

OVERFISHING IN SENEGAL: HOW TO PROTECT MARINE ECOSYSTEMS

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EXECUTIVE SUMMARY

Biodiversity loss is part of Rockström's 9 Planetary Boundaries: Biosphere Integrity. Globally, there has been large depletion in the world's marine ecosystems due to overfishing. This policy brief outlines the ecological implications of overfishing in Senegal as 90% of Senegalese fisheries are fully fished or facing collapse. Historically, Senegalese waters have been known for having an abundance in fish, however, over the past few decades foreign and illegal fishers have exploited Senegalese waters, overfishing at a large scale. Fishing plays an integral part in Senegal's development, environmentally, socially, and economically. Although the government has made efforts to protect Senegalese fisheries, corruption, insufficient institutions, and neo-colonialism allow overfishing by foreign fishers and marine biodiversity loss to continue. To overcome this, the *Coastal Fisheries Initiative* (CFI) should fund and support Target-based ecological compensation (TBEC) with Community Run Fisheries (CRF) to encourage management and preservation of the marine ecosystems in Senegalese waters.

FOUNDATIONAL SCIENCE: DISCUSSION & ANALYSIS

Rockström's 9 Planetary Boundaries (1) analyse the impacts of anthropogenic activities on instability in the Earth System (2) as shown in Figure 1(1). The boundaries are "human determined values of the control variable set a "safe" distance from a dangerous level from its global threshold" (1, p.3). This instability is linked is linked to ecological decline and functional collapse, causing environmental disasters, making it a threat to human life

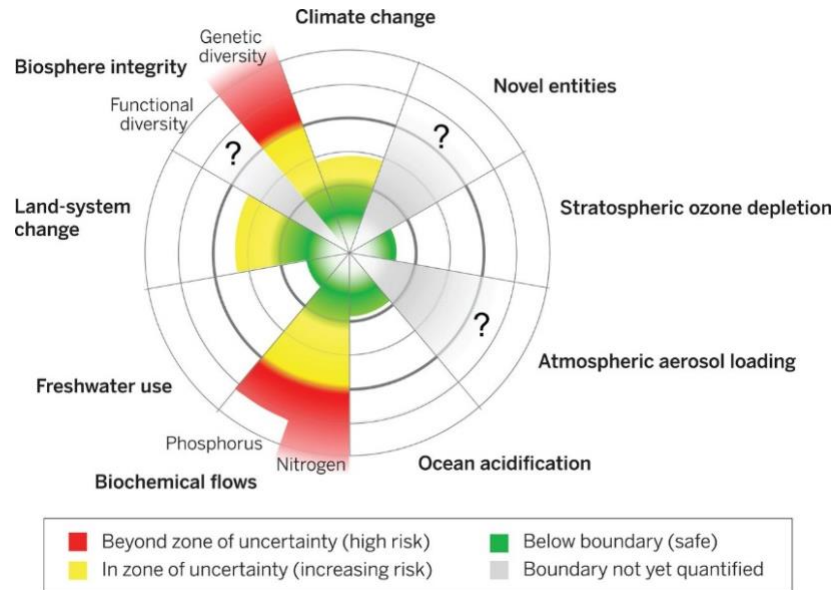


Figure 1: Rockström's 9 Planetary Boundaries (1)

Biodiversity comes under the Biosphere integrity boundary, specifically, functional diversity, and is a boundary due to its integral role in maintaining biophysical subsystems of the Earth. Biodiversity refers to the “variety of life at any hierarchical level, including genes, species, functional groups or ecosystems” (3, p.740). The 5 main drivers of extinction include: changes in land and sea use; direct exploitation of organisms; climate change; pollution and invasive alien species, all of which are caused by anthropogenic activities as shown in Figure 2 (3, 1). Humans have caused an increase of the rate of species’ extinction rates by 100-1000 times (4) and could cause the Earth’s sixth major extinction (1). Globally, governments have failed to take effective action against this.

