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USAID WULA NAFAA AND ECONOMIC GROWTH PROJECT

REPORT OF THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT (PEA) OF THE USAID/SENEGAL ENHANCED AGRICULTURAL PRODUCTIVITY ACTIVITIES UNDER THE FEED THE FUTURE INITIATIVE BY USAID/SENEGAL AND ITS IMPLEMENTING PARTNERS

October 2010
This report is made possible by the support of the American People through the United States Agency for International Development (USAID). The contents of this report are the sole responsibility of International Resources Group (IRG) and do not necessarily reflect the views of USAID or the United States Government.

Cover Photo: During the visit of the PEA Team to Dianke Souf, Kaffrine Region, Mr. Ousmane Ndiaye, Village Extensionist/Animator for the Bamtare Association, gave an in-depth presentation of the work they are doing to introduce integrated control of Striga, a parasitic plant which attacks their sorghum crop. He is using a PCE-provided visual aid to explain the steps to controlling this pest that combine organic methods with good agricultural practices.

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OCTOBER 2010

Prepared by the Wula Nafaa/PCE PEA Team, including:
Thomas Catterson, Team Leader & Senior Environmental Assessment Specialist; Beverly McIntyre, Climate Change Specialist; Ramatoulaye Ndiaye, Local Climate Change Specialist; Souleymane Diallo, Agronomist; Roger N'Decky, Irrigation Specialist; Salimata Ba, Community Organization Specialist; and Cecelia Polansky, Natural Resources Management Specialist

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ACKNOWLEDGEMENTS

This is a large program so it will come as no surprise that many people graciously cooperated in making this programmatic environmental assessment (PEA) possible. In fact, there are too many to even attempt naming them all.

Some people, however, do stand out as having gone out of their way in assisting us. We are sure that both Jeff Povolny, Chief of Party of Wula Nafaa and Jim Billings, Chief of Party of Projet Croissance Economique (PCE), will acknowledge that key members of their staff were unusually helpful in this undertaking. We are grateful to Jeff and Jim for availing us of their services.

Prominent among that group are Khar Dakono and Loly Mbaye, who organized and arranged our field visits and were our "fail-safe" means of communications throughout the PEA exercise. Also critical to getting this PEA done were the three PCE drivers who shepherded us around the country, from the extreme southeast (Kedougou) to the northwest (the Senegal River Basin): Boubacar Ba, Bakary Coly, and Daopane Ndiaye. Many long, hard days were spent "on the road" with them and they were unflinching in their dedication to getting the job done.

Another very enthusiastic contributor to the PEA was Saliou Mbodj, the Wula Nafaa Senior Irrigation Specialist. He escorted the Team on many of their early field visits and was always extremely well prepared and interested in presenting the activities he directs in a very professional and informative manner.

Of course, our real thanks and recognition should be extended to the many staff members of the projects, their partners on the ground and the multiplicity of community participants who welcomed us into their villages and showed us their accomplishments. We respectfully dedicate this report to them in the high hope that our findings will also contribute to the development of the agriculture sector in Senegal and with it bring benefits and increased food security to the country.

FOREWORD

The situation in Senegal is no different from the general situation found throughout West Africa where, with the possible exception of some commercial crops (e.g., cotton), the majority of agriculture aims at family subsistence and most of the land is cultivated by small farmers. The technology begins with saved seeds and, although improvements and indeed expansions of the agricultural frontier are commonplace, average productivity is low. This rather sobering situation clearly represents challenges but perhaps more importantly, it implies great opportunities to increase productivity, raise farm family incomes, and enhance both household and national food security.

Technological innovation, improved seed varieties, access to agricultural inputs – including fertilizers and crop protection products, policy reform, improved market linkages and terms of trade, and better sector finance are all important steps to enable subsistence farmers to make the transition to becoming small-scale commercial farmers, and beyond. The current partners and their activities under the Feed the Future (FtF) Initiative are already clearly moving the sector in the right direction, to the benefit of countless farm families across Senegal.

The need for this programmatic environmental assessment (PEA) is predicated on the conviction that these agriculture sector advances will have the most lasting impact if their environmental sustainability is assured. How these sector development activities might adversely affect both the farmers and their families who practice them, and the environment on which they depend, cannot and should not be overlooked. In Senegal, a semi-arid country long used to periodic drought and incipient desertification, the impact of and on global climate change frames the considerations of this PEA.

It was extremely stimulating to find among the partner staff and farmer community a very high degree of awareness and interest in ensuring that these programs and their achievements are environmentally sustainable. Many, many of the young Senegalese professionals that the PEA Team met in the course of its work clearly share the conviction that the time is ripe for raising awareness of the issues of the environment and doing something proactive to reverse the negative trends. Indeed, we encountered no voices of dissent nor skepticism; the Senegalese people are ready to build environmental management into their farming systems and highly convinced of its importance. It is the hope of the PEA Team that this report will further enable them to do exactly that.

ACRONYMS

AFD	Agence Française de Développement
ANCAR	Agence Nationale de Conseil Agricole et Rural. Senegal
BEO	Bureau Environment Officer
CAADP	Comprehensive African Agriculture Development Program
CFR	Code of Federal Regulations
CILSS states	Permanent Interstate Committee for Drought Control in the Sahel
DA	Development Assistance
EA	Environmental Assessment
EGSSAA	Environmental Guidelines for Small-Scale Activities in Africa
EIA	Environmental Impact Assessment
EMMP	Environmental Mitigation and Monitoring Plans
FAO	Food and Agriculture Organization of the United Nations
FAS	Foreign Agriculture Services
FtF	Feed the Future
GCM	Global Circulation Model
GDP	Gross Domestic Product
GFSR	Global Food Security Response
GHFSI	Global Hunger and Food Security initiative
GMOs	Genetically modified organisms
GOANA	Great Agricultural Offensive for Food and Abundance
HSG	Hyena Specialist Group
GOS	Government of Senegal
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IEE	Initial Environmental Examination
IPM	Integrated pest management
IRG	International Resources Group
ISFM	Integrated soil fertility management
ISRA	Institut Sénégalais de Recherches Agricoles (National Agronomy Research Agency)
JICA	Japan International Cooperation Agency
LASF	Local Agriculture Support Fund
LECZ	Low elevation coastal zone
LOE	Level of Effort (person-days of work)
MCC	Millenium Challenge Corporation
MDG	Millennium Development Goal
NEAP	National Environmental Action Plan

NEPAD	New Partnership for Africa's Development
NRM	Natural Resource Management
PCE	Project de Croissance Economique
PEA	Programmatic Environmental Assessment
PERSUAP	Pesticide Evaluation Report/Safe User Action Plan
SLR	Sea Level Rise
SME	Small and medium-sized enterprises
SO	Strategic Objective
SOC	Soil Organic Carbon
SODEFITEX	Société de Développement des Fibres Textiles
USAID	United States Agency for International Development
USDA	U.S. Department of Agriculture
USG	United States Government
USGS	U.S. Geological
VC	Value Chain
WASA	West Africa Seed Alliance
WN	Wula Nafaa

EXECUTIVE SUMMARY

Introduction: The activities being planned and carried out under Strategic Objective 11 by USAID/Senegal – Increased Economic Growth through Trade and Natural Resource Management – were recently re-analyzed as part of an amendment to the Initial Environmental Examination (IEE). Those activities being planned under the aegis of the Global Food Security Response (GFSR) Initiative (presently being called the "Feed the Future Initiative") were accorded a "threshold determination" as follows: "a **positive determination** is recommended per 22 CFR 216.2(d)(2), and an Environmental Assessment will be prepared, per 22 CFR 216.6" for the agricultural development activities under this program." The report which follows is the outcome of the programmatic environmental assessment (PEA) which examined the activities of all the implementing partners (Wula Nafaa, Project de Croissance Economique, the US Peace Corps, the US Department of Agriculture (USDA), and the West African Seed Alliance) involved in the program. It should be further noted that the motivation for the change in threshold determination arose, at least in part, as recognition of the potential environmental management challenges that incipient global climate change might have on agricultural development and food security in Senegal.

Scope of this Programmatic Environmental Assessment: This PEA is expected to enable those involved in the program to achieve three objectives. On the one hand, it will **enable the implementing partners to meet the compliance requirements of USAID's environmental procedures** (Reg. 216) and will develop analytical and planning tools aimed at ensuring the greater sustainability of the agricultural development activities of the program. Secondly, beyond compliance, this PEA and its report are expected to be important in **raising awareness and capacity building in Senegal** about the importance of environmental management to sound agricultural development program. Finally, the PEA should also contribute to **advancing the understanding of the state-of-the-art agricultural development** from the perspective of environmental management and, in particular, as seen through the lens of the threat of climate change in Senegal.

Overall Methodology: This PEA was carried out by **a multi-disciplinary team** consisting of a Team Leader/Senior Environmental Assessment Specialist, an Irrigation Specialist, an Agronomist Specialist in Semi-Arid Zone Farming Systems, an Agricultural Development Specialist with Climate Change Expertise, a local Senegalese Climate Change Professional, a Community Organizations Specialist, and a Natural Resources Management Specialist. The **methodology for this PEA** involved careful review of pertinent program literature, extensive field visits, the preparation of a Scoping Statement as a guide to the most significant issues, and most importantly, consultation with a wide range of program stakeholders including project staff, USAID staff, local partner staff, and representatives of the beneficiary community. The field work was carried out in June/July 2010 and the first draft of this report put forward in late August.

The analysis of the environmental management issues associated with program activities is based, as it must be, on a sound understanding of the agricultural development and food security context in Senegal. It also takes into account an in-depth analysis of the affected environment as the backdrop on which these development activities are being implemented. As noted above, special consideration was also given to identifying the likely impacts of global climate change from current data and information available about Senegal.

Activities Being Reviewed: The agricultural development activities being carried out or in the planning stages as part of the Global Food Security Response Initiative (now "Feed the Future") by Wula Nafaa, the Economic Growth Project and some US Peace Corps volunteers cover a wide range of

activities distributed across the rural regions of Senegal. They may be roughly grouped into the following types of activities:

- Rehabilitation and development of wetland areas (*bas-fonds*) for rice production
- Improvement of horticulture production technologies
- Commodity-based "Value Chain" (VC) development packages
- Improving soil fertility on rainfed farming system areas (conservation farming)
- Capacity building for program partner staff and beneficiaries related to all of the above

USDA and West African Seed Alliance (WASA) were primarily involved in improving seed quality, handling and supply as a basis for much of the above.

Findings of the PEA: As is typical of any environmental assessment, **the principal outcome of this PEA was a determination of the potential adverse socio-environmental impacts** that might arise from the array of agricultural development activities and a range of recommendations about mitigating and monitoring them. It is worth noting here as well that by definition and because of the real scope of global climate change, the related program recommendations are geared to adaptation rather than mitigation because the latter is typically beyond the capacity of an individual country.

Special Consideration – Global Climate Change and Agricultural Development in Senegal: The PEA Team was directed to take note of the very special circumstances of meeting the goals of the Feed the Future initiative in a Sahelian country like Senegal and its different agricultural development activities in the light of potential effects of/on global climate change. Very clearly, the probability that climate patterns in the Sahel in Senegal critical to the current cropping patterns would become even more challenging, thereby possibly jeopardizing the premises and programs of the Feed the Future, needs to be considered carefully and appropriate adaptation measures put in place to foster a more sustainable approach to food security. Early on, indeed, during the scoping phase, the PEA Team concluded:

"It is very clear that agricultural development and food security policy in Senegal without climate change awareness and a well-conceived strategy won't succeed, possibly even over the medium-term." (emphasis added).

The conclusions about the impacts of global climate change on agricultural development in Senegal and adaptation recommendations associated with them are outlined below:

- **Temperature Rise and Crop Choice** – The country's current crop mix is also already thought to be challenged by high and rising temperature regimes that could affect productivity and even crop choice. Temperatures in the CILSS states (Permanent Interstate Committee for Drought Control in the Sahel), of which Senegal is a member, are expected to be hit particularly hard, with increases greater than the global average. Senegal is already one of the hottest countries in sub-Saharan Africa. These conditions are projected to become worse in the coming decades as mean global air temperatures increase by 1 to 2°C minimally over the next decades. The continuing increase in air temperatures projected with climate change will result in growing seasons that will expose staple crops to uncommonly warm air temperatures, well beyond the optimal temperatures for growth and development for some crops.

- **Sea Level Rise and Inland Impacts in Senegal** – The potential for sea level rise and its impacts on the flat low-lying areas where marine estuaries penetrate well inland, into current crop lands, such as in the Sine Saloum, also merits consideration. While sea level rise is

projected to increase by up to 1.4 meter by 2100, it will be the surges associated with tropical storms that will endanger the Senegalese population. Similarly, the flatness of the landscape and the deep inland penetration of estuaries and rivers in Senegal will make diking to protect from sea level rise a very challenging and costly proposition.

- **Uncertainty Regarding Rainfall Amounts and Intensity** – The Global Circulation Model (GCM) projections of rainfall are much less certain than temperature projections; in fact, GCMs vary in the direction of precipitation changes (Lobell and Burke, 2008). Although, given projected increases in evapotranspiration and population, it is highly likely water will be less available. Even if rainfall increases or decreases in a given area, a greater number of events are likely to be more intense.

- **Climate Change and Peoples' Vulnerability to Hunger and Poverty** – The development challenge is to reduce the vulnerability of Senegal's farming communities as temperatures warm, precipitation regimes change, and extreme events become more common. Climate change sets the stage for more hunger and greater poverty. Climate variability is already a source of vulnerability for poor people because their livelihoods are strongly dependent on natural resources.

The following recommendations for adaptation to climate change should be considered by USAID and its Feed the Future partners in the near-term:

- Reducing vulnerability to climate change means **better management of the natural resource base** on which agriculture and 70% of the people depend.

- Access to inputs (seeds, water, organic and inorganic fertilizers) and improved input efficiency will be critical to the survival of resource-poor households and an essential component of agricultural development strategies, including resilient food systems, as climate change intensifies in Senegal.

- Financial services such as credit, savings, and drought insurance also provide resilience to shocks.

- More agro-meteorological data through expanding the "agromet" network will help detect localized trends faster and improve seasonal forecasting and farmer investment decisions.

- Conserving and rehabilitating the natural resource base is an essential component of current USAID programming in Senegal, both at the farm level (a wider array of conservation farming techniques) and being better stewards of soil and water resources (soil and water conservation at the watershed level).

- It will be even more important to protect and conserve genetic resources and biological diversity (e.g., the parkland agro-ecosystems, the remnant forest and savannah areas, and wetland areas).

- More specifically, the Feed the Future Initiative program partners should strive to encourage mixed crop and, where possibl,e mixed crop-livestock systems in order to maximize household resilience to climate change. Adding beans and grain legumes (cowpea, groundnut) to systems has the potential to decrease a household's vulnerability to climate change as well as increase household nutrition.

- The need for improved varieties with traits capable of performing in the novel temperature regimes projected for the Sahel underscores the need to maximize support for crop breeding programs and the conservation of genetic resources.

The section of this report dealing with Global Climate Change concludes with a series of recommendations about strategic measures for climate change adaptation that go beyond the present program and might be considered as part of the policy dialogue for the agricultural sector between USAID and the Government of Senegal.

The Most Significant Risks for Adverse Environmental Impacts and their Mitigation: It is worth noting that at the time of the threshold determination, the two International Resources Group (IRG) projects in the program, Wula Nafaa and Projet de Croissance Economique, had already achieved a fairly high degree of environmental "due diligence" in meeting the requirements of Regulation 216. Both projects in response to a previous finding of "negative with conditions" have developed and are implementing project specific Environmental Mitigation and Monitoring Plans (EMMP). They have both also recently completed a Pesticide Evaluation Report/Safe User Action Plan (PERSUAP) covering their agricultural (and other) activities. The Wula Nafaa Project had also taken the initiative to translate the "USAID Fertilizer Fact Sheet," a guide to the use of fertilizers for USAID programs in Africa, into French.

The following section offers a synopsis of the most significant potential adverse environmental impacts and adverse socio-environmental impacts and offers recommendations for their mitigation. They include:

- **Soil Degradation and Desertification** – One cannot help but note that there has been a widespread expansion of the agricultural frontier in Senegal, to the degree that the land-use change can be readily seen. More extensive and intensive farming, often foregoing fallow and leading to a gradual decay in the once common parklands agroforestry systems, risks soil degradation and indeed desertification.

  Mitigation Measures: Farmers are aware and have embraced some of the proposed "conservation farming" methods. The PEA Team believes that the hallmark of the agricultural development programs should include a wider range of soil improvement-oriented best agricultural practices, ranging from crop rotation, inter-cropping, enhanced fallow, improved bush fallow, low tillage/no tillage options, agroforestry configurations, green manure, and organic and chemical fertilization.

- **Upland Watershed Conditions and Lowland (*Bas-fonds*) Productivity** – Even in the relatively flat plains landscapes of semi-arid Senegal, the watersheds and catchment areas, if poorly managed, can undermine the long-term productivity of the wetlands (*bas-fonds*) or lowlands they surround. High rates of run-off and sediment transport degrade the productivity of these lowland areas and reduce the recharge of the aquifers on which they may depend for dry season horticulture.

  Mitigation Measures: Fully productive, well managed fields on the uplands or "plateaus" surrounding the lowland wetland areas go hand-in-hand with maintaining their productivity. These measures can be further strengthened by soil conservation engineering-oriented measures including "*haie vive*" (live hedges), rock bunds, soil bunds on the slope or field margins, side hill ditches or similar water entrapment structures, and contour plowing. Similarly, remedial measures to restore eroded sites such as drainage ways or gullies will also slow down the tendency of excessive run-off or sediment flowing into the *bas-fonds*.

- **Expansion of the Agricultural Frontier and Pressure on Forest Cover** – In the semi-arid and increasingly climate-challenged agricultural landscapes of many parts of Senegal, the promise of improved returns from farming could lead to pressures reducing forest cover (in both public domain and reserve forest areas) or the tree density in the parkland-like agro-ecosystems of the

country. These forests spread across the landscape to protect watershed functions and provide a mitigating effect against the extremes of weather, and possibly on climate change as well.

Mitigation Measures: Program proponents and their projects should have access to mapping services that are adequate for determining if proposed sites are within protected areas or close enough to cause a negative impact. Locations of special areas used by wildlife, cemetery and cultural sites, and traditional uses of land should all be recorded and mapped during the socio-economic studies carried out before program implementation.

- **Reduction in the Density of "Parklands" Agroforestry-based Farming Systems in Senegal** – A related and equally troubling tropical forestry-related impact of the intensification of agriculture in Senegal is the gradual reduction in the tree cover within Senegal's traditional "parkland" agroforestry systems. There are any number of parkland agroforestry systems in the country whereby farmers grow their crops under a canopy of useful tree species, including: Baobob (*Adansonia digitata*), Vene (*Pterocarpus spp.*), Kad (*Faidherbia albida*), and many others, which appear sometimes as pure stands and sometimes mixed stands of various useful trees.

  Mitigation Measures: Awareness-raising and promotion of the tangible values in terms of productivity and, especially in the light of probable changes in climate of this traditional community-based natural resources management method, will be critical to ensuring it continues to be applied as a "good agriculture practice." Where necessary, the project could make either seed (for direct seeding) of these desirable species available or even establish very small local community tree seedling nurseries to put these species back in the fields.

- **Increased Livestock Numbers, Sedentarization or Changes in Land-Use Associated with Livestock Husbandry** – Senegal has large numbers of relatively low-productivity animals spread across its landscapes. An integrated strategy will be needed if efforts to raise milk or meat production are not to cause herd size to increase and, with it, pressure on grazing resources. There are also some significant risks associated with the impacts of extensive livestock management on both the remaining forest and shrublands cover of northern Senegal and on threatened wildlife species.

  Mitigation Measures: Livestock herding is the predominant land-use option across vast areas of northern Senegal (and elsewhere in the country) so attention to the potential environmental implications from the outset will be a wise strategy. Coordinaton among programs is essential. Broad-based consultation about land-use plans and/or biodiversity conservation plans would ideally reveal where livestock, more sedentary farming practices, and wildlife management efforts need to be reconciled. Raising the productivity of individual animals before proposing herd reduction should be emphasized! Herders will quickly realize that fewer, better-fed animals will produce more if properly managed and be more likely to reduce numbers.

- **Potential Impact on Biodiversity from the Increasingly Commercialized Harvest of Natural Products** – Program proponents are promoting the harvest and commercialization of naturally occurring non-timber forest products like the fruits of Madd (*Saba senegalensis*) and Baobob (*Adansonia digitata*). Both madd and baobob are favorite food species of the endangered Chimpanzees, which also inhabitat areas where the projects are working.

  Mitigation Measures: Local conventions that frame these commercialization arrangements contain harvesting limits and promote replanting of Madd vines. Their effectiveness needs to be carefully monitored.

- **Agro-Chemical Use Risks** – Agricultural chemicals (fertilizers and pesticides) will by definition have to be a part of the efforts to raising agricultural productivity as a critical element of the national food security strategy in Senegal.

  Mitigation Measures: An affirmative action plan to advise farmers and producers on the safe use of appropriate pesticides and fertilizers and how to include them in a program of good agricultural practices and integrated pest management (IPM). The project-prepared PERSUAPs need to be translated into **awareness-raising communications packages** and **training-of-trainers curricula and training materials** to begin building the substantial capacity that will ultimately be required.

- **Flood Irrigation of Rice and Drainage Concerns** – Deep water flood irrigation of rice requires drainage. There is growing concern about where these waters, containing pesticide and fertilizer residues, can be flushed, with possible impact on natural water bodies such as the Senegal River and/or Lac de Guiers.

  Mitigation Measures: Improved farming methods including the rational expansion of irrigation schemes and the application of the recommendations of the project-prepared PERSUAPs.

- ***Bas-fonds* Development and Biodiversity Conservation** – These wetlands are typically important habitat for wildlife, both within the wetlands ecosystem and on its fringes. Environmental mitigation and monitoring plans are in place to guide their use.

  Mitigation Measures: This PEA Team would recommend a further control and something that the Government of Senegal should consider as a policy matter – designating a policy of "wild wetlands" and prohibiting the further conversion of wetland ecosystems for agricultural development in order to safeguard the ever-declining biodiversity across rural Senegal.

- **Impacts for Failure to Respect the Agro-Ecological Calendar** – The key to effectiveness and sustainability with many soil conservation and improved agricultural practices is strict adherence with the agro-ecological calendar. Unwieldy administrative procedures and other issues related to activity planning leading to slow implementation can cause certain activities to be done outside their ideal time and cause adverse environmental impacts (erosion, run-off, disturbance of natural processes).

  Mitigation Measures: The PEA Team recommends that the project authorities reconsider their project identification and approval processes and try to streamline them if possible. There should be a cut-off date for certain types of activities.

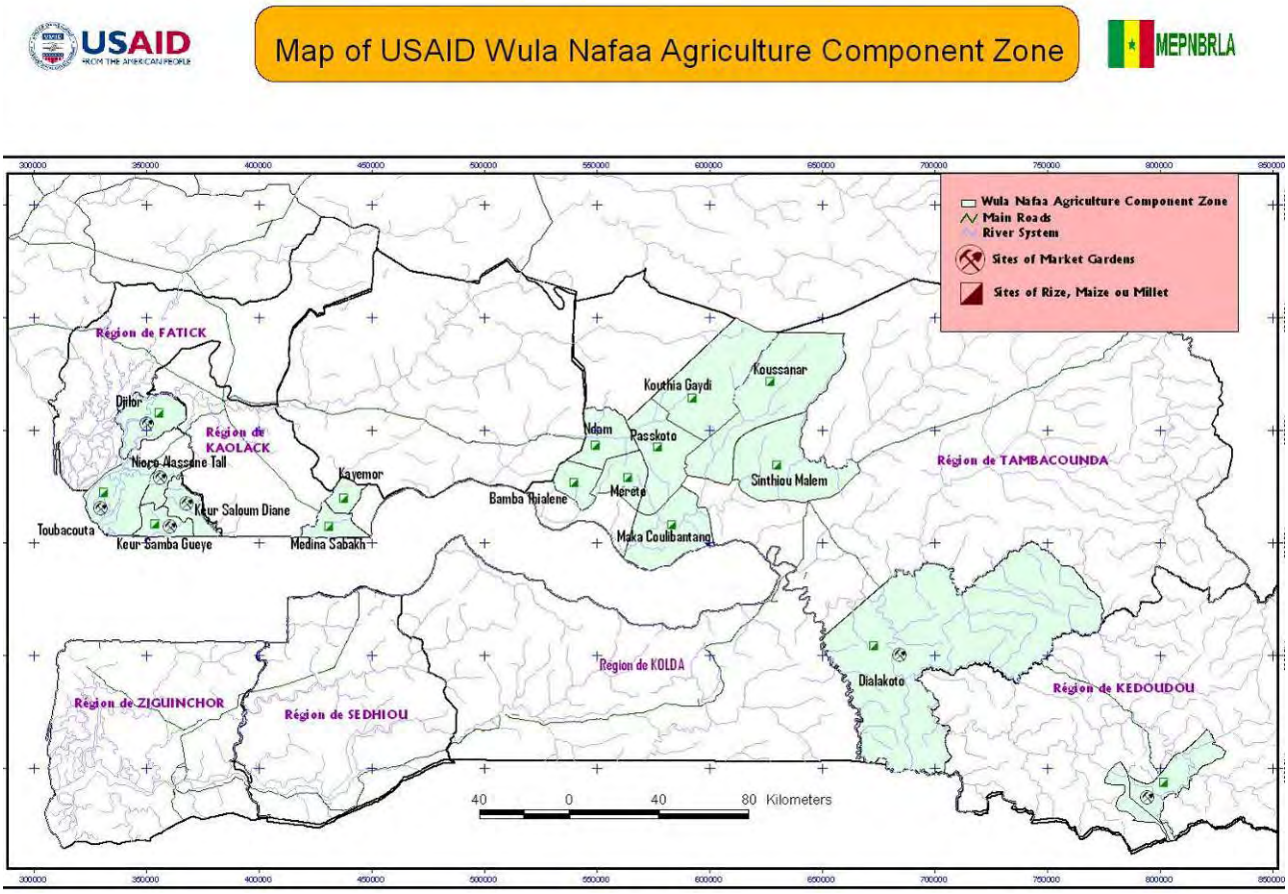
- **The Spread of Mechanized Farming and the Potential for Soil Compaction** – On-farm mechanization will have to be part of the long-term efforts to modernize agriculture and increase productivity and with it food security. Certain sites and soils will need real care in applying mechanization (tractor-drawn plows and discs).

  Mitigation Measures: Ensure that mechanization is being developed in the context of the full range of good agricultural practices for the soils and crops in question. Also, develop a better understanding of mechanization options and risks for the varying soil conditions, for both heavy and light soils, and offer training for both extension staff and farmer associations in these technologies.

- **Irrigation Schemes Increase the Spread of Water-borne Disease Vectors** – Both malaria and bilharzia are not uncommon in rural Senegal and standing or stagnant water can increase the habitat for the vectors (mosquitos and snails) which transmit these diseases, and others.

Sediment build-up and weed invasion are not only inimical to the effective functioning of the irrigated perimeter but help to create the conditions for these water-borne disease vectors.

Mitigation Measures: Design considerations and careful engineering which eliminate as much as possible ponding water or poor drainage are a good start to avoiding these issues. The need for good maintenance regimes and an ability to respond to these threats to public health should also be written into the local conventions.



These and other sites across Senegal are part of the USAID/Senegal funding for activities under the Feed the Future Initiative. In addition to Wula Nafaa, the Economic Growth Project , the US Peace Corps, the US Department of Agriculture, and the West Africa Seed Alliance all have agriculture related development activities under the program.

From left to right, Mr. Saliou Mbodj, the Water Resources Specialist from the Wula Nafaa agriculture team, with Mr. Sadiouka, one of the community members responsible for opening and closing of the sluice-gates of the dike, and guarding the perimeter, at the Ndour-Ndour Village Irrigated Perimeter, Ms. Matiguida Kaba, the WN Facilitator for the area, and Mr. Sambou Ndiaye, the Secretary of the Management Committee for the Ndour-Ndour wetland area. The promotion and planning of these improved irrigation works takes frequent and regular visits to the community, in the Sine Saloum Region.

PEA Team Member Cecelia Polansky inspects a stand of Baobob (***Adansonia digitata***) and Kadd (***Faidherbia albida***) trees in the Peanut Basin of Senegal. The untrained eye might not recognize that Agroforestry Parklands are a very common feature of the agricultural landscape across many regions of Senegal. These trees which provide food for humans and fodder for animals are excellent examples of the multi-purpose tree species that Senegalese farmers proactively cultivate in their farmlands. Of cause for concern is the current lack of young trees typical of these areas suggesting a near-term loss of tree density and with it, some of the benefits of site amelioration and production.

1. BACKGROUND TO THE PEA

The environmental regulations of the United States Agency for International Development (USAID) (22CFR216) commonly known as Reg. 216, establish the conditions and procedures for the environmental review of activities funded with Agency resources. The activities being planned and carried out under Strategic Objective 11 by USAID/Senegal – Increased Economic Growth through Trade and Natural Resource Management – were recently re-analyzed as part of an amendment to the Initial Environmental Examination (IEE). Those activities being planned under the aegis of the Global Food Security Response (GFSR) Initiative (presently being called the "Feed the Future [FtF] Initiative") were accorded a "threshold determination" as follows:

> "A **positive determination** is recommended per 22 CFR 216.2(d)(2), and an Environmental Assessment will be prepared, per 22 CFR 216.6 for activities involving irrigation and supporting increased efficiency in existing irrigated areas; support to improved rainfed agricultural practices (small-scale irrigation); for activities involving the multiplication and distribution of seeds of staple food crop; for activities supporting the increased use of organic and inorganic fertilizer; improving farm to market roads, construction of food storage warehouses and cold storage facilities at critical trading centers in various locations around the country; activities supporting the development of entrepreneurial capabilities and/or small to medium-scale enterprise developments for the private sector and farmer associations. Ongoing activities in this area must follow best practice requirements detailed in Section 4.1 of this document." (USAID/Senegal Strategic Objective (SO)-11 IEE Amendment signed and approved in April 2010)

In order to address this need for an Environmental Assessment (EA) of the agricultural development activities, USAID/Senegal asked its main implementing partner under the present Feed the Future program… International Resources Group (IRG), responsible for both the Wula Nafaa (WN) and Projet de Croissance Economique (PCE) projects…to field a team for this purpose.[1] In addition to the activities foreseen under these two projects, the USAID Mission asked that the environmental assessment cover the full range of the FtF implementing partners and their activities including the U.S. Peace Corps, USDA and the West African Seed Alliance. The methodology chosen to meet this EA requirement and one consistent with Regulation 216 is the Programmatic Environmental Assessment (PEA). Such a mechanism is particularly well suited to a program like Feed the Future, which will carry out a wide range of agricultural development activities, all with a similar focus of enhancing productivity, ensuring food security, and benefiting producers by linking production to the marketplace when possible. In addition, since these activities will be carried out over time and in different places across Senegal, the PEA – which treats them as a "generic class of actions" – is ideal for the assessment of this kind of program.

1.1 PURPOSE OF THE PEA

This PEA is being designed and carried out with the objective of viewing agricultural development activities from the broader and longer-term perspectives of sector modernization and food security. It will be premised on a broad overview of program results aimed at enhancing the sustainability of these activities and programs.

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[1] It is worth noting that at the time of the threshold determination, the two IRG projects, Wula Nafaa and Projet de Croissance Economique, had already achieved a fairly high degree of environmental "due diligence" in meeting the requirements of Regulation 216. Both projects developed and are implementing Environmental Mitigation and Monitoring Plans (EMMP) and also recently completed a Pesticide Evaluation Report/Safe User Action Plan (PERSUAP) covering their agricultural (and other) activities. The Wula Nafaa Project had also taken the initiative to translate "USAID Fertilizer Fact Sheet," a guide to the use of fertilizers for USAID programs in Africa, into French.

This approach is especially pertinent because of the growing concern about climate change. The concern is dual in nature. On the one hand, the issue of climate change is viewed from the perspective of its likely impact on program success; on the other hand are the issues of program impacts on climate change. This emphasis on climate change constitutes a *prima facie* example of how environmental oversight can and should be used as a mechanism for the proper design and adaptation of agricultural development programs.

The purpose of the PEA, however, is as follows:

- It will enable the USAID/Senegal Mission and its implementing partners to comply with the statutory requirements of Regulation 216 as it applies to their programs. It will do so by developing **a series of environmental management tools** that can be applied to current and future agriculture development activities to enhance their potential for sustainable development. These tools will include **an issues list** describing the most typical and priority-adverse environmental impacts likely to occur with these sorts of activities. This list will allow for the development of a generalized environmental mitigation and monitoring table that will guide the actions necessary to avoid these adverse impacts and to monitor the their effectiveness. Finally, the report is expected to generate a Senegal-relevant **Environmental Planning Checklist** for use with agricultural development activities so as to ensure that USAID's implementing partners (and others) take these matters into account early on in the development of specific site activities.

