

Women's Inclusion in Senegal's Rapidly Transforming Rice Sector

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Abstract

While some scientists and policy makers recognize women's centrality in Senegalese rice production, many among them conceptualize women as unskilled labor rather than as keepers of knowledge. This could not be further from the truth. Women's expertise represents a deep well of agronomic knowledge about rice, passed down over generations. Ignoring this knowledge not only takes away from women's power in rice, it also holds modern rice production back from its true potential. National investments in Senegal's rice sector have primarily focused on irrigated rice production of *Oryza Sativa* in the Senegal River Valley, but *Oryza Glaberrima* cultivars bred by West African women for 3000 years can survive in sub-ideal soils, resist drought brought on by climate change, and match local taste and texture preferences. Using a systematic review of 94 secondary sources, this thesis argues in favor of 1) incorporating women's indigenous knowledge into agricultural research and development; 2) increasing women's representation in agricultural degree programs; and 3) addressing gender bias in agricultural research as key strategies toward creating a more equitable, ecologically sustainable and economically prosperous future for Senegal's rice sector. Women's inclusion is an economic imperative; the indigenous knowledge that women hold on rice cultivars and management practices can make the rice sector financially sustainable by preventing ecological problems like excess soil salinity. The human capital that women represent will be needed to sustain high yields in modern operations, and their power as consumers and decision makers for rice purchases make women gatekeepers of domestic rice profits.

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Introduction, Frameworks, and an Overview of Women and Rice in Senegal

Introduction

I wrote this thesis to tell a story about the value of Senegalese women's knowledge in rice and how it has been systematically dismissed and ignored in the last century. Women historically have been keepers of rice knowledge in Senegal but up to today are excluded from national investments in the rice sector. There have been many efforts to include women more in recent years, both on the part of the Senegalese government and civil society organizations, but they often focus on women's labor and not their intergenerational agricultural knowledge. I argue in favor of 1) incorporating women's indigenous knowledge into agricultural research and development; 2) increasing women's representation in agricultural degree programs; and 3) addressing gender bias in agricultural research as key strategies toward creating a more equitable, ecologically sustainable and economically prosperous future for Senegal's rice sector.

First, I will explain the frameworks which have guided my thinking. Then I will give an overview of women's roles in rice to demonstrate their centrality as decision makers for rice production. From there, I will provide historical context in order to explain how policies under colonialism and afterwards have transformed the rice sector, and how events like the 2008 food price crisis have pulled the Senegalese government towards its National Plan for Self

Sufficiency in Rice (PNAR). This historical context will finish in the present, as more shocks like COVID-19 and climate change continue to shape the policy environment.

At this point, we will dive into the PNAR policy itself, with its focus on irrigation and double cropping, and the industries that are growing under its investments. These growth industries are becoming more specialized, and their workforce more educated. PNAR is also increasingly recognizing the importance of qualitative considerations like texture and taste, and I will explain how women's power as consumers must be respected if domestic rice is going to compete with imports.

From here, we will focus on the current reality for women in the rice sector, their challenges and barriers to participation in growth industries, and current efforts to address these barriers. This will culminate in a discussion of women's representation in agricultural degree programs. However, representation on its own is not enough: I explain how gender bias in agricultural research and development must be addressed by changing the units that we use. Finally, I argue that whether you approach this from an equity standpoint or an economic one, if PNAR is to be maximally successful it must learn from women's indigenous knowledge of rice production.

Frameworks and Approaches

There are several crucial concepts that can help make sense of the history of women's power in rice in Senegal and the realities that they face today.

Intersectionality

Intersectionality is necessary for understanding women's experiences in Senegal's rice sector. Intersectionality means acknowledging that people's experiences are the products of their individual intersections of multiple identities, some which might work to their advantage and some which might lead to their marginalization. An intersectional approach is one that values

nuance over simplification and acknowledges that different identities take precedence in different situations for any one person.

There are several ways to approach the framework of intersectionality. Kimberlé Crenshaw was one of the first feminist scholars to write on this concept, focusing on women of color. For issues like gender based violence, Crenshaw highlighted the necessity of understanding peoples' experiences within the context of larger power structures which affect them at their intersections of identities: particularly intersections of gender and race. She argued that movements which addressed women as a monolith group were still privy to these overarching power structures, which led (and still leads) to the marginalization of women of color and a lack of attention to their needs even in explicitly feminist spaces (Crenshaw 1991).

