status of all environmental licenses. The requirement is intended to improve transparency of Government procedures, thereby reducing corrupt practices. A transparency law passed in 2001 greatly facilitated these actions (Ahmed and Sanchez-Triana, 2008).

621. **Public disclosure of water quality parameters has been very effective** in fostering continuous improvements in drinking water quality. Reporting requirements include, for example, the Drinking Water Consumer Confidence Reports required by the U.S. EPA since 1999. Under this program, all suppliers of drinking water in the country
should provide households with information on the quality of their drinking water, including specified information regarding water sources and actual and potential contamination. Public disclosure of health-related water quality parameters for beaches and other recreational activities has also been used very effectively in Mexico (Sanchez-Triana, 2005).

2.6.6 Extrapolating Best Practices to Senegal

622. **South-south learning.** There are many ways in which Senegal could learn from international experience. Senegal could make use of south-south learning for Government agencies, for example, using Strategic Environmental Assessments (SEA) one sector at a time, perhaps just one each year. This was the approach taken in Ghana as of 2008 through the Ghana Natural Resources and Environmental Governance Program.
Section 3 – Operational Recommendations

3.1 Institutional Framework for Environmental Management

3.1.1 Improvements to Government Structures and Coordination

623. **Little influence outside the ministry.** The Ministry of Environment, Natural Resources Protection, Retention Basins and Artificial Lakes (MEPNBRLA) has limited influence over the Ministry of Economy and Finances (MEF) or sectoral policies of other economically-oriented ministries. As a result, environmental concerns are not always considered in sectoral policies, which frequently lead to the non-sustainable exploitation of natural resources. Furthermore, the lack of coordination and integration among national agencies and other players involved in environmental management contributes to efforts and programs that lack cohesiveness. This situation has been observed for a number of years (Country Environmental Analysis, 1994; National Environmental Action Plan, 1997). Consequently, the CEA in 1994 and the NEAP in 1997 recommended establishing an environmental agency reporting directly to the Prime Minister that would have greater influence over the sectoral policies of other economically-oriented ministries. This recommendation was not implemented by the Government.

624. **MEPNBRLA’s lack of authority** as well as the lack of coordination and integration among sectoral policies contributes to scattered efforts and programs, poor allocation of public funds, and a lack of environmental commitment from all sectors. Given the current state of Senegal’s natural resources and a population that largely depends on them for its livelihood, the Government should establish a structure with the necessary authority to coordinate the different partners to ensure the sustainability and renewal of available resources.

625. **Reinforce environmental management organizational structures.** MEPNBRLA’s powers and coordination role should be reinforced through a review of applicable regulations and by enforcing provisions already in place. In addition, the MEPNBRLA should have veto power over all sectoral policies that impact the sustainability and renewal of the country’s natural resources.

626. **Reinforce Regional Development Agencies (ARD) as information and consultation platforms.** The links between national structures and the ARD should be reinforced. The representation of Local Communities (LC) within the ARD should provide them with sufficient importance to enable them to be heard. The experience in planning, management, and monitoring of programs acquired by the Ministry of the Environment’s CEPS and SAGE departments through the Netherlands’ Sectoral Budgetary Support should be used to support the ARD.

627. **Clarification of roles and responsibilities for water management.** Special efforts should be made to clarify responsibilities in the water sector, a fundamental resource for sustaining life. Integration and coordination among the concerned agencies should be improved to ensure that different functions (especially the protection and
conservation of resources) are accomplished and that better use is made of available water resources. In Dakar, the priority should be to oversee management of the rainwater drainage network.

628. **Clarification of roles and responsibilities for biodiversity management.** The respective responsibilities of the Directorate of Water, Forests, Hunting, and Soil Conservation (DEFCSS); the Directorate of National Parks (DPN), and the Ministry responsible for fisheries (MEMTMI) should be further clarified to improve biodiversity conservation and protection and development of national parks and protected areas. Better links and communication between the MEPNBRAL and the MEMTMI are imperative to ensure protection of marine and coastal resources, conservation of marine biodiversity, and management of protected areas. The respective responsibilities of the DEFCCS and the DPN for forestry management and hunting activities should be clarified to preserve and promote wildlife resources in the national parks, while using hunting as a revenue source in the periphery of those protected areas. To preserve and develop these parks, their management should be handled by public-private or community partnerships.

629. **Applying the “polluter-payer” principle.** A more effective legal department should be established within the Directorate of the Environment and Classified Establishments (DEEC) to deal with environmental offenders. Improved regional representation of the DEEC would enable better coordination with LCs, better enforcement of regulations, and improved awareness of the LCs and local populations about the benefits of respecting environmental regulations.

630. **Improved monitoring capabilities.** The role of the Ministry of the Environment’s CEPS department should be focus on strategic monitoring while technical departments should look after the operational monitoring of their own activities. The capabilities of these departments should be reinforced by providing them with the needed logistical and financial resources to further develop the MEPNBRAL’s monitoring skills and access to information for the concerned departments.

### 3.1.2 Policies and Regulations

631. **Updating policies and regulations.** Most policies pertaining to the environment were developed at the end of the 1990s. These should be updated for all sectors to better integrate concerns related to protection and conservation of biodiversity, conservation and renewal of natural resources, as well as pollution control.

632. **A review of the legal and regulatory framework for biodiversity** and preservation of protected areas is necessary. Such a review should include the country’s needs.

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71. It should be noted that steps have already been taken to clarify the respective responsibilities of the DPN and the MEMTMI to protect marine areas, at both the organizational and regulatory levels.