- Beyond compliance with USAID's environmental procedures, this PEA and its report are expected to be important in **raising awareness and capacity building in Senegal** about the importance of environmental management to sound agricultural development program. The intention as well is to keep it simple and straightforward, thus favoring the ability to implement the mitigation measures and to use the report as a potential training tool for raising national capacity for environmental management in the agriculture sector. Staff capabilities and organizational systems for sustainable agriculture development programming will be value-added outcomes of this PEA.

- This PEA should also contribute to **advancing the understanding of the state-of-the-art of agricultural development** from the perspective of environmental management and, in particular, as seen through the lens of the threat of climate change in Senegal. This latter achievement will be important to USAID, its implementing partners, and to other actors and stakeholders of the sector in Senegal, including beneficiary producers and private entrepreneurs and Government of Senegal sector authorities and staff.

1.2 DESCRIPTION OF THE SCOPING PROCESS

As per the procedures specified in Reg. 216, a multi-disciplinary team undertook, early on in the PEA process a "scoping exercise." The purpose of this exercise, in keeping with the standard methodology of environmental assessments in the United States, is to focus the subsequent PEA on a selected set of priority issues of highest relevance to the success and sustainability of the agricultural development program in Senegal.

The Scoping Statement was officially circulated in mid-July to the primary implementing partners and subsequently to USAID/Senegal for their collective review and comment. It was also transmitted to the USAID Africa Bureau Environment Officer for his review and approval as per the regulations [216.3(a)(4)(ii)].

1.3 PEA METHODOLOGY

Because of the high level of previous compliance with Reg. 216 and the ongoing nature of the program, it was agreed with the Bureau Environment Officer that the PEA itself could continue directly after the Scoping Exercise took place. Thus the draft Scoping Statement was shared with the Implementing Partners involved in the Feed the Future program and also with USAID/Senegal Mission, for their review and comment.

Consultation – A key methodology for environmental assessments: Meeting at Dianke Souf with members of the community involved in PCE. The PEA Team was introduced to the community by Ms. Aminata Samb, the Sorghum and Millet Specialist of PCE, based in Kaolack. She appears here in the foreground followed by the team leader, Tom Catterson, Mr. Souleymane Diallo, the team agronomist, and Ms. Cecelia Polansky, the NRM specialist. It was an extremely productive meeting.

As mentioned above, the Scoping Exercise confirmed the choice of the different disciplines deemed essential for a multi-disciplinary PEA Team. Team work and inter-disciplinary inquiry are key elements of any good environmental assessment. With the support of the subject projects, USAID Wula Nafaa and PCE, IRG assembled **a multi-disciplinary PEA team** to carry out this assessment work, including:

- **Team Leader/Environmental Review Specialist**: The overall duties of the Team Leader were to oversee the design of both the Scoping Exercise and the PEA itself, participate in the detailed planning of the PEA and the selection of the candidates for other team positions, and coordinate the roles and inputs required of the other members of the Team. Additionally, the Team Leader was the person responsible for interactions and communications with both the projects and USAID/Senegal. Finally, the Team Leader was the primary person responsible for compiling and editing the reports to be prepared as a result of this PEA, i.e., both the Scoping Statement and the eventual PEA Report (estimated LOE: 42 person-days).

In addition, **a multi-disciplinary team** composed of the specialists (described below) was assembled and work under the general direction of the Team Leader and in close collaboration with the USAID Wula Nafaa and PCE staff assigned as focal points for this PEA (see **Annex A** for brief Biographical Sketches of the PEA Team members):

Team Member SOWs: Beyond their specific professional areas of concentration, each of the specialist team members had **the following roles and responsibilities**: review project reports and activity descriptions to become fully familiar with the activities being analyzed as part of this PEA (see the **Reference List**); be prepared to interact with other team members to ensure a good understanding of the activity being analyzed is shared by all; keep basic notes related to a working profile of the activities from their particular perspective; take responsibility in the field for ensuring that questions related to the activities and the affected environment or project participants are put forward and the responses noted; be an active and engaged participant in the multi-disciplinary team discussions convened to identify potential adverse impacts and how they can be mitigated; and finally, to contribute to outlining the

eventual PEA report and completing first drafts of the sections of said report assigned to them by the Team Leader.

- **Irrigation Specialist**: This specialist was responsible for providing expertise and analytical capability related to water resources and irrigation engineering. During site visits, the irrigation specialist was responsible for ensuring that the technical dimensions of the irrigation design have been understood and summarily documented to aid later analysis and diagnosis and intra-team discussions (estimated LOE: 26 person-days).

- **Agronomist Specialist in Semi-Arid Zone Farming Systems**: This team member provided expertise and analytical capability related to the farming systems being promoted under the Feed the Future component, and in identifying potential adverse impacts associated with them. He was also responsible for ensuring that the technical dimensions of the farming system at each field site have been understood and thoroughly analyzed for potential adverse impacts (estimated LOE: 26 person-days).

Field visit to Samecouta: The women's group at Samecouta (a GIE or Economic Interest Group of 120 women not far from Kedougou) graciously received the PEA Team and explained the challenges they face in trying to increase the productivity of this rainfed rice scheme. The woman in the center (in the plaid dress) is Mrs. Aminata Kabar, the President of the group, who spoke clearly and eloquently about what it would take to raise the productivity on this site, including the need for mechanization, additional clearing, improved seed, and agricultural inputs.

- **Agricultural Development Specialist with Climate Change Expertise**: It was foreseen that, given the emerging concerns about global climate change, the PEA should make a special point of considering the feasibility of its agricultural development and irrigation activities and investments against the backdrop of the potential impacts of and on this phenomenon in Senegal. IRG's Home Office Climate Change Specialist was asked to take on this role, with the support of **a local Senegalese Climate Change professional** also familiar with this important subject. These two team members were responsible for identifying the likely tangible impacts and relationships and suggesting measures for addressing them as part of the longer-term perspective for these agriculture sector development initiatives (estimated LOE: 18 and 26 person-days respectively).

- **Natural Resource Management (NRM) Specialist**: Possible expansions to the agricultural frontier in Senegal and/or the off-site consequences of agricultural development, on protected areas and within the fragile semi-arid landscape are of paramount concern to long-term sustainability of these development programs. The NRM Specialist was designated to play a

special role in assisting the other team members to understand both the local and the landscape context of the natural ecosystems within which improved agriculture development will take place. Land-use and agricultural development in a semi-arid country must necessarily be geared to the land capability mosaic and integrated approach to land-use that is part of farming systems. In addition to addressing these issues, the NRM Specialist had a particular role in assisting the team to properly and succinctly profile the environmental and ecosystems setting in which these programs operate and how they are likely to interact with agricultural development activities. This latter role involved preparing the sections of the report typically known as the "affected environment" (estimated LOE: 30 person-days).

- **Community Organizations Specialist**: Many of the outcomes of sound environmental design and management are best achieved by collective agreements and understandings among the users who must agree how to share and use scarce resources amongst themselves. Similarly, the most important environmental impacts are those which affect the users (farmers) themselves and their neighbors, so it is critical to arrange for and/or tap these sources of insights about adverse impacts and how to deal with them. These arrangements are also of fundamental importance to the implementability of environmental mitigation and management recommendations (estimated LOE: 26 person-days).

Once the Scoping Statement process had been completed, the PEA Team took on a series of other steps to prepare a draft PEA Report and work to get it reviewed and approved and made part of the compliance record, as follows:

Field Visits, Data Collection, and Stakeholder Consultation: The assembled PEA Team spent some almost three weeks at field sites visits, on a wide variety of sites chosen among those being sponsored by the two projects. Sample sites were spread across the landscape in Senegal and careful planning was required to choose those to be visited as a good representation of both the type of activities and the ecological zones in which they take place, and in a logistically effective manner. The intention at the field sites was to observe the area, understand the agricultural development and/or irrigation activities underway there, and to hold consultations with both project proponent staff members and beneficiary farmers and others from the area. Furthermore, the intention of the field visits was to verify whether the issues singled out in the Scoping Statement are relevant, whether there are other unforeseen issues, and to devise and discuss proposals for mitigating the adverse impacts which might otherwise arise. In addition, individual team members were responsible for collecting information and data for their contributions to the eventual PEA Report. The team collected digital photographic images of the sites, their surroundings, and instances of potential adverse impacts so as to be able to produce a well illustrated report and guidance piece.

Synthesizing the Findings and Preparing the PEA Report: The Team will reassemble in Dakar to begin to **synthesize its findings**. The following general steps were foreseen:

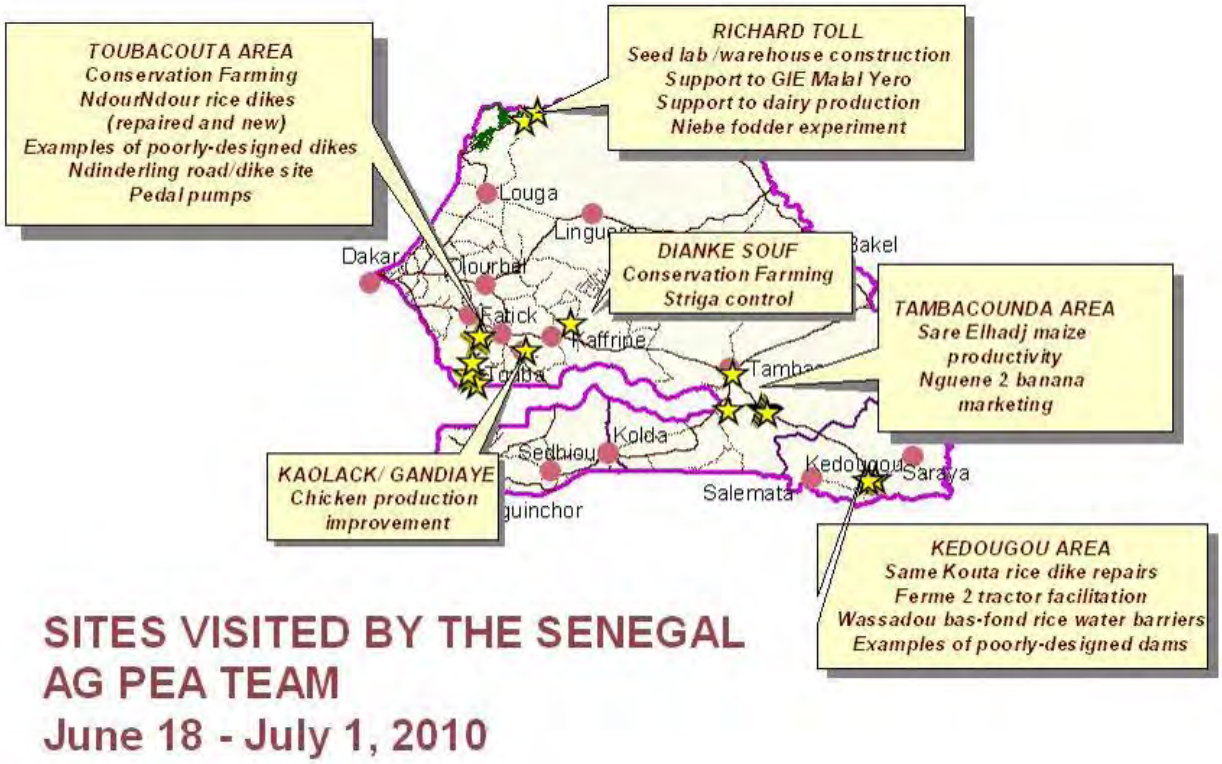
- **Presentation of preliminary findings**: Three days after their return to the capital, they will make **a presentation for project and USAID stakeholders about their preliminary findings**, i.e., the likely potential adverse impacts from agricultural and irrigation development in Senegal and a brief summary of the mitigation measures proposed to counter them.

- **Preparation of an Annotated Report Outline**: On the basis of these discussions, the draft report outline will be developed, annotated, and circulated for review and confirmation. Individual team members will be assigned responsibilities for drafting particular sections of the report.

- **First draft of the PEA Report**: With the annotated outline in hand, individual team members will then continue to produce the draft pieces he or she has been assigned. Individual team members will have a total of eight working days for drafting the report (the three leading to the preliminary findings followed by five more for writing).

- **Assembling the first full draft of the PEA Report**: The Team Leader will have another week in-country to work with his team members and guide them so that at the end of the following week, the team members will have contributed the drafts for which they were assigned responsibility. The final week will be spent by the Team Leader pulling together the full **draft of the PEA Report for electronic transmission to the PCE/Wula Nafaa and the USAID Mission.** USAID/Senegal will have two working weeks to review and comment on the draft report and will send consolidated comments to IRG for incorporation into the final report. The **final report will be prepared and presented to the Mission one working week** after receipt of the comments from USAID.

Figure No. 1.1 - Field sites locations visited by the PEA Team



Final Presentation/Debriefing Session: Should the Mission view it as worthwhile, the Team Leader will be prepared to return to Senegal to present the full report to both the PCE/Wula Nafaa proponents and USAID in a final debriefing presentation.

2. THE PROGRAM SETTING FOR AGRICULTURE DEVELOPMENT IN SENEGAL

2.1 OVERVIEW OF THE AGRICULTURE SECTOR IN SENEGAL

A Brief history of Agriculture in Senegal: Post-independence, agricultural policy was mainly inspired by western models. The Green Revolution, with its use of agrochemical pesticides and fertilizers, "improved" seeds, monocultures, and mechanization, elevated expectations of resolving the problem of hunger in Africa. For more than 20 years, the agricultural sector was the economic development engine for Senegal (Government of Senegal 2002).

A national policy of devoting resources to cash crops (peanuts and cotton) dwarfed emphasis on production of staples through the 1980s. State-run enterprises entered the market chains for rice (under SAED), peanuts (SODEVA), and cotton (SODEFITEX), providing services to producers but at a high price. Export crop revenues became vulnerable to changing global market prices (El-Hadji, von der Weid & Scialabba 2001).

Cotton and peanut prices fell during the 1990s, forcing farmers to diversify their crops. This has been a difficult task in the face of withdrawn government support and subsidies (Government of Senegal 2002).

Agriculture's share in Senegal's Gross Domestic Product (GDP) fell after the 1960-86 period; during the same period, the share of GDP in livestock grew. From 1990 to 1995, the natural resource sector accounted for almost 21% of GDP, including 10.6% from agriculture, 7.6% from livestock, 2.1% for fisheries, and 0.5% for forestry (El-Hadji, von der Weid & Scialabba 2001).

Approximately 70% of the population is said to be working in the natural resources sector. In 2004, the contribution of the sector to GDP was less than 18%, of which the contribution of agriculture was near 10% (Ibid).

Since the colonial era, food habits of the Senegalese population evolved with the introduction of imported broken rice into the diet. The addition of more consistent demand for vegetables (cooked with the rice) and fruits is a more recent phenomenon, and this sets the stage for a new emphasis on horticultural products as another means to increase incomes (Perry & Wade 2010).

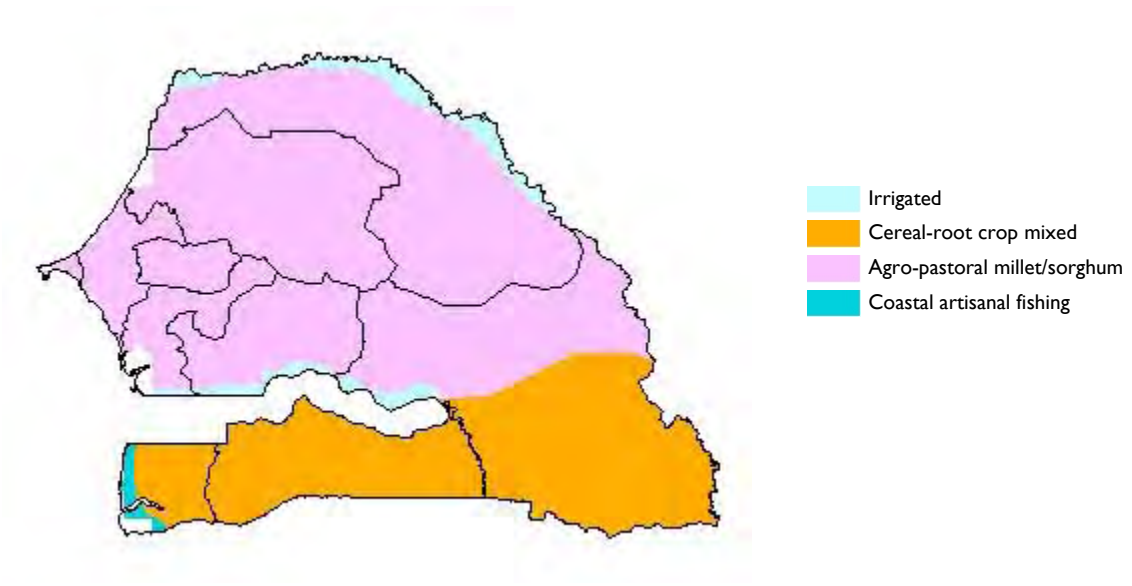
Types of farming systems: Two classification criteria for classifying major farming systems for purposes of programming agricultural development strategies are:

- Available natural resource base (water, land, grazing areas and forest, climate/ altitude, landscape/ slope, farm size, tenure, spatial arrangement)
- The dominant pattern of farm activities and household livelihoods (crops, livestock, trees, aquaculture, hunting, forest product gathering, processing and off-farm activities; technologies used, intensity of production; and integration of crops, livestock, and other agricultural activities)

Applying these criteria to Senegal, several broad categories of farming systems can be distinguished:

- Irrigated farming systems, embracing a broad range of food and cash crop production
- Rainfed wetland rice based farming systems, dependent upon monsoons supplemented by irrigation

- Rainfed farming systems in humid areas of high resource potential, characterized by a crop activity (notably root crops, cereals, industrial tree crops - both small scale and plantation - and commercial horticulture) or mixed crop-livestock systems
- Rainfed farming systems in dry areas with low potential, with mixed crop-livestock and pastoral systems merging into sparse and often dispersed systems with very low current productivity or potential because of extreme aridity
- Mixed large commercial and small holder farming systems, across a variety of ecologies and with diverse production patterns
- Farming systems mixed with coastal or artisanal fishing for additional income
- Urban-driven farming systems, typically focused on horticultural and livestock production.



Livestock: Droughts occur regularly throughout the Sahel, causing losses to herds as well as to agricultural crops. In the 1972-73 drought alone, 20% of the herds were lost. However, the herd sizes were quickly rebuilt in spite of poor rains through the 1980s. As of 1998, there were 2.7 million beef cattle; nearly 6 million goats and sheep; 370,000 horses; 303,000 donkeys; and 184,000 pigs. In the face of drought, small animal husbandry becomes the principal economic refuge for rural populations. Sheep raising, particularly for Moslem Tabaské holidays, is becoming more profitable and efficient for rural central and northern Senegalese who live in this area more deeply affected by desertification and drought (Government of Senegal 1998).

Some 350,000 families raise livestock (30% of households). Animals contribute to increasing crop production through animal traction, and by providing organic fertilizer. Fifty-five to 70% of rural revenues come from livestock (Ibid).

The meat market chain produces over 100,000 tonnes per year, mostly beef. Leather and hides are the main export income source in the livestock subsector, at 2,500 tonnes in 1999. Milk production is still relatively small; in the 1990s it was at 110 million liters.

Cattle on the move: All over Senegal during the late dry season, one encounters herds of animals on the move, in search of grazing opportunities. These relatively unproductive cows, as seen in this photo, constitute wealth for the herders who own them but often cause conflict with sedentary farmers as they amble across the landscape in search of fodder. On the other hand, some farmers welcome them to spend the night, or more, because this *parcage du bétail* adds nutrients from manure to otherwise depleted farm fields.

The PEA team was told that for migrant herders, cattle are a sign of wealth; the bigger the herd, the better. This makes it difficult to buy directly from members of this socio-economic group. Also it is difficult to buy milk that is produced, as they do not have the habit of commercializing their supply; throwing milk out happens all too frequently. Conflicts between herders and farmers are common as fields expand with population growth. Truly migrant herders are increasingly (and sometimes unfairly) blamed for many environmental ills, from setting bush fires to forcing green grass to sprout in dry season, to destroying trees by lopping branches for fodder. These migrant herders move annually with their animals from southern richly vegetated lands to north-central sylvo-pastoral reserves at the start of the rainy season, before farmers' seeds have begun to sprout. After the harvest, they return south, browsing crop residues and leaving organic fertilizer along the way.

Constraints in the agricultural sector: Although agriculture in Senegal occupies 65 to 70% of the population on 480,000 holdings, its low contribution to the GDP shows that productivity is weak. Following government reforms and structural adjustments, and the devaluation of the CFA Franc in 1994, agricultural performance is still subject to these constraints (Government of Senegal n.d. a):

- ✓ *Environment* – 11 drought years in the space of 20 years; site-specific issues including salinization, acidification, wind erosion, encroached pasturelands and forests, dune movement, silting-in of lowlands, and piercing the saltwater layer under wells; climate change leading to erratic rainfall and threatening crop productivity (El-Hadji, von der Weid & Scialabba 2001); occasional locust plagues that destroy major parts of the harvest, such as in the one in 2004 (Badjeck, El Hassani, Gacon &

Wane 2004); striga, a millet and sorghum-killing weed that has become rampant (Dixon & Gulliver 2001).

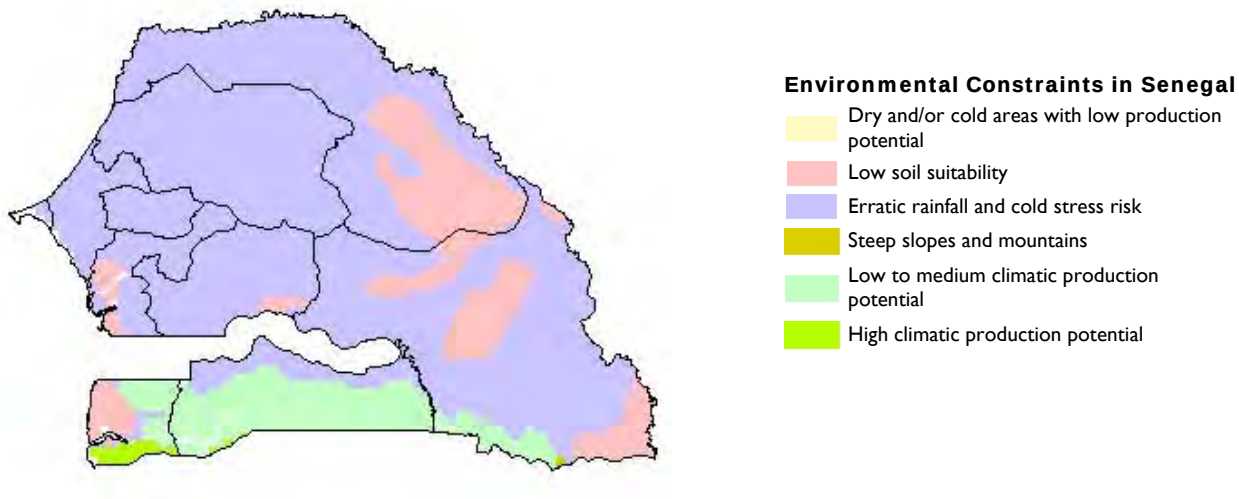
- ✓ *Land Availability* – Small average plot sizes per producer (0.27 to 0.37 ha per farmer nationally, a quarter to one hectare in irrigated plots (Government of Senegal n.d. a) (Note: demographic pressure on Senegal's estimated 2.3 million ha of horticultural and farming land is growing) (El-Hadji, von der Weid & Scialabba 2001).
- ✓ *Economics* – A lower real revenue for producers, leading to a decrease in fertilizer use (Government of Senegal n.d. a). Incomes generated by vegetables and fruits could be sufficient to cover seeds, fertilizers, and pesticides, but they may not cover costs of labor associated with irrigation or the costs of investment in power equipment.
- ✓ *Agricultural Policies* – Difficult access to credit; insufficient availability of high-quality seed; outdated equipment; rigid laws that discourage or block secure, sustainable investments; lack of financing, particularly in the livestock sector (Ibid); weak links to market access (El-Hadji, von der Weid & Scialabba 2001); retreat of government from the peanut and cotton sectors, leading to price collapses in the late 1980s.
- ✓ *Technical Issues* – Technical packages that are ill-adapted to the resources and soil composition within the harvest area (Government of Senegal n.d. a); water management, a challenge everywhere (El-Hadji, von der Weid & Scialabba 2001).
- ✓ *Social Issues* – Of the average farmer household size of 11.2 people, only a third are in the age group that is fit to do the required labor (25-49 years). Education level could also affect receptivity to agricultural advice (>91% of producers have not completed primary education) (Government of Senegal n.d. a).

Constraints specific to the livestock sector include those that cause overgrazing and bush fires, i.e. fair access to pasturelands and water. The Government of Senegal has attempted to take regulatory measures and step up pasture management (PALND 1998). Gradually, some of the area devoted to peanut production has given way to watermelon, sesame, bissap, and cashew plantations and pastureland.

2.2 OVERVIEW OF FOOD SECURITY IN SENEGAL

In spite of our entry into the 21st Century, food security is as much an issue as ever in Senegal. The daily consumption per person per day has gone from 2,450 kcal/day in 1980 to 2,288 kcal/day in 1993. The Demographic Health Survey of 2005 found that poverty affects over 44% of rural households in Senegal; chronic malnutrition in rural children 1 to 5 years old is around 33%, and vitamin A deficiency is at 61%. 16% of children are stunted; 8% are wasted. Anemia and goiter afflict many women; access to potable water and poor sanitation practices exacerbate malnutrition (FtF 2010).

Figure No. 2.2 - Mapping Environmental Constraints in Senegal



Senegal Data from: Major Environmental Constraints for Agricultural Production Project - based on FAOCLIM database, ARTEMIS NDVI imagery, and soil and terrain data provided by Soil Resources Management and Conservation Service. FAO-GIS. Prepared using Windisp software by Rene Gommes, Environment and Natural Resources Service, for the SOFI 1999 Report.

Senegal is particularly vulnerable to the rise in global food prices. Agriculture plays a major role in Senegal's economy with up to 70% of the population involved in the sector. Yet the country relies on imports for 70% of its food supply – a rate higher than any other country in Sub-Saharan Africa. Agriculture constitutes the principal source of revenue for more than 85% of the Senegalese population, urban and rural alike. To address food security and poverty in Senegal is to address agriculture and the constraints to increasing production and marketing of food and cash crops (Ibid).

To reach the first Millennium Development Goal (MDG) to halve extreme poverty and hunger by 2015, Senegal will need to grow its agricultural sector faster. Improving yields will not be solely sufficient in achieving this goal. Rather, a broad effort will be needed to improve access to markets, storage, quality of goods, increased post-harvest and associated non-farm activities, and a business environment conducive to agriculture enterprises.

In FY 2009, the U.S. Government (USG) initiated the Global Food Security Response to high food prices. Senegal was one of the focus countries for this effort. The GFSR program supports the Government of Senegal's agriculture and food security plan. The USG is widely viewed as a key partner in implementing Senegal's goals.

In a specific national response to food security, the President of Senegal launched the Great Agricultural Offensive for Food and Abundance (GOANA) to "take up the challenge of food sovereignty, eliminate any risk of food shortage or famine, and produce for abundance." This effort was complemented in April 2008 through President Wade's initiative to address Senegal's food insecurity by setting up the Stratégie National de Sécurité Alimentaire, starting with the Programme National d'Appui à la Sécurité Alimentaire (PNASA) within the Prime Minister's office. The PNASA conforms with the Poverty Reduction Strategy and the Millennium Development Goals for 2015. It is premised on two axes of intervention: increasing agricultural production and the monitoring and prevention and management of food security crises.

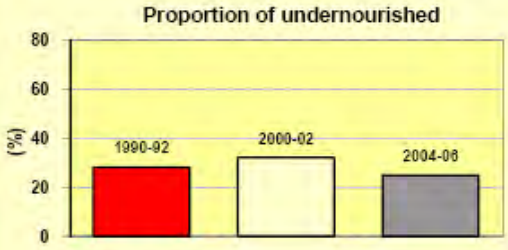
Figure No. 2.3 - The Food Security Situation in Senegal

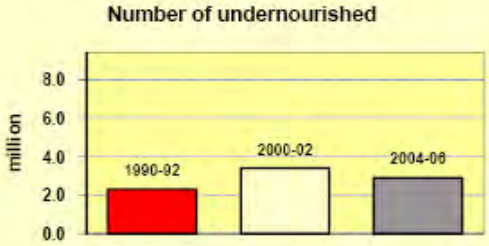
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Statistics Division
Global Statistics Service - Food Security Indicators

Senegal

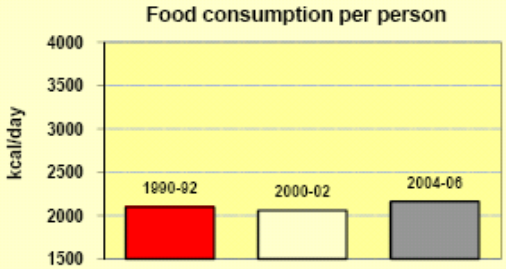
*Monitoring progress towards hunger reduction targets of the **World Food Summit** (WFS) and the **Millennium Development Goals** (MDG)*

Senegal had a high level of undernourishment in 2004-06, the latest period available; 25 percent of the total population was undernourished. The number of undernourished increased from 1990-92, benchmark period of the WFS and MDG, to 2000-02 but decreased from 2000-02 to 2004-06 while the proportion of undernourished increased from 1990-92 to 2000-02 but decreased from 2000-02 to 2004-06.

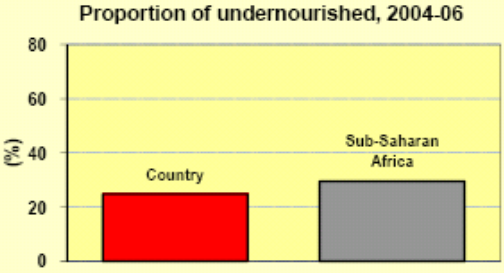




Food consumption increased in 2004-06.



The prevalence of undernourishment in Senegal was lower than in Sub-Saharan Africa



Selected statistics	*1990-92*	*2000-02*	*2004-06*
1. Population (million)	*8.1*	*10.6*	*11.8*
2. Food consumption (kcal/person/day)	*2100*	*2060*	*2160*
3. Number of undernourished (million) - WFS indicator	*2.3*	*3.4*	*2.9*
4. Prevalence of undernourishment (%) - MDG indicator			
Senegal	*28*	*32*	*25*
Sub-Saharan Africa	*34*	*32*	*30*

© FAO 2010

Figure 2.4 - Food Supply in Senegal

Senegal – adequate food supply, but some areas at risk

Although Senegal is one of the most urbanized countries in Africa, three-quarters of the population still depend on agriculture for their livelihoods. For the nation as a whole, undernourishment is moderately low and food availability is adequate to meet requirements. But medium to high levels of underweight, stunting and wasting still prevail among children nationwide. In some rural areas characterized by poor health conditions, declining agricultural productivity, widespread poverty and low income diversification, one-third or more of all children under five suffer from stunting.

The highest prevalence of stunting is found in several highly rural and remote districts of the country. Two other rural districts – Podor and Matam in the northeast – exhibit significantly lower levels of stunting, despite being high risk areas for drought and health problems. Improved child nutrition is explained in part by the use of irrigated perimeters to cushion against drought, as well as remittances from family members living outside the district. Similarly, despite a high poverty rate, semi-nomadic herders in Linguère district achieve a relatively food secure situation through use of livestock products and millet production.

Vulnerability patterns – risk factors

- Low health risk/low-moderate poverty risk/high income diversification/highly urban
- Low health risk/high-very high poverty risk/good coping mechanisms
- Low health risk/low-moderate poverty risk/high market risk
- High health risk/low-moderate poverty risk/good coping mechanisms
- High health risk/high poverty risk/low income source diversification/highly rural
- % of stunting

Source: UNICEF, 1996; WFP/VAM, 1996

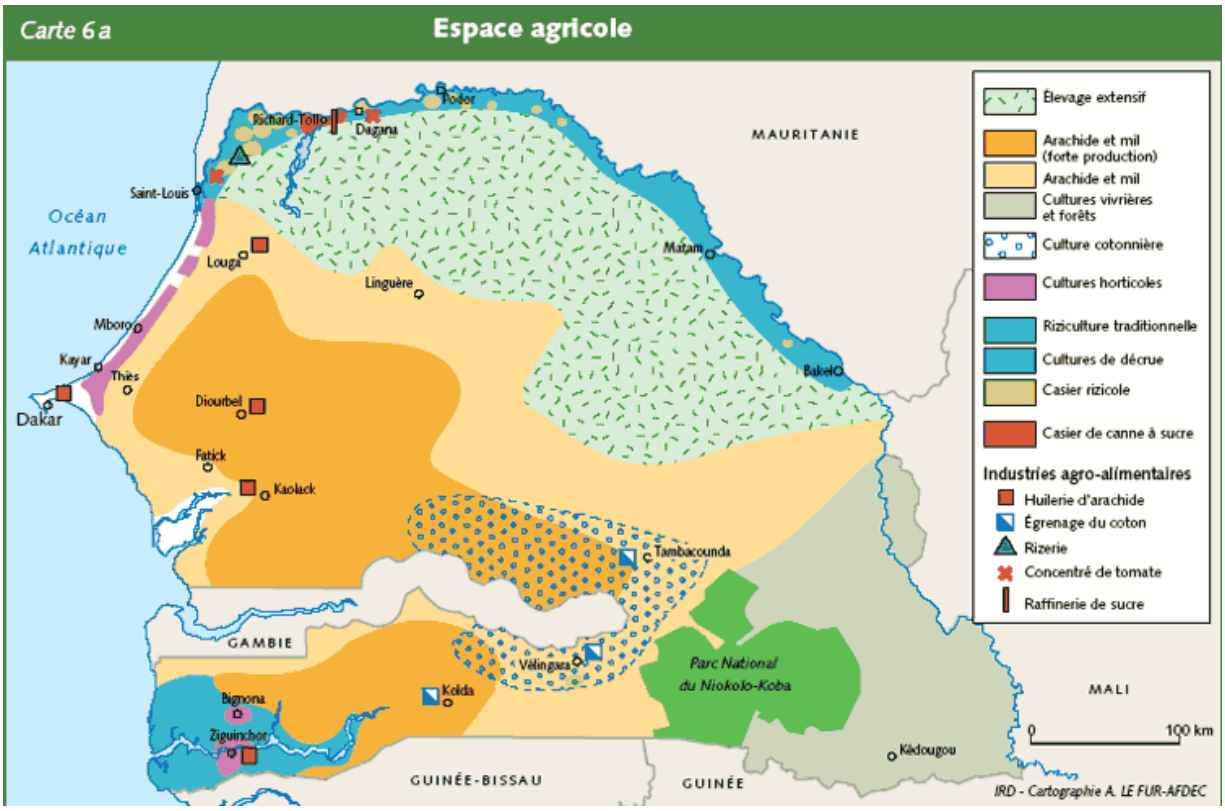
2.3 THE AFFECTED ENVIRONMENT

As a Sahelian country, Senegal's agricultural potential is much affected by climatic conditions and in particular, the annual rainfall regimes. Similarly, concerns about land-use and desertification wax and wane with the annual rainfall situation in the country. The following is a brief description of the most important parameters of the affected environment.