In his article on education-related identities, James Paul Gee described four types of identities: nature identities, or those developed from forces in nature (such as being biologically female); institution identities bestowed by authorities, such as being a doctor of science once you are granted your PhD; discourse identity, which forms from internal traits that one values like being kind or ambitious; and finally, affinity identity, which refers to identities from being in a group such as an ethnic or religious group (Gee 2000). These identities can sometimes be in conflict, and the identities that take precedent depend on the situation, often leading to unexpected outcomes for policies and projects that target women as a group.

Also, these identities have additive properties; they can be more than the sum of their parts. For example, being a Diola woman is fundamentally different than just being a woman plus being someone from the Diola ethnic group. These identities combine to form a unique, third identity (Diola woman) that has its own prescriptions on how to conduct oneself. It is especially important to note here that conceptions of gender are inextricably tied to culture. International development projects often assume a Eurocentric system of genders and sexualities. In reality, however, the gender categories that people are placed in and the roles that they accordingly play are very diverse and community specific, as well as continually

evolving, and even the 'nature identities' described by Gee are not clear cut or universal (Amadiume 2017).

As will be detailed in the section on land access, specific ethnic group governance systems around land are especially important and often overlooked in rice project design and policy, as are differences between single, married, and divorced women (Soukèye 2003). Projects and policies that treat women as a homogeneous group not only risk failure but might deepen unequal power structures. Similarly, projects and policies that focus on smallholder farmers as a monolithic group, ignoring differences between genders and ethnic groups, are sure to exacerbate existing inequalities.

Niang and colleagues in 2017 explained the nuance of women's access to land in Senegal, which necessitates an intersectional way of thinking:

"This is not to say that all women are in the same economic position. Some do manage to acquire land, and some become major producers. Nor is it true that Senegalese women are always marginalised in land management; a number of more egalitarian societies, such as the Diola in southern Senegal, recognise land rights that pass from mother to daughter, especially for rice fields." (Niang et al. 2017).

A study published in 2000 by Oumar Cheikh Ba with the Council for the Development of Social Science Research in Africa emphasized that even within ethnic groups, gendered divisions of labor can be diverse: "We have seen that in terms of land tenure and gendered division of labor, the same ethnic group living in different environments can develop different adaptation strategies"(Oumar BA 2000) [Translated from French].

A 2016 study on the dissemination of information for climate smart agriculture in rural Senegal added considerations of age into the picture. In some communities in the study, senior men would not speak in discussions about seasonal forecasts in which their daughters-in-law were present, because they were not allowed to directly address them. The authors explain, "Here, it is not just men, but senior men who experience this constraint, suggesting that the

identity associated with this constraint is not simply 'man,' but instead the intersection of the expectations associated with being a man and those associated with being 'senior'"(Carr, Fleming, and Kalala 2016).

Taking an intersectional approach means making projects and policies more participatory, trusting that beneficiaries understand their own nuanced needs and realities best, allowing for flexibility, and being as inclusive of different types of rice farming and farmers as possible. While this is much easier said than done, Gengenbach and colleagues in their 2018 paper, *Limits of the New Green Revolution for Africa* gave a practical recommendation:

"We find the concepts of 'gender subjectivities' and 'different lived experiences' to be more useful than the notion of 'closing the gender gap' for analysing women's participation in GR4A [Green Revolution for Africa] projects"(Gengenbach et al. 2018).

In agricultural research and development, an intersectional approach means valuing qualitative research that reveals lived experiences alongside quantitative research. Quantitative studies have been privileged in the agricultural sciences, but quantitative and qualitative data together are more than the sum of their parts, and including qualitative methods in research can lead to more nuanced understanding and equitable outcomes.

Intersectionality has been enthusiastically adopted in some scholarships but is lacking in others, especially for studies of work and employment (McBride, Hebson, and Holgate 2015) and agronomy. This approach is crucial if women are to be truly included in transformations of Senegal's rice sector. Intersectionality means dismantling silos between fields of research and accepting a larger and more complicated reality.