Pressures	Main impacts
Climate change	Increased/changed risk of floods and erosion, sea-level rise, increased sea surface temperature, acidification, altered species composition and distribution, biodiversity loss
Agriculture and forestry	Eutrophication, pollution, biodiversity/habitat loss, subsidence, salinisation of coastal land, altered sediment balance, increased water demand
Development of industries and infrastructures	Coastal squeeze, eutrophication, pollution, habitat loss/fragmentation, subsidence, erosion, altered sediment balance, turbidity, altered hydrology, increased water demand and flood-risk, seabed disturbance, thermal pollution
Urbanisation and tourism	Coastal squeeze, highly variable impacts by season and location, artificial beach regeneration and management, habitat disruption, biodiversity loss, eutrophication, pollution, increased water demand, altered sediment transport, litter, microbes
Fisheries	Overexploitation of fish stocks and other organisms, by-catch of non-target species, destructions of bottom habitats, large-scale changes in ecosystem composition
Aquaculture	Overfishing of wild species for fish feed, alien species invasions, genetic alterations, diseases and parasite spread to wild fish, pollution, eutrophication
Shipping	Operational oil discharges and accidental spills, alien species invasions, pollution, litter, noise
Energy and raw material exploration, exploitation and distribution	Habitat alteration, changed landscapes, subsidence, contamination, risk of accidents, noise/light disturbance, barriers to birds, noise, waste, altered sediment balance, seabed disturbance

Figure 2: Anthropogenic effects on marine and coastal ecosystems (5).

Overfishing, the direct exploitation of organisms, is a driver of extinction, causing a decline in marine biodiversity; this is particularly impacting Senegal as 90% of their fisheries are fully fished or facing collapse (6). This is in response to foreign fleets overfishing their waters to meet global demand (7). This has many environmental, social, and economic implications as marine biodiversity has large significance to Human Development (HD). In terms of the UN SDGs¹, it correlates to life in water (SDG 14) (8). Marine biodiversity loss impacts ecosystem functioning as it causes imbalance in food webs and in trophic levels (3). As certain species become extinct, i.e., prey or primary consumers due to overfishing, species in higher trophic levels i.e., predators or secondary, tertiary and apex consumers will have a shortage of food, making their populations shrink. Also, in turn if predators are overfished, this could cause an overpopulation in fish on lower trophic levels (3), as shown in Figure 2, while species loss is more prevalent for higher trophic levels, species gain through invasions is prevalent in lower levels.

¹ UN Sustainable Development Goals set in 2015, to help economic, social and environmental development in UN member states, to be reached by 2030 - <https://sdgs.un.org/goals>

(5).Consequently, the CFI should implement policies to protect marine biodiversity loss to resolve the imbalance in food webs and trophic levels, protecting marine life (SDG 14).