Land-Use and the Agricultural Environment: Between 1945 and 1960, agricultural production increased at an average of 4% per year, and a maximum of 2.66 million hectares were cultivated in 1968. The average growth between 1967 and 1996 declined to 0.8% per year. During this period, the rise and fall of peanut cultivation occurred (thanks to the drop in peanut prices, a withdrawal of government subsidies, and declining soil fertility), leaving in place the ravages of a massive campaign to reward complete stump removal from fields by paying a premium for each stump. Today the old "Peanut Basin" appears as a vast expanse of flat plains of poor and often saline soils with few trees to improve soil structure; they come to life with corn and, more frequently, millet and sorghum as the first rains arrive usually in late June or July.

Responsibilities for land allocation, customarily dependant on family lineage, were given to Rural Communities as they became legal entities in 1972; however, land tenure remains a difficult issue for producers. The map below depicts cropping patterns and distributions in 1988, according to Institut de Recherche pour le Développement.

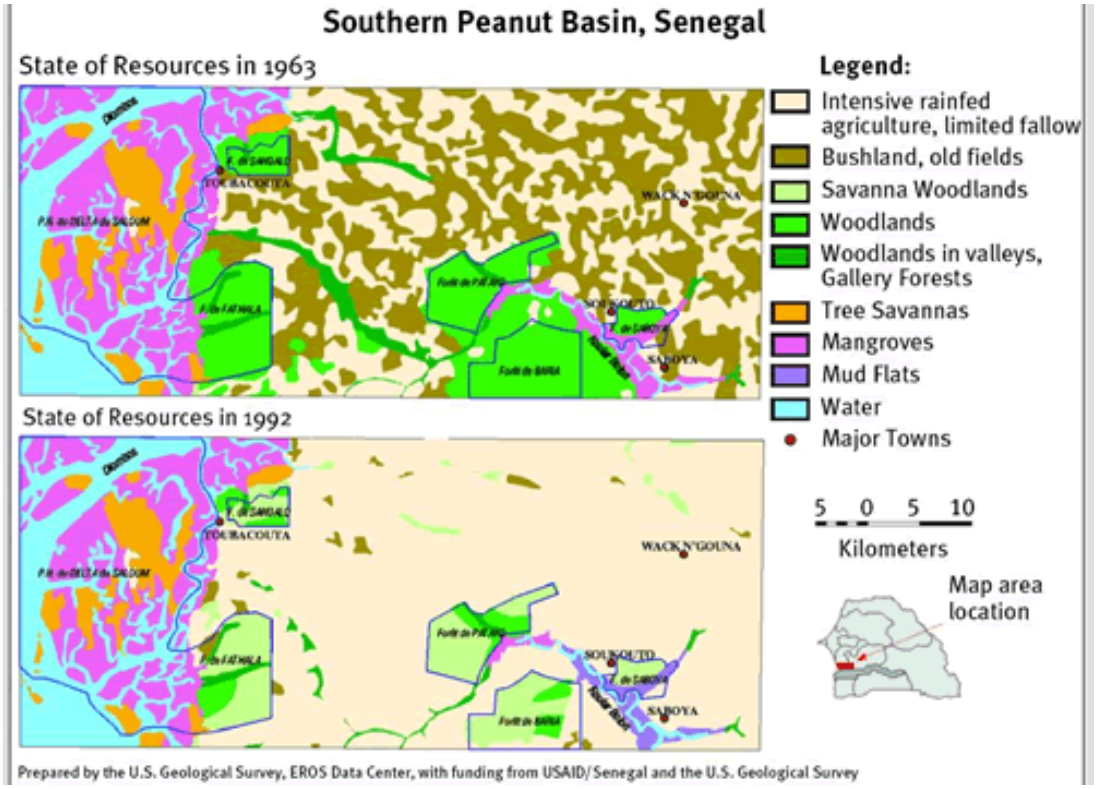
Figure No. 2.5 - *Espace Agricole* - the cropping patterns of Senegal (1988)



(Map from 1988 drawn by Institut Régional de Développement, available at http://www.au-senegal.com/Cartes-thematiques-du-Senegal.html)

No less telling are these graphics which show the evolution of land-use in Senegal's Peanut Basin:

Figure No. 2.6 - Land-Use Change in the Peanut Basin of Senegal

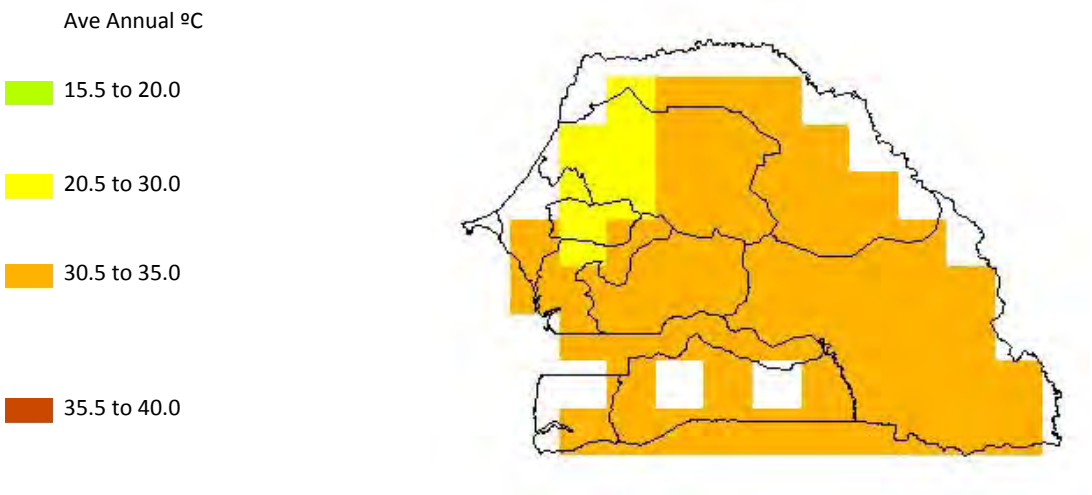


SOME ADDITIONAL DEPICTIONS OF SENEGAL'S AGRICULTURAL SITUATION

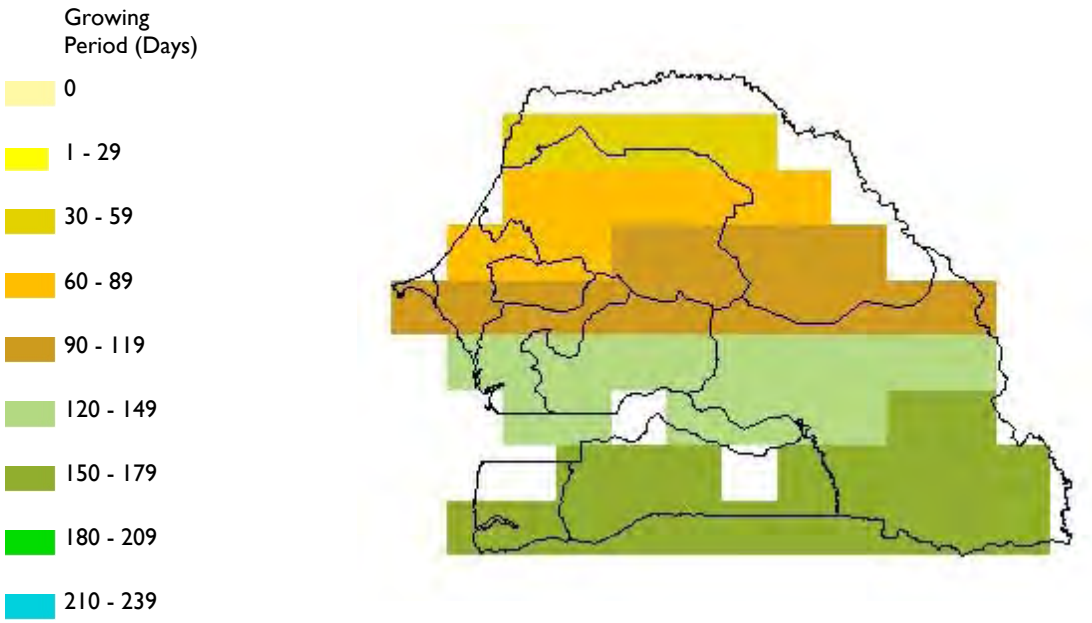
The following maps are from the FAO Senegal country profile, used by permission and found at http://www.fao.org/countryprofiles/Maps/SEN/

Figure No. 2.7 - Senegal's Agricultural Situation in Graphics

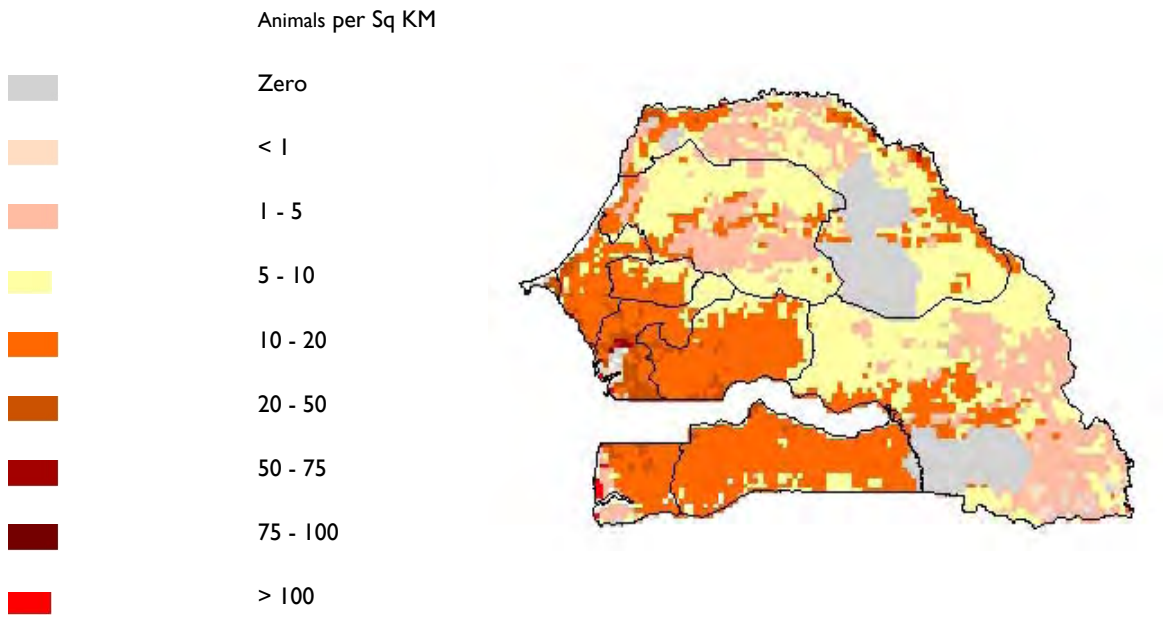
Temperature: Dataset averaged over a period of 37 years, based on Leemans, R. and Cramer, W., 1991. The IIASA database for mean monthly values of temperature, precipitation and cloudiness on a global terrestrial grid. Research Report RR-91-18. November 1991. International Institute of Applied Systems Analyses, Laxenburg, pp. 61. Raster data-set has been exported as ASCII raster file type.



Length of Growing Period : Derived from the Global Agro-Ecological Zones Study, Food and Agriculture Organization of the United Nations (FAO), Land and Water Development Division (AGL) with the collaboration of the International Institute for Applied Systems Analysis (IIASA), 2000. Data averaged over a period of 37 years. Raster data-set has been exported as ASCII raster file type.



BOVINE DENSITY: Derived from late 1990s data provided by Jan Slingenbergh (AGAH, FAO) Livestock Distibution, Production and Diseases ; Towards a Global Livestock Atlas. Raster data-set has been exported as ASCII raster file type



RAINFALL INFORMATION FOR SENEGAL

Climatic - vegetation zones: Given the growing concern about global climate change, discussed at length elsewhere in this report, it was thought only fitting to include special attention to the climatic situation in Senegal, especially rainfall. Interestingly, current data sets show that rainfall may not be significantly affected by global climate change in Senegal, especially if viewed in the context of decades of drought. It is thought that the rainfall will become more erratic with more intense storms which can also affect the cropping success.

The climatic zones found north to south in Senegal include the sahel, sahelo-sudanian, and the soudano-guinean. Divisions are based on rainfall and vegetation regimes, but the exact range of annual rainfall defining a climatic zone varies according to reference used. Senegal's Centre de Suivi Écologique is a leader in collecting, analyzing, and presenting georeferenced data for the country; the rainfall divisions this institution uses are as follows:

Table No. 2.1 - Climatic Zones of Senegal

Annual precipitation	Associated vegetation*
Northern sahel: <300 mm	Open vegetation dominated by *Acacia raddiana, Acacia senegal, Acacia seyal, Balanites aegyptiaca, Commiphora africana*, and annual grasses in a contiguous stratum
Southern sahel: 300-500 mm	
Northern sudanian or sahelo-sudanian: 500-1000 mm	Tree or wooded savannas in dry forests, including *Bombax costatum, Cassia sieberiana, Combretum sp, Cordyla pinnata, Daniella oliveri, Pterocarpus erinaceus, Sterculia setigera*, and a herbaceous stratum dominated by perennial grasses
Southern sudanian or sudano-guinean: >1000 mm	Semi-arid dense forest with two stories composed of *Afzelia africana, Detarium microcarpum, Elaeis guineense, Erythrophleum guineense, Khaya senegalensis, Parinari curatellifolia* and a dense understory of vines and grasses

* Special ecosystems occur along the seacoasts, including the Niayes (mango and garden zone northeast out of Dakar); along southwestern estuaries where some of the country's remaining mangroves are found, as well as in dense forest galleries that are home to wildlife competing with man for resources.

The depiction of these zones on a map is frequently seen as follows:

Figure No. 2.8 - The Climate/Vegetation Zones of Senegal

The zones correspond roughly to isohyètes for rainfall through 1960

The set of maps below, from CSE, illustrates how the isohyètes have shifted south more than 120 km since 1971.

Distribution of rains: Rainfall distribution during the year typically means two basic seasons – dry (from November to April-May, called the "*contresaison*" when referring to the gardening period) and rainy (called "*hivernage*"), from May-June to October, depending on latitude. Most rains fall as monsoon storms. The month of highest rainfall is August, making it the most important in terms of agricultural production. When considering specific sites year to year, spatially unpredictable rainfall is easy to see from the following rainfall maps produced by USGS/EROS in 1995, appears in the FAO country overview document for Senegal:

Figure No. 2.9 - The Shifting Rainfall Patterns of Senegal

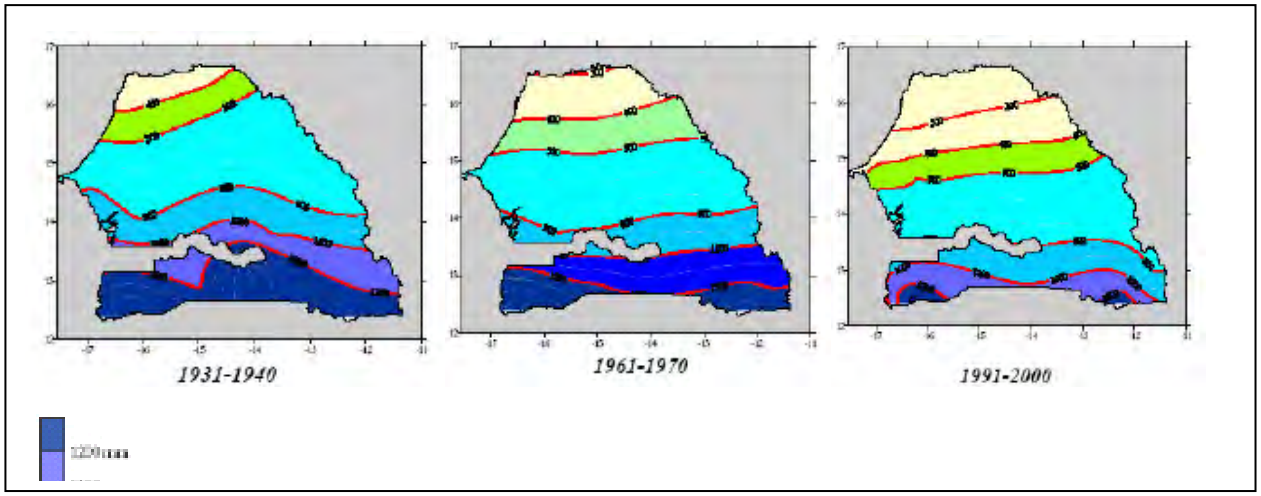
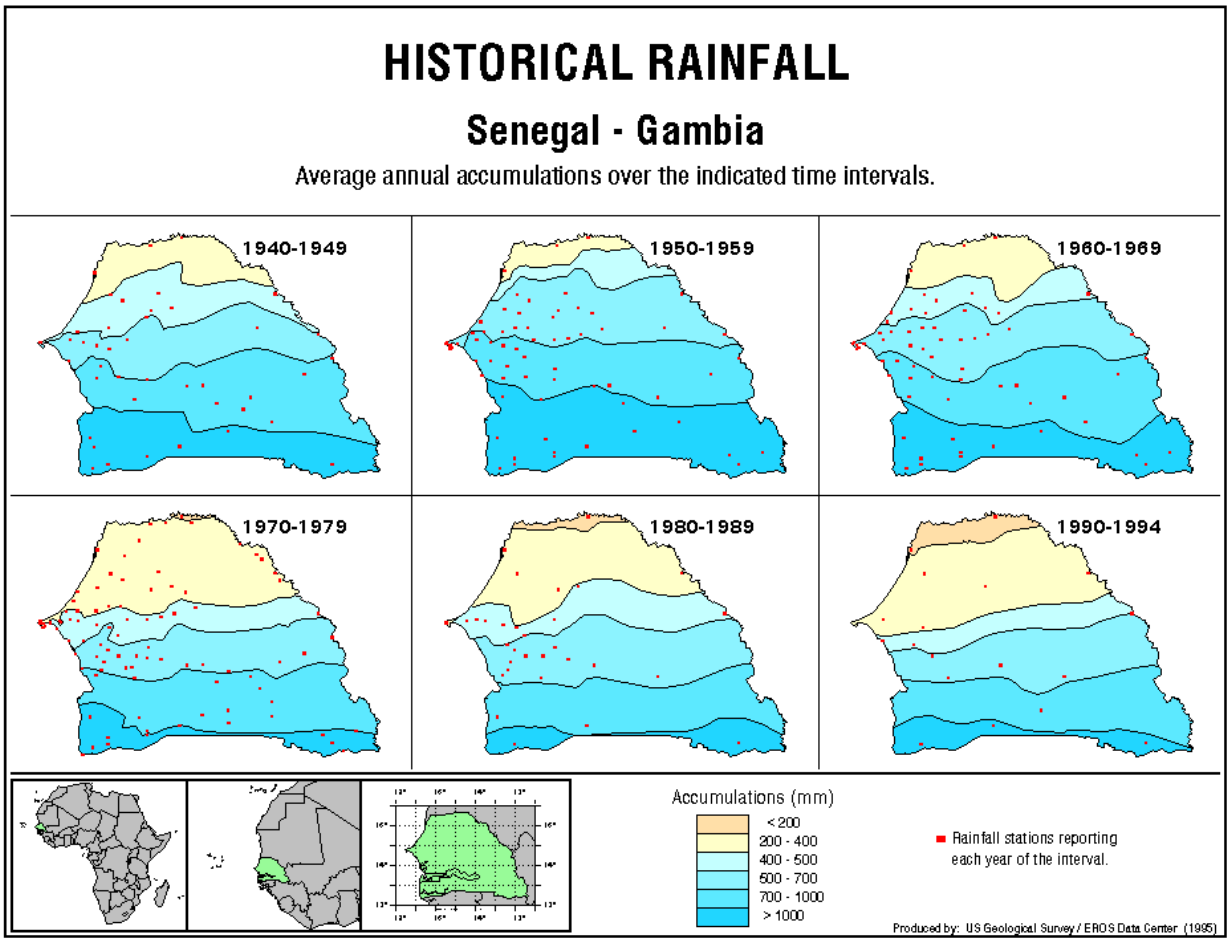


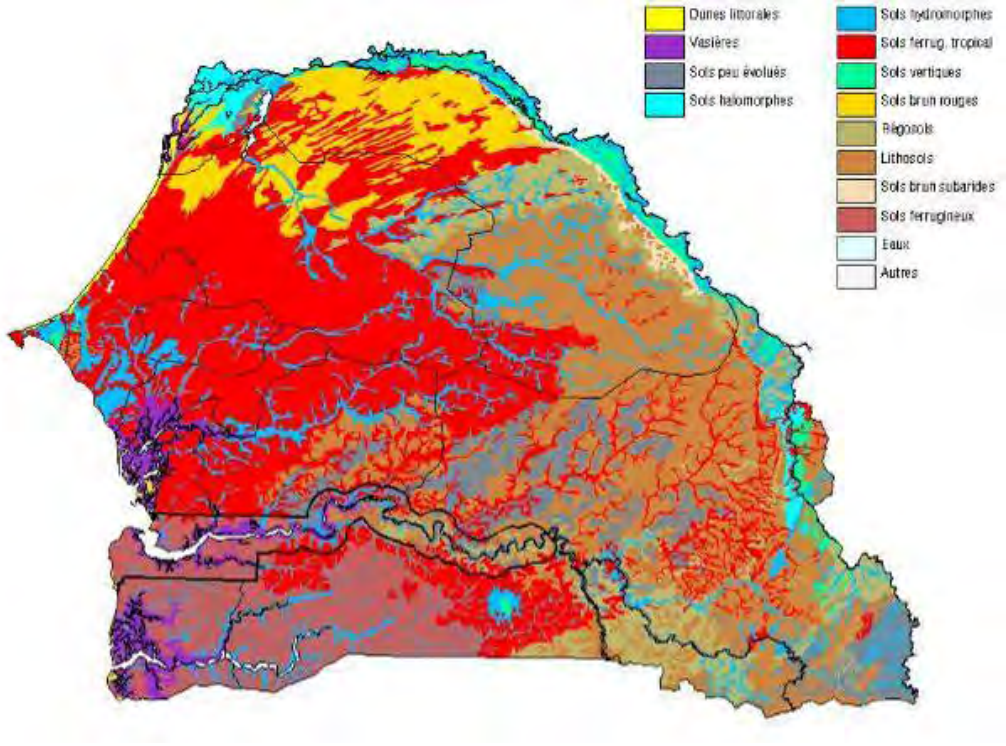
Figure 2.10 - Historical Rainfall Maps for Senegal.



SENEGAL SOILS MAP

The country-wide soils map produced by USGS/EROS 20 years ago may not be detailed enough to determine whether tractors should be disking soils in certain areas at certain times of the year. However, what is extremely clear is that the projects working on agricultural development should have access to soils specialists who can work to further refine the farming systems and agronomic technologies being proposed as part of the activities to raise productivity and improve food security. A lot of these practices are new enough, particularly where farm mechanization is concerned, to require sufficient expertise to avoid compacting or damage to soil structure. Furthermore, it is also necessary to ensure that project staff are accessing more information on soils, their productivity, typical problems and techniques for restoring fertility or enhancing their resilience to drought. Such capabilities would also include adherence to the guidance proposed in the USAID Africa Bureau Fertilizer Fact Sheet (now available in French on the ENCAP Africa web site – www.encapafrica.org).

Figure 2.11 Senegal Soil map



Source: EROS Data Center, 1985-1992

3. AGRICULTURAL DEVELOPMENT ACTIVITIES AND THEIR LINK WITH FOOD SECURITY

As stated above, to address food security and poverty in Senegal is to address agriculture and the constraints to increasing production and marketing of food and cash crops. In addition, Senegal's Accelerated Growth Strategy, adopted in 2006, targets agriculture to promote economic growth (FtF 2010).

Food Security Initiative intervention sites are chosen based on these criteria: 1) areas or enterprises that have the most potential to improve growth of targeted value chains; or 2) areas or households that are most vulnerable or have economic or social characteristics that can make them more vulnerable. All income levels are eligible (Ibid).

Using these criteria to assist in defining objectives and activities, the USAID-financed agriculture programs of the Mission's Implementing Partners in Senegal have concentrated on increasing productivity and better marketing in the following market chains and products:

ONION PROFITABILITY
Official statistics on the production of vegetables and fruits are not available; however, even one-tenth of a hectare of onions can draw nearly 170,000 FCFA using family labor, or almost 400,000 FCFA if a treadle pump is also used. Despite this important income potential, the development of horticultural production is limited by labor's high cost and scarcity as well as the high cost and inappropriate motorized irrigation equipment (Perry & Wade 2010).

Rice: Reducing salinization and increasing area under cultivation by building dikes and dams in strategic locations; facilitating access to credit for fertilizer and improved seeds; supporting research on improved varieties of this principal staple.

Millet, sorghum, and corn: Supporting research on improved varieties and hybrids; promoting Conservation Farming and soil improvement through demonstration plots; facilitating access to credit for equipment, fertilizer, and improved seeds.

Onions: Reducing vegetable imports, 57% of which are onions, is a goal of the Government of Senegal .

DRIED MANGO VALUE CHAIN
The processing of mango into dried slices is a way of valuing this fruit. It was developed in West Africa in the early 1980s in Burkina Faso, the pioneer of this value chain. The first drying units were installed with the support of other Governments and western NGOs, and by targeting and securing an export market to Europe (Perry & Wade 2010).

Peanuts: This market chain is still the main source of revenues in the rural arena, and is among the top four exports of Senegal, after fish products, phosphates, and tourism.

Garden vegetables: Vegetable production increased sevenfold between 1960 and 2007, going from 42,000 tons to 285,000 tons [FAOSTAT 2009]. A horticultural producer who uses family labor and cultivates a garden of 1,000 m^2 will earn about 169,000 CFA Francs. If he goes to 2,000 m^2 with the assistance of a treadle pump promoted by USAID programs, he will earn about 400,000 CFA. A high percentage of garden produce is sold to Senegal's relatively high urban population and the demand remains high (Perry & Wade 2010).

Other marketable produce: Supporting existing banana, sesame, mango, bissap, mango, baobab, and cashew export market chains through equipment purchase, training, pest control, and business development services.

Livestock: The beef cattle and sheep/goat market chains have been growing at a rate of 3 to 4 % on average. Pullet production was doubled between 1987 and 1992. The leather and skins market chain is mainly for export, and was bringing in a billion FCFA as of the early 1980s.

Program activities include integrating livestock into a rice cropping system in order to sedentarize some migrant herders and experimenting with improved cowpea hay as an alternative to wild fodder.

3.1 USAID'S ANTICIPATED CONTRIBUTION TO AGRICULTURE DEVELOPMENT AND FOOD SECURITY IN SENEGAL UNDER THE FEED THE FUTURE INITIATIVE

In May 2008, President Bush announced his request to Congress for additional supplemental resources to help address the impact of high global food prices on developing countries. This was followed in June 2008 by the signing of Public Law 110-252 (the Act) providing for a variety of FY 2008/09 funding modalities to address the international food crisis. The strategy targets increasing food productivity in sub-Saharan Africa, focusing on those countries where significant expansion of production is feasible, and then reducing barriers to the movement and procurement of food throughout sub-Saharan Africa.

In Senegal, pillar two of this integrated framework for the response to the global food crisis aims at: "urgent measures to address high food prices through agriculture and trade programs." These include actions to increase agricultural productivity; alleviate transportation, distribution, and post-harvest supply-chain bottlenecks; and promote sound market-based principles.

In July, 2009 during the G8 meeting in L'Aquila, a statement was made by the participants to support a $20 billion, three-year effort to greatly enhance the world's agriculture capacity. Implementation will be guided by the five core L'Aquila principles to address the underlying causes of hunger and under-nutrition through country-led, comprehensive plans, strategic coordination, sustained commitment, and multi-lateral cooperation. The USG announced that it will provide up to $3.5 billion during this time period through the new Global Hunger and Food Security initiative (GHFSI).

In FY 2010, the USG through USAID intends to obligate $24.7 million of FY 2010 Development Assistance (DA) funds for agricultural activities to prepare for the GHFSI in Senegal. USAID will integrate additional FY 2010 DA funds in the Initiative, $4 million to promote trade, and $2 million to improve biodiversity. These funds build on $33 million of GFSR and agriculture funds already obligated in FY 2009 and provide a bridge to the Administration's FY 2011 new Feed the Future Initiative. A further expansion in funds is expected under the Feed the Future initiative.

The Feed the Future-related findings of the amended IEE include the enhanced agricultural productivity activities of the two major contracts being implemented under SO 11: the Agriculture and Natural Resource Management Program (known locally as USAID Wula Nafaa) and the Program to Support Accelerated Growth and Increased Competitiveness (SAGIC – or otherwise known as the "PCE"– Projet de Croissance Economique). The prime contractor for both of these projects is International Resources Group (IRG), which is also carrying out the Programmatic Environmental Assessment foreseen by this Scoping Statement. In addition to the two IRG projects, this PEA will also consider the activities of the U.S. Peace Corps, the West Africa Rice Association, and the U.S. Department of Agriculture Foreign Agriculture Services (FAS) being implemented with funding under Feed the Future.

The scope of the Programmatic Environmental Assessment will encompass all programs currently foreseen in the Feed the Future Initiative and as described in the 2010 Implementation Plan. USAID/Senegal is currently developing a multi-year strategy, elements of which will be available for the assessment team once work starts. The scale of the Feed the Future is significant and for planning purposes we are assuming current levels continuing through the six-year, 2010-2015 period. The following table is illustrative only, but it gives an idea of the scope of the Feed the Future program and its major investment areas:

Table 3.1 - Current and Potential Projects and Relative Funding Weights

Project	Percent of Budget	Purpose
Rural Infrastructure/Feeder Roads	27%	Feeder roads, small bridges, warehousing, rural market infrastructure
USAID/Economic Growth Project	17%	Value chain development, finance, transport corridors, enabling environment.
Agriculture/Nutrition Program	14%	Value chain development, natural resource management, nutrition
Agriculture Education and Training	11%	Capacity building for universities and training centers in agriculture, scholarships
Water and Sanitation	10%	Potable water, wells, latrines
USAID/Wula Nafaa	6%	Natural resource management, small-scale irrigation, governance
Coastal Resources/Fisheries	5%	Coastal resource management, climate change adaptation, fisheries development
Fertilizer Development	3%	Fertilizer policy development, improved distribution channels
Biodiversity Conservation	2%	Protected area management
USGS Inter-Agency Agreement	1%	Mapping, land use analysis
USDA Inter-Agency Agreement	1%	Phytosanitary capacity building, medium-term training
Peace Corps Inter-Agency Agreement	1%	Agriculture productivity, capacity building, small business development
ICRISAT/Seeds	1%	Seed development and improved distribution
Coordination, analysis, logistics	1%	Program support services
TOTAL	100%	

3.2 MORE SPECIFICS ABOUT USAID SUPPORT TO AGRICULTURE DEVELOPMENT UNDER THE FTF

The activities aimed at addressing the objectives of the Feed the Future under Wula Nafaa will include the following: rehabilitation and development of existing wetland rice production areas, development of new small-scale irrigation, improvement of horticultural production farming areas, improvements in soil fertility and rainfed farming resource management ("conservation farming"), introduction of improved seed sources for wetland rice cultivation, business development services for input provision to local farmers, and capacity building related to improved horticulture and farming systems. **Annex B** provides the list of existing sites currently being brought under implementation by Wula Nafaa; these are part of the first year's plan which will be extended in the outyears of the project.