72. For updating policies and regulations, a document on sectoral institutional and organizational reform has recently been produced by the Ministry. A review by each department of regulations pertaining to environmental and natural resources management is currently underway and is progressing rapidly (including by-laws relating to the Environment Code, outlining the reorganization of different fields, forestry tax legislation, etc.).
various biodiversity management mandates to judge whether current national biodiversity conservation policies properly respond to Senegal’s international commitments. The local players involved in biodiversity management should also be invited to participate in such a review.

633. **The resources allocated to enforce regulations should be increased** through larger fines for environmental infractions, charging higher fees for filing authorization requests or licenses, and charging user fees for natural resources. More severe fines for environmental infractions should be defined in the Environment Code and be high enough so that polluters modify their behavior. Furthermore, economic or tax incentives should be introduced to encourage classified establishments and businesses, projects, and the population to comply with environmental regulations.

634. **Improved regulatory framework, monitoring, and incentive programs.** Fishing, agriculture, and pollution control should be better regulated. Additional criteria and standards should be developed, adopted, and enforced to improve the quality of fresh water, soils, ambient air, water and marine sediments, as well as to improve control over pollution sources. Major polluters should be systematically monitored by the State. Incentive programs should be implemented to encourage them to respect these standards.

3.1.3 **Funding Sources**

635. **Imposing user fees for natural resources.** To ensure food security and satisfy water needs, the Government must establish sustainable and stable income to protect, conserve, and renew natural resources. The Government and the MEPNBRLA should demonstrate the political will to impose user fees on major users of natural resources, including industries and businesses that put pressure on such resources. They should be required to pay their fair share for use as well as to protect and renew such resources. This would generate income that the State, and particularly the LC, could inject into natural resource protection and conservation programs to ensure their sustainability.

636. **Assessment of different sources of income.** Economic studies should examine potential income sources such as user fees for resources, fines for environmental infractions, or a fund (public or public-private) to protect natural resources. Such sources of income could be derived from licenses on natural resource use or industrial or commercial operations, gasoline, coal, etc. Establishing a fund specifically dedicated to conservation and renewal of natural resources should be examined. The ratio between funding derived from international aid and from other sources should be published and could serve as a performance indicator as well as an incentive for organizations to diversify their funding sources.

3.1.4 **Capacity Building**

637. **Improve human resources and training.** The Ministry of the Environment and other ministries involved in environment should establish a human resources development and training strategy. This would solve the problem created by aging
qualified personnel and it would also contribute to reinforcement and renewal of the required human resources needed by these ministries to operate adequately.  

638. **Administrative and financial management capabilities must be improved** at the national and regional levels (particularly for major programs). The experience acquired in program planning, management, and monitoring by the Ministry of the Environment’s CEPS and SAGE departments, through the Netherlands Sectoral Budget Support, could reinforce the capabilities of other programs and departments. Preparation of the MEPNBRLA budgets is done through the Ministry’s Medium-Term Sectoral Expenditure Framework (CDS-MT) that takes into account environmental issues found in strategic planning documents, such as the MDG, the PRSP, NEPAD Environment, etc. Since 2007, the Ministry allots its budget per activity or per component, which enables the Ministry to compare allocated financial resources against the end results. However, internal inspections should be carried out by qualified personnel, trained in the latest audit and control techniques (MEPN, 2006). Furthermore, there should be an annual control program for all Ministry structures.

3.1.5 **Reinforcement of Environmental Assessment and Authorization Processes**

639. **Formal consultation and participation processes** should be put in place before impact assessments are carried out. This would allow optimization of projects at the environmental and socioeconomic levels by integrating, in an efficient manner, community concerns in project design.

640. **Elements to be reinforced in the environmental assessment process** include lack of public notice for projects, site selection process, weak quantification of impacts, absence of cumulative impact assessments, and lack of monitoring during the construction, operation, and closure phases. It is imperative that the MEPNBRLA systematically ensures implementation of Environmental Management Plans and Monitoring Plans. The degree to which various specialists could participate in the environmental assessment process would be substantially improved if each agency set aside resources dedicated specifically to the EIA process.

3.1.6 **Intersectoral Coordination**

641. **Coordinate sectoral policies.** At the national level, different partner efforts and energies must be channeled into a common national purpose to assure optimal use of available resources and an impact on the preservation and renewal of natural resources. The identification of a structure responsible to coordinate sectoral policies related to the environment would facilitate coordination and integration of policies and programs between the MEPNBRLA, the MAHS, the MAT, the MAH, the MEMTMI and the MEF.

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73. The Ministry has recently developed a training plan that outlines very precisely the training needs for different types of personnel over the next three years. These needs correspond to the mission and current objectives of the MEPNBRLA, as well as to the implementation strategy set out for the sectoral environmental policy.
It would also enable international cooperation agencies and NGOs to align themselves on national priorities.

642. **Reinforce functional links and dialogue.** At the sub-national level, it is important to reinforce functional links and dialogue between the MEPNBRAL, the MICL, regional departments, and the LC. To encourage decentralization, consideration is being given to holding a forum of local elected officers as well as organizing an Environment Code workshop for their benefit.

3.1.7 **Information and Public Consultation**

643. **Promote participation by the public.** Information, consultation, and active public participation must be reinforced upstream of the impact assessment process because this is the stage when the potential to influence projects is at its peak with a minimal cost. The Environment Code must stipulate who is eligible to participate, inform, consult, and how the public can better participate in the process. To promote participation by the public, there should be a formal notice at the onset of the project. To eliminate any conflict of interest, an independent organization should preside over public hearings.