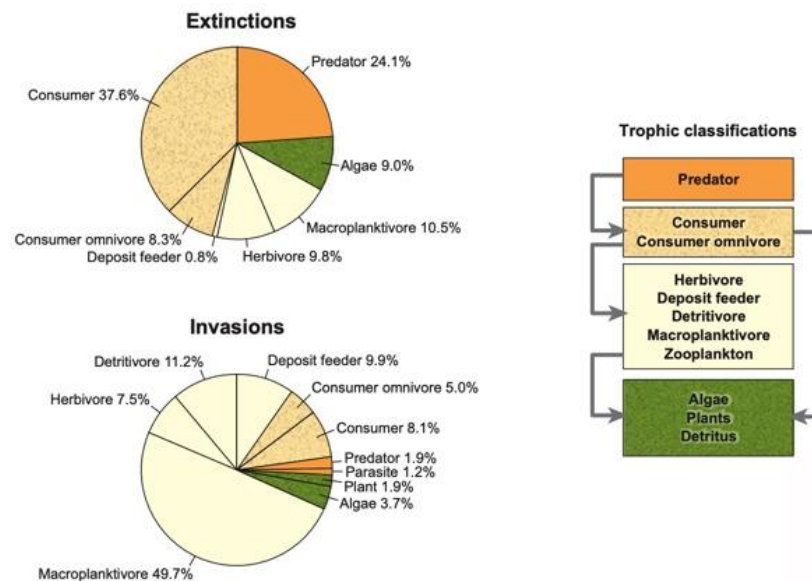


Figure 3 : Changing patterns of trophic skew in coastal marine ecosystems as the combined results of species local extinctions. Species loss is biased toward higher trophic levels, whereas species gain is biased toward lower levels (primary consumers). (9)

Furthermore, marine biodiversity supports ecosystem services (11). The overfishing of Senegalese waters has led to the collapse of the local fishing businesses, impacting the 600,000 people employed by Senegalese fisheries (10). This has directly impacted the provisioning services of food, as fish represents more than 75% of Senegalese protein consumption as cattle and chicken is difficult to grown in Senegal's climate (12, 7). This shows that overfishing is a barrier to achieving SDG 1,2,3 & 8, negatively impacting poverty alleviation, ending hunger, good health and economic growth and employment. Furthermore, as large foreign fishing companies gain profit from Senegalese waters, the locals suffer economically and socially, increasing inequalities between Sub-Saharan Africa (SSA) and the rest of the world (SDG 10) (8). Protecting marine biodiversity will allow Senegal to achieve a variety of SDGs, hence the CFI should act urgently.

ASSESSMENT OF EXISTING GOVERNANCE

Senegal has historically been known for its abundance of fish and its diverse marine ecosystems, however, over the past few decades, overfishing has caused marine biodiversity loss. Although the government has used top-down approaches to overcome this, overfishing is still a problem. Overfishing occurs when the rate of fishing of species is higher than the most sustainable rate (13).

The government has created institutions and regulations to protect fisheries since their independence, particularly the continual reformation of the Fisheries Act since the 1970s which implemented fishing zones, protection of species and fishing licences and more recently introduced the co-management of fish resources as well as a monitoring and fining system, further protecting marine ecosystems (12). These policies did help to increase fish catches during the 1960s-70s as shown in Figure 2, showing that there was more access to fish, therefore more species of fish in the waters, making them effective in helping the growth in biodiversity. However, major depletion of marine ecosystems has occurred due to major overfishing (12). As shown in Figures 3, the total fish catches have been decreasing from about 500 in the late 1980s to 350×10^3 in 2014 (12). The FAO² suggests that 90% of fisheries are fully fished or collapsed (6).

These top-down, government policies and regulation have been ineffective due to weak extractive institutions; political institutions created through exploitative methods during colonialism in which power is concentrated amongst elites who are uninterested welfare of the nation (14). In relation to Senegal, these weak institutions facilitate more corruption to occur within communities, preventing policies from being directly implemented within communities (12); for instance, the revenue lost from illegal unregulated fishing accounts for 2% of GDP (15).

² Food and Agriculture Organization of the United Nations.

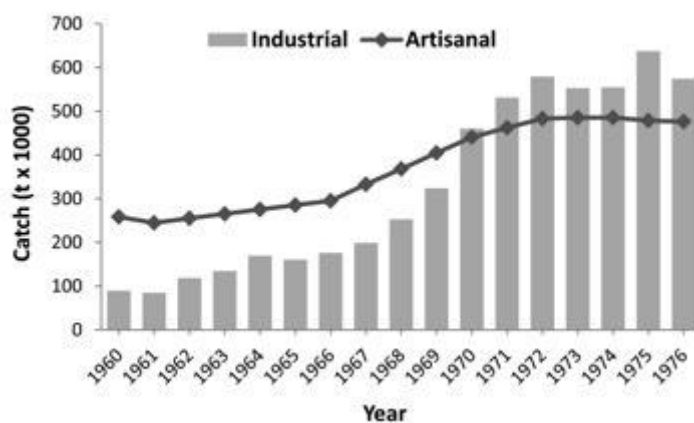


Figure 2. Total artisanal and industrial catches landed ($t \times 10^3$) in Senegal from 1960-76 (16)