As noted in the table above, USAID will be designing a new rural infrastructure program in 2010. This program is expected to invest significantly in feeder roads and other needed infrastructure in support of the overall Feed the Future investments in value chains. This present agricultural development PEA will be closely followed up by a Rural Infrastructure/Feeder Roads PEA, which will be expected to provide overall guidance on how to mitigate environmental impacts in the design and implementation of these components of the Feed the Future program.

The PCE is the largest USAID Food Security Program in Senegal. It is a national program and the intended results are considerable. The Task Order 5 Contract states, for example:

i. GFSR Component 1 (Clin 01) Increasing Agricultural Productivity and Production. "Increasing, even doubling, of production of key staple food crops by 2013, and aim for a 12% increase in the immediate term of 2009/10.

ii. GFSR Component 2 (Clin 02) Alleviating Transportation, Distribution and Supply Chain Bottlenecks. "…a goal of achieving a 25% reduction in transport costs along selected corridors by 2011 and reducing food prices by an estimated 10% of targeted food staples."

iii. GFSR Component 3 (Clin 03) Promoting Sound Market-Based Principles. "GFSR assistance should result in a 25% decrease in the amount of agricultural tariffs for regional trade of selected staple foods."

In addition, PCE will be carrying out its role as lead integrator of the USAID Global Food Security projects in Senegal, (PCE, USAID Wula Nafaa, USDA, Peace Corps, and WASA). The objective of the lead integrator is to ensure that cross-cutting issues and activities among the five projects are well-connected and supportive and that they institute a common reporting process, improve synchronization of complementary activities, and explore additional ways to enhance cooperation between the implementing partners. The work related to addressing the environmental impacts of these activities is another example of a cross-cutting theme that can be addressed most effectively across projects. Hence, this PEA, in keeping with the thrust for integration, is being deliberately implemented in close collaboration between IRGs' two projects – PCE and USAID Wula Nafaa – and in anticipation of other partners that will be implementing new programs.

Under PCE, in addition to the activities related to Policy and Communications (Component 1) and Capacity Building and Applied Research (Component 3), two other components will undertake activities **wherein this positive determination is most directly applicable**. They include the Value Chain Program (Component 2) and the Trade, Infrastructure, and Public-Private Partnerships (Component 5), which include a wide variety of agricultural development and irrigation infrastructure related activities. **Annex C** provides a quick synopsis of the activities foreseen under these two PCE components[2] which will be examined during the PEA.

Other Program Partners

In addition to WN and PCE, there are other program partners funded under the FtF program, including the US Peace Corps, the US Department of Agriculture and the West Africa Seed Alliance. Their activities have also been incorporated into the considerations of this PEA and may be summarized as follows.

The **United States Peace Corps in Senegal** has a program known as the Senegal Food Security Initiative, which has been developed in collaboration with USAID/Senegal and is funded through the

[2] Some of these activities are clearly those which would traditionally merit a categorical exclusion under 22CFR216. Ideally, the Scoping exercise will verify that situation and help to further focus the analysis to be carried out under the PEA.

Feed the Future Initiative. This four-year program, currently funded at about US$1.6 million, targets interventions on agricultural productivity, food security, nutrition, and capacity building at the grass-roots level. The activities are implemented by individual Peace Corps Volunteers based in villages across rural Senegal. The goals of this program include: providing technical assistance to enable intensive "permaculture" of nutritious crops; training pilot farmers and enabling them to extend these technologies; establishing school and community gardens as demonstration sites related to horticulture, permaculture, nutrition and food security; and introduction and/or revitalization of agroforestry technologies. In addition, some volunteers are promoting improved grain storage facilities, training farmers in seed collection methods, and introducing drip irrigation projects for dry season gardening.

The **United States Department of Agriculture** in Senegal works out of the Office of the Agricultural Attache at the US Embassy. Under the FtF program, USDA is cooperating by providing capacity building support in the areas of animal health, plant health and food safety. These activities target Government of Senegal agencies engaged in the national Sanitary and Phytosanitary Program. The intent is to strengthen national systems and improve their consistency with the WTO and other international standard-setting bodies related to agricultural trade.

Under the FtF, **the West African Seed Alliance** will contribute to Component 2 of the program: Urgent Measures to Address the Causes of the Food Crisis through Agriculture and Trade Programs. The WASA program has been operating in the region for years but is only recently getting underway in Senegal where the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) will launch the full complement of WASA activities. The intent is to make more high-yielding seed varieties of staple food crops available to farmers through research and the production of improved seed and the development of the private sector-led seed supply system. The WASA Program is intended to directly support priority value chains being targeted by PCE. The program will also provide support to seed system development at the research and foundation seed levels, including: the Base Seed Unit of the Institut Sénégalais de Recherches Agricoles (ISRA) in breeding foundation seed for millet, cowpeas, rice, sorghum, fonio, and groundnuts. Finally, it will also target the strengthening of a number of the seed associations in Senegal to increase their role in seed production and distribution.

3.3 RELATIONSHIP OF THE USAID AGRICULTURE PROGRAM WITH OTHER GOVERNMENT OF SENEGAL PROGRAMS

The agriculture sector is of particular importance to the country for a number of reasons. Fully 70% of the population is engaged in activities related to the sector, and yet, food supply is still dependent, up to 70%, on imports. The Annual Implementation Plan (2010) for the Feed the Future Initiative in Senegal, the target of this PEA, notes that "To address food security and poverty in Senegal is to address agriculture and the constraints to increasing production and marketing of food and cash crops" (USAID/Senegal 2010).

Senegal's Millennium Development Goal of reducing extreme poverty and hunger by half by 2015 will clearly depend on its success in the agriculture sector. In 2006, the Government of Senegal targets agriculture to promote economic growth as a key part of its Accelerated Growth Strategy. Furthermore, in 2008, the president of the country launched the "Grand Offensive for Food and Abundance" (http://goana-senegal.org/html/goana-senegal.php?xx_rubrique=Presentation).

This PEA is specifically analyzing the activities of the Global Food Security Response in Senegal which purposefully supports the Government's agriculture and food security plan. In developing this GFSR (now known as the Feed the Future Initiative), USAID/Senegal and other USG agencies aligned in support of the Government of Senegal and its development strategies specifically consulted with the Government of Senegal (GOS) Ministry of Agriculture's Division of Strategic Planning and Monitoring to ensure that these program complement national sector development goals.

In addition, it is worth noting that Senegal is an active and committed participant in the Comprehensive African Agriculture Development Program (CAADP) of NEPAD, the New Partnership for Africa's Development.[3] The CAADP program in each country is organized around four pillars: land and water management, market access, food supply and hunger, and agricultural research. Here again, there is ample room for synergy with the outcome of this PEA and the learning within the agriculture sector in Senegal.

In short, the outcome of this PEA, in examining the potential for adverse socio-environmental impacts resulting from the agricultural development activities funded under the GFSR/Feed the Future can and should be directly applicable to many of the national sector initiatives. This should ensure compatibility in using these findings and the tools for both policy awareness and capacity building as concerns the environmental management of agricultural development in Senegal.

3.4 ENVIRONMENTAL REVIEW PROCEDURES REQUIRED BY THE GOVERNMENT OF SENEGAL

There is a long list of laws in Senegal which were promulgated with the objective of contributing to the protection of the environment in the country. These laws and even the National Environment Code also often reflect the issues inherent to the international environment-related treaties signed by the Government. At the national level, the most recent Environment Code was adopted in 2001 (Loi 01-2001 du 15 Janvier, République du Sénégal). This code constitutes the new legal procedures that any project that could possibly affect the environment must follow.

General Dispositions of the National Environment Code: The revitalization of the National Environment Code has made it possible to incorporate several fundamental and indispensable elements in the efforts to protect the environment in Senegal. Among the elements which led to the need for this revitalization, one can highlight the following measures:

- The start-up of the principles and measures announced as Agenda 21
- The transfer of the authority for the management of natural resources and the environment to the local communities, since 1996
- The adoption of new strategic planning instruments: the National Environmental Action Plan (NEAP), the National Plans for the Fight against Desertification, the Forestry Action Plan for Senegal, the National Strategy for the start-up of the Framework Convention on Climate Change, the Action Program for Biodiversity, the Action Plan for the Protection of the Ozone Layer, and the Plan for the Management of Dangerous Wastes
- The importance of impact studies as part of the protocol for environmental decision-making
- Conformity of the national law with the international environmental conventions signed and ratified by Senegal

According to Article L48 of the National Code, all development projects or activities which pose a threat to the environment, as well as policies, plans, programs, regional or sectoral studies, should be the subject of an environmental impact assessment. The environmental assessment is a systematic process which evaluates the possibilities, capabilities, and functions of the resources and the natural and human

[3] A copy of the signed Pact between Senegal (government, private sector, producer organizations, civil society) and the CAADP (known in French as the Programme Détaillée pour le Développement de l'Agriculture en Afrique (PDDAA) can be found at: http://www.nepad-caadp.net/pdf/senegal.pdf.

systems in order to facilitate the planning of sustainable development and decision-making in general. It is also expected to reveal and manage the possibility of negative impacts and the consequences of resources management in particular. These procedures consist of environmental impact studies, strategic environmental assessments, and environmental audits.

An Environmental Impact Assessment (EIA) is the procedure which makes it possible to examine the consequences, both positive and negative, which a planned development project or program might have on the environment and to ensure that these consequences are duly taken into account during the conception of the program. An impact study is defined by the Code as comprising all the studies required for the implementation of the resources management project, the physical works, the equipment, the installation or establishment of an industrial production unit, agricultural or otherwise, and including the plans and work programs which enable an understanding of all the direct and indirect consequences of this investment on the environmental resources.

Furthermore, according to Article L49, the Environmental Impact Assessment becomes part of an existing procedure for the authorization, approval or award of a concession. The principal actors who should be involved in the EIA are the project promoter and the competent authorities of the Government. The procedures are the responsibility of the project promoter who submits the EIA report to the Ministry in charge of the Environment which may deliver an authorization certificate after the technical review by the Environment Directorate and other statutory agencies of Government.

Article L50 stipulates that the different activity or works categories whose implementation may require an impact study are defined by decree of the competent Ministry of the Environment. This decree establishes and regularly updates the categories of activities, works or planning documents about which the public authorities may not decide, approve or authorize works without having on hand an impact study which allows them to fully appreciate the consequences on the environment. All new projects being added to that list and requesting an authorization to go ahead must have by obligation a full file on the environmental impact assessment.

The EIA involves, at a minimum, an initial analysis of the state of the site and its environment, a description of the activities, a study of the changes the activities may bring about, and the measures envisaged to avoid, reduce or compensate for the negative impacts of the activity as well as the cost of them before, during and after the implementation of the project. A further decree issued by the environmental ministry provides a detailed list of the table of contents of an impact study. It is only after the submission of an environmental impact report that an authorization for the project to get underway can be issued by the Directorate of the Environment. The Senegalese system also includes a categorization process whereby the need for an Initial Environmental Examination or a full Environmental Impact Assessment is determined on the basis of the characteristics of the activities being promoted.

It is worth noting that although USAID has certainly entered into an agreement protocol with the Government of Senegal (Strategic Objectives Agreement- SOAG-SO 11), and also agreements with different rural communities under the aegis of both PCE and Wula Nafaa, according to the Directorate of the Environment, to date no environmental impact studies have been received nor environmental permits issued for certain of their activities which would necessarily require them under the law.

4. FEED THE FUTURE AGRICULTURAL DEVELOPMENT ACTIVITIES AND ALTERNATIVES

4.1 A TYPOLOGY OF AGRICULTURAL DEVELOPMENT ACTIVITIES

The agricultural development activities being carried out or in planning as part of the Global Food Security Response Initiative (now "Feed the Future") by the Wula Nafaa and Economic Growth Projects cover a wide range of activities distributed across the rural regions of Senegal. They may be roughly grouped into the following types of activities, to wit:

4.1.1 REHABILITATION AND DEVELOPMENT OF RICE-GROWING WETLAND AREAS

The management program for wetland areas foreseen under Wula Nafaa is part of the general agriculture development policy of the Government of Senegal, whose objectives are as follows:

- Provide tools consisting of viable production techniques which respect the environment to the rural populations working wetland areas
- Provide an opportunity to the agricultural labor force, under-occupied and attracted to the growing rural exodus for gainful employment, that guarantees family nutrition and additional income generation

To achieve these objectives, Wula Nafaa has foreseen several irrigated agriculture strategies among which can be distinguished dikes for retention or water spreading, anti-salt dikes, and the rehabilitation and management of rice cultivation plots.

Water Retention or Water Spreading Dikes: These are generally linear or straight earthworks which could be characterized as small dams or barrages of varying capacity according to each situation. These are generally built at the lower end of a catchment area or across a water course, perpendicular to the flow of water. They are built to retain water for agro-sylvo-pastoral use purposes. The height of these dikes varies between 0.5 and 2.5 meters and the width across the crest rarely exceeds 3 meters. These are earthen dikes compacted with heavy machinery with slopes of 2H/1V. The upstream slope may be protected with rock and stone.

To allow for regulation of the water in the basin and for the passage of people and vehicles across the dike, they are often furnished with a "duck's beak water regulator." This device is built at the lower drain level so as to facilitate draining the basin when necessary or maintaining a certain water level for crop purposes, or taking the pressure off the dike during excessive run-off situations.

Anti-Salt Dikes: Like the retention dikes discussed above, anti-salt dikes are typically linear and resemble small barrages of varying capacity (according to the situation). They are constructed in lowland settings subjected to high tides generally perpendicular to the flow of the water. Well constructed and managed, these dikes impede the sea water from entering the wetland areas at high tide and also retain sweet water during the rainy season.

These earthworks are built at the height of exceptionally high tide and their width across the top rarely exceeds 3 meters. These are earthen dikes compacted with heavy machinery with slopes of 2H/1V. Typically both the upstream and downstream sides of the dike are protected with stones or rocks. In

order to allow for good water management and for the passage of people and vehicles across the dike, they are built with a "duck's beak water regulator" or *"un ouvrage à batardeau."* These anti-salt dikes are structures which, if well built and operated, can be expected to have two roles:

- The reduction of salinity within the wetlands achieved by keeping out the tidal waters and/or by washing out these salts during the rainy season through the correct management of the drain structures (closing the gates during the rains and the complete draining of the retained water carrying away the salts afterwards).

- Retaining and spreading of rainwater within the perimeter of the wetland thus allowing for the correct irrigation of the crops within it.

Rice Paddy Cultivation: These are small management areas in the form of paddies of varying surface areas (0.25 ha, 0.5 ha and 0.75 ha), which correspond to the area typically cultivated by a local producer/farmer. Each paddy is bounded by small earthen dikes which contain the water within it. The ensemble of paddies or plots are further surrounded by an outer berm which prevents the run-off from the catchment area from entering the fields during high water. The water blocked by the outer berm is managed by the farmers through a system of drains made of PVC pipes installed under the berm and the interior dikes. When needed, farmer participants can request additional water for their paddies or they can ask that the water level be lowered or even drained. This type of management system is best known in areas of good rainfall and wetlands of minimum slope (almost flat) or as part of very small catchment areas with limited slopes and poorly drained soils, usually with high clay content.

4.1.2 DIFFERENT SERVICES FOR WETLANDS DEVELOPMENT

Winter rice cultivation constitutes the principal baseline activity for the exploitation and development of rehabilitated wetlands. Accordingly, Wula Nafaa has programmed activities known as "Rice Cultivation Services," which include the following:

- Providing support for leveling and plot delimination so as to ensure good homogeneous distribution of water resources, operations which require heavy machinery which may be beyond the capabilities of the small producers

- Introducing, with the support of AfricaRice, rice varieties and improved seeds adapted to the wetland areas

- Ensuring that producers get good technical training in best practices for rice cultivation, with the assistance of Agence Nationale de Conseil Agricole et Rural. Senegal (ANCAR)

The other activities include diverse support services for the producers, including:

- The development of horticulture wherever conditions permit

- The promotion of fruit tree crops and agroforestry made possible by facilitating access to plant materials (nurseries and seedlings)

- Support for mechanization of labor, post harvest practices for rice, and drying techniques for horticultural products

4.1.3 IMPROVEMENT OF HORTICULTURAL MANAGEMENT

From the list of Wula Nafaa objectives, the improvement of horticultural management is foreseen through the provision of equipment and appropriate irrigation systems. As such, Wula Nafaa plans to put in place among the chosen horticultural areas the following: wells for horticultural use; lift wells or

filtered springs; manual or treadle pumps; water storage based irrigation systems; and galvanized wire fencing. These are further described below:

Low cost horticulture wells: Certain project areas present geological conditions which make it impossible for hand-dug wells, notably in the Tambacounda and Kedougou regions, because of lateritic layers 2 to 3 meters in depth, which occur before one reaches the near surface acquifers. Under these particular circumstances, the project has opted for low-cost horticulture wells constructed with reinforced concrete rings of 1.4 meters in interior diameter and 1 meter in height. This column of rings is put in place, one by one, by undercutting to obtain the necessary height of casing and water capture necessary for the well in question. As the excavation proceeds, the column descends of its own weight and as additional rings are placed on top at ground level.

Manually Driven Wells or Filter Points: The manually driven well is a system perfected to allow small-scale horticulturalists to obtain irrigation water at low cost. They can be driven manually and utilize PVC tubes in unconsolidated soils up to 14 meters in depth, and entail:

- **Required materials:** PVC pressure pipe and well driving tools usually fabricated locally
- **Diameter of the well:** usually between 50 and 200 mm
- **Depth:** varies between 4 and 14 meters
- **Limitations:** its function is highly dependent on the nature of the soil and the capacity of the acquifer but can attain a production of 8 cubic meter/hour

The manually driven well is recommended in the zones where the soils at the depth of the acquifer do not contain significant quantities of clay or loam. The best performance is obtained in zones where the acquifer is found in coarse sands of 3 meters or more in width. This kind of well is well adapted to the conditions in the fossil valleys of the country. This kind of well is something which local artisans are very capable of carrying out in the project zones.

Manual or Treadle "Pull-Push" Pumps: Treadle pumps, locally known as "*Pompes Diambar*" were introduced into Senegal by the American NGO Enterprise Works and/or A.T. International Senegal during the 1990s. Many local artisans in Senegal as well in the rest of the Sahelian countries were trained to build these pumps. The pump is operated with human force and built of a limited number of parts which makes it a simple and low cost method to extract water. Treadle pumps are simple, practical and very efficient to use. They can furnish 5,000 to 7,000 litres (5 to 7 cubic meters) of water per hour. A well adjusted and well maintained treadle pump, where the pressure is not too excessive, is capable of being operated for several hours each day without unnecessarily tiring the operators.

On the basis of two hours of pumping per day, and taking into account the permeability of the soil and the water needs of a particular crop, this pump would be capable of irrigating up to 1,500 square meters of land per day in the dry season. The standard treadle pump can suck water from a depth of 7 meters, carry a head up to 150 meters away on flat land, or push it uphill up to 7 meters high or vertically (e.g., used to fill a water tower). These pumps can be used with wells, boreholes and surface waters (river, lake, the sea). These kinds of pumps are recommended where the garden is located above the water source or for some reason, the water needs to be provided under pressure. The pump can also be connected to an irrigation system of buried PVC pipes.

Treadle pumps are being introduced under Wula Nafaa for irrigating farm and market gardens. These locally manufactured, low-cost appropriate technology pumps can be operated with small driven wells and without the need for a power source. Farmers who might otherwise not have a chance to produce vegetables for the local market are obtaining good incomes from small patches of land irrigated with pedal pumps.

Hand Operated "Push-Pull" Pumps: A hand operated "Push-Pull" pump shares a lot of the characteristics of a treadle pump with one main difference. It is operated manually with two handles installed instead of pedals on the pump. Its use is recommended in gardens where for one reason or another, the operator cannot mount the treadle system. Surveys have demonstrated that the hand-operated pump is less efficient than the treadle pump because it is tiring and very hard to operate.

Water Storage-Based Irrigation Systems: Water storage-based irrigation systems are rather widespread in Senegal, consisting of circular storage basins of one meter in diameter built of reinforced concrete and semi-buried, of one meter in height thus capable of storing roughly 3 cubic meters of water, and installed on every 0.25 ha area through the horticulture perimeter. These basins are connected by a system of gravity-based canals to an elevated sump or deposit located near the water source (well). Completing the system is a series of openings and closing (valves and faucets) linking the water source to each of the basins.

Therefore, a farmer-user can fill his basin from the pumped water source through these gravity-based canals. After filling the basin, the farmer uses a watering can to irrigate his plot. This type of system reduces the distance a farmer must haul water from the source and also minimizes the losses of water.

These types of systems are often favored in zones where the farmers have little formal training and nor mean and could therefore not manage a drip irrigation system which demands much more investment (for a pump and water tank) and more serious vocational training.

Galvanized wire fencing: To protect the horticultural farms from wandering livestock and wildlife, the project will be supplying each irrigated perimeter with a fence of galvanized wire. The fencing is installed with angle iron posts, corner posts every 25 meters and intermediate bracing every 3 meters. Each such fence structure comes with a metallic gate.

4.1.4 THE VALUE CHAIN PROGRAM

The value chain program being developed by PCE addresses both staple food crops and income-generating commodities. For staple cereal crops, the VC approach envisages promoting increased competitiveness based on product quality, ensuring quantities and prices, and securing the supply going to small and medium-sized enterprises (SME) markets and local agribusinesses. For the income-generating commodities, it is a question of increasing and diversifying the value-added products as well as the market for finished products. Additionally, the hope is to profit from both local and export marketing opportunities. Finally, growing the partnerships for commercial goods and services, and thus developing marketing services, are important objectives of the program as is the promotion of private investment.

Cereal Value Chains: The cereal value chains include: irrigated rice, rainfed rice, irrigated and rainfed corn, millet and sorghum, and fonio. The activities of this program focus on the promotion of supply lines from different segments of the interior market. The accent is marketing, product quality, conditioning, and labeling, with a view to maximizing value added and promotion of local investment. For certain of the chosen value chains, such as rainfed rice, rainfed corn, and millet and sorghum, there will be activities aimed at addressing the known constraints to improving productivity and production. These activities will include introduction of improved seed, technical agronomic packages, and improved post-harvest techniques. In addition to the partnership with the private sector, the start-up of this PCE program will involve and bring in other institutional partners such as: Millenium Challenge Corporation (MCC), Japan International Cooperation Agency (JICA), Agence Française de Développement (AFD), and the Société de Développement des Fibres Textiles (SODEFITEX).

Income Oriented Export Crop Value Chain: The chosen crops include: mangos, bissap ("*oseille de Guinée*"), cashew nuts, and sesame. These value chains are predominantly oriented towards the export market. Market access is emphasized through building relationships with the exporters. But for all these crops where the producers have a relatively low level of technical skills, there will be efforts to increase productivity and raise production. To that end, the actions foreseen include: better performing varieties, good agronomic practices, improvement of seed supply lines, and techniques related to post harvest management and quality control. Partners will include: ISRA for base seeds, Bamtaré/SODEFITEX, TROPICASEM (horticultural seeds).

Seed Value Chain: The Seed Value Chain will be directed at the sustainable development of basic seed sources of high quality as well as the production of certified high quality seed by professional seed producers. Investment promotion, both public and private, will also be encouraged through a strong partnership between public and private institutions. The principal activities foreseen in this area are:

- The construction of three new seed quality control laboratories in support of ISRA (Kafrine, Kolda, Sédhiou) for certification at the local level
- Rehabilitation of three seed quality control laboratories (Dakar, Saint-Louis, Kolda) to strengthen ISRA capabilities for producing base seed for the cereal value chains

- Rehabilitation or construction of three new base seed production centers so as to increase the amount of base seed produced by ISRA
- Strengthen the community-based seed production program by the construction of a new seed conditioning center at Richard Toll, the acquisition of a mobile conditioning unit for Kolda and Velingara, and the acquisition of mobile conditioning units for Podor and Matam.

Conservation Farming: An intensive manual labor-based system called conservation farming is being promoted with both Wula Nafaa and PCE participant farmers. Using the traditional hoe, farmers dig 30 cm diameter holes, 15 cms deep on a regular grid (80 cm x 40 cm) across the field. Prior to seeding these spots, they add 2 kg of composted barnyard manure and 12 grams of 15-15-15 commercial fertilizer. This treatment is followed up by crop rotation and maintaining vegetative cover on the soil. There are high expectations about soil fertility restoration.

These activities will involve support for private seed operators, producer organizations, and NGOs in the area of multiplication, certification, and commercialization of quality seed.

Livestock Products Value Chain: This activity focuses on the improvement of productivity and increased profitability for meat production (red meat), in particular for sheep for the Tabaski holidays and on the improvement of value added for the poultry meat value chain. The activities of the value chain concerned with milk are localized in Richard Toll, Kolda, and Tambacounda where the objective is the further development of the local supply of milk, its collection, transformation and commercialization. To reach these different objectives, efforts revolve around improving the availability and quality of fodder as well as other sources of livestock feed, strengthening the sanitary baseline of the animals with a strategic program of vaccinations and prevention of diseases, and the strengthening of the capabilities of local stakeholders and finally developing working relations with the local industrial sector.

4.1.5 IMPROVING SOIL FERTILITY FOR RAINFED FARMING (FARMING SYSTEMS)

The objective foreseen for these activities is to restore and improve soil fertility for upland rainfed farming systems so as to increase productivity of cereal crops in a sustainable way. Soils across many agricultural regions of Senegal are highly degraded due to the deep reduction of fallow periods and the absence or very light use of fertilizers, either organic or chemical. **Conservation farming** tests have now been established or are programmed for 1,300 farmers in 93 sites and a total of nearly 976 hectares. This activity is primarily targeted at millet and sorghum production and involves a series of key techniques, including: leaving crop residues or crop hay on the sites after harvest; excavating a series of

small holes (30 cm diameter and 15 cm deep) on a regular pattern on the field; and adding a dose of both compost and chemical fertilizer to each hole.

4.1.6 CAPACITY BUILDING

For all of the activities foreseen by Wula Nafaa, the programming includes training of trainers and/or producers. The objective is to enhance the capabilities of the stakeholders in a wide range of different fields such as: improved agronomic practices and good rice farming techniques so as to enhance the efficiency of production on the rehabilitated wetland sites; improving site fertility in the uplands through conservation farming and reforestation; improved organizational capabilities and communication within the user community; leadership and management of producer organizations; commercialization, rural entrepreneurship, and wealth creation. Putting these capacity building activities in place will call for collaboration with diverse partner organizations such as AfricaRice, ANCAR, Bamtaré/SODEFITEX or expert consultants.

The value chain activities sponsored by PCE also include training oriented for primary producers but targeting others as well. Emphasis in this training is on quality control, competitiveness, marketing and commercialization. Furthermore, one of the components of PCE addresses building capabilities and its principal training themes are as follows:

- Strengthen the basis for the value chain approach by helping to create the conditions for a regular training circuit among the training institutions to develop a critical mass of both trainers and experts in the VC approach
- Training of key actors of the value chains with the aim of developing the entrepreneurial spirit focused on small and medium enterprises that operate as part of these value chains
- Development of the capabilities of the key professional support institutions (ISRA, DAPS, DA, ANCAR) to enable them to assist in overcoming the shortcomings of agricultural development

4.2 A SYNOPSIS OF THE ACTUAL FIELD SITES VISITED

The following table (Table No. 4-1) provides the reader with more detailed information about the sample of sites visited by the PEA Team. Although the sample spans the present range of sites where activities were being undertaken by Wula Nafaa and PCE, it was not possible nor feasible to visit every active site of the two projects nor those of the other institutional partners engaged in the Feed the Future Program with funding from USAID/Senegal.

However, in keeping with the PEA methodology, the sites selected are thought to be representative of the generic class of agricultural development actions and agro-ecological situations in which the program operates. If new activities different from those described herein and/or radically distinct agro-ecological conditions were to be identified, additional environmental oversight would be necessary.

Table No. 4.1- An Overview of Field Site Visits

Location	Geographic Region	Agro-ecological Type	Type of Agricultural Development	Site Dimensions	Organizational Setting	Observations
Vallée de Ndinderleng – Rehabilitation & Development of Wetlands (Dike Construction)						
Communauté Rurale de Keur Samba Guèye et Toubacouta, Arrondissement de Toubacouta, Département de Foundiougne, Région de Fatick	Sudanian Zone; Treed savannah, more/less degraded; rainy season: June-October; isohyète 800mm Situation géographique : X = 13° 39' 43'' N ; Y = 16° 23' 23'' W.	Wetland w/ hydromorphic soils, clay to clay-loam, suitable for rice & horticulture; catchment slopes w/ sandy loams, for peanut, millet, sorghum, fruit trees & horticulture.	After construction of a secondary dike, rice cultivation- 500 has & horticulture- 100 has; rice seed production- 8 has; dry season corn- 50 has; agricultural intensification with support from ANCAR & AfricaRice; tests of new varieties, application of good ag practices, conservation farming and training.	Large wetland area with a floodable surface of 974 has & a catchment area of 30.05 sq. kms.	Five villages involved: Saloli, Ndiop, Dayam, Passy Ndinderleng, Dassilamé Socé with a total population of 3056 in 267 households. Existing traditional community based organizations fairly non-functional. Women are the principal producers w/l the valley & 3 more dynamic GPF involved in rice & horticulture: Pasteef de Ndinderleng, Fakanto de Dassilame Soce et Deggo de Keur Saloly Bouya	Absence of a formal management structure for the Valley & of rules for rational use of natural resources. The Rural Communities of Keur Samba Guèye et de Toubacouta have signed an Agreement Protocol with Wula Nafaa. WN will assist the CRs w/ organizational strengthening at village/inter-village levels (management committees) & elaboration & implementation of a COGIRBAF.
Bas-fond de Ndour Ndour – Rehabilitation and Development of Wetlands (Secondary Dikes and Leveling)						
Communauté Rurale de Djilor, à 5,5km du village de Djilor, Département de Foundiougne, Région de Fatick	Coastal fringe of the Sudano-Sahelian Zone; more or less marked maritime influence; degraded treed savannah; rainy season- mid-June to mid-October; Isohyète 600mm Situation géographique : X = 14° 03' 44'' N ; Y = 16° 20' 57'' W	Lowland areas with halomorphic soils of varying degrees of salinity; suitable for rice and horticulture once salinity has been reduced.	After rehabilitation measures (de-salinization), project will assist farmers to develop improved rice cultivation on 60 has. Horticulture and fruit tree culture are also foreseen. Conservation farming will be tested on 1 hectare (millet) on surrounding plateau.	Medium sized wetlands with a floodable area of 60 has.	Ndour-Ndour is the only village involved and has 46 households which exploit about 35 has. This is mainly done by28 women organized into a Women Promotion Group (GPF) headed by a Management Committee. Wula Nafaa has signed an Agreement Protocol with the Rural Community of Djilor and will support	Each women farms about 1 hectare and participates collectively in safeguarding the site. Ag inputs (seed, fertilizers & phytosanitary products) are purchased individually and this is affected by local levels of poverty. Wula Nafaa envisages assisting the women to work

					institutional strengthening for the group and the preparation and operation of a COGIRBAF.	together to improve their productivity & production.
Bas-fond de Djilor – Rehabilitation and Development of Wetlands (Rehabilitation of an existing dike & management of three others)						
Communauté Rurale de Djilor, village situé sur la route Passi-Foundiougne, Département de Foundiougne, Région de Fatick	Coastal fringe of the Sudano-Sahelian Zone; more or less marked maritime influence; degraded treed savannah; rainy season- mid-June to mid-October; Isohyète 600mm	Lowland areas with halomorphic soils of varying degrees of salinity; suitable for rice and horticulture once salinity has been reduced.	After rehabilitation measures (de-salinization), project will assist farmers to develop improved rice cultivation on 60 has. Horticulture and fruit tree culture are also foreseen.	Medium sized wetlands with a floodable area of 200 has.	The men & women farmers on this site have been organized into a site management committee.	Similar to above…
Vallée de Boli 1 – Rehabilitation and Development of Wetlands (Basic leveling & construction of a second intermediate dike)						
Site is situated 3 kms north of the Village of Djilor; Communauté Rurale de Djilor, Département de Foundiougne, Région de Fatick	Coastal fringe of the Sudano-Sahelian Zone; more or less marked maritime influence; degraded treed savannah; rainy season- mid-June to mid-October; Isohyète 600mm; Situation géographique : X = 14°05’ 25’’ N ; Y = 16° 18’ 15’’ W	Wetlands with hydromorphic soils and a potential for salinity problems: will be used for rice and horticulture.	After rehabilitation measures (de-salinization), project will assist farmers to develop improved rice cultivation on 100 has. Horticulture and fruit tree culture are also foreseen.	Medium sized wetlands with a floodable area of 154.2 has.		Similar to the other sites in this general geographic area and following the same development model proposed by Wula Nafaa.
La vallée de Boli 2 – Rehabilitation and Development of a Wetland (Rehabilitation of existing dike and construction of a mid-way second dike)						
Situated about 3 kms north of the Village of Djilor; Département de Foundiougne, Région de Fatick	Coastal fringe of the Sudano-Sahelian Zone; more or less marked maritime influence; degraded treed savannah; rainy season- mid-June to mid-October; Isohyète 600mm;	Wetlands with hydromorphic soils and a potential for salinity problems: will be used for rice and horticulture.	After rehabilitation measures (de-salinization), project will assist farmers to develop improved rice cultivation on 10 has.	Small sized wetland with a floodable area of 11.5 has.		Similar to the other sites in this general geographic area and following the same development model proposed by Wula Nafaa.

