Platform
for Agricultural
Risk Management

Managing risks
to improve farmers'
livelihoods

Risk Assessment

PARM
PLATFORM FOR AGRICULTURAL RISK MANAGEMENT

Senegal

In collaboration with

MINISTRY OF AGRICULTURE
AND RURAL INFRASTRUCTURE

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Agricultural Risk Assessment Study
in the livestock farming and fishing sub-sectors

Executive Summary

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Assessment of the agricultural risks

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Preface

The Platform for Agricultural Risk Management (PARM), an initiative of the G8/G20 within the International Fund for Agricultural Development (IFAD), is a multi-donor partnership co-funded by the European Commission (EC), the French Development Agency (AFD), the Italian Government and IFAD to support governments and stakeholders in agricultural risk management (ARM). PARM is also supported by Germany through an agreement between KfW and the New Partnership for Africa's Development (NEPAD). PARM works in strategic partnership with NEPAD and the Comprehensive Africa Agriculture Development Programme (CAADP) in African countries in order to integrate agricultural risk management in national agricultural policy and investment plans (www.p4arm.org). Its current work relates to agricultural risk management in a number of countries, including Cabo Verde, Cameroon, Ethiopia, Liberia, Mozambique, the Niger, Senegal, Uganda and Zambia.

This risk assessment study is part of the PARM process in Senegal. It complements the study on agricultural risk assessment in Senegal published by the World Bank in 2015. The sub-sectors of livestock farming and fishing were identified by the Senegalese Government as priorities requiring in-depth evaluation. The Senegalese Government, in particular the Ministry of Agriculture and Rural Infrastructure and the Ministry of Fishing and the Marine Economy, has actively contributed to both the planning and the completion of this study. Other ministerial departments, government agencies and civil society organizations have also supplied contributions and critical analysis, including during the feedback and validation workshop held in Dakar from 27 to 29 June 2016, allowing the study's two reports to be completed and improved.

The study's main objective is to identify and quantify the risks in the livestock farming and fishing sub-sectors in Senegal, to facilitate decision-making and to build the capacities of decision-makers with regard to risk assessment and management. The report on the livestock farming study was written by **Dr. Abdrahmane Wane**, research economist at the Agricultural Research Centre for International Development (CIRAD) on assignment to the International Livestock Research Institute (ILRI), based in Nairobi (Kenya). He benefitted from the significant support of Aliou Diouf Mballo, engineer and statistician economist, and a graduate of the *École nationale de la statistique et de l'analyse* économique (ENSAE) in Dakar (Senegal). The report on the fishing study was written by **Alioune Badara Sy**, international fishing consultant.

Soxna Mbaye Diop, technical adviser at the Ministry of Agriculture and Rural Infrastructure, provided significant support for both studies, notably regarding the organization of the workshops and the setting up of meetings between the consultants and all public and private actors and stakeholders involved in the study.

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Fishing farming study acknowledgements

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Section one: Risk assessment study in the livestock farming sub-sector

Senegal has a livestock farming sub-sector that contributed an average of around 30 per cent of the country's agricultural gross domestic product (GDP) and 4.2 per cent of its overall GDP between 2000 and 2012. The sub-sector also recorded average annual growth of 6.1 per cent (ANSD, 2013). As a production activity, livestock farming provides an income for nearly 350,000 mostly rural families, the equivalent of 3,000,000 individuals (DIREL/CEP/MEPA, 2013). The sub-sector revolves around three animal production sub-systems: **(i)** a pastoral sub-system based on mobility and the extensive exploitation of natural resources, providing 549,737 tropical livestock units (TLU), of which 19 per cent are ruminant (bovine, ovine and caprine) and spread over more than a third of the country; **(ii)** an agropastoral system that has encompassed up to 67 per cent of bovine animals and 62 per cent of small ruminant animals since the 2000s (Niang and Mbaye, 2013) and that is developing progressively, to the detriment of transhumant pastoral sub-systems; and **(iii)** an intensive and semi-intensive sub-system producing mainly poultry, eggs, pigs and, to a lesser extent, ruminants, particularly for dairy production.