Gender Blind Versus Mainstreamed Versus Transformative

Policy makers and practitioners, especially in the international development sector, have evolved over the last 40 years in how they consider gender in their work. Gender mainstreaming, or the inclusion of gender considerations in every project and policy, has

become the norm. This has certainly led to more equitable outcomes than gender biased or gender neutral projects, which often exacerbate structures of inequality because they fail to take gender into account. However, gender mainstreaming is not sufficient for women's inclusion. Simply including a gender component does not mean that a project or policy is gender transformative, and transformation is the key to creating true equity. A 2015 working paper from the non-governmental organization CARE International explained that, "Gender-transformative approaches aim to move beyond individual self-improvement among women and toward transforming the power dynamics and structures that serve to reinforce gendered inequalities" (Hillenbrand et al. 2015). Gender transformation means structural change--paradigm shifts in how we value women's contributions to society.

Over the course of this thesis, I will argue that gender biased or sometimes blind policies have led to women's exclusion in Senegal's rice sector. While many projects and policies in the rice sector today have gender components, they are not transformative enough. I argue that true transformation will require increasing women's representation in agricultural higher degree programs, addressing gender bias in agricultural research, and incorporating women-held indigenous knowledge into projects and policies.

Either/or Thinking versus Both/and: Moving Beyond Binaries

West African governments have faced enormous external pressure to adopt policies that are often framed in terms of a binary: invest in universal "best practices" for modern agriculture, or your farmers will be stuck in poverty, at the mercy of climate change, and unable to compete with imports from countries that have already escaped one side of the binary and entered the other. The binary that I am referring to is the platform of the Green Revolution for Africa (to be discussed in depth later on) versus a characterization of 'traditional' agriculture as doomed subsistence farming.

This kind of binary thinking is common in debates about self sufficiency and free trade. Economists, especially those at international institutions like the World Bank and International Monetary Fund, often frame choices in terms of self sufficiency coming from complete autarky (closed economies) versus completely open trade, and any agricultural protection like tariffs is painted as a step towards the former (Anderson and Nelgen 2012). These economists argue that it is not necessary to be self-sufficient in staple foods through domestic production, and import dependency is a non-negative feature of complete free trade policies. As Jennifer Clapp argued in 2017,

“These broad swipes against food self-sufficiency are presented in a binary way, comparing complete autarky to an ideal trading system with no distortions. Often these kinds of strong rhetorical statements mask what is a much more complex situation upon a closer look. [...] A more open and nuanced policy dialogue on food self-sufficiency could create space for an objective assessment of the types of circumstances under which some governments may wish to pursue it as a policy goal. For most countries, the choice and mix of policy tools for their food and agriculture sector depends on their own unique circumstances” (Clapp 2017).

This binary framing of trade liberalization versus food self-sufficiency is especially egregious because of the long history of protectionism in the Global North which continues up to this day. Such protectionism includes any policy that shields producers from global competition, such as subsidizing domestic agriculture or restricting food imports. In the United States, for example, government subsidies in 2020 accounted for 39% of net farm income ([Abbott 2020](#)). Critics coming from the Global North where such subsidies are common accuse countries in the Global South of autarky when they enact similar protections. Imbalances in allowances for agricultural protections have been institutionalized in global trade agreements, and were a central theme in the Uruguay (1986-1993) and Doha (2001-2006) rounds of negotiation for the General Agreement on Tariffs and Trade (GATT) from the World Trade Organization ([Martin 2018; Clapp](#)

[2012](#)). The Doha negotiations were suspended in 2006 without resolution, and there has not been another round of global negotiations since then (ibid.). The roots of these imbalances come from the structural adjustment era which will be discussed in more detail later on in the section on historical context. Binary approaches to trade have obscured some of these dynamics.

Binary thinking has also limited our understanding of agriculture. As will be discussed later on, the Green Revolution for Africa entails a specific set of priorities, policies, and investments for modernizing agriculture. Senegal along with many other countries in West Africa adopted this approach about 30 years ago. In the last decade, however, the government of Senegal has moved away from the pieces of this approach that have not been working and has allowed for more inclusivity. Instead of pushing for all rice farmers to become large scale, irrigated contract farmers, a recent interview with Waly Diouf, coordinator of PNAR, emphasized developing technologies for all kinds of producers including rainfed producers that continue traditional practices (*Waly Diouf, Coordinateur, PNAR, L'expérience Réussie de l'Anambé* 2019). Senegal has recognized that governments do not need to comply with binary ideologies that push them to either adopt this package of reforms wholesale or not modernize their agriculture. This is a step in the right direction, but binary frameworks are still deeply embedded in agricultural policy and international development. As I argue here, we need a more flexible approach.