	Situation géographique : X = 14° 05’ 09’’N ; Y = 16° 13’ 37’’ W					
Bas-fond de Wassadou – Wetland Rehabilitation and Development (Secondary Dikes)						
The Wassadou Valley is found in the Rural Community of Dialakoto, Région Tambacounda. It extends about 14 kms from the village of Bakadadji, above the village of Dialakoto to the confluence with the Niériko.	The site is phytogeographically w/i the Soudanian Zone, and is largely a treed savannah area; the rainy season last five months from May to October and it is in the 900 mm isohyete.	This wetland is characterized by clay loam hydromorphic soils in its lower reaches and sandy clay ferruginous soils in the upper plateau reaches; it is apt for rice, horticulture and fruit trees at the lower end.	Rice, horticulture and bananas are grown at the lower end; corn, sorghum, millet, peanuts and cotton are planted in the plateau areas.	Large wetland area with a floodable extent of 200 has.		The socio-economic study revealed that the average producer cultivates on the order of 0.25 to 0.75 has. The management scheme being proposed is equal sized plots of 0.5 has although certain plots may be affected by nearby sloping grounds.
Bas-Fond de Samecouta – Wetland Rehabilitation and Development (Construction of Dikes)						
The Samecouta Wetland is located about 10 kms east of the City of Kedougou, Communauté Rurale de Bandafassy, Région de Kédougou	The wetland is in the Soudano-Guinean phytogeographical zone, with a rainy season of 5 to 5.5 months and a dry season of 6 to 7 months. Rainfall averages 1200 mm.	This rice cultivation perimeter has hydromorphic soils of a sandy clay texture at the lower end, with some gravelly bits while on the surrounding plateau the soils tend towards ferrugionous to ferralitic gravels.	The plan is to expand the cultivated rice perimeter from 9 to 20 has, to improve productivity and to further develop horticulture options on the site.	Relatively small wetland with a floodable area of about 20 has.	This Women’s Promotion Group is organized as a GIE (Economic Interest Group) bringing together 120 women (reduced from 135 owing to site productivity constraints. The improved site will be divided into small plots of approximately equal size.	The expansion of the irrigated perimeter will require some tree cutting which should be carried out as rationally as possible.
Ferme 2 de Kédougou—Wetlands Rehabilitation and Development (Secondary Dikes)						
Ferme2 (Farm No. 2) is located about 5 kms north of the City of Kedougou; Communauté rurale de Bandafassy, Région de Kédougou.	The site is part of the Sudano-Guinean or Sub-Guinean phytogeographic zone, typically treed savannah or gallery forests; the rainy season lasts 5 months from May to October, and the isohyète : 1200	This rice cultivation perimeter has hydromorphic soils of a sandy clay texture at the lower end, with some gravelly bits while on the surrounding plateau the soils tend towards	This is an irrigated rice perimeter of about 10 has managed by a women’s group from the town of Kedougou. Wula Nafaa support will help to expand the area to 35 has to develop rice and horticulture.	This is a medium sized wetland with a floodable area of 50 has.	About 300 women from the nearby City of Kedougou are grouped into different GPFs and exploit this farm under the aegis of the Women’s Federation of Kedougou.	Part of the same catchment area and lowland as Samecouta.

	mm.	ferrugionous to ferralitic gravels.				
Site : Sarré El Hadji – Corn Value Chain activities						
The village of Sarré El.Hadji may be found about 15 kms from Tambacounda; Communauté Rurale de Missirah, Région de Tambacound	Located in the Soudanian phytogeographic zone; somewhat degraded treed savannah; rainy season lasts from 4.5 to 5 months; isohyète : 800 - 900 mm.	Upland plateau soils of a sandy loam type that have been farmed for a long time; crops include: millet, sorghum, corn, peanut, & cotton .	Project will assist farmers to raise productivity by 30% and increase the production of quality corn with adapted techniques and support for private certified seed producers. Part of the overall corn value chain which also includes equipping and setting up storage sites, marketing advice and development of financial mechanisms.	Farmer partner of PCE is using 5 has of his 15 has farm for corn improvement trials; village of 34 farming households has average land size between 5 & 15 has.	Lead farmer as test interacting with his peers.	Very little land left in fallow owing to high demographic pressures; much of the land appears over-utilized.
Nguènte 2 – Banana Value Chain – Support for improving the competitiveness of banana producers, with APROVAC from Tambacounda						
This banana plantation is located about 50 kms south of Tambacounda ; Communauté Rurale de Missirah, Région de Tambacounda.	Soudanian phytogeographic zone with somewhat degraded treed savannah; rainy season last for 4 to 5 months; isohyète : 900 mm	Loam or loamy clay alluvial soils (on the banks of the Gambia River); crops include bananas, horticulture, corn and sorghum.	Increasing competitiveness by raising banana plantation productivity, improved fruit quality with post harvest techniques and support for commercialization.	Relatively small cooperatively farmed banana plantation, with 140 participants on 37.5 has.	Individual producers as part of a Economic Interest Group (GIE) and with support of APROVAC too.	
Site de Dianké Souf—Millet and Sorghum Value Chain: conservation farming; Integrated control of Striga hermonthica						
The site is located some 30 kms north of Kafrine, Communauté Rurale de Dianké Souf, Région de Kaffrine.	On the limit between the Soudanian and the Soudanian-Guinean Zones; very degraded treed or shrub savannah; isohyète 700-800 mm	Upland plateau soils, more or less sandy and of the tropical ferruginous type; crops include millet, peanut, sorghum and niebe (beans).	Conservation Farming test w/ 15 farmer participants; Integrated Control of Striga w/ 25 farmer participants in partnership w/ Green Senegal.	Small areas on each of the farms…0.25 has for Conservation Farming and 0.75 has for Striga Control.		

Site de Sanguil – Millet/Sorghum Value Chain – Conservation Farming						
Located 15 kms south of Kaolack, Communauté Rurale de Latmbengue, Région de Kaolack	Soudanian Phytogeographic Zone; very degraded treed or shrub savannah; rainy season lasts for 4.5 – 5 months; isohyète 700-800 mm	Upland plateau site with sandy to sandy clay soils; crops include: millet, sorghum & peanuts.	Conservation Farming test plots in cooperation with Green Senegal.	Small site with 0.25 has test plots.	The inhabitants of the village are organized into a Sanguil Development Committee.	
Site de Richard Toll (GIE Malal Yéro) – Support for quality rice production (paddy & white rice)						
The site is located near Richard Toll at about 102 kms north-north-east of St. Louis; Département de Dagana, Région de Saint-Louis	Extreme north w/i the Sahelian Zone; rainy season only last 3 to 4 months; isohyète 300mm.	An irrigated perimeter on the Senegal River Delta (High Delta); hydromorphic soils of moderate salinity, with sandy to sandy-clay texture, suited to rice production & horticulture.	Intensified rice production techniques on about 20 has; with some mechanization, conditioning and commercialization; this GIE is acting as a service provider for rice transformation with a rice mill bought under aegis of PCE.	This 20 has site in Haut Diawel is only part of a 100 has irrigated perimeter exploited by the GIE.	This GIE was established by a group of women involved in a mutual credit association in 1990.	
Site de Richard Toll-- Seed Treatment Center – Program to strengthen community-based quality seed production						
This seed treatment center is located within the town limits of Richard Toll; Département de Dagana, Région de Saint-Louis	Extreme north w/i the Sahelian Zone; rainy season only last 3 to 4 months; isohyète 300mm.	NA	Construction of a new seed conditioning center at Richard Toll and acquisition of mobile seed treatment equipment for use in Podor, Matam, Kolda & Velingara .	NA	This program is assisting ISRA and through this Govt. of Senegal Agency the seed producers organized by the l'Union Interprofessionnelle des Semences (UNIS).	Construction taking place of less than 10,000 square feet.
Site de Richard Toll – Partnership with the Laterie du Berger milk plant						
The milk plant is located within the town limits of Richard Toll; Département de Dagana, Région de Saint-Louis.	located within the town limits of Richard Toll; Département de Dagana, Région de Saint-Louis	The milk collection area which the plant draws from is part of the extensive pastoral areas of the Fleuve Region of Northern Senegal where the fodder resources are relatively poor and widely dispersed.	Increased marketing of milk products through development of new product lines, enhanced market penetration, and expansion of collection of local milk from local producers, from 645 thousand litres to 775 thousand per year.	The collection area is situated to the south and east of Richard Toll with a transport radius of about 50 kms.	Milk producers are organized into the Mbane Producers Cooperative which brings together 637 members.	A number of other donors cooperating with LDB.

4.3 ALTERNATIVES TO THE PROPOSED DEVELOPMENT ACTIVITIES

Considering the alternatives to a program broadly targeting agricultural development and food security in Senegal is perhaps a pointless task because the permutations and combinations are almost endless. What is clear, however, is that any USAID development program that does not address the challenges of poverty and food insecurity which have increased as a result of both internal issues as well as the overall state of the world economy, will not be in the strategic interests of the United States, the Government of Senegal, and most importantly, the people of Senegal. The PEA Team has carefully considered the array of activities that the present FtF partners are implementing, involving increasing productivity, raising production, linking farmers and producers to the market so that they can sell their products and earn income and have concluded that these activities are wise choices to address poverty and food security.

From an environmental perspective, the matter of alternatives is less one of options as of shading of the approaches – the modernization of agriculture versus the restoration of agricultural productivity, the degree to which the activities target natural resources management as key to sustainable agriculture, the choice between commodity-oriented and input-based agribusiness versus improved mixed farming systems, the importance of building resilience into farming systems in the light of impending climate change impacts.

The present PEA Team and its report stresses the importance of fully accounting for the growing phenomena of global climate change as the key to success with an agricultural development and food security strategy for Senegal and its people. That reality would tend to favor the more mixed farming, building resilience into present systems approach over an approach more structured to greater use of agricultural inputs and mono-cropping of export commodity approach. Actions that become even more germane in that context are things like: conservation farming, raising the productivity of individual livestock heads and reducing overall numbers, more attention to sustainable use of forest, charcoal and rangeland resources, restoring the fallow period, and continuing to promote parkland type agroforestry systems.

5. ENVIRONMENTAL CONSEQUENCES OF FTF-FUNDED AGRICULTURAL DEVELOPMENT IN SENEGAL

5.1 ENVIRONMENTAL ISSUES IDENTIFIED DURING THE PEA

In the course of the PEA and growing out of the Scoping Exercise, the information garnered from a careful review of the literature, the observations made during the field visits and primarily consultations with program stakeholders and among the team itself, **a full list of "environmental issues"** was identified. These environmental issues reflect the potential for adverse socio-environmental impacts that might occur as a result of the planned agricultural development activities and constitute the *raison d'etre* of this PEA.

The sections which follow provide a fulsome **description of each of the potential adverse impacts** so as to ensure that there will be adequate awareness and recognition of them in future planning of program activities.[4] This description may be enhanced where it is not manifestly obvious with a **brief discussion of "cause and effect"** with the intention again of raising awareness among non-environmentalist practitioners about these issues and how and why they might occur. This later discussion will also highlight **the technical understanding needed for a capacity to monitor** for such adverse impacts. Where possible and pertinent, this discussion will also note **how environmental issues can affect the overall and/or long-term sustainability** of the planned development activities and thus jeopardize the food security objectives of the program. Finally, this section will discuss **suggested mitigation measures** to avoid or compensate for these unintended adverse impacts.[5]

The issues which follow here have been separated into those which are environmental in nature and those which are socio-environmental in nature. As the astute reader will note, however, some of these issues may be interrelated and adverse impacts on the physical

FERTILIZER APPLICATION GUIDELINES

- Before applying fertilizers, obtain an assessment of soil conditions (fertility).
- Indiscriminate use of chemical fertilizers should be avoided.
- Different kinds of fertilizers are required in order to maintain a given level of soil fertility. This depends on site-specific factors, including the soil type, the nutrient requirement of the crop and the various sources of available nutrients. Nitrogen and phosphorous are the most important nutrients lacking in SSA soils.
- Fertilizer application has to be considered in the context of the overall farming system. This includes the use of organic manure and residues, soil cultivation and crop rotation and water harvesting. Collectively, these factors influence the efficiency of nutrient use.
- When fertilizers are used, it is very important to apply the correct amount for the given situation. The challenge to the farmer is to match as closely as possible the input of nutrients to the nutrient uptake of the crop, thereby minimizing losses. Over-fertilization is both costly (wasteful) and potentially harmful to the environment.

Source: USAID AFR Fertilizer Fact Sheet (now also available in French from Wula Nafaa).

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4 Because of the importance of these considerations, one set of impacts, namely those related to "climate change" have been separated out and will be discussed more fully in a separate and dedicated section which follows this one.

5 It should be noted that the methodology being employed here, built into the present USAID Environmental Procedures (Reg. 216) does not equate compensation by balancing adverse impacts with possible positive impacts. In other words, adverse impacts cannot be excused or canceled by the presence of positive impacts as part of the outcome of the development activities no matter how beneficial the latter may be. This point is made here because of a recurrent tendency to use the "Leopold Matrix" approach to impact assessment in Senegal wherein positive and negative impacts are charted on a table sometimes implying the positive may be worth the negative.

environment can lead to adverse social impacts on the local people. These adverse impacts are reiterated again in tabular format designed as a handy reference tool for field practitioners and drawing upon and closely resembling, as they should, the Environmental Mitigation and Monitoring Plan Tables previously elaborated for the two main FtF projects, Wula Nafaa and PCE.

5.2 SPECIAL CONSIDERATION – CLIMATE CHANGE AND AGRICULTURAL DEVELOPMENT IN SENEGAL

Introduction: One of the driving factors behind the decision to invoke the need for this PEA was the very real prospect of climate change and its effect on the success of the agriculture development program in Senegal. The PEA Team was directed to take note of the very special circumstances of meeting the goals of the Feed the Future initiative in a Sahelian country and its different agricultural development activities in the light of potential effects of/on global climate change.

Very clearly, the probability that climate patterns in the Sahel in Senegal critical to the current cropping patterns would become even more challenging, thereby possibly jeopardizing the premises and programs of the Feed the Future, needs to be considered carefully and appropriate adaptation measures put in place to foster more sustainable approaches to food security. Senegal, like many of the neighboring countries of the Sahel, has lived with drought years and the spread of the effects of desertification. The country's current crop mix is also already thought to be challenged by high and rising temperature regimes that could affect productivity and even crop choice. The potential for sea level rise and its impacts on the flat low-lying areas where marine estuaries penetrate well inland, into current crop lands, also merits consideration.

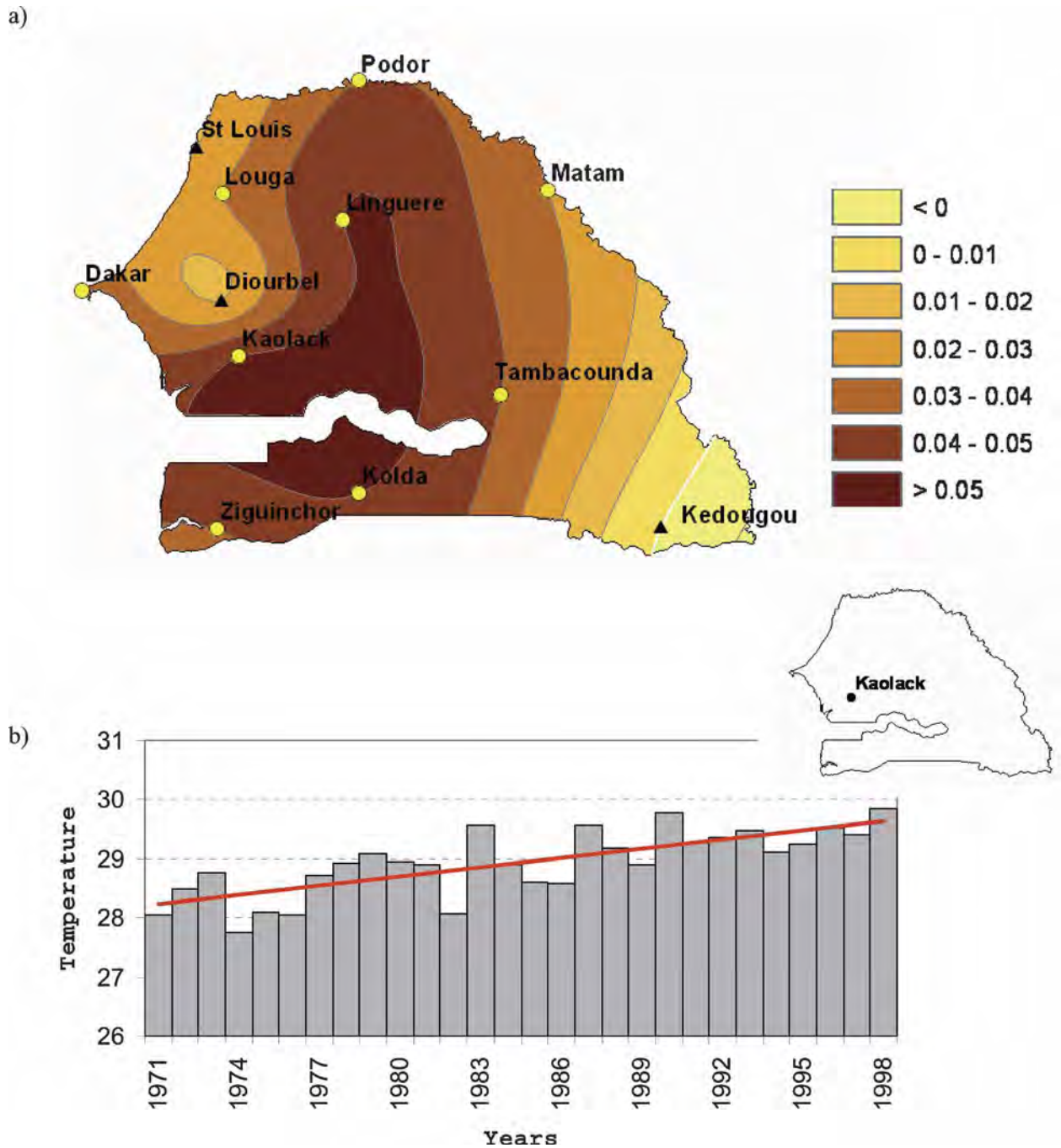
In addition, the potential impacts from the advancement of the agricultural frontier, the byproducts of agricultural productivity, resulting new demands on scarce water resources, and the threat of land degradation in a fragile semi-arid landscape, the effects of agricultural development on the drivers of climate change were also examined as part of this PEA.

As part of the outcome of the Scoping Exercise, the PEA Team concluded that "It is very clear that agricultural development and food security policy in Senegal without climate change awareness and a well-conceived strategy won't succeed, possibly even over the medium-term." This section of the report addresses this topic of special consideration and the outcome of the Team's analysis of the situation in the light of the goals of the Feed the Future Initiative.

Climate: Historical and Projected Variability and Extremes

Senegal's history of climate variability, including drought, is well documented. These conditions are projected to become worse in the coming decades as mean global air temperatures increase by 1 to 2°C minimally over the next decades. This projected range for increases in global temperatures obscures harsher impacts at regional scales, such as in the Sahel and West Africa. Temperatures in the Permanent Interstate Committee for Drought Control in the Sahel (CILSS) states, of which Senegal is a member, are expected to be hit particularly hard, with increases greater than the global average. Senegal is already one of the hottest countries in sub-Saharan Africa. The increases in mean annual air temperature in Senegal from 1971-1998 are depicted below.

Figure 5.1 - Mean Temperature Trends in Senegal 1971-1998



(a) Mean annual temperature trends relative to the period 1971–98. Negative values (in the southeast) are marked by the white solid line. Yellow dots represent the stations whose trends are significant at the 95% level, using the *t* test. Black triangles represent stations with trends that are not significant. (b) Mean annual temperature for Kaolack (14.13°N,16.07°W). A linear regression line is fitted. A warming trend is observed in most of the stations in the study area. (From Fall, Niyogi, and Semazzi, 2006)

The continuing increase in air temperatures projected with climate change will result in growing seasons that will expose staple crops to uncommonly warm air temperatures, well beyond the optimal temperatures for growth and development for some crops. Even brief periods of hot temperatures can dramatically reduce crop yields if the periods coincide with flowering.

While sea level rise (SLR) is projected to increase by up to 1.4 meter by 2100, it will be the surges associated with tropical storms that will endanger the Senegalese population. The people most adversely affected are those living in the low elevation coastal zone (LECZ) defined as the contiguous coastal areas that are less than 10 m above sea level. Approximately 3,239,000 people living in this zone will be affected by SLR, totaling 25% of Senegal's urban population and 10% of the rural population (McGranahan, Balk, and Anderson, 2007). Similarly, the flatness of the landscape and the deep inland penetration of estuaries and rivers in Senegal will make diking to protect from sea level rise a very challenging and costly proposition.

The Global Circulation Model (GCM) projections of rainfall are much less certain than temperature projections; in fact, GCMs vary in the direction of precipitation changes (Lobell and Burke, 2008). However, given projected increases in evapotranspiration and population, it is highly likely water will be less available. Even if rainfall increases or decreases in a given area, a greater number of events are likely to be more intense.

The development challenge is to reduce the vulnerability of Senegal's farming communities as temperatures warm, precipitation regimes change, and extreme events become more common. Climate change sets the stage for more hunger and greater poverty. Climate variability is already a source of vulnerability for poor people because their livelihoods are strongly dependent on natural resources. Women's lives may be disproportionately affected because of their engagement in agricultural labor and because of their role in water and fuel collection (Terry, 2009).

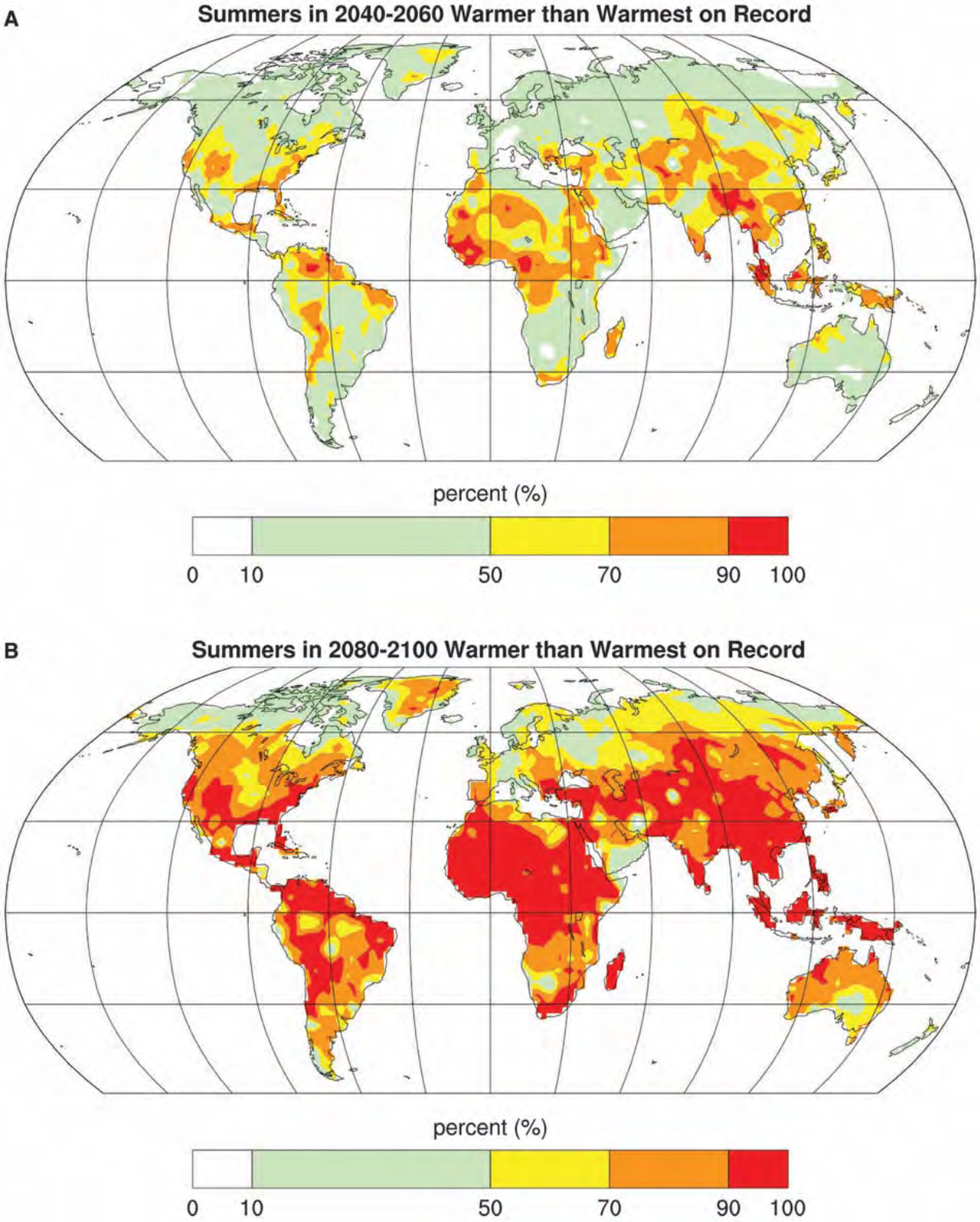
Adaptation to Climate Change

Reducing vulnerability to climate change means better management of the natural resource base on which agriculture and 70% of the people depend. Access to inputs (seeds, water, organic and inorganic fertilizers) and improved input efficiency will be critical to the survival of resource-poor househouseholds and an essential component of agricultural development strategies, including resilient food systems, as climate change intensifies in Senegal. Financial services such as credit, savings, and drought insurance also provide resilience to shocks.

More agro-meteorological data will help detect localized trends faster. Farmers need reliable information to assess labor and input needs. Expanding the network of "agromet" collection sites would help improve seasonal forecasting and hence their investment decisions (Mortimore, 2010).

Conserving and rehabilitating the natural resource base is an essential component of current USAID programming in Senegal. With climate change, it will be even more important to protect and conserve genetic resources and biological diversity (e.g., the parkland agro-ecosystems, the remnant forest and savannah areas, and wetland areas), and to be better stewards of soil and water resources.

Figure 5.2 - Warmer Summers Worldwide



From Battisti and Naylor, 2009: Fig. 3. Likelihood (%) that future summer average temperatures will exceed the highest summer temperature observed on record (1900-2006)-- (A) for 2050 and (B) for 2090.

Agricultural systems: recommended practices for adaptation to climate change

Crops differ in how they convert carbon dioxide (CO_2) into biomass. Some first convert carbon into a three-carbon compound (C_3), others into a four-carbon compound (C_4). In general, plants that utilize a C_4 pathway (maize, millet, sorghum) perform better under conditions of higher temperature than those that utilize a C_3 pathway to fix carbon (beans, rice, wheat). Some examples of optimum (T_{opt}) and maximum (T_{max}) temperatures during flowering for well-watered and well-fertilized crops are given below.

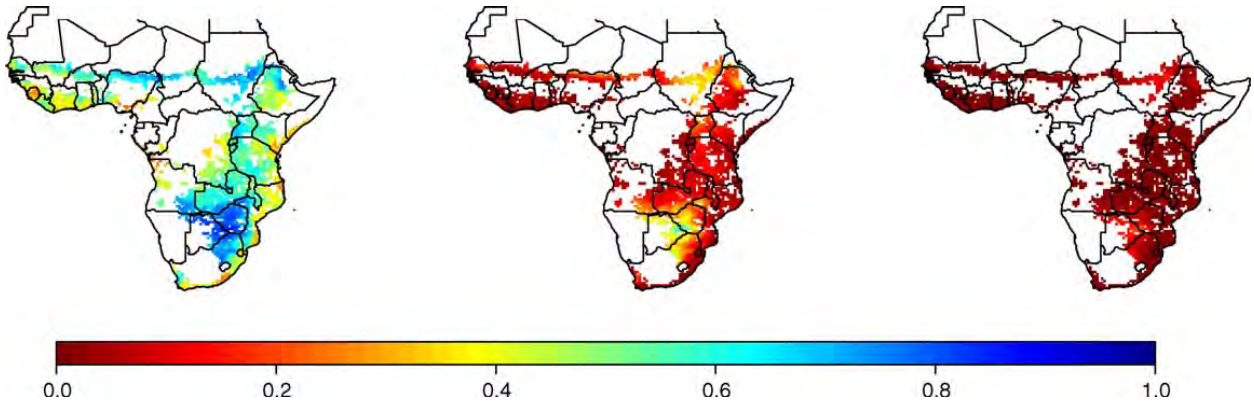
Table No. 5.1- Typical growing season optimum (Topt) and maximum (Tmax) air temperatures for various crops

Crop	T_{opt} (°C)	T_{max} (°C)
Cotton	28	35
Groundnut	30	35
Maize	30	35
Rice	30	36
Sorghum	30	36

The Feed the Future Initiative program partners should strive to encourage mixed crop and where possible mixed crop-livestock systems in order to maximize household resilience to climate change. Adding beans and grain legumes (cowpea, groundnut) to systems has the potential to decrease a household's vulnerability to climate change as well as increase household nutrition.

The need for improved varieties with traits capable of performing in the novel temperature regimes projected for the Sahel underscores the need to maximize support for crop breeding programs and the conservation of genetic resources. Traditional plant breeding and agronomy can increase crop adaptation to climate change, but diverse crop genetic resources and more plant breeders will be needed to accomplish the task. Currently, Senegal has an average of about one breeder for each crop; this paucity of plant breeders results in a very low number of new varieties being produced each year (Gueye, 2006). There is "a pressing need to develop breeding programs that anticipate rapidly warming environments" given the very strong possibility that within a few decades growing season climates in Senegal will be hotter than anything in recent historical experience (Burke et al., 2009).

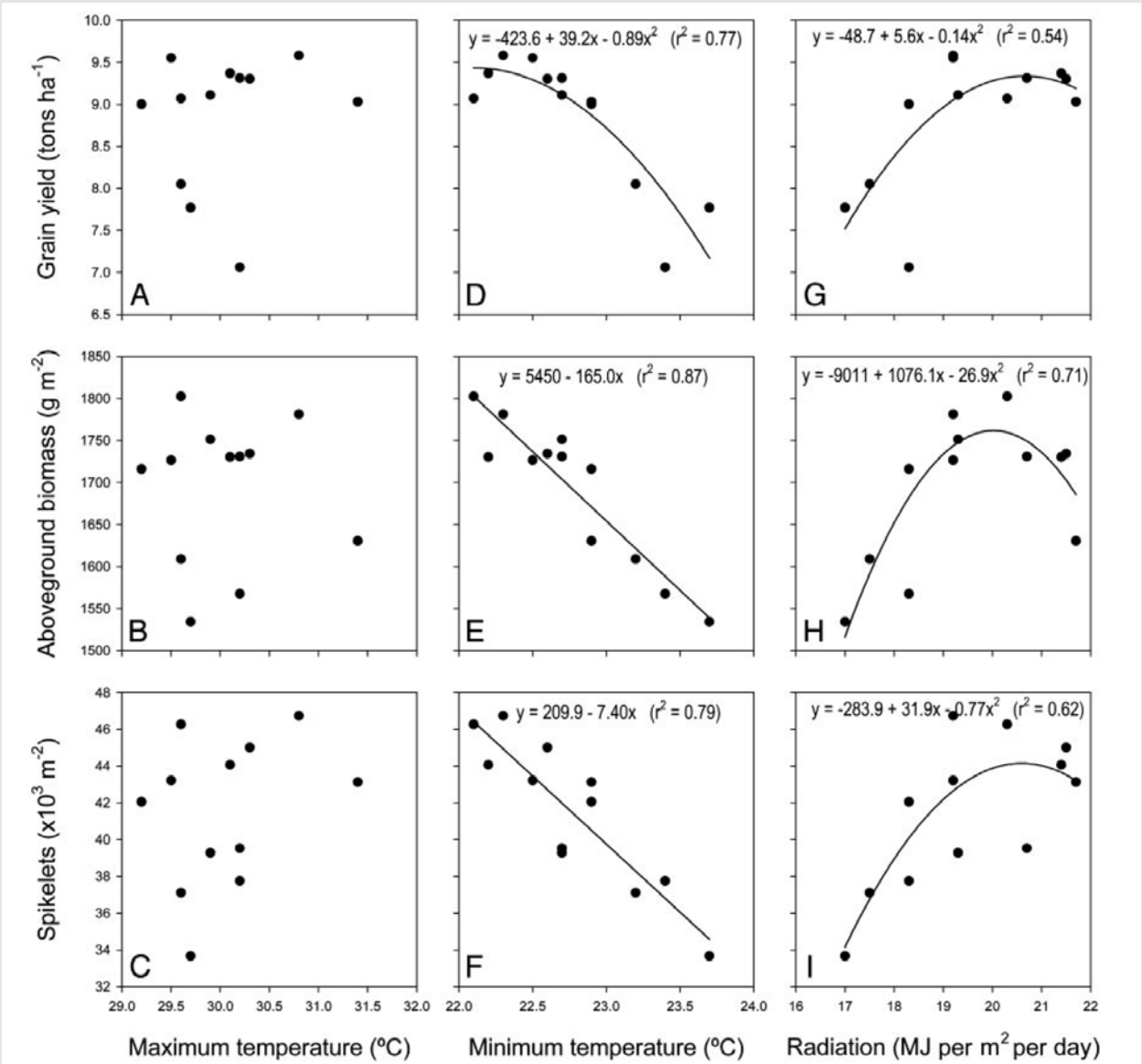
Figure 5.3 - Percentage Overlap in Growing Season Temperatures



From Burke et al. 2009: Percentage overlap between historical and 2025 (left), 2050 (middle), and 2075 (right) simulated growing season average temperature at over African maize area. Dark blue colors represent 100% overlap between past and future climates, dark red colors represent 0% overlap. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

Burke et al. (2009) predict that the percentage overlap in growing season temperatures for maize, millet, and sorghum between current (1993-2002) and projected (2050) temperatures will be less than 35%. While Burke et al. did not look at rice productivity, an increase in daily minimum air temperature affects rice more adversely than an increase in daily maximum temperature. Global warming is characterized by larger increases in daily minimum than daily maximum air temperatures (IPCC, 2007). Daily minimum temperatures increased as much as three times more than daily maximum over most of earth's surface during 1951-1990. In a study by Peng et al. (2004) yield declined by 10% per degree Celsius above about 22°C (see the following graphic).