644. **Wide diffusion among the public** of the criteria used to select the Ministry of the Environment’s activities would appear to be just as important (MEPN, 2006). It should be noted that technical pre-arbitration of such activities already exists within the Ministry in accordance with project eligibility criteria about sectoral priorities and national environmental issues.

645. **Key role for leaders.** The important role played by religious and community leaders, farmers, fishermen, women, and youth must be taken into consideration. They should play a key role in development and implementation of programs and policies. More effective communication and participation mechanisms should be established. Information should be accessible to these groups that enables a better understanding of the links between their environmental practices and the impact of such practices on the natural resources on which they depend. Without their active participation, chances of success are nil. The main constraints identified by the Ministry of the Environment (MEPN, 2006) about active participation, particularly by women, in the different stages of the implementation of natural resource management activities include:

- Access and the rights to use natural resources, including land;
- Access to credit; and
- Access to information and to decision making.

646. **Public participation in development planning** requires reinforcement of their capabilities and their own forms of organization. The support of NGOs could definitely be of value.
3.1.8 Governance

647. **Policy development and program selection.** Strategic environmental assessments and cost-benefit analyses (including environmental costs and benefits) should serve as selection tools for sectoral programs. Where resources are scarce, the programs chosen by the Government in the *Programme Triennal d’Investissements Publics* (PTIP) and the *Cadre de Dépenses du Moyen Terme* (CDMT) should aim to maximize positive effects on the environment per unit cost. Lessons learned from successful case studies should be more widely communicated and used in policy development. Pilot projects should be encouraged to confirm the effectiveness of environmental programs before implementing policies on a larger scale. Also, feedback mechanisms should be used to quickly identify program advantages and disadvantages and then make required corrections in a timely fashion.

648. **Decision-making process.** Clear decision-making processes should be identified by the Ministry of the Environment’s CEPS to select programs and projects as well as allocate and disburse budgets to ensure greater transparency.

649. **Financial and administrative management.** The budgets of the MENPBRLA and other ministries involved in environmental management should be further decentralized toward the regions, and mechanisms should be developed so that LC have better access to the financial resources necessary to perform their prescribed functions. Certain fiscal measures or facilitated access to credit should be examined.74

3.1.9 Decentralization

650. **Links must be reinforced between the regional branches** of national structures and Local Communities (LC). The LC must be aided in their implementation of environmental regulations, their capacity to manage natural resources, and the integration of biodiversity preservation practices in agricultural and livestock development programs.

651. **Funding.** A strategy and funding mechanisms must be put into place to ensure that LCs benefit from sustainable funding sources (Van der Linde et al., 2006). As with the PEPAM, lines of credit could be made available and decentralized to provide better local access to financial resources (Senegal, 2005a), and flexible and adapted budget transfer mechanisms should be put in place to benefit LCs (MEPN, 2006). Basic administrative and financial management training is especially important in rural areas to improve allocation and management of budgets (UAEL, 2006).

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74. It should be noted that the Ministry’s operating budget is already decentralized, which helps the affected services to better accomplish their mission at the regional and local levels. As for decentralization of investment budgets, such an experience is presently being carried out by the Public Health and Education ministries. If this experience proves to be conclusive, the MEPNBRLA is also considering adopting it. However, a protocol has already been signed with the Thies Regional Council, and another protocol is presently in process with the Touba Rural Community (under the budget’s article VI, a protocol authorizes a transfer of financial resources from the MEPNBRLA to the LC). These resources are used to implement PAER, developed in a participatory manner with the involved LC under the supervision of a regional task force.
Regional Development Agencies (ARD) must be provided with the necessary resources to coordinate and mobilize local organizations to assist the LCs with environmental and natural resources management (UNDP, 2005; Ngaido, 2002).

Finally, incentives such as performance contracts based on program objectives and results could be further considered for decentralized and/or autonomous structures.

3.1.10 Role of NGOs and Civil Society

NGO success as a guide. When developing their programs, it would be to the advantage of national institutions to look closely at NGO success with community consultation, environmental awareness/education, integrated resource management, and delivery of environmental services. The Government should financially assist NGOs that offer quality environmental services at better costs and in a more efficient fashion than the State.

3.1.11 Role of the Private Sector

Public-private partnerships. The Government should consider the approaches adopted by the PEPAM to give a greater role to public-private partnerships (PPP), especially in areas where the private sector can offer better services at a better cost than the State (Senegal, 2005a; 2004).

3.2 Sustainable Management of Terrestrial Ecosystems

3.2.1 Sustainable Land Management

Developing a complete and coherent vision for Senegal and sustainable land management (SLM) is urgent. This should be done by introducing a Strategic National Investment Framework for SLM. Such a framework would be a multi-partner and multisectoral program implemented through an efficient functional model (to avoid duplication of efforts and to strategically target the use of limited resources). It would consider land degradation in the country’s different development sectors, as well as support the strategies of various development partners.

SLM framework. The Government of Senegal is presently putting such a framework in place. It is drawing up terms of reference to recruit consultants with a mandate to define the framework’s operating procedures. The framework will be composed of a larger group that will include the main ministerial directorates and other structures that can be involved in sustainable land management.

The purpose of this structure is to encourage partners to better appreciate the links between existing national strategies by creating synergies to minimize land degradation — sectoral strategies, decentralized strategies, other strategies based on the Rio Convention, the proposed creation of a national fund to fight desertification, and in particular, the poverty reduction strategy. If it is developed and endorsed by all
concerned, such a framework will lead a common front under the leadership of a committed Government and with the stable support of donors. The fact that donors are increasingly in need of a coordinated approach also justifies setting up such a framework.