Such animal production in Senegal is undertaken in an environment with strong socio-ecosystemic constraints, along with a lack of infrastructure and basic social and economic services and, lastly, in a sub-optimal and unfavourable environment (4 per cent investment in the agricultural sector and difficulties in applying laws and regulations adapted to the dynamics of livestock farming). In addition to these constraints, the livestock farming sub-sector in Senegal is facing effects caused mainly by climate change, which is both the direct cause of losses and an aggravating factor in other economic, health, political and social threats. The aim of this study ***is* clearly *not to analyse those constraints***, but rather to ***identify and assess the risks***, even if there are obvious links between the two. This study limits itself to analysing the risk profile of the livestock farming sub-sector in Senegal, identifying risk factors, taking stock of specific risk-management initiatives, quantifying risks, determining their impact at the micro-, meso- and macroeconomic levels and prioritizing them with a view to facilitating decision-making with regard to risk management.

How has this study been undertaken?

This study is based on an extremely in-depth analysis of literature on the livestock sub-sector in Senegal, and occasionally in the Sahel more generally, and on the mining of secondary data collected by State technical departments and research institutions. Interviews were held with many actors in the sub-sector to pinpoint as accurately as possible the main threats and their dynamic. For risk factors such as those linked to rainfall and for which we had observations stretching back a relatively long way, we carried out further analysis using simulation methods such as the Monte Carlo method and extreme value theory. For the other risk factors, reasoned analysis was undertaken based on the information available from development and research institutions. A prioritization approach allowed us to classify the risks according to their severity, frequency and potential impact. To finalize the study, the observations and comments made during a feedback workshop organized in Dakar from 28 to 30 June 2016 were integrated as best as possible.

Livestock farming risk analysis

The situation of livestock farming in Senegal is varied and remains vulnerable to a number of risks that could lead to physical and financial damage. Although it is difficult to measure owing to the major shortcomings in the available data, we have been able to simulate the financial impact linked to the identified risks. **According to some theories, which should be taken with caution, the minimum financial costs of these risks are estimated at 601.05 billion CFA francs.**

Risks associated with inputs

Commercial inputs: In Senegal, the industrial livestock feed market is almost a duopoly dominated by NMA Senders and Sentenac. Around 36 per cent of the cereal produced – the majority of which is traded on the international markets – make up around 50 per cent of livestock feed. During the livestock feed crisis of 2008, there was a 38 per cent price increase owing to the varying provenance of the raw materials used to produce livestock feed and an overlapping of markets. Thus, any significant price variation can potentially become contagious, particularly for countries with very open economies, such as Senegal.
Another important commercial input concerns local production of groundnut hay that saw a boom and bust cycle between 2000 and 2014: continuous growth between 2002 and 2006, followed by a progressive decrease until 2010, then a significant peak in production thanks in particular to very favourable rainfall and then, again, progressive decline. Over the same period, the animal population saw renewed growth, representing potential growth in the demand for livestock feed. The production of groundnut cake follows the same trend as groundnut hay. Since 2013, the production of groundnut cake seems to have seen a degree of resurgence, although historical analysis of production over the last 14 years seems to indicate an imminent decrease in 2016. However, the quantity of produced groundnut cake does not cover the overall demand for livestock feed, particularly in the lean season during which livestock farmers in extensive systems tend to use a form of strategic supplements. Maize and wheat bran are imported, but at very low levels.

Non-commercial inputs: Biomass production represents an essential element in the livestock farming sub-sector. It provides information on the availability of livestock feed. This biomass production is in increasing decline, particularly in northern Senegal in the Ferlo region. The south of the country has a surplus, while the centre of the country sees moderate deficits. In 2015 there remained deficits in the north of the country, although we saw a degree of improvement between 2014 and 2015. The risk linked to the biomass deficit correlates to the risk of insufficient rainfall. The overproduction of dry matter observed in recent years in the southern and central regions of the country could boost transhumant numbers, leading to concentrations of them in these areas, causing increases to the price of food (high demand), conflict with locals and environmental damage. It should also be noted that plagues of locusts reduce the available feed considerably.

In terms of managing the risks linked to inputs, the Senegalese authorities concentrate mainly on mechanisms to establish frameworks for consultation between the different actors, as well as on mitigation through the distribution of livestock feed as part of Operation Livestock Protection (OSB).

The annual losses relating to risks linked to inputs are, however, difficult to predict exactly. Therefore, in this study, it was possible only to predict minimum losses based on the risks linked to both bush fires and plagues of locust. Therefore, the estimated cost is around 155.36 billion CFA francs.

Risks associated with bush fires

Each year, the Senegalese countryside suffers vegetation fires. This recurring problem is a serious threat to the biomass available for livestock feed. In the ten years from 2002 to 2012, the annual average surface area burnt reached 791,332 hectares, of which 59 per cent may be classified as bush fires. The regions most affected are those with a lot of biomass as well as significant numbers of livestock (Kédougou, Tambacounda, Kolda and, to a lesser extent, Sédhiou).