Figure 5.4 - Temperature and Yield Relationships in Rice



From Peng et al. 2004: The relationship between rice-yield attributes (grain yield, above-ground total biomass, and spikelets per m2) and growing-season mean maximum temperature (*A–C*), minimum temperature (*D–F*), or radiation (*G–I*). Yield-attribute data were obtained from irrigated field experiments in which crop-management practices were optimized to achieve the highest possible yields from rice cultivar IR72 at the IRRI Farm in the dry seasons from 1992 to 2003. Growing-season mean maximum and minimum temperatures and radiation were calculated from daily values for the entire growing season from transplanting to harvest.

Some Other Considerations Related to Agricultural Development and Climate Change

Livestock: In most countries in sub-Saharan Africa, the livestock sector is expected to become more critical to the survival of resource-poor people as climate change intensifies, since poor people benefit more from livestock systems or mixed systems. In places where cropping systems are already marginal, livestock will become essential to livelihood resilience. Mixed crop-livestock systems can facilitate a transition to increased emphasis on livestock and should be strongly supported in order to ensure sustainability of income and food security (Jones and Thornton, 2009). Senegal has a mixed history of project success with livestock due to the cultural status associated with owning livestock but, as noted above, any support the program partners can give to mixed crop-livestock systems will pay off as climate change worsens.

Finance: Financial services are already being used in sub-Saharan Africa to reduce the impact of changes in climate and extreme events on small-scale producers. Access to credit can increase the rate of technology adoption and improved management practices (Padgham, 2009). Crop and livestock insurance, using weather indices, can help resource-poor producers manage risk better and financial services can help balance production needs with risk minimization (Mortimore, 2010). Throughout sub-Saharan Africa, banks and microenterprise schemes are extending opportunities for credit, savings, and insurance to small-scale producers and processors. PCE should investigate how to help project participants better understand and utilize financial services.

Community Participation: Farmers in Senegal have experienced and adapted to extreme climate events such as drought over decades. Although the scale of projected changes over the coming decades will be much greater, farmer observational studies as well as community-level discussion of perceived risks are needed. Through their reaction to extreme events (drought, high intensity rainfall), we can learn about what steps they take during environmental shocks and what more is needed to reduce their vulnerability.

Local knowledge: The wealth of expertise gained by producers in previous extreme events should be sought out and utilized in climate-proofing Senegalese agricultural systems (Mortimore and Adams, 2001, Mortimore, 2010). For example, farmers have extensive knowledge of the significant variations in the productive capacity of their soils and hence can add biomass where most needed. Specialized knowledge is one of the reasons small-scale family farms that adopt agroecological practices can be as productive as industrial operations while conserving biodiversity and genetic resources and being more energy efficient (Perfecto and Vandermeer, 2010). It would be quite useful for Wula Nafaa and PCE to catalogue adaptive knowledge in order to encourage cross-community exposure to successful technologies and practices. Project staff should proactively work with communities to catalogue adaptive knowledge and encourage cross-community exposure to successful technologies and practices.

Natural resources: Climate change will require much better stewardship of the natural resources (water, soil, vegetative cover, biodiversity) on which agriculture depends. Senegal in general is characterized by poor soils (USDA, 2007). Soils are key to productivity; testing is crucial to managing them for sustainable productivity. Soil bulk density sampled over time is a simple and inexpensive way to learn whether practices such as irrigation or mechanized plowing are degrading the environment and are in need of revision.

Similarly periodic sampling of soil salinity, pH, and nutrients can indicate practices that are causing soil degradation. Increasing soil organic carbon (SOC) is perhaps the essential component to increasing productivity through increased nutrient availability and water-holding capacity. Some of the factors affecting SOC are intractable – for example, geomorphology and topography. However, vegetation and land use can be managed to increase SOC (Stoorvogel et al., 2009). The soils we observed in Senegal have SOCs below 0.5%. Leaving residues in the field when possible, adding biomass (composted

manure and wastes) and growing leguminous cover crops act to increase SOC and decrease Aeolian erosion. The residue of groundnut, which occupies 40% (2 million ha) of the cultivated land in Senegal, is highly valued for fodder (USDA, 2007) and hence is a key component of the mixed crop-livestock systems projected to be the most adaptive system in terms of projected climate change in the Sahel (Thornton et al., 2009; Jones and Thornton, 2009). However, other crop residues are available (e.g. cotton) – though often burnt, which could usefully augment SOC and reduce carbon emissions. Leaving parklands shrubs and trees in the landscape have the added bonus of conserving indigenous biodiversity.

Sustainable management of resources on PCE and Wula Nafaa sites could benefit from integrated soil fertility management (ISFM). Over-fertilization is wasteful economically and potentially harmful to the environment (groundwater contamination, soil acidification, eutrophication of surface waters). In addition, volatile gases that contribute to climate change can be released to the atmosphere. Fertilizer microdosing can enhance productivity and avoid waste and environmental pollution. The microdose technology is based on the application of small quantities of fertilizers in the hills of plants thereby enhancing fertilizer use efficiency and improving yields while minimizing input cost. (Sorghum and millet yields were 44 to 120% higher when using microdosing than with the earlier recommended dosages and farmers practices in studies in the Sahel (Tabo, 2005). While it appears that some of the farms in PCE and Wula Nafaa were practicing microdosing, others were simply depositing manure in rows. (On the farm where we viewed this, the manure application was being done by a six-year-old and an eight-year-old, who presumably were not trained in microdosing.)

Soil sequestration of carbon is being recommended to mitigate climate change in Senegal (Lufafa, et al., 2008; Tieszen, Tappan and Toure, 2004). Since Senegal emits only approximately 0.4 tonnes per capita (US DOE, 2009), it will be allowed to increase emissions under proposed international agreements and thus, the focus should be on adaptation, not mitigation of climate change.

Gender Considerations: Since studies have shown that women and men perceive different risks in terms of climate, asking men and women to map perceived vulnerabilities can help target adaptation policies, activities, training, and information respond to the priorities and concerns of women as well as men (Thomas et al., 2007). Adaptation strategies that provide women with access to inputs (water, fertilizer, credit, tools) can increase their ability to adapt to climate change. Sometimes meeting the needs of women has an indirect though significant effect on the ability of women to adapt to climate change. For example, women with access to health and nutrition clinics have increased labor productivity (Terry, 2009).

Recommended Strategic Measures Related to Climate Change Adaptation

The astute reader will understand that the proposition of "mitigating climate change" is not one within the scope of an individual program or even a country. Countries are being counseled to develop a strategy for and measures to "adapt" to climate change so the recommendations that follow are geared to adaptation.

Most of these recommendations are beyond the purview of the current USAID partners involved in the Feed the Future Initiative, however, they also clearly reflect the conviction of the PEA Team that an agricultural development and food security strategy for Senegal that does not increasingly take into account the very real prospects of climate change will not succeed. The PEA Team suggests that as part of their engagement with the Government of Senegal, both the current program partners – but perhaps more particularly, USAID/Senegal – should continue to raise the following themes of macro-adaptation options as part of the dialogue on national policy and strategy:

- Build into national disaster preparedness programs an awareness of the reality that climate change could increase the occurrence of weather-related emergencies like floods, drought, and

windstorms. These natural events can also adversely affect rural infrastructure that the country is trying to develop to better link its agriculture sector with the markets.

- Develop an awareness of or listing of "high risk" areas for climate-related disasters, including drainage ways and water courses, watersheds, flood prone areas, and infrastructure that might be damaged from such events.
- Give more attention to the need for watershed management, land rehabilitation, protection of riparian areas, wetlands protection, grazing lands management, and forest and biodiversity conservation as priority choices in the adaptation of land-use patterns to climate change in Senegal.
- Improve the regulatory framework for macro-level or regional land-use planning and its enforcement and ensure that environmental assessments and permitting carefully consider the off-site consequences of development activities both individually and cumulatively.
- Continue to develop a pro-active approach to climate change monitoring and modeling in Senegal and use its results for mandatory, informed sectoral decision-making across the spectrum of Government agencies and programs.

The conservation farming, natural resources management, and natural forest management activities being undertaken as part of the Feed the Future program aim in part to add more sustainable land-use options to the current development patterns of rural Senegal. The PEA Team believes that they deserve even greater support and attention to new variations and opportunities of natural resources management that are supportive of agricultural development. From the natural resources perspective, sustainability is achieved by increasingly matching land-use to land capability.

In addition, however, the current agricultural development practices need to take much greater account of the prospects of climate change and choose activities that will help them to adapt in the future. The following are some recommendations related to agricultural development policy and practice, including:

- Ensure availability of cultivars resilient to air temperature extremes.
- Encourage conservation of genetic resources and indigenous biodiversity.
- Incorporate livestock into agricultural systems.
- Increase access to financial services.
- Involve communities in vulnerability assessment.
- Learn how communities have traditionally dealt with climate variability.
- Track soil and water parameters (bulk density, salinity , etc.) over time to prevent resource degradation.
- Promote inclusion of indigenous shrubs and trees in cropping systems.

Doubtless there is any number of additional adaptation measures that should be considered as sector options related to climate change. Identifying them all is well beyond the scope of the present undertaking, however, the PEA Team understands that there are plans for a major study of climate change strategy to be funded by USAID/Senegal in the near-term.

5.3 ENVIRONMENTAL IMPACTS

Soil Degradation and Desertification

The erratic and often intense rainfalls, combined with a growing tendency to forego fallow, strongly highlights the potential for spreading soil degradation and even desertification in the semi-arid agricultural landscapes of Senegal. Figure 2.6 (Land-Use Change in the Peanut Basin) illustrated how land-use has so radically changed in the Peanut Basin of Senegal, and while the phenomena may be most widespread there, it is also found elsewhere throughout the country.

"Conservation Farming" is being promoted by both Wula Nafaa and PCE: In this photo, the trial involves plowing the fields at regular intervals and adding manure and fertilizer, and then covering it over with straw. This treatment is expected to restore the fertility and condition of othewise depleted upland soils, with likely significant increases in crop productivity. Issues related to the availability of sufficient manure and the intensity of the labor required for this wholesome practice may jeopardize its expansion.

Indeed, the prospect of desertification and its links with recurrent drought have been a part of the environmental discussion agenda in Senegal and throughout the Sahel for decades. Rainfall this past decade has generally been better than the extremes of the "drought years" and this may have suppressed the parallel concerns about desertification. In reality, however, there is some reason to be concerned that in fact exactly the opposite is true, that improved rainfall regimes have prompted farmers to more intensively cultivate the land, expand the agricultural frontier and forego fallow periods. In the high heat of surface temperatures in semi-arid Senegal and the occasional intense rainfall events, soil organic matter can be easily volatized thus reducing the cation exchange capacity of these soils and with it their inherent fertility.

Mitigation Measures: The current range of agricultural development activities clearly recognize the need for nurturing the soil substrate on which the plans for enhanced productivity, production, and food security are based, witnessing the widespread introduction of the "conservation farming" model. This fairly labor intensive practice (200 – 300 person-hours of work per year during the first three years) may need reconsideration given reported growing shortages of farm labor across rural Senegal. A wider range of soil improvement oriented best agricultural practices should also be considered, ranging from crop

rotation, inter-cropping, enhanced fallow, improved bush fallow, low tillage/no tillage options, agroforestry configurations, green manure, and organic and chemical fertilization. Similarly, and to that end, the Wula Nafaa Project has recently translated the USAID Africa Bureau Fertilizer Fact Sheet into French so as to guide the introduction of fertilizers and soil amendments to farming system improvements in Senegal (and elsewhere in francophone Africa).

Erosion and sedimentation – not so obvious on the Plains of Senegal: In this photo the white strip which runs across the site appears to be a dry stream bed. In actuality, it is a sand-filled road gully caused by high run-off from the surrounding barren fields. These fields, despite their low slope degree, can be extremely susceptible to run-off and erosion because they are left bare after all the crop residues have been removed or sometimes burnt leaving the surface soil exposed to the intense early rainfall events of the wet season. Topsoil and often even the sandy subsurface soils are easily washed off the farmers' fields and swept down the landscape, often winding up clogging the drainage ways or filling-in the wetlands. High rates of run-off can also damage the soils of the wetlands and inhibit infiltration into the aquifers thus decreasing the inherent productivity of these wetland sites.

Upland Watershed Conditions and Lowland (Bas-Fonds) Production Options

Even in the relatively flat plains landscapes of semi-arid Senegal, the watersheds and catchment areas, if poorly managed, can undermine the long-term productivity of the wetlands ("bas-fonds") or lowlands they surround. High rates of run-off and sediment transport degrade the productivity of these lowland areas and reduce the recharge of the aquifers on which they may depend for dry season horticulture.

Mitigation Measures: Fully productive, well-managed fields on the uplands or "plateaus" surrounding the lowland wetland areas go hand-in-hand with maintaining the productivity of the latter. Many of the measures aimed at nurturing the soil and maintaining a productive soil cover mentioned above, will also enhance the conditions for infiltration of rainwater thus avoiding run-off and erosion. These measures, depending on the slope of the area, can be further strengthened by soil conservation engineering oriented measures which slow down the run-off from the land and detain erosion, including "haie vive" (live hedges), rock bunds, soil bunds on the slope or field margins, side hill ditches or similar water entrapment structures, and contour plowing. Similarly, remedial measures to restore eroded sites such as drainage ways or gullies will also remediate the tendency of excessive run-off or sediment flowing into

the bas-fonds and causing damage to the structures, crops or covering productive soils and crops with sandy sediments.

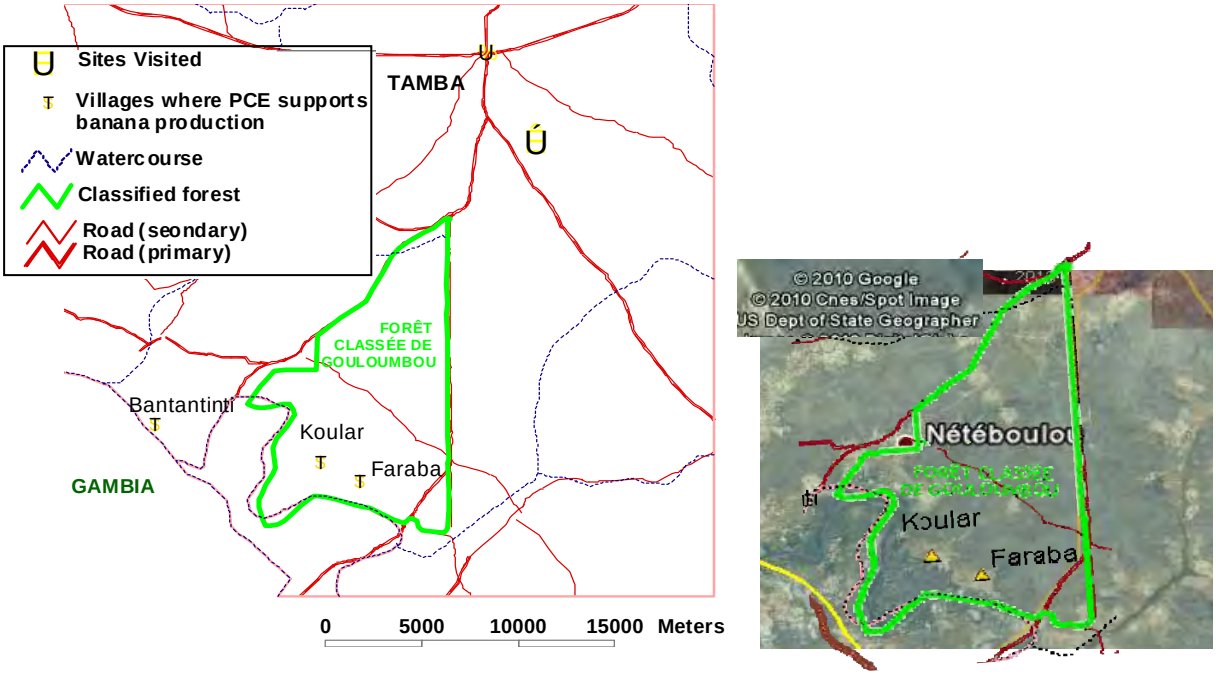
Expansion of the Agricultural Frontier and Pressure on Land and Forest Cover

In the semi-arid and increasingly climate-challenged agricultural landscapes of many parts of Senegal, the promise of improved returns from farming could lead to pressures reducing forest cover (in both public domain and reserve forest areas) or the tree density in the parkland-like agro-ecosystems of the country. Here again, the images from Figure 2.6 above clearly suggests the gradual – although dramatic – reduction of tree or shrub cover in the Peanut Basin. This effect is being felt everywhere as a result of the gradual and unavoidable increase in population pressure and the slow but steady influence of improved agricultural practices including mechanization.

Certain forests have been placed under government protection for the sake of protecting water sources; some are to reserve high-quality timber for the highest bidders to bring maximum revenues to the state; some are to preserve wildlife habitat or special rare species. Whatever the reason, protected areas are legal entities that must be taken into consideration before installing agricultural development works.

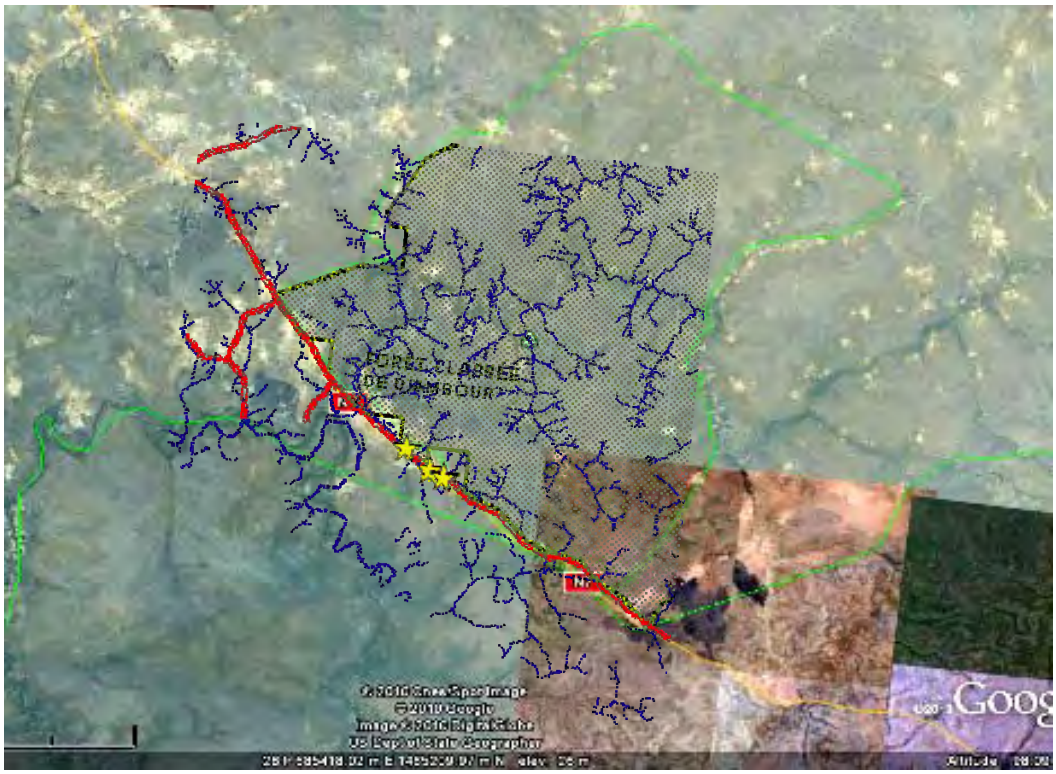
The PEA Team observed a case of banana plantations within a published classified forest boundary. Some sites where USAID/PCE is supporting banana growers (Koular, Faraba) appear to be located within the Gouloumbou Classified forest, according to published maps of the area. However, PCE is not the first program to support the banana growers; several other programs have signs posted in the area. The Senegalese Forest Service sometimes declassifies protected areas to accommodate more profitable activities carried out by the private sector. Nonetheless, a development program should not lead to such a declassification, even if one mandate of the program is to work with the private sector. The imagery and maps which follow illustrate this issue.

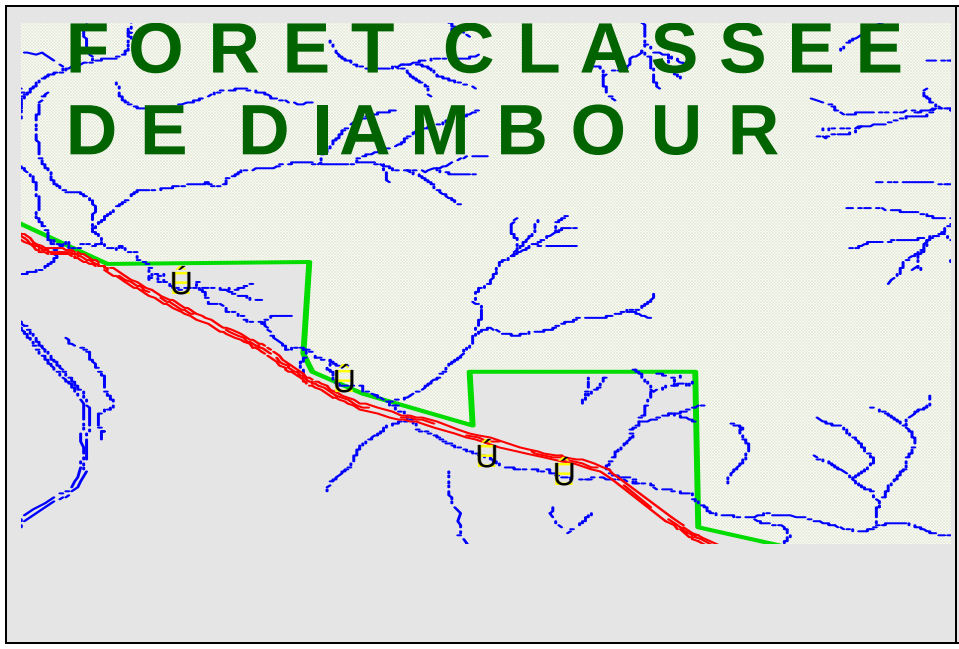
Figure No. 5.5 - PCE Banana sites within the confines of the Gouloumbou Reserve Forest



Similarly, as seen from a distance, it is hard to tell whether the proposed series of rice expansion dikes are located within the Diambour Classified Forest boundary. The following Google Earth image (supplied by Wula Nafaa) is overlaid by GPS points from PEA team visits of planned dike-building sites:

Figure No. 5.6. Some rice expansion dikes may be built inside published classified forest boundaries on the road to Kédougou



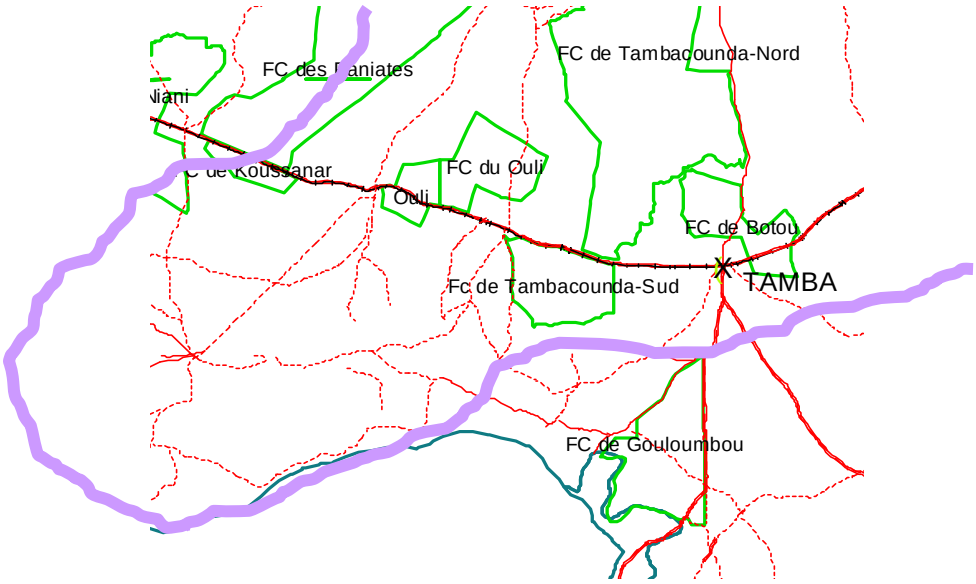


Upon looking with a zoom applied, and using published coverages of Senegal's protected areas with GPS points taken during PEA field visits, the watercourse and therefore the worksites fall just within the boundary.

It is not known if the Forest Service has allowed exceptions to the usual prohibition on villages within forests; the area in question was ceded to inhabitants relocated upon creation of Niokolo-Koba National Park. in 1969.

Another example was observed in the potential to impact protected areas near Sandougou bas-fond. Sandougou watershed is a future site for Wula Nafaa water management activities. Of the many maps presented in the program design and justification report ("Global Water Initiative for Senegal") prepared by CRS and IUCN in 2008, none shows the locations of the nearest classified forests, of which there are several: Malème Niani, Paniates, Ouly, Tamba Nord and Sud, Koussanar, Botou.

Figure No. 5.7 - Reserved Forests near Tambacounda in the Wula Nafaa Project Area



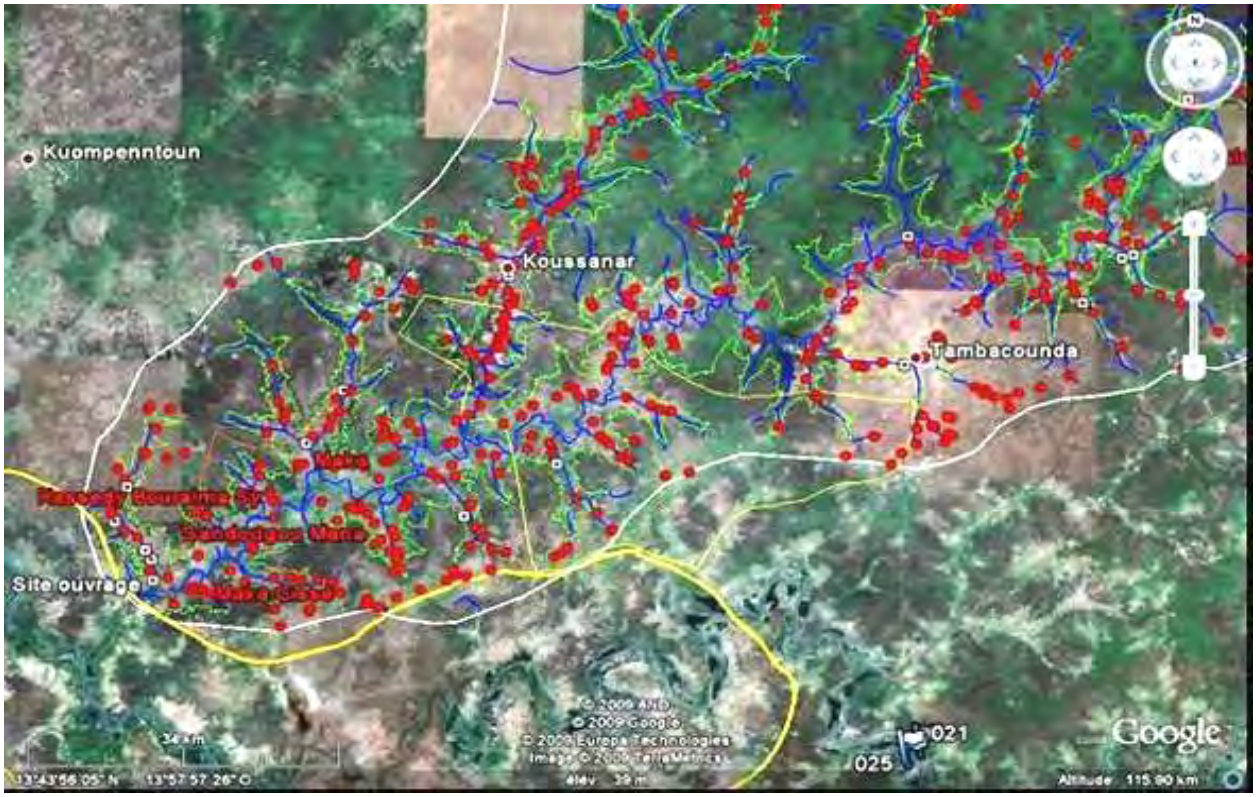
The project proposal contains two paragraphs on the disappearing wildlife habitat in the area:

"Perte des milieux particuliers: L'importance des ressources fauniques est conditionnée par l'existence et la nature des formations végétales.... Les principales espèces rencontrées dans la zone sont les primates, l'hyène, le chacal, le lapin, l'antilope, les phacochères et les oiseaux tels que les touterelles, les pigeons, les pintades. ["Monkeys, hyenas, jackals, hares, antelopes, warthogs, and birds are in the zone; their importance is determined by the nature of the vegetation there."]

"Ces milieux sont de plus en conquis par l'homme. Les coupes abusives d'arbres et la surexploitation des ressources (charbon de bois et bois de chauffe) mais surtout les feux de brousse sont les principaux facteurs de dégradation de ces ressources." ["These areas are more and more dominated by man..."]

But the report offers no information on where this habitat is found, nor suggestions on how to avoid further negative impacts, while a complete system for managing the watershed is the object of the report.

Figure No. 5.8 - The Sandougou Watershed



The image-map of Sandougou watershed shows water sources in the area: 6 improved wells and 205 unimproved wells; where is the wildlife habitat? What importance does wildlife have in the lives of residents? These issues should be addessed in the socio-economic study.

- Correct research and use of maps, together with understanding the terrain, are key to avoiding legally-protected-area-specific environmental impacts. Therefore each project should have access to mapping services that are adequate for determining if proposed sites are within protected areas or close enough to cause a negative impact. As recommended below, Wula Nafaa is in a good position to assist projects with this important task through its support of the Forest Service's decentralized mapping units (BICs).

- Before deciding on intervention zones to be included in the workplan, map or obtain reliable maps of protected areas, but also visit local Forest/ Wildlife Service offices to verify boundaries with the agents.

- Locations of special areas used by wildlife; cemetery and cultural sites; and traditional uses of land should all be recorded and mapped during the socio-economic studies carried out before program implementation. Too often the socio-economic studies are put on the shelf and never consulted, even after intensive work, money, and energy have been put into them.

Reduction in the Density of "Parklands" Agroforestry Systems in Senegal

A related and equally troubling tropical forestry related impact of the intensification of agriculture in Senegal is the gradual reduction in the tree cover within Senegal's traditional "parkland" agroforestry systems. There are any number of parkland agroforestry systems in the country whereby farmers grow their crops under a canopy of useful tree species, including: Baobob (*Adansonia digitata*), Vene (*Pterocarpus spp.*), Kad (*Faidherbia albida*), and many others which appear sometimes as pure stands and sometimes mixed stands of various useful trees.

Parkland oriented agroforestry systems are common in Senegal as they are across many of the countries of the Sahel. There is growing concern among those who understand these systems that the stands themselves are growing sparser, with older individual trees dying off and no younger regeneration to replace them. This photo is of a Vene (*Pterocarpus erinaceus*) based parklands agroforestry system, seen at Sare El Hadj, near Tambacounda. As can be seen in the photo, the trees are frequently lopped to provide fodder to animals who are sometimes "parked" within these fields to increase their fertility by leaving concentrated manure. The trees do more than feed animals; their presence, in adequate numbers, can mitigate the harshness of the climate, slowing hot dry winds and providing some shade for the soil. Leaf and twig litter drop adds organic matter to the soil and as a legume species, the roots fix nitrogen in the soil. When they die the wood is used for fuelwood.

These trees protect the farm lands below from the extremes of weather, wind, sun and intense rainfall events, and also typically add organic matter to the soil through leaf and litter fall and/or fix nitrogen in the soil. All of them provide products useful to local people, including wood, firewood, fodder, fruit, and other non-timber forest products. In the example in the photo of *Pterocarpus*, lopping the trees for

fodder keeps herds on the field for an extended period of time during which they deposit manure, thus improving fertility.