659. **The techniques leading to improved value-added production** and economic and environmental progress correspond to the options promoted by SLM. These include diversification of cultivation and farming businesses on the basis of livestock components; extension of irrigated perimeters; increased production by promoting value-added cultivation and using local knowledge; livestock development by increasing herd size; seasonal migration practices; and development of grazing reserves and watering holes.

660. **Implementing SLM in Senegal requires:**

- Establishing an incentive policy environment that particularly favors small-scale farmers in their capacity as managers of rural land;
- Integrating SLM in sectoral policies and programs;
- Considering concerns of farmers and breeders in rural development policy, and creating off-farm jobs;
- Local governments, farmers, and breeders have the necessary means to play a key role in the development of SLM practices;
- SLM techniques are adopted and disseminated by farmers and breeders;
- National competences are reinforced at all levels for integrated and sustainable land management in rural areas; and
- Monitoring and evaluation programs that integrate SLM investments are developed and implemented.

661. **Such a framework could be developed with the joint assistance** of the World Bank and other donors under the supervised partnership of TerrAfrica. This would enable Senegal to take advantage of experience from neighboring countries and enable benefits from a partnership platform recognized by the majority of the parties involved in SLM. It is imperative to proceed with the following steps to move the Senegal SLM agenda:

- Establish a national SLM platform bringing together all sectors and involved parties.
- Initiate development of an SLM investment strategy with the cooperation of partners with immediate support from the World Bank and the UNDP under the GEF/SIP program.
- Identify strategic investments to broaden SLM on the basis of in-depth studies such as economic data, cost-benefit analyses for land management, development of market opportunities, etc.
- Establish a national SLM knowledge database linked to other databases endorsed by TerrAfrica at the regional level. This knowledge database would include: (i) a
list of information and tools pertaining to each aforementioned constraint; and (ii) a monitoring-evaluation system supported by a geographic information system to follow progress in the field and report on various activities related to SLM.

3.2.2 Management of Forests and Biodiversity

662. Clarification of roles and responsibilities to manage biodiversity. The respective responsibilities of the DEFCCS, the DPN and the MEMTMI should be further clarified. Better links and communication between the MEPNBRLA and the MEMTMI are required to ensure preservation of marine and coastal resources, conservation of marine biodiversity, and management of protected areas. The respective responsibilities of the DEFCCS and the DPN for forestry and hunting management should be clarified and their capacities reinforced to ensure conservation and promotion of wildlife resources in the national parks.

663. Decentralization of forestry management. Decentralization of forestry management, as stipulated in the new Forestry Code, should be strengthened. The following measures should be considered to address the constraints associated with the decentralization of forestry management:

- Increase the autonomy of locally elected officers and reinforce local democracy (instruction on the rights of local councils, preparation of meeting minutes, elimination of the obligation for locally elected officers to belong to an official political party).
- Increase the resources and capacity of local councils (mainly through a tax on charcoal for the benefit of Local Communities and more transparent mechanisms for handing out funds to rural councils).
- Reinforce support of local organizations by speeding up the devolution of human and financial resources and increasing the availability of foresters to assume their role as advisors (by assigning administrative and policing tasks to certain foresters and advisory tasks to others).
- Replace forestry development plans with a system of minimum standards that would be easier to implement. The basic criteria would be set by a commission that would include the DEFCCS and local councils. The DEFCCS would determine maximum harvestable quantities in different forests, but it would be up to local councils to determine allocated quantities in each particular forest.

664. Define forest use for charcoal production. Local councils should define a specific amount of forest resources for charcoal production instead of authorizing production of given quantities. This would encourage charcoal producers to use the most efficient charcoal production processes. The full environmental cost of using forest resources should be paid by the charcoal industry through a tax that would finance the activities of rural councils that oversee reforestation activities under the supervision of the DEFCCS. Such a tax would increase the cost of charcoal, making it less appealing when compared to butane.
665. **Biodiversity conservation.** To remedy the current underfunding and lack of scientific resources for Senegal’s protected areas, it is imperative to improve the management and funding of protected areas. In a context of increasing human pressure on protected areas and constant threats to these resources, the Government should consider new management approaches. Four options can be considered to improve management:

- Allocate a share of revenues derived from hunting activities to funding protected areas and renewal of major wildlife resources;
- Co-manage parks with participation by local communities through co-management councils;
- Create private parks for tourism (one such park already exists; the Bandia animal reserve, which is owned and managed by private operators who offer safari packages); and
- Create community reserves for sacred forests and biodiversity zones.

666. **A review of the legal and regulatory framework for biodiversity** and preservation of protected areas is presently underway. With implementation of the GIRMaC Program in the fisheries sector, there has already been a call for tenders to carry out a comparative analysis of different types of legislation that regulate protected areas, with a view to developing a Biodiversity and Protected Areas Code. To be thorough, such a review should address the country’s various biodiversity conservation mandates to assess whether national conservation policies are in accordance with Senegal’s international commitments. It should also include participation by the different local players in biodiversity management.

667. **End confusion over responsibilities.** The confusion that currently exists between forestry management and hunting should end. The respective responsibilities of the DEFCCS and the DPN should be clarified and their capacities reinforced to ensure preservation and promotion of wildlife resources in the national parks, such as the Niokolo Koba and the Ferlo wildlife reserves, while using hunting activities as a source of revenue in the periphery of those protected areas.