Bush fires are monitored by the *Centre de suivi* écologique (CSE), which since 2002 has drawn up annual summaries and maps of burnt areas combined with biomass maps. The Centre aims to provide information in real time and make it available to technical services working in the areas of water and forests.

Beyond the decrease in the volume of available biomass, the CSE estimated that the losses linked to bush fires represented an average loss of earnings in the meat industry of around 151 billion CFA francs between 2007 and 2010. Another indirect effect of bush fires, probably combined with the effects of droughts, is increased movement of livestock farmers in extensive systems and a potential rise in the risk of conflict.

Risks associated with plagues of locusts

Plagues of locusts are a risk to biomass. Average annual losses are estimated at 4.352 billion CFA francs. Their impact on livestock farming areas is relatively similar.

Risks associated with climate variations

Variations in rainfall (interannual and intra-annual) have a significant effect on animal production. Since the 1960s, rainfall has alternated between excess and shortfall in comparison with the norm between 1961 and 1990, and with the average between 1961 and 2014. The highest rainfall was recorded in 1967, 1969, 1999 and 2010, while the lowest occurred in 1972, 1977 and 1983, causing significant droughts. The rate of unusual rainfall[1] is recorded at 34.6 per cent across the country, with upper anomalies at 20 per cent and lower anomalies at 14.6 per cent. There remain disparities between the major agro-ecological animal production areas: the risk of rainfall anomalies is greater in the Niayes area (32.7 per cent) than in Ferlo and the South East (27.5 per cent in both of these areas).

To manage these climate risks, the public authorities have established a range of mechanisms ranging from **(i)** *impact mitigation* by distributing supplies and food vouchers, food supplements for the most vulnerable (children and mothers) and OSB, launched in June 2012; **(ii)** *risk transfer* with the creation of the National Agricultural Insurance Company of Senegal (CNAAS) in 2008 and by signing up to the African Risk Capacity (ARC), a mutual fund set up by the African Union to provide parametric insurance covering the impact of climate change. Beyond these initiatives and adaptation strategies specific to livestock farmers, others have been implemented by private companies, such as the Laiterie du Berger dairy, which has developed a partnership with rice growers regarding access to rice straw, with rice factories for access to rice bran and with the Compagnie Sucrière Sénégalaise sugar company to promote and access sugarcane straw and molasses in order to secure the provision of milk and stabilize opportunities and milk dairy revenues for pastoralists in the collection area.

1 We have calculated the anomaly thresholds on the basis of the average and the standard deviation of the data provided by the *Agence Nationale de l'Aviation Civile et de la Météorologie* (ANACIM). The threshold for excess rainfall is the sum of the average and standard deviation for rainfall from 1961 to 2014, and is obtained for rainfall shortage by subtracting the standard deviation from the average rainfall in the same period.

The risk of a rainfall shortage is 20.2 per cent and of excess rainfall is 17.5 per cent. The return period for excess rainfall is 5.89 years, while for a shortage it is estimated at 4.94 years. Although the situation differs from one agro-ecological area to the next, the differences remain relatively low. However, the risk of rainfall shortages is higher in Ferlo and the South East, which are important breeding areas.

In terms of impact, between 1972 and 1984, droughts led to estimated losses of around 1.8 million cows, 1.2 million sheep and 1.3 million goats, while the unseasonal rain in 2002 contributed to the loss of 116,537 cows, 271,219 sheep, 102,320 goats and 2.2 million chickens. For example, to gain a quick idea of the burden imposed by drought between 1972 and 1984, the financial cost of ruminant animal loss owing to drought, based on the price of ruminant animals indicated by Tyc (1994), may be estimated at a minimum of 56.3 billion CFA francs. Unseasonal rain led to losses of 116,537 cows, 271,219 sheep, 102,320 goats and 2,139,512 head of poultry in 2002. Again, using the prices identified by Tyc (1994), these cold rains caused a minimum financial loss of 13.436 billion CFA francs in terms of ruminant animals.