The PEA Team could not help but notice something that has been mentioned by other authors as well, that of late, these stands seem to be gradually losing their density. Individual trees of a relatively even-aged stand die and are not being replaced by natural regeneration. Until and unless farmers make the transition from animal traction to mechanized plowing, there is little reason to remove the trees from the field and considerable environmental losses associated with their demise. In other countries in West Africa (e.g., Niger), farmers themselves have been assisting natural regeneration of these useful trees by protecting seedlings as they appear on their fields because they recognize the potential benefits. This would clearly be an excellent option to be considered as a tactic to address the impacts of global climate change.

Mitigation Measures on Parklands Agroforestry Systems: Awareness-raising and promotion of the tangible values in terms of productivity and especially in the light of probable changes in climate of this traditional community based natural resources management method will be critical to ensuring it continues to be applied as a "good agriculture practice." Farmers have done this by themselves for years, but the promise or pretense of mechanization may be prompting them to remove the trees or to allow them to disappear. Where necessary, the project could make either seed (for direct seeding) of these desirable species available or even establish very small local community tree seedling nurseries to put these species back in the fields. Some of the current extension service messages, in poster format and in local languages, can go a long way towards changing attitudes about trees in the fields.

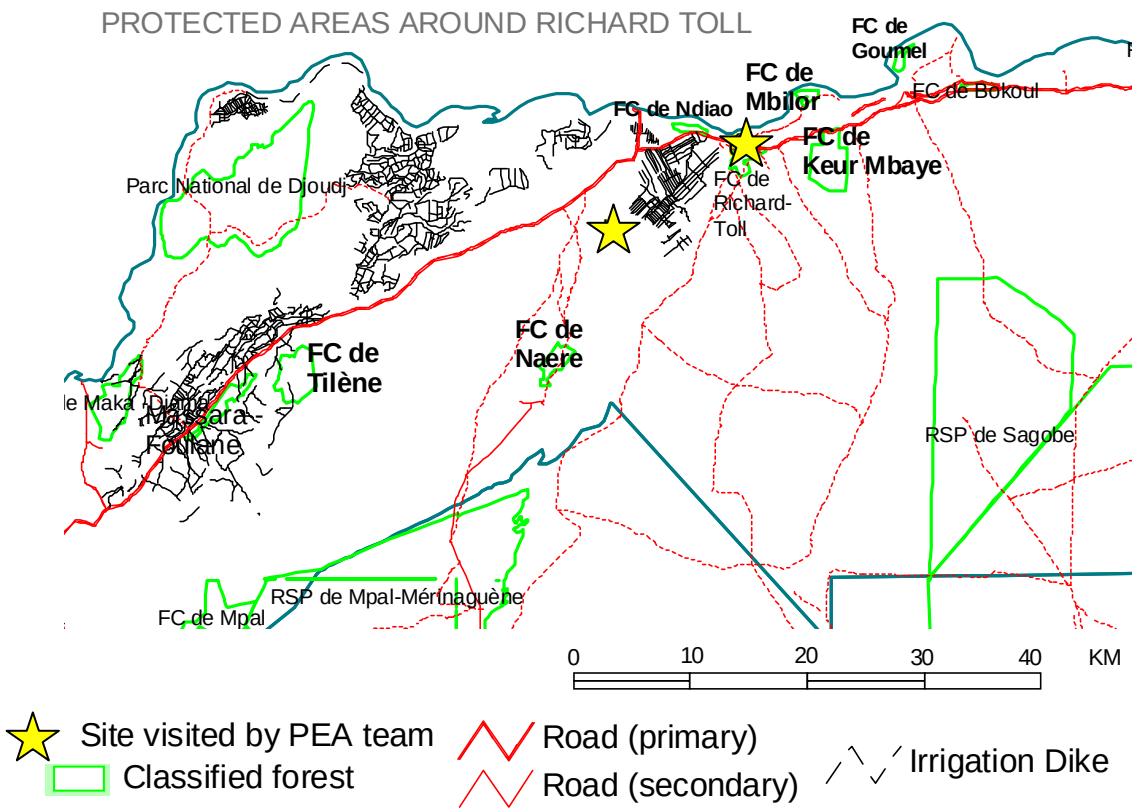
Increased Livestock Numbers, Sedentarization or Changes in Land-Use associated with Livestock Husbandry

Field visit to the forage crop trials of the *Laterie du Berger*: The Berger Dairy in Richard Toll is testing forage crops of beans (Niebe or *Vigna unguiculata*) for livestock fodder production on an irrigated farming site on the outskirts of town. The hope is to be able to provide the herder community that is increasingly being drawn towards the Senegal River and its emerging agribusiness opportunities, with an alternate food source to feed their cows and raise milk production. In the photo, the PEA Team Agronomist, Mr. Souleymane Diallo (on the left) is discussing these LDB test plots with the PCE Livestock Specialist in Richard Toll, Mamadou Bobo Sow (on the right) and the Laiterie du Berger agricultural technician, Ousmane Fall (center). Fewer, more productive animals are seen as a "win-win" option for both the herders and the environment.

Senegal has large numbers of relatively low productivity animals spread across its landscapes. An integrated strategy will be needed if efforts to raise milk or meat production are not to cause herd size to increase and with it, pressure on grazing resources. PCE will be supporting a low-key activity that will deliver two milk cows to each herder family that settles in a rice-production area near Richard Toll. The objectives are to stabilize the milk supply to the local dairy and build the local brand by increasing profits and quality and to gradually sedentarize the herder community and assist them to raise the productivity of their animals. Smaller herds with fewer but more individually productive animals will stimulate the local economy and reduce the pressure on the grazing resource base. It can also help to resolve some of the conflicts that occur when herders migrate south every year and end up in fields where crops get damaged and forage trees get overcut. In Senegal, conflicts are frequently reported between migrant herders and village herders over water resources, excessive forage tree-lopping, and invasion of crops.

There is, however, also some potential for impacts on wildlife from programs targeting the sedentarization of migrant herders. The section below discusses the cases of two at-risk species, and their habitat, in the Senegal Valley regions. The map below shows various protected areas in the vicinity of the large settlement of Richard Toll in northern Senegal. At least one intervention site borders on, or is inside, the classified forest, near the Forest Service offices.

Figure No. 5.9 - Protected Areas around Richard Toll



On the road to Richard Toll: Remnant patches of "forest" – patches of open savannah woodlands such as the one seen in this photo deserve protection.

Wildlife in the small *Acacia senegal* and *A. raddiana* forests that grow in the depressions in the area has already been decimated and reduced to a few warthogs, jackals, and red monkeys, according to local residents and the project Biological Diversity Conservation (*Projet Biodiversité Mauritanie-Sénégal*), working in the four main ecosystems in the northern Senegal River region. Red-fronted gazelles, polecats, reedbucks, and others have practically disappeared.

WORKING IN THE SAME AREAS AS USAID-SPONSORED PROGRAMS: PROJET BIODIVERSITÉ MAURITANIE-SÉNÉGAL

http://www.projetbiodiversite.org/IMG/pdf/Acquis_et_lecons_5_080901_version_pourPDF.pdf

The Biodiversity Project aims to contribute to saving and valorization of natural resources through community management of natural resources.

Its approach is based on the premise that the following practices:

- simple, repeatable management techniques, such as restricted branch cutting and direct seeding, and
- community-approved and regulated exploitation of natural resources

... will lead to

- restoration of the ecology and the biodiversity
- generation of revenues through rational resource exploitation

The following excerpt from the biodiversity project describes the fate of Spotted Hyena, whose conservation status is as follows, according to the Hyena Specialist Group (HSG): "The rapid decline of populations outside conservation areas due to persecution and habitat loss makes the species increasingly dependent on the continued existence of protected areas. The HSG therefore agrees with the latest classification of the spotted hyena as ***Lower Risk: conservation dependent*** (IUCN 2000)." The

hyena's habitat includes the several protected forests and reserves in northern Senegal where PCE is working.

Direct displacement of wildlife **and** the reduction in grass production following a switch from seasonal to permanent grazing (both associated with sedentarization) are causes of wildlife loss. (Western, Grooma, & Worden 2009). In the context of customary, annual (as opposed to drought-driven) migratory herding, impacts from eliminating migration will be felt in places previously visited by the herds. One impact could be the return of wildlife that had been competing with livestock for forage and regeneration habitat. But another impact could be that vegetation formerly grazed along previous migratory routes would no longer regenerate into diverse landscapes of different ages, thus lowering vegetative structural diversity and related faunal diversity. (Western & Nightingale 2003).

Overgrazing is a major cause of desertification. Heavy concentrations of livestock can lead to unproductive land surfaces as woody cover disappears around boreholes. Overgrazing, overbrowsing, and trampling lead to loss of herbaceous and woody cover and to soil compaction, which in turn leads to water erosion of the upper soil horizon (Tappan, Sall, Wood & Cushing 2004).

Figure No. 5.10 - Working in the same areas as USAID-sponsored programs: Sahara Conservation Fund

Dama Gazelle *Nanger dama*
Threats: Critically endangered with possibly fewer than 300 left in the wild in small highly isolated groups. Like most Saharan ungulates, victim to combination of over-hunting, drought and habitat loss. Appendix I on both CITES and CMS conventions.
Priorities:
(1) Protection of remaining wild populations in Chad, Niger and Mali
(2) Captive-breeding and reintroduction to secure areas in former range states, including Senegal
(3) Increased focus in international collections on securing captive populations of the *N. d. dama* race

SAHARA CONSERVATION FUND

http://www.saharaconservation.org/

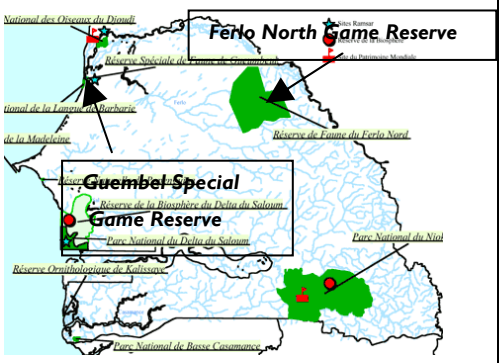
SCF is helping implement Senegal's strategy to conserve and restore its Sahelo-Saharan wildlife. Our program is carried out in partnership with Senegal's Direction des Parcs Nationaux, Parque de Rescate de la Fauna Sahariana (Almeria, Spain), and Exotic Wildlife Association (USA)

Two protected areas are currently the focus of Senegal's strategy: the Réserve Spéciale de Faune de Guembeul (720 ha), which was established in 1983 in coastal Acacia woodland some 15 km south of St Louis, and the Réserve de Faune du Ferlo Nord (287,000 ha), established in 1972 in south Sahelian wooded grassland in the centre of the country. Between 1984 and 2009, dama gazelles, scimitar-horned oryx, and dorcas gazelles were reintroduced in Guembeul, which has become a holding and captive-breeding facility.

ITo complement Guembeul a second facility was developed in 2002 at Katané in the Ferlo North Game Reserve... Since 2002, the original Katané enclosure (440 ha) has received oryx and dama and dorcas gazelles from Guembeul. In 2009, SCF helped increase the area of land under protection to over 600 ha by installing a new adjoining fence 4 km in length...

The new enclosure will have an immediate impact on habitat regeneration and increase capacity to hold and mange the captive wildlife more efficiently. Next steps are under consideration and could include the import of new dama gazelle and oryx stock from the United States to bolster the genetic pool.

SCF is keen to help Senegal develop a solid strategy for its Sahelo-Saharan wildlife conservation program, including supporting efforts to protect Ferlo's remaining relict populations of the vulnerable red-fronted gazelle and ostrich.



Mitigation Measures for Livestock Sedentarization Activities: The present level of activities related to livestock development and inducing greater sedentarization are very modest in nature and unlikely to have significant impacts anywhere.[6] However, livestock herding is the predominant land-use option across vast areas of northern Senegal (and elsewhere in the country), so attention to the potential environmental implications from the outset will be a wise strategy, particularly in the light of incipient climate change. It is also worth noting that there have been many projects and programs aimed at the migratory livestock herders over the years, in northern Senegal and elsewhere across the Sahel and

[6] This analysis is based on the premise that the activities here focus on either grazing based or mixed farming based livestock systems. No efforts are foreseen to support industrial production systems such as feedlots or large-scale modern ranches.

consequently there are important lessons learned. Then too, as noted above, conflict between the herder community and more sedentary farm communities, even those with notable livestock activities, is a fact of life in Senegal.

Overgrazing is a major cause of desertification: Heavy concentrations of livestock can lead to unproductive land surfaces as woody cover disappears around boreholes; overgrazing, overbrowsing, and trampling lead to loss of herbaceous and woody cover and to soil compaction, which in turn leads to water erosion of the upper soil horizon (Ecoregions and Land Cover Trends in Senegal, by G.G. Tappan, M. Sall, E.C. Wood, and M. Cushing, in *Journal of Arid Environments 59* (2004) 427–462).

Accordingly, the following mitigation measures[7] are suggested:

- Because of the extensive nature of livestock herding in these regions of Senegal, **coordinaton among programs** is essential. **Broad-based consultation about land-use plans** and/or biodiversity conservation plans would ideally reveal where livestock and wildlife management efforts need to be reconciled. Similar to what was recommended above with the Reserve Forests, the current projects should proactively consult with the Wildlife Authorities in northern Senegal to learn about the existence and plans for the Faunal Reserves in these areas. There is also ample opportunity to employ modern remote sensing techniques including GIS, GPS and satellite imagery to develop sound working maps of the areas concerned.

[7] A more fulsome treatment of the potential for adverse environmental impacts resulting from livestock development programs can be found in Chapter 11 on Livestock of the USAID/Africa Bureau produced Environmental Guidelines for Small-Scale Activities in Sub-Saharan African (please see the www.encapafrica.org website).

- **Emphasize raising the productivity of individual animals** before proposing herd reduction! Herders will quickly realize that fewer, better-fed animals will produce more if properly managed and be more likely to reduce numbers. In addition to ensuring adequate fodder resources, the sources of water should also be guaranteed. Veterinary services and ectoparasite management can also be critical to a healthy and fully productive herd.

- Better management of grazing resources can often be better accepted if the herder community has **legal or recognized tenure rights to the grazing lands and their resources**. These tenure rights can be enshrined in the local management compact signed with the projects and which also address **the responsibilities for sustainable management** that come with these rights.

Dried pulp of the baobob fruit – candy for humans and chimps alike: This calabash is full of the dried pulp of the Baobob which is eaten as candy or pounded into a white powder called "Bouye" which, mixed with water, creates a flavorful chalky drinked common in Senegal. The seeds themselves can also be exported for oil production used in the cosmetics industry.

- **Rotating community-agreed exclusion areas,** wherein the local herder community agrees not to graze their animals nor allow fire or illicit cutting, can work. It has been demonstrated in many arid zone countries that setting aside a small percentage of the rangelands from use for a year or two will allow natural regeneration to improve the stocking and vegetative cover. This treatment, usually involving no more than 10% per year of the total rangelands, can be rotated over the whole area.

Commercialized Harvest of Natural Products Impact Biodiversity

The Wula Nafaa Project has achieved some success in promoting the harvest and commercialization of naturally occurring non-timber forest products like madd (*Saba senegalensis*), a vine species found in the forests of Southeastern Senegal, and baobob (*Adansonia digitata*). These efforts focus on quality control of the product, organizing the producers, and improved marketing practices leading to higher prices. For example, better negotiation skills and improved organization have allowed the Madd Producer Group in Tomoboronkonto (in the extreme southeast of Senegal) to triple their earnings. Similar results have been obtained in nearby Kedougou and Velingara where 30 producer groups and 23 family businesses have doubled their revenue (to over US$50,000 per year).

There are concerns, however, that these improved market conditions could lead to highly increased offtake and eventually interfere with food sources for wildlife and/or affect the integrity of the biodiversity resources within the protected areas of the region. Both madd and baobob are favorite food species of the endangered Chimpanzees that inhabit this area. The common chimpanzee is one of six African primate species considered "in danger of extinction" by IUCN, including the subspecies called "savanna chimpanzee" (*Pan troglodytes verus)* found in Senegal. Populations of this subspecies in various West African countries are estimated as follows (USAID-Wula Nafaa Report on the workshop to define a strategy for chimpanzee management in Kédougou Region, Senegal – May 2009):

→ Mali: 1,600 to 5,200 individuals

→ Ivory Coast: 8,000 to 12,000 individuals

→ Guinea: about 17,600 individuals

→ **Senegal: less than 500 individuals (2003 estimation)**

Fortunately, the nature of the working arrangements with the now numerous communities involved in harvesting and selling these natural products is based on a local convention which guarantees them access to the resource base but also involves rules about offtake and management of the forest. The text box below describes a success story about madd fruit marketing presented by USAID in 2006.

MADD IN SENEGAL – A SUCCESS STORY FROM 2006

http://africastories.usaid.gov/search_details.cfm?storyID=493&countryID=21&sectorID=0&yearID=6

Saba senegalensis, a popular tart fruit locally called madd, has become a rallying point in southern Senegal. Nestled along Senegal's lush Niokolo Koba National Park, the rural community of Tomboronkoto is home to 7,000 people and countless species of profitable plants, trees, and fruit, such as madd. With USAID support, harvesters, environmentalists, and local authorities wrote up regulations and acted together to put an end to poor harvesting techniques and to bushfires that destroy the vines.

"I have harvested madd for 10 years, during which time we have faced many difficulties," said Souleymane Bayo, a harvester from the village of Badou. "Production used to be low and prices highly variable. Certain people cut the vines or completely chopped down the supporting trees in order to harvest the fruit. So, production was falling from one year to the next."

And, since the harvesters were poorly organized, itinerant traders called banabanas fixed unfair prices, leading to poor income for the people whose lives depend on the fruit. Madd leaves and bark are also used for cooking and to treat burns and diarrhea. At a social level, harvesters and herders have squabbled about who has access to the forest foliage.

USAID's Wula Nafaa (meaning "benefits of the bush" in the local Bambara language) program stepped in at the community's request in 2004 to help tackle these challenges. Bringing together all parties involved in a participatory set of meetings, Wula Nafaa advised the regional council and others as they drafted a local convention. This management tool contains rules to fix dates for harvesting and the techniques to be used as well as preventative measures to protect against bushfires and livestock damage. For example, the eight-page convention finalized in August 2004 prohibits cutting down madd vines and a number of other forest species that can provide long-term benefits for villagers. Anyone caught slashing madd foliage will face a fine of about $10 per vine or tree. Just a handful of such fines would equal the monthly salary of a typical peasant farmer in this region.

With the rules in place for protecting the forest products, Wula Nafaa worked with harvesters to better market the produce and help obtain higher prices. Harvesters are now organized into networks that demand realistic prices and organize marketing activities aimed at large cities such as Dakar. They have essentially eliminated the hold of the banabanas, enabling them to demand fair prices. And a fund set up with revenue from harvest licenses supports efforts to regenerate forest resources, for example, through planting or erecting fences to keep out grazing livestock.

The results speak for themselves. "Up to 2003, I earned 60,000 FCFA ($115), the equivalent of 48 sacks sold at 1,250 FCFA ($2.40) per sack, a level far too low to maintain my large family with seven children," said Bayo, who is now a member of the Animation and Discussion Unit for Tomboronkoto's local convention. "Now the situation has changed, since the local convention was applied, to allow better management and increased profits from our products."

The following description of ongoing (2010) research in the region southeast of Niokolo Koba National Park, partially subsidized by Wula Nafaa, emphasizes the importance of monitoring madd offtake as it pertains to chimpanzee survival.

> [We are doing] research on the conflict between chimpanzees and humans over a natural food resource at Fongoli, the liana fruit, [madd, or] *Saba senegalensis*. Chimpanzee feeding behavior on and seed dispersal of this important food species is compared to human gathering and use of the resource. As *Saba* is economically important to people in the area, especially women, a solution to the problem of long-term sustainable harvest that takes into account the needs of local humans as well as chimpanzees must be employed. However, efforts to curb the impact of human gathering, such as restricting the gathering season, appear to have little or no effect thus far on the detrimental aspects of this human practice. In an open-access system such as the *Saba* market system in southeastern Senegal, people are predicted to prefer short-term gains (e.g., income from Saba fruits) as opposed to long-term conservation of resources (Alvard 1998), especially given the poor economic status of most individuals in the Tomboronkoto region. There is no systematic limitation to the amount of Saba collected, if the collector can pay for the permit
>
> – Jill Pruetz, PhD working with teams of volunteers in the area east of Niokolo Koba National Park on targeted chimpanzee research

Recommended Mitigation Measures: As the statements above indicate, the actual level of conflict between chimps and people for the harvest of wild fruits like madd and baobob are not well calibrated. This will need continuing study and research – something those addressing biodiversity issues in Southeastern Senegal, with support from Wula Nafaa should be able to address. In the meantime:

- Continue to monitor the replacement of madd vines through plantations being undertaken by cooperator groups
- Verify the effectiveness of the Local Convention rules and their impact on the sustainability of the commercial operations

Understanding Agro-Chemical Use

Both the USAID-funded projects under the Feed the Future Initiative (FtF) are giving a good deal of attention to raising agricultural productivity as a critical element of the national food security strategy in Senegal. Agricultural chemicals (fertilizers and pesticides) will by definition have to be a part of those efforts. Accordingly, the two projects have taken a rather proactive approach to dealing with both pesticides and fertilizers. For example, two Pesticide Evaluation Reports/Safe User Actions Plans (PERSUAPs) have been prepared, one on the control of the mango fruit fly and the other on general pesticide use for staple cereal crops and horticultural products. In addition, Wula Nafaa has taken the initiative to translate the USAID Africa Bureau Fertilizer Fact Sheet into French to facilitate its use and widespread circulation.

Although these actions have been taken this year, the PEA Team noted, that the message being transmitted to the producer beneficiaries still needs to be clarified and greater capabilities developed for using these inputs. The tendency seems to be to treat the subject matter as something "taboo" or to suggest that pesticides weren't being used and might not

Regulation 216 – USAID's Environmental Procedures…Related Compliance Documentation available for Wula Nafaa And PCE:

- Wula Nafaa Environmental Mitigation and Monitoring Plan (also available in French)
- PCE Environmental Mitigation and Monitoring Plan
- Pesticide Evaluation Report/Safe User Action Plan for WN & PCE, for both control of the Mango Fruit Fly and for general agricultural development purposes
- USAID Africa Bureau Fertilizer Fact Sheet (also available in French)

be necessary. Not dealing with the issue leaves the farmer producers at the mercy of the marketplace which in Senegal is not well regulated and thus likely to cause adverse impacts to both local people and the environment.

Recommended Mitigation Measures: Both Wula Nafaa and PCE have the tools they need to embark on an affirmative action plan to advise farmers and producers on the safe use of appropriate pesticides and how to include them in a program of good agricultural practices and integrated pest management (IPM). These PERSUAPs need to be translated into **awareness-raising communications packages** and **training of trainers curriculums and training materials** to begin building the substantial capacity that will ultimately be required. Doing so will ensure enhanced product acceptability in increasingly demanding export marketplaces, which eschew products with pesticide residues.

Flood Irrigation of Rice and Drainage Concerns

Closely related to the above issue is the matter of deep water flood irrigation of rice which requires drainage. There is growing concern about where these waters, containing pesticide and fertilizer residues, can be flushed, with possible impact on natural water bodies such as the Senegal River and/or the Lac de Guiers. This concern becomes particularly acute where agricultural activities might be considering the use of pyrtheroids or synthetic pyrtheroids which can have a toxic effect on fish and aquatic insects.

Informal irrigation schemes: In addition to the long-established and formal irrigation schemes found along the Senegal River between St. Louis and Richard Toll (and beyond), one also encounters informal irrigation schemes being developed without public permits. This site is a canal built by a group of entrepreneurs tapping the waters of the Lake de Guiers without permission. Individuals in turn use pumps such as seen here to develop irrigation schemes nearby, often for horticulture and using modern agricultural inputs without much guidance or control.

Recommended Mitigation Measures: The contamination of nearby surface waters can be avoided by using farming methods that reduce pollution (off-site flow of agro-chemicals), including:

- Appropriate levels of planning, regulation, and management of the expansion of irrigation schemes in many areas of the country but most particularly in the area around Lac de Guiers. Anarchic development of irrigated perimeters typically leads to low water use efficiencies because users do not want to invest in better infrastructure or leveling and tend to be careless about the off-site consequences of their actions.

- The recently completed PERSUAP recommended avoiding the commonly used broad spectrum insecticide Deltamethrin in any of the agricultural schemes adjacent to water bodies or watercourses, particularly in both wetland situations ("*bas-fonds*") and along the Senegal River. Abiding by the recommendations of the PERSUAP and/or amending it when new pesticides are being considered should reduce the potential for adverse off-site impacts of pesticide use.

- Leaving buffer strips along riparian zones (the water's edge) or channeling field run-off through vegetative filter strips.

- Adjust fertilizer use to optimum levels by testing for the need for additional nutrients and avoiding excessive fertilization.

Bas-Fonds and Biodiversity Conservation

Migratory birds, an abundant localized avifauna, fish, and crustaceans could be affected by the use of bas-fond areas, especially in coastal settings and where agrochemicals will be used. Related to the above concern, wetlands are typically important habitat for wildlife, both within the wetlands ecosystem and on its fringes. In Senegal, the wetland ecosystem, even in the densely populated and cultivated areas of the Peanut Basin, typically harbors a wide variety of birds, both wetland and savannah species. The combination of their agro-ecological "edge" situation as well as the availability of water in an otherwise semi-arid environment is the cause for this biodiversity.

At present, all of the *bas-fonds* sites where the projects are working have been previously converted to farming areas, usually by the addition of a major dike across the lower end of the drainage-way. As such, their ecological characteristics have been greatly altered in the process. It is for this reason that they had originally received the "negative with conditions" threshold determination and were thus subject to the recommended mitigation measures mentioned below. However, it is worth reiterating some of the basic premises here.

USAID environmental regulations specify that activities that would alter an otherwise undisturbed wetland ecosystem would require a full environmental impact assessment before they could be considered for funding. This PEA Team would recommend a further control and something that the Government of Senegal should consider as a policy matter – that of **designating a policy of "wild wetlands" and prohibiting the further conversion of wetland ecosystems for agricultural development** in order to safeguard the ever-declining biodiversity that they harbor as part of the natural legacy for generations of Senegalese to come.

Recommended Mitigation Measures: Where USAID-funded projects are working on the rehabilitation of wetland (*bas-fonds*) agricultural schemes, the following biodiversity conservation-oriented mitigation measures are proposed:

- Be especially mindful of the upstream and the downstream areas and their users as we make plans for the development of an irrigated perimeter that taps the water resources of these watercourses and wetlands. Often, in Senegal, there are Reserved Forests associated with the nearby upstream areas of important wetlands. The integrity of this forest cover is critical to even flow in the watercourse but may come under pressure from local villagers or herders. Similarly, in many situations, downstream users, whether sequential downstream wetlands or other farm communities, will be disadvantaged if flow is completely cut off as a result of trapping all the water within a perimeter. Where other wetlands are involved, the design of the perimeter should maintain "minimum ecological flow" to protect the biodiversity assets downstream.

Bas-Fonds – Wetland sites of often high biodiversity: As might be expected in this semi-arid setting in Senegal, with the presence of water in the lowland wetlands (*bas-fonds*), there is a marked increase in biological diversity. Here at the outlet of one of the wetland-based irrigated rice perimeters near the Sine Saloum, shore birds and water birds can be commonly seen. This is particularly accentuated in those areas nearest to the saltwater estuaries that extend so far inland and constitute especially important habitat niches that might not exist if it were not for the dike containing water well into the dry season. This PEA Report recommends that the Government of Senegal consider a "wild wetlands" policy and restrain further conversion of natural wetlands so as not to use these unique ecosystems. USAID policy would already discourage conversion of untouched wetland areas, requiring a full environmental assessment before funds could be used for this purpose.

- As noted, these areas are frequently rich in bird life and aquatic organisms and the wise use of agricultural chemicals is fundamental to conserving this biodiversity heritage. In certain areas of Senegal, particularly in the Sine-Saloum and in Casamance, these irrigated areas may drain directly into nearby estuaries and mangroves where aquatic species concentrate for breeding purposes. The potential for adverse impacts on fisheries productivity and biodiversity conservation are profound.

Respect For The Agro-Ecological Calendar
The key to effectiveness and sustainability with many soil conservation and improved agricultural practices is strict adherence with the agro-ecological calendar. The PEA Team noted that several of the wetland (*bas-fonds*) sites where the projects were planning on building either secondary dikes or other structures had not been started during its June visit. Building such dikes and/or moving earth at the end of the dry season may simply lead to more erosion as early rains wash down over the unconsolidated soils of recently completed structures. Field staff explained the delays as being the result of slow approval processes. Unwieldy administrative procedures and other issues related to activity planning leading to slow implementation can cause certain activities to be done outside their ideal time in the agro-ecological calendar.

The following chart (Table 5.2) is an indication of the complexity of the present grant process under the Local Agriculture Support Fund (LASF) for Wula Nafaa.

Mitigation Measures: This is not really a case of adverse impacts, although the failure to respect the agro-ecological calendar can indeed cause environmental issues such as soil erosion within the irrigated perimeters that would be inimical to their productivity, ecological functions, and thus, their long-term sustainability. These wetland sites are classically the lowest lying sites around and the tendency to accumulate run-off and sediments in them can add to the costs of operations and maintenance and thus reduce returns to the producers.

The PEA Team would recommend that the project authorities, in this case Wula Nafaa, but probably PCE as well, **reconsider their project identification and approval processes and try to streamline them** if possible. They might also take some of the administrative staff to the field to see the sites and meet the communities they are assisting so as to keep them fully engaged in the success of the program. Finally, there should be **a cut-off date for certain types of activities, for example,** so that earth moving is not taking place just before the start of the rains so as to avoid the potential for erosion.

PROCESSUS DE METTRE EN OEUVRE ET ACHEVER LES OUVRAGES À FINANCER PAR LASF WULA NAFAA

Mois numéro:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1. IDENTIFICATION DES SITES (visites, priorisation, approbation USAID)															
2. MANIFESTATION D'INTÉRÊT (construire base de données prestataires, entreprises)															
3. ÉLABORATION TDR POUR ÉTUDES (pédo, socio, enviro, géotech, topo, carto)															
4. SÉLECTION BUREAU D'ÉTUDES (classement par commission WN; P-V publié pour transparence; approbation USAID)															
5. PRÉPARATION CONTRAT ET PURCHASE ORDER (documents de l'USAID)															
6. ACHÈVEMENT DES ÉTUDES (draft; commentaires; restitutions vg et WN; synthèse)															
7. LANCEMENT DOSSIER D'APPEL D'OFFRES (classement des entreprises selon moyens, proposition technique et financière; shortlist de 5 entreprises)															

8. SÉLECTION ENTREPRISE POUR L'OUVRAGE (maximum de 1 lot à gagner par entreprise à la fois; dossiers LASF et ID de projet, signés par le Conseil Rural)															
9. PRÉPARATION CONTRAT ET PURCHASE ORDER (documents de l'USAID)															
10. EXÉCUTION DE L'OUVRAGE (P-V, notes de service; inspection du travail fait par un inspecteur nommé par le Bureau d'Études) DE PRÉFÉRENCE AVANT JANVIER															
11. RÉCEPTION PROVISOIRE (garanty de 5 à 20% du montant du contrat retenu par WN pendant un an en cas de besoin de réparation de l'ouvrage)															
12. RÉCEPTION DÉFINITIVE par les bénéficiaires - 1 an après réception provisoire															1 AN

Sandy soils – a fragile environment: Despite the obviously modest impacts of this horse-drawn seeder, soil quality issues as a result of more intensive agriculture on sites like this are growing more common. High surface temperatures, increased removal or burning of crop residues, and increasing deforestation within the farm landscape are exacerbating the effects on soil organic matter which is quickly either mineralized or volatized under these conditions. Intense rainstorms wash away the topsoil and dust storms carrying away the remaining silty particles are not uncommon. PEA Team members Salimata Ba and Ramatoulaye Ndiaye discuss the seeder operations with the young farmers.

Spread of Farm Mechanization and the Threat Of Soil Compaction

At present, agricultural mechanization is not a common sight across the rural landscape in Senegal. It is clear, however, that it will have to be part of the long-term efforts to modernize agriculture and increase productivity and with it food security.

Certain sites and soils will need real care in applying mechanization (tractor drawn plows and discs). On the one hand, some of the sandy slightly sloping sites of the plateau in places like the Peanut Basin could become more prone to both water and wind erosion if large-scale mechanization goes ahead without purposeful attention to best practices. On some of the low-lying lands, increased plowing could lead to greater soil compaction on some sites.