668. **The status of protected coastal areas** such as the Djoudj Birds National Park in the Senegal River estuary, the Saloum Delta National Park in the Sine Saloum estuary, or the Lower Casamance National Park in the Casamance river estuary, should be revised so they may complement fisheries management in their capacity as protected reproduction zones. The funding of these protected coastal areas could be derived, in part, from revenues drawn from marine fishing. The environmental monitoring of these protected reproduction zones could be integrated into wider monitoring of marine fish stocks.

669. **Promoting the use of traditional forestry products** that have nutritive value (wild berries or juice) or medicinal value could be encouraged to the benefit of local communities, and also generate greater interest in the preservation of plant biodiversity.

670. **To optimize the potential for biodiversity preservation in hunting preserves (zones amodiées),** local populations could be more actively involved in managing hunting
activities and related economic benefits. Rural councils could contribute to the definition of terms and specifications (cahier des charges) in each hunting preserve, play a key role in the selection of hunting outfitters and guides (amodiataires), and participate in the monitoring and control of hunting activities. Wildlife inventories in each hunting preserve would provide knowledge of wildlife potential and ensure tighter control over hunting activities.

671. **Rural communities would be more interested** in participating in wildlife habitat improvement if they could draw a more substantial and direct benefit from hunting activities, especially through the creation of a Hunting Fund. Such a fund could be provided by a share of hunting taxes (taxes d’amodiation) collected by the State, as well as through contributions from hunting outfitters that would be proportionate to the hunting season’s success. Such a fund could be used to monitor hunting activities and improve wildlife habitat. Improved communications between hunting outfitters and rural communities could improve community benefits from tourism and provide additional incentives for habitat preservation.

### 3.3 Water Resources Management

672. **Clarification of roles and responsibilities.** Water is a fundamental resource to sustain life. Special efforts should be made to clarify responsibilities in this sector. Links and coordination between the concerned agencies should be improved to ensure that different functions (in particular protection/conservation of the resource) occur properly and better use is made of available water resources. In Dakar, the priority should be to oversee management of rainwater drainage networks.

673. **Management of transboundary resources in the Senegal River basin.** An organization (to be determined) that would be responsible for coordinating sectoral policies related to the environment could also be responsible for coordinating transboundary environmental management activities such as those related to management of Senegal River basin resources. This role is presently assumed by the OMVS, a multinational river basin agency that is rather ineffective in integrating environmental concerns.

### 3.4 Fisheries Management

674. **Reinforcement of sustainable management in the marine fisheries sector.** Measures put forth since 2000 to reorient the fisheries sector toward more sustainable management of the resource are a step in the right direction. Their reach, however, still remains modest in comparison to the required reduction in fishing to maintain the resource. Fisheries regulation should be better controlled to protect fish reproduction sites, impose a moratorium on fishing certain species whose stocks are depleted, and ban fishing in certain areas and periods of the year in order to replenish fish stocks.

675. **To ensure conservation of fish stocks**, industrial fishing with trawlers and artisanal fishing should be drastically restricted according to renewal capacity. Restrictive measures for artisanal fishing that go beyond registration fees (licenses) must be quickly
implemented in order to replenish stocks. The management of artisanal fishing should be
use the TURF (Territorial User Rights Fisheries) model. A registry system for artisanal
fishing pirogues and their owners has been in force since 2005. It is imperative, however,
to proceed to the second phase, which involves issuing licenses on a geographic basis (by
authorized fishing area) according to the state of existing resources (with quotas for each
species during authorized fishing periods). To be effective, banning fishing in certain
areas and periods must be respected by the whole marine fisheries sector and not only by
the industrial fisheries sub-sector.

676. **In a context of local co-management of resources**, it is imperative that the legal
and regulatory framework be amended. Under the current framework, even if a
fishermen’s community organization decides to restrict its fishing activities in a given
area to protect fish stocks, there is nothing that restricts fishermen from other areas from
exploiting such resources at will. Licensing fishermen by the MEPNBRLA or by a
commission set up for such purposes should be conditional to environmental approval by
the MEPNBRLA. Fisheries management should also be structured around marine
protected areas to ensure replenishment of stocks.

677. **To effectively preserve the marine and coastal resources of Senegal**, it is
necessary to adopt an ecosystem-based approach. The entire marine and coastal
biodiversity must be protected, not just species with a commercial value. The protection
of crucial marine areas to maintain biodiversity should be a priority. Passing a new
Biodiversity Law is essential to recognize co-management efforts in protected areas and
protect the country’s biodiversity in conformity with Senegal’s commitments as a
signatory to a number of international treaties.

678. **The status of coastal protected areas** should be revised so that they may
complement fisheries management in their capacity as protected reproduction zones. The
funding of these protected coastal areas could be derived, in part, from revenues drawn
from marine fishing. Environmental monitoring of these protected reproduction zones
could be integrated into a wider monitoring of marine fish stocks.

### 3.5 Urban Environmental Management in Dakar

679. **Reinforcing the role played by Dakar in urban environmental management.**
Mechanisms must be put in place to ensure that sanitation is an integral part of urban
planning (Dakar’s Urban Development Plan). The best approach is to promote urban
development programs that integrate sanitation, water, and road services. This would
guarantee that the State, development partners, the private sector, developers, and local
governments all refer to an agreed-upon Development Plan.

680. **By putting more emphasis on urban planning**, providing sufficient resources,
and reinforcing existing capacities, Dakar could play a key role in the management of air
quality and sanitation. City representatives are in close contact with the population and
are well aware of problems. There should be stricter and more effective controls over
industrial effluents, solid waste disposal, and industrial air emissions (Iszatt et al., 2007).
In the industrial sector, there should be incentives to encourage retrofitting of old
installations and environmental compliance. Industrial development activities should be rebalanced to reduce the concentration of industries in Dakar. Research and development on air emissions should be encouraged. Finally, there should be more efforts on public awareness programs for public health risks related to poor water and air quality, and the measures and behaviors to substantially reduce those risks.