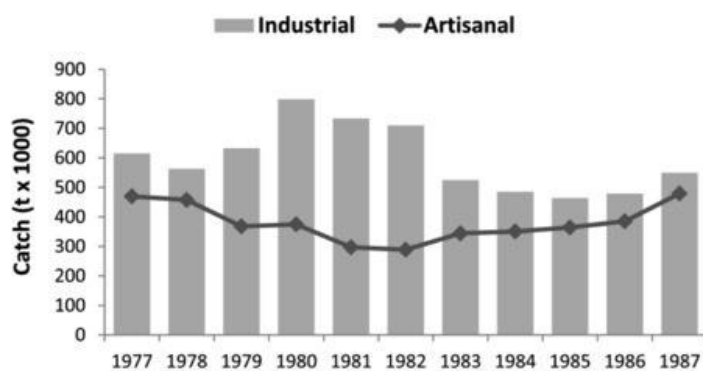


Figure 4 Total artisanal and industrial catches landed ($t \times 10^3$) in Senegal from 1999-2014 (16)

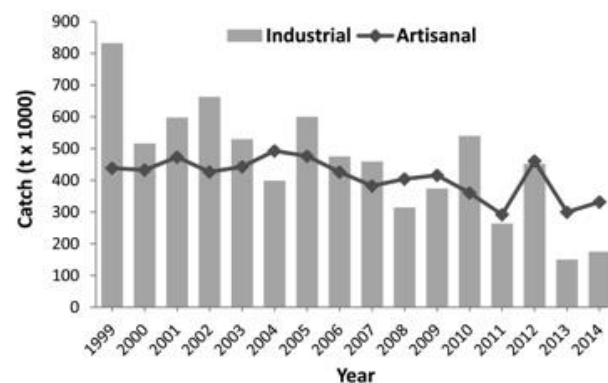


Figure 4 Total artisanal and industrial catches landed ($t \times 10^3$) in Senegal from 1977-87 (16)

Furthermore, these institutions allow ex-colonial powers and corporations like the EU to take advantage of Senegal's fisheries (17). Traditionally, Senegalese fishes were caught using pirogues and distributed throughout the country (7). However, post-independence, many development deals were first made with European countries, then later with countries in Asia to meet the growing foreign demand for fish (7). These countries often have neo-colonial motives, wanting to exploit Sub Saharan Africa's resources to export them to their own countries, causing locals to suffer with a shortage of fish. Regardless of all the efforts the Senegalese government make to reduce overfishing, they are bound by these neo-colonial powers and institutions, explaining why the government has not been able to overcome overfishing.

GOVERNANCE RECOMMENDATIONS

To restore Senegalese marine ecosystems, the *Coastal Fisheries Initiative* (CFI) must consider the following process as shown in Figure 5 (19).

1. Establish Biodiversity feature target levels for each marine species (Target Based Ecological Offsetting (TBEC) method)
2. Sponsor ecologists to highlight species with biodiversity feature below target
3. Implement TBEC using Community Run Fisheries (CRF) to regulate overfishing
4. Achieve “Net gain” in biodiversity level, replenishing marine ecosystems in Senegalese waters

The Senegalese government must introduce target-based ecological compensation (TBEC) and user-managed resources (UMR) to protect marine ecosystems and overcome overfishing. TBEC aims at jurisdictional outcomes associated with certain biodiversity targets (18). As shown in Figure 6, in Senegal, if marine species are close to extinction and the biodiversity feature is below the target, TBEC should be introduced, facilitating a “Net gain” in biodiversity (b in Figure 6). Consequently, the CFI should give funding to marine ecologists and researchers to analyse specific levels of biodiversity.