A central theme to this thesis is moving beyond binary frameworks: away from either/or thinking and towards both/and. This is inherently a feminist issue, because women rarely fit neatly into the binaries that have become entrenched in rice sector projects and policies. As will be described in more detail in the section, “The Units We Use”, allowing for more flexibility and more than two options in development measures is necessary to not just include women but to acknowledge the value of their labor.

Throughout this thesis, you will find tensions between the push to increase rice yields as much as possible in order to escape import dependency, and the need to make the rice sector more equitable and ecologically sustainable. These do not need to be competing interests. Women's inclusion is an economic imperative; the indigenous knowledge that women hold on rice cultivars and management practices can make the rice sector financially sustainable by preventing ecological problems like salinity (to be detailed later on). The human capital that women represent will be needed to sustain high yields in modern operations, and their power as consumers and decision makers for rice purchases make women gatekeepers of domestic rice profits.

Overview of Women and Rice in Senegal

Women in West Africa have held power in rice for most of its history. While most people globally grow and eat *Oryza Sativa*, a rice variety that was first domesticated in Asia, another variety of rice called *Oryza Glaberrima* was independently domesticated in West Africa about 3000 years ago (J. A. Carney 2009; Linares 2009; Choi et al. 2019). There is a huge variety of cultivars of *O. Glaberrima* in West Africa, reflective of the diversity of ecological environments in which rice has been grown for millenia (Barry et al. 2009).

In Senegal, irrigated rice production of *O. Sativa* is concentrated in the Senegal River Valley, and in other regions, people still mostly grow traditional varieties of *O. Glaberrima* (Colen, Demont, and Swinnen 2013). For non-irrigated rice, women are still responsible for most operations in rice production, especially processing (Colen, Demont, and Swinnen 2010; 2013; Linares 2009). A 2003 paper from the National Network of Rural Women in Senegal reported that women made up 60% of the rural workforce and 70% of labor in subsistence agriculture, primarily for rice (Soukèye 2003).

While gendered divisions of labor vary among rice growing societies in West Africa, generally during the period before colonialism women were responsible for most of the tasks of rice production. As Judith Carney wrote in her book *Black Rice*:

“Female labor is central to the cultivation of rice throughout West Africa, either as a crop that women alone grow or through the specialized agricultural tasks that they alone perform. The Diola of Casamance, Senegal, refer to rice cultivation as a ‘woman’s sweat’ while the Serer of Senegambia note the importance of female labor in all foodstuff processing by placing the deceased’s mortar and pestle on her grave” (J. A. Carney 2009).

While some scientists and policy makers who write about rice in Senegal recognize women’s centrality, many among them conceptualize women as unskilled labor rather than as keepers of knowledge. This could not be further from the truth. Women are traditionally responsible for seed selection, weed management, planting and transplanting seeds, and processing harvested rice in most West African communities (J. A. Carney 2009; J. Carney 1993; Linares 2009). They select seed not just for characteristics like taste and ease of cooking, but also for its ability to grow in different ecological conditions at different times in the growing season. These decisions ensure that crops mature in sequence, spreading out labor obligations. There are *O. Glaberrima* cultivars selected for their ability to resist salinity, drought, and high iron toxicity, and cultivars that grow in both deep and shallow flooding (J. A. Carney 2009).

Women’s expertise represents a deep well of agronomic knowledge about rice, passed down over generations. Ignoring this knowledge not only takes away from women’s power in rice, it also holds modern rice production back from its true potential. A 2020 economic study on the impacts of access to credit for irrigated rice producers in the Anambe Basin of Senegal found that female rice farmers were significantly more efficient in production than their male counterparts. The authors noted that similar results were found in past studies in 2002 and

2008, but did not explore why. Later in the paper they described the dominance of men in irrigated rice:

“In terms of gender, most surveyed farmers are males (67.31%) while female farmers account for 32.69%. This finding is consistent with the typical setups in rural Africa where most households are dominated by males.” (Diallo et al. 2020)

Studies like this accept and assume male authority in rice operations without question, ignoring the long history of rice as a woman’s crop in Senegal. I am not suggesting that the authors did this intentionally, only that their training in plant science contained gender bias, which will be explained further in the section, “Gender bias in Agricultural Research and Development.”