681. **Benefits of using cost-benefit analyses to identify the most promising environmental policies.** A number of remediation activities have shown a benefit-cost ratio varying between 1.5 and 3. Examples were identified for (i) malaria control; (ii) hand washing programs that target mothers and caretakers of young children; and (iii) household point-of-use drinking water purification programs.

682. **Other benefits.** For other activities, benefit-cost ratio larger than 1 depends on the type of benefits and the monetary value given to mortality. Examples include: (i) a household water basin with soakway (BALP) and a pour-flush toilet (TCM) connected to a pit; (ii) diesel with sulfur content of a maximum of 500 ppm in greater Dakar for both heavy and light diesel vehicles; (iii) moving from 500 to 50 ppm diesel; and (iv) installing diesel oxidation catalysts (DOC) and diesel particulate filters (DPF) on some types of vehicles.

### 3.6 Environmental Monitoring

683. **The absence of an operational national environmental monitoring framework** and the limited applied environmental research constrain: (i) the capacity to support decision making by institutions responsible for environmental and natural resource management, and (ii) the capacity of institutions and funding agencies to assess the effectiveness of environmental policies and programs. Monitoring indicators used by the Ministry of the Environment do not enable a quantitative assessment, at a national level, of the state of the environment and pressures exerted on natural resources. This situation has been observed since the last Country Environmental Analysis completed in 1994, which extensively discussed this issue.75

684. **Many of the indicators currently used are not systematically measured over time and all regions.** In addition, the spatial and temporal coverage varies considerably from one set of indicators to another. Many indicators used to assess the state of the environment are not followed or are not easily accessible.76 Administrative procedures required to access data and the absence of systematic updating of databases constrain the capacity of institutions to exchange and use data, as well as their capacity to have a common vision of the main environmental issues and priorities.

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75. However, the CEPS is currently establishing such a monitoring system in collaboration with the CSE as well as a strategic monitoring framework for the Ministry’s programs. Such a framework should be extended to relevant programs of other ministries involved in environmental activities.

76. To address important air quality issues in Dakar, an air quality monitoring program has recently been put into place by the CETUD. The program became operational with the acquisition of a vehicle for air quality monitoring in Dakar.
685. **The operational and strategic monitoring framework** to be developed should be supported by the necessary human, financial, and technical resources to ensure its systematic application at a national level over the long term. The framework should be open, transparent, and accessible to all. A national environmental data management system should be a decision-support and monitoring system. This tool should be provided with the necessary funding to enable regular environmental data updates and the widest possible use by concerned parties, especially local communities.77

686. **The reinforcement of GIS and environmental monitoring capabilities** should enable concerned agencies to have the required decision-support tools to: (i) define a common and updated vision of environmental issues and priorities, and (ii) assess the environmental impacts of development programs and levels of pressure on natural resources. Land-use maps should be updated in ways that clearly identify pressures exerted upon the environment. For Dakar, land-use maps should distinguish between residential, commercial, and industrial land uses and should identify the main emitters of pollutants to control pollution at a basin management level. The results of monitoring programs could then be added to these maps to identify priority sectors of intervention. A similar exercise should be undertaken for rainwater management and flood-prone areas.

### 3.7 Environmental Information, Education, and Awareness

687. **Environmental stakeholders in Senegal have limited access to data** available in national public institutions or international research institutions. Improved access to environmental data should be supported by:

- Refurbishing the National Center for Scientific and Technical Documentation, including resources for the production, updating, and publication of data;
- Establishing a networking system among all technical Government agencies that includes a data-sharing mechanism;
- Adoption of a charter to manage, share, and access data;
- Establish mechanisms within Ministries to facilitate the circulation of documents; and
- Establish mechanisms to ensure circulation and sharing of relevant data with international research institutions.

688. **Proper attention should be given to the application of a National Environmental Education Strategy Paper** that is currently under review at the MEPNBRILA. This strategy combines a number of information, education, and awareness activities to promote behavior changes to benefit the environment.

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77. It should be noted that the CSE periodically produces, in collaboration with the concerned institutions, an Environmental Directory (*Annuaire sur l’environnement*) and a State of the Environment Report (*Rapport sur l’état de l’environnement*).
Table 3.1  Summary of recommendations