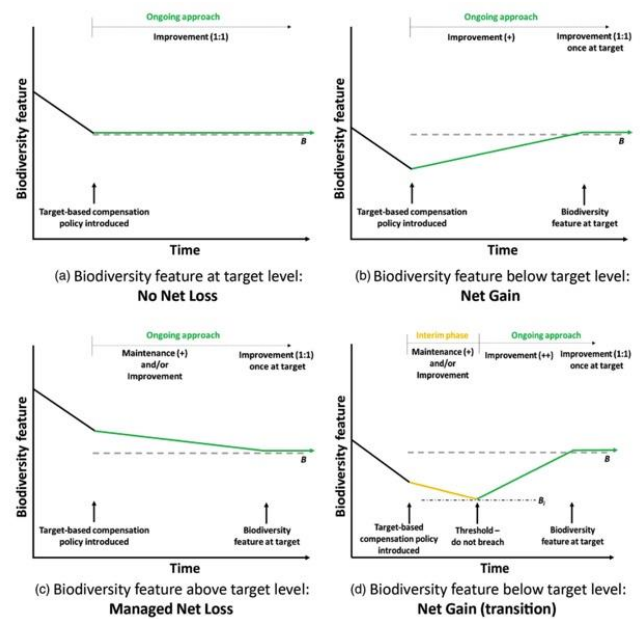
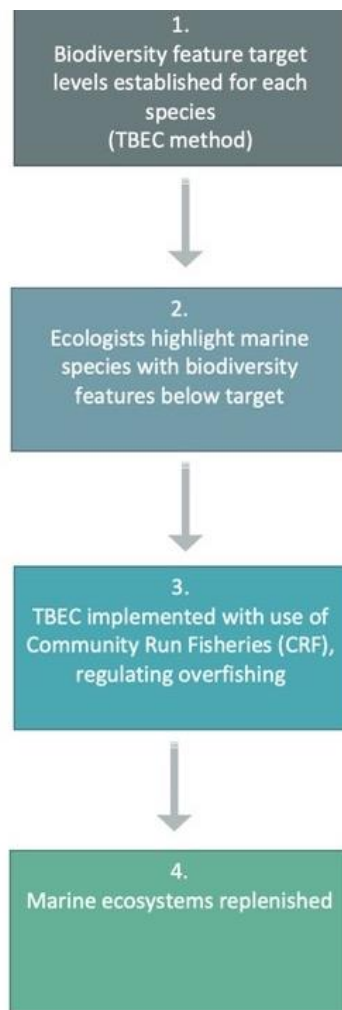


Figure 6: Illustration of the target-based ecological compensation approach (13)

Figure 5 Summary of Governance Recommendations to regulate Senegalese waters and replenish marine ecosystems 19

However, as described before, due to corruption, there may be problems with implementing these targets. Therefore, User-Managed resources (UMR), and particularly Community Run Fisheries (CRF) should be established to achieve the targets, especially as overfishing is an example of the Tragedy of the Commons³. UMR is when there are informal rules to govern the use of the fisheries, using a system of monitoring and sanctioning which is managed by the community (19).

This bottom-up policy encourages polycentrism, focusing on governance from a community level, prioritising local needs and relieving locals from corruption from

³ As fisheries are common goods, individuals i.e., fishermen behave individually, contrary to societal interest, causing overfishing as the depletion of marine ecosystems as fishers will always prioritise their additional income from catching fish rather than considering the ecological consequences (22)

the government or weak institutions. CFI must encourage Senegalese fishing communities to:

- **Establish specific fishing spots, creating Marine Protected Areas (MPAs)**
- **Compile a list of all local fishers that can fish in Senegalese waters**
- **Implement rotation-based system (19)**

CRF was successful in Ostrom, Turkey; after a major depletion in fish stock in the 1970s, they were able to replenish their fish stocks using these methods and will have the same impact in Senegal (19).