Risks associated with animal health

In Senegal, the different illnesses affecting livestock are monitored to prevent health risks. Through the National Epidemiological Surveillance System (SNSE), the Direction des services vétérinaires (DSV) monitors around 10 priority illnesses, paying particular attention to three (contagious bovine pleuropneumonia, Rift Valley fever and foot-and-mouth disease). The average prevalence of contagious bovine pleuropneumonia (CBPP) is estimated at 4.3 per cent, but its distribution is uneven, with a higher number of positive cases in the Ziguinchor region and the central western region, where the illness was not previously present. Rift Valley fever is present almost everywhere in the country, with high levels in the central and northern regions and a prevalence of 9.9 per cent, particularly in the Groundnut Basin and in Ferlo, mainly because of the mobility of small ruminant animals. The prevalence rates of foot-and-mouth disease are 49.5 per cent for type O, 45.2 per cent for type A and 19 per cent for type SAT2. The Thiès region sees the most infections, with a prevalence rate of 94.3 percent. The regions of Dakar, Diourbel, Saint-Louis and Tambacounda all show prevalence rates of more than 30 per cent in 2015. The risk of trypanosomiasis remains present in the south of the country and in Niayes, although operations to eradicate tsetse flies are underway in Niayes owing to its particular ecological conditions. Those operations have a significant chance of success.

In order to manage animal disease, the DSV undertakes passive surveillance based on field reports which are then submitted to research institutions according to a range of operational processes for confirmation or invalidation. The DSV also undertakes active surveillance by monitoring a network of sentinel herds.

The most frequent diseases are Marek's disease in poultry, African horse sickness, CBPP, rabies and poisoning. The risk of these diseases appearing is reasonably high, particularly for Marek's disease, which is present in 32 per cent of livestock farmers' households. Senegal's low vaccination coverage (15.36 per cent for ovine rinderpest, 29.17 per cent for African horse sickness, 32.29 per cent for bovine lumpy skin disease and 1.48 per cent for Newcastle skin disease in 2011-2012) may lead to a high-scale disaster should the diseases strike.

In terms of impact, animal disease can lead to a reduction in the size of livestock farmers' herds and decreased productivity in terms of meat, milk, leather and hide production. Based on the priority diseases monitored by the veterinary authorities and whose prevalence rates are available, the potential losses were estimated at 414.1 billion CFA francs for 2015. This evaluation, which is very much a minimum figure, does not consider other priority diseases or the economic effects of trypanosomiasis, particularly in the Niayes region and the southeast.

Risks associated with markets

Animal prices fluctuate greatly over the course of the year: they are favourable for livestock farmers between February and April and August and September, and unfavourable during lean periods (May to July), when animals are lean. Prices can differ from one year to the next, and at the same period, owing to the difference in animals' weight, which depends on the available feed. In terms of regions, cereal and animal prices are often higher in Dakar and Thiès. Another method for addressing risks linked to price is to analyse them through the particular relationship of Senegalese livestock farmers with the markets, who generally think in terms of relative prices of ruminant animals and staple cereals. The terms of trade seem to vary greatly across the year: they favour livestock farmers' households in August and September and are unfavourable in November and December. An improvement to the terms of trade has been observed in recent years, despite the net downturn that occurred in 2013 compared with 2012. Moreover, as a big importer and consumer of rice, Senegal has suffered from increases to global rice prices that ultimately influence local millet and goat prices, which are two significant parameters of the terms of trade for Senegalese livestock farmers' households.

To monitor and regulate agricultural markets (including the livestock market), Senegal has established the Commissariat à la Sécurité Alimentaire (CSA) which also serves to study the cereal market in cooperation with other bodies involved with a view to suggesting suitable measures to the competent authorities.

Variations in the price of food (local rice and millet), animal feed and animals have a significant effect on livestock farmers' living conditions. Understood in terms of the monetary revenue of livestock farmers in extensive systems, the research results display a fairly high intra-annual (2015 dry season/rainy season) mobility in that revenue (Shorrocks index: = 0.475), reflecting a decrease in revenue (= 0.418) rather than an increase (= 0.055) and significant interannual mobility (2005-2015) that is relatively higher (Shorrocks index: = 0.560) but that suggests an overall improvement to cash receipts in the markets. All of this suggests that impact is better observed in the long-term than in the short-term.

The impact linked to market risks is estimated at an annual average of 2.119 billion CFA francs.

Risks associated with livestock theft

Livestock theft is becoming a regular occurrence throughout the country, particularly in the south and the agricultural and woodland grazing area in the north. The national extent of the phenomenon contributes to the impoverishment of livestock farmers through economic losses, while worsening their lack of food security and feeling of overall insecurity.