<table>
<thead>
<tr>
<th>Issues</th>
<th>Proposed actions / recommendations</th>
<th>Instrument</th>
<th>Concerned agencies</th>
<th>Timetable</th>
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</thead>
<tbody>
<tr>
<td>1. Changes to the institutional framework for environmental management</td>
<td>Reinforce institutional structures pertaining to environmental management by: reinforcing the MEPNBRLA’s powers and coordination role through a review of applicable regulations and by enforcing provisions already in place (the MEPNBRLA should have veto power over all sectoral policies that impact the sustainability and renewal of the country’s natural resources). Other required interventions include: reinforcement of the ARD as consultation platforms; clarification of the roles and responsibilities for water management; clarification of the roles and responsibilities for biodiversity management; applying the “polluter-payer” principle; and improving environmental monitoring and public education and awareness capacities.</td>
<td>Technical assistance Policy</td>
<td>MEP</td>
<td>Short to medium term (1 to 5 years)</td>
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<tr>
<td>1.2 Low level of natural resource protection and conservation</td>
<td>Improve and implement the regulatory framework by: updating policies and laws presently in force, mainly the preservation of protected areas and of biodiversity; increasing and enforcing penalties for environmental infractions; improving standards, monitoring and incentive programs, in particular fishing, agriculture, and pollution control.</td>
<td>Policy</td>
<td>MEPNBRLA MEMTMI</td>
<td>Short to medium term (1 to 5 years)</td>
</tr>
<tr>
<td>1.3 Under-funded programs</td>
<td>Improve funding sources for natural resources protection by: charging user fees for natural resources and assessing different sources of revenue.</td>
<td>Policy</td>
<td>MEPNBRLA MEMTMI MAHS</td>
<td>Short term (1 to 2 years)</td>
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<td>1.4 Difficulty in recruiting qualified personnel</td>
<td>Reinforce capabilities within the MEPNBRLA and other ministries involved in environment</td>
<td>Technical Assistance</td>
<td>MEPNBRLA and other ministries</td>
<td>Short term (1 to 2 years)</td>
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<tr>
<td>1.5 Low integration of environmental concerns in project design</td>
<td>Establish formal consultation and participation processes before impact studies to optimize projects at the environmental and socioeconomic levels by integrating community concerns in the project design because it is the critical phase when the potential to influence projects is at its peak and at the lowest cost.</td>
<td>Policy</td>
<td>MEPNBRLA</td>
<td>Short term (1 to 2 years)</td>
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<td>1.6 Low intervention coordination between sectors</td>
<td>Better inter-sectoral coordination, whether by identifying an organization or by reinforcing the MEPNBRLA’s coordination powers and role through a review of applicable regulations and enforcing provisions already in place.</td>
<td>Technical assistance Policy</td>
<td>MEPNBRLA and other concerned ministries</td>
<td>Short term (1 to 2 years)</td>
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<td>1.7 Low capacity for strategic assessment of programs and projects</td>
<td>Better governance by: use of strategic environmental assessments and cost-benefit analyses as tools to develop policies and select sectoral programs; putting into place clear decision-making processes; devolution of budgets of the MEPNBRLA and other ministries involved in environment toward the regions.</td>
<td>Technical assistance</td>
<td>MEF, MEPNBRLA and other concerned ministries</td>
<td>Short term (1 to 2 years)</td>
</tr>
<tr>
<td>1.8 Weak links between national structures and ARD/LC</td>
<td><strong>Reinforce decentralization by:</strong> improving links between the ARD/LC and regional services of national structures, sustainable funding of LC, and improved support and capacity building of LC.</td>
<td>Policy</td>
<td>MEPNBRLA, MICL, ARD and LC</td>
<td>Short term (1 to 2 years)</td>
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<td>1.9 Low incentives offered to NGOs to act as partners</td>
<td><strong>Examine the factors of success of NGOs and provide support to them</strong> in sectors where they offer environmental services at better costs and more efficiently than the State.</td>
<td>Technical assistance</td>
<td>MEF, MEPNBRLA, MAHS</td>
<td>Short term (1 to 2 years)</td>
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<td>1.10 Low incentives offered to private sector to act as partners</td>
<td><strong>Offer a greater role to public-private partnerships (PPP),</strong> particularly in sectors where the private sector is able to offer quality services at better cost than the State.</td>
<td>Technical Assistance</td>
<td>MEF, MEPNBRLA, MAHS</td>
<td>Short term (1 to 2 years)</td>
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</table>
| 2. Terrestrial ecosystem sustainable management                        | **Develop and implement a Strategic National Investment Framework for Sustainable Land Management** to bring together all active participants in SLM and development partners to avoid duplication of efforts and better target priority interventions and actions in the context of a “road map” with a timetable. This framework would involve:  
  • Assess the status of land degradation;  
  • Energize and reinforce existing consultation platforms and develop new synergies;  
  • Identify priority and strategic investments to broaden SLM;  
  • Develop an SLM investment strategy with the immediate support of funding from the GEF/SIP program; and  
  • Reinforce the environmental monitoring system, update and consolidate the national SLM knowledge national database, and reinforce the monitoring-evaluation framework.                                                                                       | Technical Assistance | MEPNBRLA, MAHS, Livestock Ministry, MICL                                        | Short term (1 to 2 years) |
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<tr>
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</table>
| **2.2 Management of forests and biodiversity** | Improve management of forestry resources  
- Put in place measures to reinforce the capacity of Rural Communities (RC) to manage forestry resources (by clarifying the autonomy of locally elected officers, reinforcing local democracy, increasing human and financial resources, and reinforcing support to the RC by allowing foresters to act as advisors).  
- Replace forestry development plans with a system of minimum standards that would be easier to implement (basic criteria would be set by a commission including the DEFCCS and local councils; the DEFCCS would determine maximum harvestable quantities in different forests and LC would determine allocated quantities).  
- Identify areas that are off limits to development, specifically in the Niayes that are important areas of biodiversity, and allocate them to environmental associations for their protection.  
- Determine charcoal quotas according to quantities of exploitable resources and not according to quantities of charcoal to be produced.  
- Establish a database on classified forests (*forêts classes*) and community forests to create an institutional memory on forestry resources.  
- Finalize the ongoing forestry tax reform process.  
**Promote biodiversity conservation and improve management and financing in protected areas**  
- Identify and implement new approaches for funding and management of protected areas (payment of ecosystem services, public-private partnerships, community partnerships, or others).  
- Pursue revision of the legal and regulatory framework for management of biodiversity and preservation of protected areas (Hunting and Wildlife Code, Law on Biodiversity and Protected Areas, National Management Strategy for Protected Areas, etc.).  
- Clarify the respective responsibilities of the DEFCCS and the DPN and reinforce their capacities to ensure the preservation and promotion of wildlife resources in national parks, while using hunting activities in the periphery of those protected areas as sources of revenue. | Technical assistance  
Investment | MEPNBRLA  
MEMTMI | Short term (1 to 2 years) |
Table 3.1 Summary of recommendations