Establishing specific fishing areas and MPAs in which areas of water are sectioned off from fishing will allow the reproduction and regrowth of certain species helping to restore marine ecosystems. This promotes a more specified approach for each community based on their level of fish stocks, also encouraging more precise research for each marine ecosystem (18). Authenticating the fishers that can use Senegalese waters would prevent illegal and foreign fishers from exploiting Senegalese waters. A rotation-based system is when fishers move daily (18). This encourages fishers to monitor and sanction each other, preventing them from overfishing/ depleting fisheries, as any of them will suffer from the consequences at some point (18). This would help to replenish marine ecosystems in Senegal. Additionally, this gives the fishers equal chance of catching, enabling them to feed their families and have a reasonable income.

Furthermore, these methods bring local fishers together as a community, giving them more trade union power, giving them more authority to fight against foreign or illegal fisheries and to influence government policies impacting them, having positive social implications.

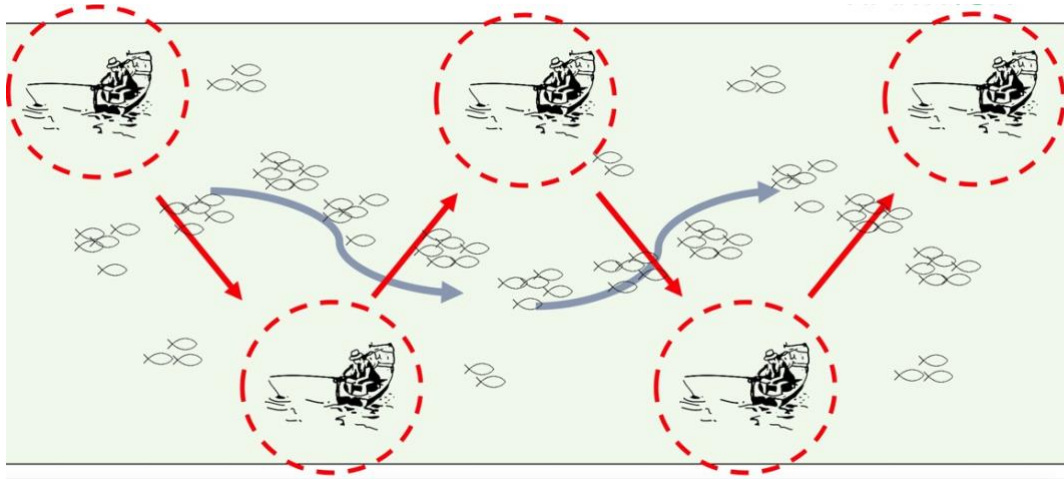


Figure 5 Depicting what a Rotation-Based System would look like in a CRF (18)

The CFI could give money directly to the government, however, due to illicit money flows and weak institutions, these investments may not trickle down into the local fishing communities. Therefore, each family in the fishing communities must donate a small loan for the CRF and will be paid back gradually through fish portions from increased fish stocks. Some may argue that these locals in poverty do not have the economic capacity to lend money. Yet, by improving fisheries, the community will have better nutrition and health, and have a higher protein intake (SDG 2 & 3). Also, increased fishing would give the fishers more economic gain, which could trickle down into the community, helping poverty alleviation (SDG 3).

Seeing as marine diversity is integral to Senegal's Development, environmentally, economically, and socially, the CFI should support the implementation of the TBEC and CRF in Senegal to overcome overfishing and protect marine ecosystems.

1. Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* **14**(2): 32. [online] URL: <http://www.ecologyandsociety.org/vol14/iss2/art32/>
2. Steffen, W. et al., 2015. Planetary boundaries: Guiding human development on a changing planet. *Science*, 347(6223), pp. 5-6.
3. Stachowicz, J. J., Bruno, J. F. & Duffy, J. E., 2007. Understanding the Effects of Marine Biodiversity on Communities and Ecosystems. *The Annual Review of Ecology, Evolution, and Systematics*, Volume 38, pp. 739-766.
4. Mace, G., H. Masundire, J. Baillie, . 2005. Biodiversity. Pages 79–115 in H. Hassan, R. Scholes, and N. J. Ash, editors. *Ecosystems and human wellbeing: current state and trends*. Island Press, Washington, D.C., USA.
5. Byrnes JE, Reynolds PL, Stachowicz JJ., 2007. Invasions and extinctions reshape coastal marine food webs. *PloS ONE* 2(3):e295
6. Food and Agriculture Organization of the United Nations. (2018). The state of world fisheries and aquaculture: Meeting the sustainable goals. Retrieved from <http://www.fao.org/3/i9540en/i9540en.pdf>
7. CGS Global Education, 2021. *Overfishing in Senegal*. [Online] Available at: <https://ccsglobaled.com/overfishing-in-senegal/> [Accessed 12 April 2021].
8. Blicharska, M. et al., 2019. Biodiversity's contributions to sustainable development. *Nature Sustainability*, 2(1083-1093), pp. 1083-1090.
9. Byrnes JE, Reynolds PL, Stachowicz JJ., 2007. Invasions and extinctions reshape coastal marine food webs. *PloS ONE* 2(3):e295

10. Jönsson, J. H., 2019. Overfishing, social problems, and ecosocial sustainability in Senegalese fishing communities. *Journal of Community Practice*, 27(3-4), pp. 213-230.
11. Gouilletquer, P., Gros, P., Boeuf, G. & Weber, J., 2014. The Importance of Marine Biodiversity. *Biodiversity in the Marine Environment*, Volume 1, pp. 1-13
12. Diedhiou, I. & Yang, Z., 2018. Senegal's fisheries policies: Evolution and Performance. *Ocean and Coastal Management*, Volume 165, pp. 1-8.
13. FAO. (2010). Report of the FAO/UNEP Expert Meeting on Impacts of Destructive Fishing Practices, Unsustainable Fishing, and Illegal, Unreported and Unregulated (IUU) Fishing on Marine Biodiversity and Habitats. Rome, 23–25 September 2009. FAO Fisheries and Aquaculture Report. No. 932. Rome.
14. Acemoglu, D. & Robinson, J. A., 2012. Why Nations Fail Today: the origins of Power, Prosperity and Poverty. In: *Why Nations Fail Today*. New York: Crown Publishers, pp. 620-677.
15. USAID, 2016. Fishing for Food Security. The Importance of Wild Fisheries for FoodSecurity and Nutrition. pp.
56.http://pdf.usaid.gov/pdf_docs/PA00M1T3.pdf, Accessed date: 17 August 2010.
16. *Sea Around Us: Fisheries, Ecosystems & Biodiversity, 2014. Mapped Data - Senegalese Fisheries. [Online]*
Available at: <http://www.seaaroundus.org/data/#/spatial-catch?entities=157>
[Accessed 20 April 2021].
17. Nguyen, K. T., 2012. *What are the consequences of overfishing in WestAfrica, and how can sustainable and flourishing fisheries be promoted?*, Agder: University of Agder
18. Ostrom, E., 1990. *Governing the Commons: The Evolution for Institutions for Collective Action*. 2015 ed. Cambridge: Cambridge University Press.
19. 2045789., 2021. *Overfishing in Senegal: How to Protect Marine Ecosystems*. GSD Policy Brief. University of Warwick.

20. Dörrie, P., 2015. A land fo plenty or plenty of illusions: Development and natural resources in Senegal. *Offiziere.ch*. Senegal. [Online] Available at: <https://www.offiziere.ch/?p=20062> [Accessed 29 April 2021].