In order to address the problems relating to livestock theft, the government's strong commitment to repressive measures is demonstrated through its creation of the Anti-Livestock Theft Unit (CLVB) attached to the Office of the Minister of Livestock Farming (see Decree No. 2002-543 on the distribution of State services), its amendments to the Criminal Code, its steps to identify livestock through a public-private partnership to implement the DARAL application and its promotion of livestock insurance.

In terms of impact, the Parliamentary network that addresses livestock theft and the protection of animal resources estimates that livestock theft causes annual losses of two billion CFA francs and contributes to the impoverishment of the rural population.

Risks relating to conflict and tension between farmers and livestock farmers

Since 1982, the country has been experiencing conflict with an armed rebel group in Casamance. This situation has led to difficulty in accessing fertile farming areas because of the proliferation of armed violence and anti-personnel mines, fierce competition for land in safe areas, the forced displacement of persons and a drastic reduction in agricultural production, leading to a decrease in food security. Other types of conflict have also erupted on the country's borders, for example in northern Mali in 2010 and Mauritania in 1989-1990. Those two countries are significant suppliers of livestock to Senegal. In the north of the country and in Niayes, the expansion of agriculture, the development of agribusiness and rampant urbanization have restricted the space available for animal production. Conflict between farmers and livestock farmers has become a recurrent phenomenon at the heart of public debate.

In order to address this potential risk, the Senegalese State has established frameworks for long-term country-wide consultation and, in 2013, began to draw up a pastoral code aiming to give the country an updated and appropriate legal framework.

Unlike the impact of internal conflict, which remains very difficult to measure, the external conflict with Mauritania between 1989 and 1990 coincided with the loss of 147,080 cows, while the conflict in northern Mali contributed to the disappearance of 188,673 sheep. These cross-border conflicts led to financial costs estimated at around 14.223 billion CFA francs.

Risk prioritization

We have been able to rank the risks based on the scores obtained for the severity, frequency and impact criteria: risks associated with bush fires dominate, with a score of 5, followed by risks linked to animal health (4.60), rainfall (3.84), markets (2.52), conflict (1.81) and plagues of locusts (1.31).

	WORST-CASE SCENARIO	AVERAGE FREQUENCY	AVERAGE ANNUAL LOSSES	SCORE
RISKS ASSOCIATED WITH BUSH FIRES	VERY SIGNIFICANT	VERY SIGNIFICANT	VERY SIGNIFICANT	5.00
RISKS ASSOCIATED WITH ANIMAL HEALTH	VERY SIGNIFICANT	SIGNIFICANT	VERY SIGNIFICANT	4.60
RISKS ASSOCIATED WITH RAINFALL	VERY SIGNIFICANT	MEDIUM	SIGNIFICANT	3.84
RISKS ASSOCIATED WITH THE MARKET	LOW	SIGNIFICANT	LOW	2.62
RISKS ASSOCIATED WITH CONFLICT	MEDIUM	VERY LOW	LOW	1.81
RISKS ASSOCIATED WITH PLAGUES OF LOCUSTS	VERY LOW	VERY LOW	LOW	1.31

For the agro-ecological areas that we monitored specifically as main livestock farming areas, the ranking is modified to reflect the socio-ecosystemic realities: bush fires are a frequent and very high risk in all livestock farming areas. The risk of a lack of inputs is higher in the Niayes and Ferlo regions. Only the south-east of the country seems to be reasonably protected from a lack of rainfall, which has a lower impact there. Conflicts have recently had an increased impact on the Ferlo region, which is more sensitive to the conflicts with Northern Mali and Mauritania. However, we should not forget the internal conflicts that persist in the south of the country.

	FERLO	NIAYES	SOUTH EAST
RISKS ASSOCIATED WITH BUSH FIRES	🔴	🔴	🔴
RISKS ASSOCIATED WITH ANIMAL HEALTH	🟡	🔴	🔴
RISKS ASSOCIATED WITH RAINFALL	🟡	🟡	🟢
RISKS ASSOCIATED WITH THE MARKET	🟡	🟡	🟡
RISKS ASSOCIATED WITH CONFLICT	🔴	🟢	🟢
RISKS ASSOCIATED WITH PLAGUES OF LOCUSTS	🟢	🟢	🟢

Recommendations

Move from emergency response to threats to long-term risk management

With regard to identifying the main source of threats, taking stock of risk-management approaches and tools, quantifying the risks, determining their main impact on the micro-, meso- and macro-economic levels and prioritizing them, the following two measures must be urgently adopted with a view to improving risk management in the livestock farming sub-sector:

Make the collection of reliable information the responsibility of the State

Implement an effective and sustainable system for collecting and analysing statistical information on the ecological, biological, economic and social aspects of livestock farming in Senegal. Such a system would be funded by the government and monitored by its technical departments, which could use it to establish an information and early warning system for threats that could have a severe impact on the economy and health.