<table>
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<td></td>
<td>• Review the status of coastal protected areas so that these areas may serve as a complement to fisheries management (revenues drawn from marine fishing could provide funding for these areas and environmental monitoring of these protected reproduction areas could be integrated into monitoring of marine fish stocks.</td>
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<td></td>
<td>• Give greater importance to traditional forest resources that have nutritive or medicinal value to generate greater interest in the preservation of plant biodiversity.</td>
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<td></td>
<td>• Pursue a systematic approach to conserving plant genetic resources.</td>
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<td>3. Water resources management</td>
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<td>Clarify roles and responsibilities for water management: Particular effort should be put into clarifying responsibilities in this sector and improving links and coordination between concerned agencies to ensure efficient handling of different functions (especially the protection/conservation of the resource) and better use of available water resources. In Dakar, the priority should be to oversee the management of rainwater drainage networks.</td>
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<td>Management of transboundary resources in the Senegal River basin: Identify an organization that would be responsible for coordination of transboundary environmental management activities, such as those related to management of Senegal River basin resources (this role is presently assumed by the OMVS, a multinational river basin agency that is rather ineffective at integrating environmental concerns).</td>
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<td></td>
<td>Technical assistance</td>
<td>MAH, MEF, MEPNBRLA, MAHS, MICL, LC, SONES, ONAS, PEPAM, DEFCCS, City of Dakar, etc.</td>
<td>OMVS</td>
<td>Short term (1 to 2 years)</td>
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<td></td>
<td>4. Fisheries management</td>
<td>Technical assistance</td>
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<td>Sustainable management of industrial and artisanal fishing:</td>
<td>MENRPDBAL</td>
<td>Short term (1 to 2 years)</td>
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<td></td>
<td>• Stricter measures should be implemented to promote renewal of the resource (protection of reproductive sites, moratorium on fishing certain threatened species, banning fishing in certain areas and periods of the year).</td>
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<td></td>
<td>• Artisanal fishing management should be modeled on the TURF model.</td>
<td>Investment Policy</td>
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<td></td>
<td>• Issuing fishing licenses should be conditional on environmental approvals from the MEPNBRLA to ensure the sustainability of resources of this valuable resource.</td>
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<td></td>
<td>• Reinforcing the legal and regulatory framework to allow for local co-management of resources.</td>
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<td></td>
<td>• Structuring fisheries management around marine protected areas to ensure the renewal of stocks.</td>
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<td></td>
<td>• Promote ecologically sustainable aquaculture and fish farming as an alternative to marine fishing.</td>
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5. Urban environmental management in Dakar

**Air quality and sanitation management**

- Ensure that sanitation, water, and road networks are integrated into urban planning (Dakar's Urban Development Plan).
- Reinforce urban planning capacity and provide Dakar with the necessary resources to play a key role in the management of air quality and sanitation.
- Exercise stricter and more efficient control over industrial air emissions.
- Provide incentives to the industrial sector to encourage retrofitting of old installations and environmental compliance.
- Favor rebalancing industrial development activities to reduce the concentration of industries in Dakar.
- Promote research and development related to air emission controls.
- Promote public awareness about health risks caused by poor air and water quality and measures and behaviors to substantially reduce such risks.

**Benefits of using cost-benefit analyses to identify the most promising environmental policies**

A number of remediation activities have a benefit-cost ratio varying between 1.5 and 3. Examples include:

- Malaria control.
- Hand washing promotion program targeting mothers and caretakers of young children.
- Household point-of-use drinking water purification promotion program.

Technical assistance City of Dakar, MAT, MEPNBLRA, MAH, Ministry of Industry Short term (1 to 2 years)
### Table 3.1 Summary of recommendations

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<td>6. Environmental monitoring</td>
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<tr>
<td>Reinforcement of environmental monitoring capacity</td>
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<td>• Reinforce GIS and environmental monitoring capacities to have the necessary tools for decision making and for better assessing program impacts.</td>
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<td>Technical assistance</td>
<td>MEPNBRLA</td>
<td>Short term (1 to 2 years)</td>
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<td>• Implement a national environmental data management system that is updated and accessible.</td>
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<td>CSE</td>
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<td>• Provide the necessary human, financial, and technical means for the systematic implementation of environmental monitoring.</td>
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<td>Other concerned ministries</td>
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<td>7. Environmental information, education, and awareness</td>
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<td>Establish an environmental database accessible to all:</td>
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<td>• Refurbish the National Scientific and Technical Documentation Center.</td>
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<td>Technical assistance</td>
<td>MEPNBRLA</td>
<td>Short term (1 to 2 years)</td>
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<td>• Establish a networking system among all technical government agencies that includes a data-sharing mechanism.</td>
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<td>• Adopt a charter to manage, share, and access data.</td>
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<td>Other concerned ministries</td>
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<td>• Establish mechanisms within ministries to facilitate the circulation of documents.</td>
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<td>and international institutions.</td>
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<tr>
<td>• Establish mechanisms to ensure the circulation and sharing of relevant data with international research institutions.</td>
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<tr>
<td>• Information, education and awareness: Proper attention should be given to implementation of a National Environmental Education Strategy Paper that is currently under review at the MEPNBRLA.</td>
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