Mitigation Recommendations: Among the mitigation measures that should be considered for overcoming the possibilities of adverse environmental impacts due to increased farm mechanization are the following:

- Practice crop rotation and fallows, combined with judicious use of organic and mineral fertilizers to improve soil fertility

- Develop a better understanding of mechanization options and risks for the varying soil conditions, for both heavy and light soils, and offer training for both extension staff and farmer associations in these technologies
- Increase use of shelterbelts, such as those in use by Wula Nafaa at Ndinderling, to minimize soil erosion. Shelterbelts can reduce negative impacts of drought on water tables, and reduce biomass lost from soil, as well as provide protection from heat and wind for livestock
- Reintroduce native grass and maintain useful tree species like the kad (*Faidherbia albida*) and others in parkland agroforestry systems as mentioned above, which can improve soil organic matter and/or introduce improved bush fallow options (direct seeding of leguminous local shrubs or trees as land is left for fallow) where possible
- Improve the efficiency of irrigation systems
- Enhance crop residue management as it can have a substantial influence on soil organic carbon.

Effluent Discharge From Agro-Industries

Both the effluent issue and location of plants present challenges for handling solid and liquid waste streams from agro-industries – e.g., Laiterie de Berger, and where to evacuate liquid milk wastes from their plant. This problem is in part due to the fact that some industries established on the outskirts of the towns and villages of provincial Senegal have been overtaken by the rapidly expanding urban areas that have grown out to meet them. Clearly, however, waste management in urban settings is a serious public health issue in a number of the towns of the country. Poor urban sanitation leads to greater incidences of diarrheal and water-borne diseases which would undermine the achievement of the food security goals of the Government of Senegal and its donor partners such as USAID.

Care with modern agricultural practices needed: Agricultural practices, such as plowing (see photo above just outside Kedougou), biomass burning, and wetlands drainage can result in decreased soil fertility, including a decline in soil organic carbon. At the Samecouta Bas-fond seen below, the soil is a Vertisol, characterized by high expanding clay content, which leads to shrinking or cracking when dry and swelling when wet. Vertisols are difficult to work and are very sensitive to mechanization; the use of tractor for plowing can lead to soil compaction.

Mitigation Recommendations: It is the understanding of the PEA Team that the present array of FtF actors and their funding are not expected to address these larger agro-industrial infrastructure issues that are emerging with the new programs of agricultural development. There are, however, plans for direct investments in infrastructure and the PEA Team would recommend that any plans for business park development should include adequate attention to effluents and solid waste management and disposal.

5.3 SOCIO-ENVIRONMENTAL IMPACTS

Conflicts within Local Villages because of Prospect of Project Opportunities
The arrival of projects may create false expectations and lead to false claims about land usage rights at the local level, thus exacerbating social tensions. This is especially true with irrigation settings where both upstream and downstream water users may find that a project has disadvantages for them. Part of this issue arises from a legacy of dependency on previous projects which have done so much for the communities in the past that they distort the collective motivation for these investments.

Mitigation Recommendations: The key to avoiding this issue is, as is well known to program staff, careful and transparent discussions in the project area, which take time and staff resources. The present model, as seen in a number of settings where Wula Nafaa has been working, is the "local convention." These conventions are often the only way to deal with the potential for adverse environmental impacts because they provide the basis for a fulsome discussion of community rights and responsibilities and the needed changes in human behavior that are subsequently transformed into a written document available to all concerned. These conventions take a lot of time – and should – because a transparent treatment of the expectations of the stakeholders and a resolution of any outstanding issues before the work and investment gets underway is the best guarantee to avoiding social conflict over project resources. It should be noted, however, that these conventions guarantee a dialogue, which is the key to participatory development and conflict resolution.

In addition to the "local convention," it is fundamental to include capacity building for organizational management skills and community leadership for these associations (GIEs) and similar user groups. There is an abiding need for adequate attention to effective institutional arrangements for collective management and conflict resolution so that system management and maintenance are respected and performed as required. Non-functional water user committees or similar scheme management arrangements can undermine even the most successful technological interventions.

Conflicts with the Herder Community affected by Agricultural Development
Irrigation systems may limit herder access to water sources or force herds to traverse longer distances around such systems. The issue of the impacts of livestock was discussed above, but this matter of access to water resources is one facet of it that merits consideration under socio-environmental impacts.

Mitigation Recommendations: As in the previous issue, the PEA Team is raising this matter because it recognizes that the potential for this type of conflict is well understood within the program. Wula Nafaa staff planning the rehabilitation of irrigated perimeters and wetland sites include water sources and livestock routes on their base maps. Where access must be restricted because livestock cannot be allowed to traipse across the irrigated site during the cropping seasons, compensation or alternative water holes have been foreseen. Guards are also typically appointed to protect the margins of the irrigated perimeters from wandering livestock so that there is no inadvertent damage that leads to social tensions. It is also understood that the horticulture sites which function during the dry season need fencing to keep out the animals which are allowed to wander at that time in pursuit of forage resources around the villages.

Environmental Rights and Responsibilities in the "Convention Locale" Documents
The local ordinances known as "conventions locales" represent an opportunity for raising awareness and building capacity for environmental management that should not be overlooked.

Mitigation Recommendations: In reading through some of the texts of the local conventions subscribed with partner communities, the PEA Team concluded that greater attention for awareness-raising and the need for attention to environmental responsibilities, in return for the right to use natural resources, should and could be further strengthened in the language of the local conventions.

Gender Appropriateness and Women's Rights related to Agricultural Development
Changing perceptions of agricultural outcomes can lead to shifts in women's rights to use and benefit from farm lands. This can affect gender equity and even family nutrition, household health, and overall welfare. Careful attention should be paid as to why farmer beneficiaries, especially women on many of these older irrigation schemes, were not able to keep the systems going themselves, and the meaning for environmental impacts and sustainability.

Mitigation Recommendations: The current use of female area facilitators and a large number of women's groups working with the program projects should continue to be formalized and institutionalized. The PEA team believes that the current experience accruing with these groups should be studied and a set of guidelines to ensure that such efforts can be repeated and scaled up produced for other programs and donor/government programs.

Irrigation Systems Increase the Spread of Water-Borne Disease Vectors
Both malaria and bilharzia are not uncommon in rural Senegal and standing or stagnant water can increase the habitat for the vectors (mosquitos and snails) which transmit these diseases, and others. Sediment build-up and weed invasion are not only inimical to the effective functioning of the irrigated perimeter but help to create the conditions for these water-borne disease vectors.

Mitigation Recommendations: Design considerations and careful engineering which eliminate as much as possible ponding water or poor drainage are a good start to avoiding these issues. Paramount, however, is local understanding among the user community of the linkages between poor water management and disease so these programs should include awareness raising and training for beneficiaries. Project facilitators in these areas should share this information with local health authorities so that the word is being spread at as many levels as possible. In addition, the need for good maintenance regimes and an ability to respond to these threats to public health should also be written into the local conventions that the projects put in place for the local governance of these schemes.

5.4 ANTICIPATED ISSUES THAT DID NOT APPEAR DURING THE PEA

A number of issues which were expected to be part of the analysis during the PEA have been reviewed and ruled out during the Scoping Exercise, for reasons that are briefly explained below. They include:

- **The need for a biosafety review**: Project proponents informed the PEA Team that there is no intention of using or bringing in "genetically modified organisms" (GMOs) under this program in Senegal. Accordingly, it will not be necessary to carry out the USAID-mandated Biosafety Review that accompanies such introductions.

- **Preparation of a PERSUAP**: Both USAID Wula Nafaa and PCE have recently completed a Pesticide Evaluation Report/Safe User Action Plan (PERSUAP) for the range of crops that they are promoting. In addition, an earlier PERSUAP was prepared for the programs aimed at controlling the mango fruit fly. Follow-up and capacity building related to these PERSUAPs is

already planned as part of the program and they are also being shared with other Implementing Partners so they can be generalized across the program.

- **Improved chicken farming programs**: This very small-scale program aims at introducing an improved rooster to the flocks of local women, spread over a fairly large area, in order to increase meat production for local sale. There is no scope for widespread disease outbreaks and, in any event, training is being provided on bird nutrition, health and sanitation in the coops and selected women are being trained as vaccinators against typical bird diseases (e.g., Newcastle).
- **Seed laboratory construction or rehabilitation**: Present plans for constructing or rehabilitating some of the facilities of ISRA (Institut Sénégalais de Recherches Agricoles or National Agronomy Research Agency) or the Ministry of Agriculture will not exceed the 10,000 square foot threshold. These construction activities will abide by the guidelines for small-scale construction in the Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA).

6. SUMMARY OF MITIGATION AND MONITORING MEASURES

As might be expected, the Mitigation and Monitoring Measures being proposed by the PEA Team directly reflect the recommendations that are part of the Environmental Mitigation and Monitoring Plans (EMMPs) put in place by the two IRG projects. The most critical part of these recommendations are the principles which focus on what is required to ensure that they are both implementable and implemented. Too often, mitigation measures remain as recommendations and are not implemented because of the lack of specificity about whose role and responsibility they are. The PEA Team will also highlight the existing guidance put forward under the ENCAP Program by the Africa Bureau of USAID. Finally, the section will conclude with a specific mitigation and monitoring table wherein some of the impacts requiring special att

6.1 PRINCIPLES OF MITIGATION OF ADVERSE ENVIRONMENTAL IMPACTS

Mitigation and Monitoring – An Active and Dynamic Process: The PEA Team believes that these recommendations must be part of active process which clearly acknowledges the environmental risks associated with the agricultural development activities being promoted by the FtF program. Indeed, as was noted in the partner EMMPs, the original IEE clearly states that "As required by ADS 204.5.4, the SO 11 Team and activity implementing partners will "actively monitor and evaluate whether these conditions associated with these activities are being implemented effectively and whether there are new or unforeseen consequences arising during implementation that were not identified and reviewed in accordance with sound environmental management." (USAID/Senegal 2006). The nature of mitigation and monitoring needs to be carefully understood. Mitigation measures are measures recommended to avoid the occurrence of an adverse environmental impact. Monitoring presumes that the project proponents recognize the importance of these mitigation measures, are implementing them and (importantly, the monitoring function), verifying that they are effectively avoiding the adverse impacts. Monitoring is also important because of the possibility of unforeseen adverse impacts; hence, the dynamic relationship between mitigation and monitoring which is conveyed in the jargon but not always acted upon in the field.

Implementation, not just documentation: There is a long legacy of great concern about ensuring that Reg. 216 documentation is in place and too little attention given to the implementation of the recommendations contained therein. This PEA Team would reiterate the admonition that the obligations as an Implementing Partner within the USAID/Senegal program must be focused on ensuring that the implications of the "Environmental Procedures" are translated into positive actions. Too often the basic rationale for Reg. 216 gets lost in the shuffle related to the multi-faceted requirements for compliance. Sometimes, due to the overwhelming focus on ensuring that the appropriate documentation is in place, an IEE, an EMMP or even a PEA sbecomes the raison d'etre of the process. This PEA must reverse that trend and ensure that the real expectations of Reg. 216, i.e., that something affirmative is being done to avoid the adverse environmental impacts that may arise from the nature of USAID's programs in the country.

Integration rather than segregation: Similarly, the PEA Team recommends that the FtF partners strive to integrate the mitigation measures as a routine part of the management practices being promoted rather than treating them, as so often happens, as a separate or segregated implementation requirement. The basic premises of "food security" from "increased production and natural resources management" are grounded in the notion of sustainability, that one uses natural resources within the carrying capacity

of the resource base whatever it is. The soil and water of a farm field are prima facie examples of natural resources and their wise management will lead to sustainable agricultural development programs for Senegal.

Capacity Building for Environmental Management: The PEA Team recommends that the guidance contained in the various USAID documents mentioned below for each of the program components will be used, beyond design and implementation of the component, for awareness-raising and training of both technical staff and community participants in the environmental management of their improved farming systems and/or natural resources management related value chains. The sense of a need for the stewardship of the natural resources base must become part of the psyche of the farmer (and herder) communities of Senegal if sustainable agricultural development is to take hold and succeed; it is not something that can or should be solely managed by Government and Donor partners.

6.2 USING EXISTING ENVIRONMENTAL GUIDANCE FROM USAID

The previous EMMPs for Wula Nafaa and PCE cite a series of USAID Africa Bureau guidance and related materials currently available and which will be used in sound design and management of their activities. This guidance is no less pertinent for the activities being considered herein and can be considered, as it was in the EMMPs, as the general conditionality for the design and implementation of related activities. The PEA Team would propose that the Implementing Partners of the FtF Program take note of and carefully adhere to the following:

General Conditionality associated with agricultural development and small-scale irrigation activities. First of all, it is essential to note that most of the sites that have been selected for program interventions have been under agricultural development and/or irrigation programs for some time and are currently degraded and not meeting production goals. Many are in low-lying areas (the *bas-fonds* or drainage ways found throughout Senegal) that have been subject to human interventions for some time. These activities will be implemented following the sectoral guidance prepared and recommended by USAID in its **Environmental Guidelines for Small-Scale Activities in Africa** (http://www.encapafrica.org/egssaa.htm), especially **Chapter 1** on **Agriculture and Irrigation** (http://www.encapafrica.org/sectors/agriculture.htm). (See graphic on next page)

In addition to and building on the efforts within USAID itself to further develop the guidance available on environmental sound management of small-scale irrigation, it is recommended that the FtF program partners pay particular attention to the guidance available in the **Programmatic Environmental Assessment of Small-Scale Irrigation in Ethiopia** which is also available on the ENCAP Africa Website (http://www.afr-sd.org/Publications/PEA.pdf). Of particular interest for local implementers of small-scale irrigation will be **Appendix H** of this PEA which is an **Environmental Planning Checklist for Small-Scale Irrigation** (See **Appendix A** of this EMMP).

All the FtF program partners are also reminded that the full potential and productivity of these improved agriculture schemes, whether for staple crops (consumption) or for horticulture (for sale), will rest on an ability to bring appropriate modern technology and incorporate it into the present farming systems. This includes both fertilizer use and pesticide use. In the case of fertilizer, program partners will follow the guidance provided by USAID and developed by the Africa Bureau of USAID, Office of Sustainable Development in the ***Fertilizer Fact Sheet for Africa*** (http://www.encapafrica.org/meo_course/specialTopics.htm#fertilizer).

This document was recently translated into French by the Wula Nafaa project so that it can be more widely assimilated here in Senegal and elsewhere in francophone Africa. In light of the fact that these production systems will also likely require the use of pesticides, as part of an integrated approach to pest management, both PCE and Wula Nafaa recently completed a "small-scale irrigation and horticulture related PERSUAP" (**Pesticide Evaluation Report-Safe User Action Plan**) to ensure that these agrochemicals are properly used. It should be noted that the PERSUAP also takes into account current national and regional (CILSS) practices regarding pesticide registration and use.

6.3 AN ENVIRONMENTAL MITIGATION AND MONITORING TABLE

The Environmental Mitigation and Monitoring Table which addresses some of the most typical socio-environmental risks associated with the agricultural development and rehabilitation of small-scale irrigation perimeters and related activities that are part of the Feed the Future Initiative in Senegal. The list is built on the basis of the mitigation measures recommended in the sections above related to specific adverse environmental issues noted during the PEA. It is worth reiterating one of the important principles of environmental assessment, which was applied to this consideration of the program activities. Any environmental compliance review supposes that the chosen technology is being applied more or less correctly. One does not mitigate mistakes, they are corrected. Furthermore, the rather ample environmental guidance documents noted above are part of the extensive and detailed literature generally available for the sub-sector of agricultural development, small-scale irrigation and related activities, and on which the activities of this component have been designed and put in place.

Table 6.1- Environmental Mitigation and Monitoring Measures for the Feed the Future Program

Activity	Possible Adverse Impact	Proposed Mitigation Measures	Monitoring Indicators	Monitoring/ Reporting Frequency	Responsible Parties	Observations and/or Verification Checklist
Restoration and Rehabilitation of Irrigated Perimeters						
Restoration of an existing small-scale irrigation perimeter and its productivity.	Water Resources development-related social conflict, such as property rights, farmer/livestock conflict, and water availability constraints.	The basis for this investment must be an agreement with the participant community that results in signed local convention (accompanied by in-depth awareness-raising and training as part of the early steps to set up the work site) attesting to a high degree of social cohesion related to the investment and/or recognition of these potential issues and a willingness to abide by the need for negotiation and solution.	Monitoring of the number of times the participants must appeal to the rural community for interventions about conflicts that they are unable to resolve themselves. A review of the local convention to ensure that it covers the full range of the experiences of the participants as the scheme is launched and operated.	As required during the entire year.	The Scheme Management Committee and the traditional authorities will be the main persons to resolve these issues and monitor the situation. They may appeal to the CR and/or program personnel (eg. local facilitator) to assist them as needed.	Transparent management of the Scheme Management Committee and its regular meetings should be part of the training package, and program proponents should verify that it is working well.
Engineering and drainage works within the site being restored.	Stagnant water or poor drainage within the perimeter can lead to an increase in the incidents of water related diseases, such as malaria or bilharzias.	Careful use of leveling technology to ensure correct bunding and drainage works.	Visual inspections during the production season to be sure that water spreads evenly across the perimeter and drains as well.	At the height of the rainy season and at the end of the production season.	FtF Program staff water resources engineer with support from the local facilitator in collaboration with the leaders of the management committee.	Verify that the site has been traced using appropriate leveling technology.
Expansion of the perimeter.	Although the sites being chosen are mainly very flat, the actual extent of the	Here again, appropriate leveling technology will be employed to ensure	Visual inspections during the production season to be sure that	At the height of the rainy season and at the end of the production season.	FtF Program Staff water resources engineer with support from the	Verify that the site has been traced using appropriate leveling technology.

Activity	Possible Adverse Impact	Proposed Mitigation Measures	Monitoring Indicators	Monitoring/ Reporting Frequency	Responsible Parties	Observations and/or Verification Checklist
	expansion is sometimes hard to foresee because of micro-changes in topography, leading to possible displacement of other users or land-use change.	that the bunding or diguettes established within the perimeter are well done, and also do not lead to siltation or sedimentation of the water course into which the wetlands drains.	water spreads evenly across the perimeter and drains as well.		local facilitator and the ACF, in collaboration with the leaders of the management committee.	
General Agricultural or Horticultural Development Activities (applies to similar activities within irrigation schemes as well)						
Introduction of more modern farming techniques including greater use of agricultural inputs and machinery	Pesticide use leads to pesticide poisoning incidents among users or others and/or contamination of food commodities, the environment and off-site consequences.	Program proponents will apply the recommendations contained in the Safer Use Action Plan of the recently completed Wula Nafaa/PCE PERSUAP. Individual programs within the FtF should develop a SUAP oriented training course for staff.	Program field staff will monitor the pesticides being chosen by participant farmers and how they are used. Special attention to export crop production activities and the requirements such as GlobalGap that must be put in place.	During the cropping season and at the end of the season as well. Reports on incidents of export crops being rejected because of pesticide residues.	Each major program partner should nominate one of their senior field staff to be the coordinator of implementation of the PERSUAP.	Additional pesticides or new formulations require amendments to the PERSUAP.
Ibid…	Commercial fertilizer use increases among the farmer community and inappropriate use leads to site contamination or off-site run-off that adversely affects	Adhere to the recommendations of the USAID Fertilizer Fact Sheet and begin to build a more nuanced sense of soil fertility and soil quality options within the program. Continue to promote	Monitor studies of cost/benefits of fertilizer use and conservation farming techniques to ensure their effectiveness. Monitor off-site examples of eutrophication from	Both during and at the end of the cropping season.	Farmer participants should be directly engaged in assessing the effectiveness of these new practices, from both the cost and productivity perspectives. There may also be need, however, for well	At present, there are significant limitations generally to the variety and mixture of chemical fertilizers available in Senegal. This is expected to improve as the newly established soil testing facilities that the GoS are setting up

Activity	Possible Adverse Impact	Proposed Mitigation Measures	Monitoring Indicators	Monitoring/ Reporting Frequency	Responsible Parties	Observations and/or Verification Checklist
	surface waters.	"conservation farming" oriented site restoration methods.	run-off.		monitored control plots and field assessments.	regionally develop regional soil information.
General intensification of agriculture	Some lands and soils across Senegal are susceptible to generalized degradation or incipient desertification from leaching of nutrients or wind and water erosion.	More attention to soil and water conservation practices on the plateau upland agricultural fields, including the very beneficial practices of parkland agroforestry promotion.	Even in the relatively flat countryside of rural Senegal, run-off, flooding and siltation of the lowland areas need more attention.	At the beginning and the end of the rainy season.	This kind of monitoring is best done at the local level by the program facilitators of the various partner organizations based in the region.	Building resilence into local farming systems is one of the most viable options for adaptation to the impacts of global climate change.
Livestock-related Development Activities, especially Sedentarization						
Activities related to increasing production of livestock husbandry	Linking herders to markets for their milk may lead to greater sedentarization and could exacerbate grazing pressures on a localized basis.	Grazing management options combined with finding other sources of forage, such as fodder crop banks. Improved health services and better marketing arrangements for the herder community so that they can raise the productivity of individual animals.	Grazing pressures, particularly in the dry season can lead to conflict within the community which will be a good proxy indicator that overgrazing may be taking place. Program proponents need to establish a working relationship with the herder communities to ensure that the "win-win" solution of fewer more productive animals is being achieved.	Production measures for milk and meat will be collected regularly as part of the enterprise development linking herders to the markets. Other analysis of herd status should take place at the end of the rainy season and at the end of the dry season.	There efforts should ideally be carried out by a local program partner, such as the Laterie de Berger in Richard Toll, in conjunction with the livestock specialists of the program proponents.	These activities are not being directed at large-scale ranching nor feedlots which would require another level of environmental oversight. They target small-scale herders and their animals.

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ANNEX A

Brief Biographical Sketches of PEA Team Members

Thomas Catterson will serve as Team Leader/Environmental Review Specialist. As a current IRG staff member, he brings almost 40 years' experience in environmental assessment, forestry, and biodiversity, with particular strength in program/project management and monitoring and evaluation. An IRG Senior Manager since 2005, Mr. Catterson has recently served as IRG's Team Leader/ Environmental Policy Advisor on the USAID/Sudan Field Office-funded Sudan Transitional Environment Program (STEP). His primary responsibility was to build the capacity for environmental policy and impact monitoring at the Government of Southern Sudan Ministry of Environment, Wildlife Conservation and Tourism. In addition, Mr. Catterson has provided regular support and participation as a key staff member supporting the ENCAP Program that IRG is implementing for the Africa Bureau of USAID, which includes various activities related to the development and implementation of Reg. 216 – USAID's Environmental Procedures.

Beverly McIntyre will be acting as the Climate Change and Agriculture Specialist on the PEA Team. She is a Senior Manager at IRG, and is a technical advisor for USAID-funded contracts and teams working on food security and climate change adaptation in relation to agricultural development in Sub-Saharan Africa and Asia. Prior to IRG, she worked on agricultural development for the World Bank, served on the climate change team for the U.S. State Department, and conducted agricultural research for the Rockefeller Foundation in East Africa. She has a PhD in Soil Science from Cornell University.

Salimata Ba, served as the PEA Community Organizations Specialist. She is a holder of the Titulaire du Brevet de Fin d'Etudes de l'Ecole Nationale d'Economie Appliquée, Option Animation de Développement, depuis 1986. As an independent consultant for the last 15 years, her specialisations include: the action research method and participatory planning developed in conjunction with work for the International Institute of Environment and Development (IIED ; Advance Participatory Methods with USAID; Strategic Environmental Analysis with the Institute of the University of Wageningen (Netherlands); and Gender, Natural Resources Management and Energy with FAO. Over the last 20 years her work has included the organization of base communities, gender equity, and communication and training for the management of natural esources, the environment and domestic energy. Her clients have included public sector agencies (Government of Senegal), the NGOs and projects financed by USAID, the World Bank, the United Nations System (FAO, UNDP, UNFPA, and UNIFEM).

Cecilia Polansky serves as the Natural Resources Management Specialist on the PEA Team. She is a participatory natural resource inventory specialist and independent consultant. Ms. Polansky earned an MSc in Forest Inventory in 2001 and has undergraduate degrees in forest management and technology. Her specialization, since 1982, has been in image-based inventories, data collection, and analysis as applied to forest management, and natural resource mapping, with an emphasis on Africa.

Souleymane Diallo serves as the agronomist on the PEA Team. He is the Weed Science Service Chief of the Agricultural Research Center at Saint-Louis, Institut Sénégalais de Recherches Agricoles. Tropical Agronomist and Plant Protection Engineer 1982, more than 30 years of experience in research and development research on rainfed crops in the center and south of Senegal and on irrigated crops in the Senegal River Valley of the north.

Ramatoulaye Ndiaye serves as climate change specialist on the PEA Team and normally works as a Research Analyst on climate change and land use-land cover change with a focus in West Africa. She earned her PhD in Physical Geography with an emphasis on Impact of Climate Change and quantitative

analysis of the environment by using remote sensing and Geographic Information Science (GIS) tools at Kansas State University in 2009. Her dissertation topic was: Geographic Information Sciences (GIS): Contribution to Understanding Salt and Sodium Affected soils in the Senegal River Valley. She also has a MSc. in Geoscience and a BS in Earth and Life Sciences from Cheikh Anta Diop University.

Roger N'Decky, served as the Irrigation Engineering Specialist on the PEA Team. He holds a Rural Engineer's degree with a specialization in Irrigation Hydrology. Since 2002, he has been the person in charge of studies and works control at the Studies Division of the Retention Basins and Artificial Lakes Directorate of the Ministry of Environment. He has also served as a National Consultant for the FAO in the areas of Irrigation, Infrastructure Construction and Market Inspections, since 2007. Mr. Ndecky has eight years of experience with the management of agricultural hydrology projects.

ANNEX B

USAID Wula Nafaa – Volet Agriculture : Catégorie d'activités, sites et questions environnementales associées

Légende :

- en vert, sont les dossiers réalisés ou en cours de réalisation
- en orange, les dossiers proches de l'engagement

3 mars 2010

Catégorie d'activité	Site spécifique	Action principale spécifique	Surface concernée	Mesures environnementales prévues	Etat d'avancement de la mise en œuvre de l'activité
Réhabilitation et développement de bas fonds (riz)	Ndinderleng	Endiguement	1 000 ha	Checklist SSI (Small Scale Irrigation) + EMMP	Etude réalisée, entrepreneur choisi
	Kaymor	Endiguement	50 ha	Checklist SSI + EMMP	Etude en cours, aménagement fin 2010
	Pakane	Endiguement	50 ha	Checklist SSI + EMMP	Etude en cours, aménagement fin 2010
	Dialacoto	Endiguement	50 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010 à fin 2010
	Samé Couta	Endiguement	20 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010 à fin 2010
	Djilor (partie 1)	3 digues dont une digue route	100 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010 à fin 2010
	Djilor (partie 2)	Reprise digue actuelle	100 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010
	Ndour Ndour	Diguettes secondaires + nivellement sommaire	50 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010
	Boli 1	Nivellement sommaire + digue amont	100 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010
	Boli 2	Digue amont + diguette aval	15 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010
	Némabah	Diguettes secondaires	10 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010 à fin 2010

Catégorie d'activité	Site spécifique	Action principale spécifique	Surface concernée	Mesures environnementales prévues	Etat d'avancement de la mise en œuvre de l'activité
	Ferme 2	Diguettes secondaires	35 ha	Checklist SSI + EMMP	Etude en cours. Travaux prévus mi 2010 à fin 2010
Amélioration d'aménagements maraichers	Diabang	Clôture + puits	10 ha	Fertilizer Fact Sheet + PERSUAP	Clôture en cours. Puits mi 2010
	Nemabah	Clôture + puits	5 ha	Fertilizer Fact Sheet + PERSUAP	Clôture en cours. Puits mi 2010
	Darsilamé Sérère	Clôture + puits	5 ha	Fertilizer Fact Sheet + PERSUAP	Clôture et Puits mi 2010
	Ndour Ndour	Clôture + puits	5 ha	Fertilizer Fact Sheet + PERSUAP	Clôture et Puits mi 2010
	Djilor	Clôture + puits	1 ha	Fertilizer Fact Sheet + PERSUAP	Clôture et Puits mi 2010
	Keur Saloum Diané	Clôture	10 ha	Fertilizer Fact Sheet + PERSUAP	Clôture mi 2010
Amélioration de la fertilité / gestion de l'eau de plateau	93 sites, touchant plus de 1 300 producteurs, sur près de 1 000 ha	Conservation Farming	93 x 15 x 0,70 ha = 976 ha	Fertilizer Fact Sheet	En cours depuis début 2010. Plus de 1 300 producteurs impliqués
Production rizicole	Tous les sites cités ci-dessus où des aménagements de bas fonds sont prévus (création, ou extension) + Darsilamé Sérère, Mansarinko, Dielmon, Nemanding, Keur Aliou Gueye, Diabang, KSD, Andallah	Introduction de semences améliorées adaptées au bas fonds (avec AfricaRice)		Fertilizer Fact Sheet + PERSUAP	Prévue mi 2010 pour bénéficier de l'hivernage 2010
Développement de Services pour les producteurs (BDS)	Toutes les zones USAID WN	Fabricants de pompes pédales		Néant	Réalisé
	Toutes les zones USAID WN	Foreurs		Néant	Réalisé
	Toutes les zones USAID WN	Prestataire de labour		Néant	Démarre sous peu

Catégorie d'activité	Site spécifique	Action principale spécifique	Surface concernée	Mesures environnementales prévues	Etat d'avancement de la mise en œuvre de l'activité
	Toutes les zones USAID WN	Fournisseur d'arbres fruitiers		Néant	Démarrage mi 2010
	Toutes les zones USAID WN	Service de séchage des produits horticoles		Néant	Démarrage mi 2010
	Toutes les zones USAID WN	Vendeur de semences		Néant	2011
	Toutes les zones USAID WN	Post récolte riz		Néant	2011
Formations SIGESCO et maraichage				Fertilizer Fact Sheet + PERSUAP	En cours

ANNEX C

Agricultural and Irrigation Development activities of the PCE to be considered under this PEA

Type of Activity	Brief Description of the Activities
Improved Seed Development	Construct 3 new seed quality control laboratories at ISRA. Rehabilitate 3 seed quality control laboratories at ISRA. Increase production of foundation seed by ISRA.
Enhance community-based seed production program	Follow on and Consolidation of 2009 seed program. Construction of new seed conditioning center at R.Toll. Acquisition of mobile seed conditioning unit for Kolda and Vélingara. Acquisition of seed conditioning unit for Matam and Podor.
Millet and Sorghum Value Chain	Facilitate supply contracting for millet/sorghum between producers, retail sellers, and/or processors. Modernize the processing of cereals for semi-industrial processors. Improve the productivity of millet/sorghum and the quality of raw materials.
Irrigated Rice Value Chain	Support for the production of high quality rice (paddy and processed rice) by the GIE Malal Yéro at Richard Toll. Feasibility study (technical and financial) to establish an integrated rice market at Ross-Bethio. Develop a partnership between Union SP1 de Ndierba and SOENA for the commercialization of rice.
Rain-fed Rice Value Chain	Strengthen production potential by constructing or rehabilitating water management infrastructures. Broad-based technology dissemination program focused on agronomic best practices for rain-fed rice production.
Irrigated Maize Value Chain	Development of an operational framework to facilitate the commercialization of irrigated maize. Disseminate a package of improved agronomic practices for increased production and productivity of quality irrigated maize.
Rain-fed Maize Value Chain	Dissemination of technical and management innovations to increase the productivity and the quality of both maize seed and commercial grain. Facilitate the development of a network of 100 producers and professional distributers to increase the production and distribution of certified seed. Develop an organizational/service framework and an information system to support and improve maize value chain performance. Develop raw material markets for industries and small and medium enterprises.
Livestock Value Chain	Ensure availability of animal and poultry feed. Increase the quantity of red meat and sheep commercialized during Tabaski in Senegal. Increase the quantity of poultry products: broilers and eggs consumed in Senegal. Control major diseases that limit animal production – Vaccinations and training.
Dairy Value Chain	Development of local milk production in Tambacounda. Development of local milk production in Kolda. Stabilize agro-pastoral livestock production in the R. Toll zone.
Bissap Value Chain	Improved commercialization: Improvement of post-harvest practices.

Type of Activity	Brief Description of the Activities
	Improve seed quality and the production of bissap. Assist in improving the technical capacity and efficiency (and quality) of bissap processing enterprises.
Mangos Value Chain	Certification and improved commercialization of mangoes to promote competitiveness. Improve operations in processing units in Casamance and Niayes. Control of Fruit Flies: quarantine treatments against fruit flies – production, harvest and post-harvest.
Cashews Value Chain	Improve productivity and production: Improve tree varieties/plantations for cashew. Investment environment: Competitiveness study of the cashew value chain. Market support: Promote exports of raw cashew nuts.
Sesame Value Chain	Improved productivity and production: Support the development of improved sesame seed quality and production. Improve quality and competitiveness: Improve quality by reducing impurities and increasing white grains. Improve value-added: The premise of export markets improve processing of sesame. Dialogue/communication for the increase of the production and the exports.
Banana Value Chain	Finalize and present Banana Value Chain Study. Design and implement a competitiveness study for the banana value chain. Introduction of agronomic best practices and Improve the quality of and extend the use of healthy plants.
Infrastructure development and investment	Infrastructure projects such as warehouse rehabilitation and secondary road development, to more service-oriented projects such as modernizing and refurbishing seed conditioning centers or repairing key pieces of rural agricultural equipment.

U.S. Agency for International Development
1300 Pennsylvania Avenue, NW
Washington, DC 20523
Tel: (202) 712-0000
Fax: (202) 216-3524
www.usaid.gov