Boost passive and active surveillance systems for the main threats

Boosting passive and active surveillance systems for the main threats to the livestock farming sub-sector would allow risks to be identified, anticipated and covered. This will entail improved coordination between different State bodies, the launching of systems to support rapid responses to emerging threats and the reinvigoration of the Agricultural Risks Group.

Of course, specific actions in terms of improving herd vaccination coverage, joint management of natural resources, increased participation of agricultural sector actors in defining and building an equitable land policy, improvements to commercialization mechanisms and control of animal feed will be necessary to improve the management of agricultural risks in Senegal.

Section two: Risk assessment study in the fishing sub-sector

The main objective of this study is to evaluate and prioritize the risks facing the fishing sub-sector in Senegal, in addition to the study undertaken by the World Bank in 2015 that focused on agricultural risk assessment. Specifically, it seeks to: (i) establish an inventory and a detailed assessment of the risks facing the sub-sector over the last 20 years and in the foreseeable future, and to provide information on their probability and the effects on the economy and livelihoods of artisanal fishers; (ii) review the existing tools and means of action relating to risk management; (iii) analyse risks through the systematic quantification of effects and probabilities and (iv) rank the identified risks and risk-management tools.

The sectoral context

Importance of fishing in the country's economy

In Senegal, fishing contributes an average of 2 per cent of the country's total GDP and 12 per cent of the GDP of the primary sector. Thanks to its fish products, fishing is one of the main income-generating economic activities in the country. In 2015, exports of fish products represented 20.87 per cent of Senegal's total receipts from exports, making them the most exported products (source: ANSD). At the social level, fishing plays an important role in providing food and nutrition to the Senegalese population. In fact, fish products provide 70 per cent of the population's animal protein intake.

Focus on artisanal coastal fishing

The study focuses mainly on artisanal coastal fishing, which dominates the fishing sub-sector because it makes up the majority of the sub-sector's economic and social results. In fact, it represents 80 per cent of total landings, 60 per cent of supplies to exporting factories and around 90 per cent of national fish consumption. In most coastal towns and villages, artisanal fishing and connected occupations are the main drivers of the local economy. Inland fishing is uncommon and mainly limited to subsistence fishing. Additionally, data and information to characterize it are not available because of a lack of regular monitoring, making it difficult to evaluate the associated risks.

Identifying the main risks in the fishing sector

The major risks affecting the fishing sub-sector vary and are often inter-linked. The study that identified the risks in the fishing sector highlighted the following main risks:

Business risks

As a hunting activity, fishing involves an intrinsic risk linked to the fact that a fishing operation utilizes inputs (labour and capital) and involves costs that are not necessarily met by the turnover generated by the sale of fish products. The fishing operation's physical and economic performance is variable and fishers are exposed to the risk of net operating losses each time that the value of their landings is lower than the costs involved in their fishing operations. This risk, which is inherent to the nature of the activity, is exacerbated in Senegal by the worsening situation of fishing grounds and a fishing regulation system that remains ineffective.

Risks linked to variable environmental conditions

Environmental conditions play a significant role in the abundance of many fish stocks. The abundance of the small coastal open water fish that represent more than 80 per cent of the fishing potential in Senegal's exclusive economic zone (EEZ) depends on the hydro-climatic system, particularly the temperature of surface water and the intensity of upwelling (Dakar-Thiaroye Centre for Oceanographic Research, CRODT). For fishers, this environmental variation represents a risk in terms of how much they can catch in the EEZ from year to year.

Meteorological and climate risks

Bad weather is a risk to fishing on two levels: (i) when they involve a temporary suspension, which may be of varying length, to fishing activities to conform to the safety advice of the competent bodies (ANACIM, DPSP); (ii) when they cause accidents at sea such as capsizing, collisions, the destruction of vessels, persons overboard and becoming lost. In the case of Senegal, although studies into the impact of climate change on fishing are still in their infancy, a few events and completed studies clearly demonstrate: (i) a change to the temperature of surface waters at sea, affecting resource distribution; (ii) an increase to average sea levels, worsening coastal erosion; (iii) an intensification of extreme events such as storm surges, large swells and the associated flooding, which can cause unprecedented damage, weaken ecosystems, destroy local infrastructure and result in loss of human life.

Risks associated with illegal, unreported and unregulated (IUU) fishing

IUU fishing in the Senegalese EEZ represents a grave risk that occurs very frequently and whose effects include: (i) the destruction of artisanal fishers' tools (nets) caused by boats fishing in restricted areas; (ii) damage to resources linked to the fishing of immature fish by trawlers with obstructed nets; (iii) the destruction of fish habitats; and (iv) the elimination of resources to the detriment of the legal fishing industry and Senegalese fishers when such fishing is carried out by pirate vessels.

Risks associated with the market

These risks relate mainly to access to export markets in the European Union, which are lucrative but very demanding in terms of respect for health regulations and the traceability of catches. A failure to respect those regulations means that the country is at risk of seeing its fish products temporarily banned from the European market, leading to a reduction in the turnover of producers who depend on exporting.

Risks associated with restricted access to the EEZ of neighbouring countries

Like other countries with developed fishing fleets, Senegal exports its surplus fishing capacity by forming fishing agreements with third countries. Thus, Senegal has reached fishing agreements with Cabo Verde, the Gambia, Guinea-Bissau and Mauritania, giving artisanal and industrial fishers access to their waters. Of those, the agreements most commonly used by Senegal are those with Guinea-Bissau and Mauritania. The suspension or termination of those agreements risks depriving many Senegalese fishers of productive fishing grounds, thus affecting their income.

Political and institutional risks

The particular status of fishing resources means that the State has an important role in regulating their exploitation to guarantee equity and ensure that fishing is a socio-economic activity that is profitable and ecologically sustainable. Given the current situation of Senegalese fish stocks, limits to access to fish resources are urgently needed and should clarify who has the right to exploit them and according to what limits (quotas). This issue takes on both technical and political dimensions given that it raises the problem of sharing and distributing an economic resource. There has been a squandering of the country's fish resources due to years of poor governance in terms of regulation of access, but also in terms of unsuitable decisions relating to the granting of fishing rights.

Other risks

Other, less severe, risks affect fishing production. These include:

i) Risks linked to pollution, which may become significant in the fairly near future owing to industrial development and current offshore oil activity. However, we can already observe the pollution of coastal areas by the industrial companies located on the coast (ICS, SAR), new pollution phenomena in artisanal fishing areas caused by the dumping of waste in the sea and on land by the fishmeal and freezing industries, which have recently been established in these areas with no regard for environmental regulations.

ii) Risks linked to post-catch losses owing to several reasons, including the catching of immature fish, shortcomings in the preservation of catches, insufficient use of ice and a failure to develop a cold chain once on land. These losses could be significant in terms of volume and money.

Stocktaking of existing risk management tools and measures

Risk management in fishing policy

In 2009, the Government of Senegal produced a sector policy letter on fishing and fish farming to establish a strategic framework for planning public interventions. This political framework for managing the sector was updated in 2016. It comprises risk management tools and measures.

Summary of risk management tools and measures

Tools and measures for managing business risks

Firstly, we will take stock of the tools and measures applicable to farmers and communities. They address, among other things, the adaptation of fishing strategies, improvements to the efficiency of fishing vessels, adjustments to the cost of fishing and the use of prohibited fishing techniques that are harmful to ecosystems. In the current context, fishers seem to use strategies in response to business risks that contribute to an increase in effort and fishing overcapacity in the best case scenario, and fishing practices that harm fish stocks and habitats in the worst. At the governmental level, the sector policy letter on fishing and fish farming introduced risk management strategies and tools linked to fish products at various levels. Indeed, it involves tools and measures that mitigate business risks (planning), but the diagnostic assessment of the implementation of the letter carried out by the Department of Fishing demonstrates that these tools are infrequently or poorly used.

Tools and measures to manage risks linked to variable environmental conditions

With regard to farmers and communities, the main measure adopted is migration involving moving to fishing grounds where environmental conditions are favourable. There are no tools or measures that allow the Government to manage this risk.

Tools and measures to manage climatic and meteorological risks

Since 2015, initiatives have been launched to address meteorological risks as part of the USAID/COMFISH project. Through this project, a memorandum of understanding was signed with ANACIM to build the capacities of local actors regarding safety at sea and to improve access to meteorological information and alerts. These initiatives also include the establishment of an insurance system for fishers that covers this type of risk.

Tools and measures to manage risks linked to IUU fishing

In 2014, the Ministry of Fishing and the Marine Economy produced a national action plan to combat IUU fishing. The aim of the plan is to significantly reduce the huge economic losses caused by IUU fishing activities with a view to increasing the fishing sector's contribution to national wealth. In addition to the plan of action, it

should be noted that in 2015 Senegal adopted a new law on the marine fishing code (Act No. 2015-18 of 13 July 2015). One of the Act's major innovations is the substantial increase to fines for IUU fishing as a form of deterrence.

Tools and measures to manage risks linked to restricted access to the EEZ of neighbouring countries

Senegal is not currently prepared for a restriction to, or removal of, access to the EEZ of neighbouring countries. It is likely that if this risk were to occur, it would cause significant social tension in Saint-Louis, for example, or aggravate fishing overcapacity in Senegalese waters owing to the return of the fleet to Senegalese fishing grounds.

Tools and measures to manage risks linked to markets

These risks relate to the traceability of catches and respect for health regulations. In 2010 Senegal implemented a catch certification system managed by the Directorate for the Protection and Surveillance of Fish Stocks. With regard to the health risks that could threaten the approval of Senegalese exports for the EU market, there is a competent authority (DIC) responsible for managing this risk.

Tools and measures to manage other risks

Risks linked to post-catch losses: Positive progress has been noted over the past two decades in the use of materials to preserve fish products in good condition while on board (use of polystyrene crates, increased icing rates). This has allowed post-catch losses to be reduced considerably. At the governmental level, the main tool used by the Department of Fishing to manage post-catch risks is the refrigeration programme.

Pollution risks: Act No. 2001-01 of 15 January 2001 on the Environmental Code is a tool that allows pollution risks to be managed provided that it is applied correctly.

Risk analysis and quantification of the negative effects

The quantification of risks linked to fishing is estimated at 149,682,231,244 CFA francs. Risks linked to IUU fishing are among the biggest risks in terms of overall financial impact.

Business risks lead to many of the other risks listed as part of this study. They are strongly linked to political and institutional risk, as well as risks linked to IUU fishing, whose respective financial effects are significant. Particular importance should be granted to tools that allow these three risks to be managed. Governmental regulation of production, as well as good governance, are therefore an absolute priority for any fishing sector development policy aimed at mitigating the risks that have been identified.

Risk ranking

Based on the evaluation of the frequency and severity of the risks, the risks appear in the following table in order of significance:

NO.	RISK NAME	FREQUENCY	SEVERITY	SCORE
1	RISKS LINKED TO IUU FISHING	HIGH	VERY HIGH	4.5
2	BUSINESS RISKS	VERY HIGH	MEDIUM	4
3	CLIMATE RISKS	HIGH	MEDIUM	3.5
4	RISKS LINKED TO VARIABLE ENVIRONMENTAL CONDITIONS	VERY LOW	VERY HIGH	3
5	OTHER RISKS: RISK OF POLLUTION OF BODIES OF WATER	MEDIUM	MEDIUM	3
6	OTHER RISKS: RISKS LINKED TO POST-CATCH LOSSES	HIGH	LOW	3
7	RISKS OF RESTRICTED ACCESS TO THE EEZ OF NEIGHBOURING COUNTRIES	VERY LOW	MEDIUM	2
8	METEOROLOGICAL RISKS	MEDIUM	VERY LOW	2
9	RISKS LINKED TO THE MARKET	VERY LOW	VERY LOW	1

Conclusions and recommendations

The study into the risks linked to fishing in Senegal provides definitive proof that the sector is highly exposed to risks, probably to a greater extent than other rural sectors (such as agriculture and livestock farming) because of the specific characteristics of the activity and of fish stocks. Fishing production is indeed limited by natural factors and cannot be increased past a certain threshold (maximum sustainable yield) as is the case today for many fish stocks in Senegal. If use of this resource is not monitored and regulated, the activities of each individual fisher is put at serious risk because of the negative externalities that have been analysed. This major risk to activity is the cause of several other risks that have been listed as part of this study. We also observe that IUU fishing is the most costly risk in terms of financial effects. As a result of the study, it is strongly recommended that governance is improved and the existing tools for managing major risks to the subsector strengthened through the following actions:

1. Managing the sustainability of fish stocks by matching efforts and fishing capacities with fish stocks' natural potential.
2. Improving the system for decisions on the granting of fishing licences.
3. Granting the national action plan for combating IUU fishing the resources that it requires to be implemented.
4. Strengthening the means for the ongoing implementation of fishing planning.

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