In the next section, I demonstrate how colonial and postcolonial interventions undermined the central roles that women played in rice cultivation in Senegal since *O. Glaberrima* was first domesticated.

Historical Context Leading up to the National Plan for Self-Sufficiency in Rice

The following sections discuss the history of rice production in Senegal during and after colonialism, leading up to the Green Revolution in Africa approach which has taken hold in Senegal’s rice sector and across West Africa. This approach has deep parallels to the extractive agricultural policies and projects enacted under French colonialism. As Decker and McMahon argue in their 2020 book, *The Idea of Development in Africa*, “development ideas and practices in Africa arose directly out of imperialism, colonialism, and neocolonialism” (Decker and McMahon 2020).

This is a history of structural and top-down transformation. However, it is important to understand that changes in rice production imposed by colonizers, development organizations, transnational companies and governments have not occurred without resistance and negotiation from smallholder farmers (J. Koopman 2012b; 2012a). Especially outside of the Senegal River

Valley, most rice growing communities persist in producing rice using indigenous varieties and practices (Linares 2009; Colen, Demont, and Swinnen 2010; 2013).

Women have not been passive victims, even though this process has tried to take away their power in rice. Gender norms have been in a constant state of negotiation and articulation (Gengenbach et al. 2018). This is central to critiques of the “feminization of agriculture”, or the recent recognition from international institutions that women make up large shares of agricultural workforces. Feminist political ecologists like Kaitlyn Spangler and Maria Elisa Christie argue that focusing on women as laborers instead of recognizing their dynamic decision-making processes in heterogeneous households is a problematic oversimplification of their contributions to agriculture (Spangler and Christie 2020). Furthermore, the recent ‘feminization of agriculture’ scholarship, by arguing that women should be brought into the fold of agricultural projects today, belittles the reality that they have been inventors of technologies and producers of knowledge since the beginning of agriculture itself. Especially for rice systems in West Africa, women have been the primary engineers of innovations since rice was first domesticated. As such, the existing knowledge base about *Oryza Glaberrima* is not just indigenous knowledge but women’s knowledge.

This process of dynamic negotiation and the tenacity of women’s indigenous knowledge about rice create opportunity. Rice production systems in Senegal can become more equitable and ecologically sustainable if women are included in the modernization process, as long as this process utilizes and respects the knowledge and power that they have held for thousands of years. Food sovereignty movements have long called for incorporation of indigenous knowledge as part of self-sufficiency efforts in Latin America (Altieri and Toledo 2011), but this push has been less prominent in West Africa, despite the importance of self sufficiency to national governments in the last 20 years.

Colonialism and Rice (~1895-1960)

Colonialism changed gendered divisions of labor in rice in Senegal and overhauled customary (indigenous) systems of land tenure. It forcefully reoriented Senegalese agriculture towards export, while at the same time building the foundation of import dependency on rice. Colonialism also marked the beginning of large-scale irrigation projects, particularly in the Senegal River Valley, that specifically targeted male beneficiaries. After independence, this trend would continue, with 90% of irrigation subsidies going to male heads of households in the 1970's and 80's (J. E. Koopman 2009).

Although women held a lot of power in rice before colonialism, some tasks for rice production were traditionally men's domain in most ethnic groups. However, colonialism made the gendered divisions of labor in Senegalese rural societies more rigid, because men were recruited into contract farming of cash crops for export, leaving women responsible for growing food for household consumption. Judith Carney and Michael Watts, in a study on rice and Mandinka gender relations in the Senegambia explained, "The burden men were able to shed in food production was shouldered by their wives, mothers, and daughters"(J. Carney and Watts 1991).

The French colonial government implemented a head tax on male citizens in order to push men into the wage labor market (Decker and McMahon 2020). Each household was required to pay taxes in the colonial currency, and wage jobs were reserved for men under European style patriarchy. This had profound gender implications, because it was primarily young men that would leave home to earn wages as seasonal laborers, while women were left to grow food for the household, entrenching the division of men growing cash crops and women growing food crops. Traditional divisions of labor were fundamentally changed, and women both gained and lost power in the process. Their labor obligations ballooned, and there was a rise in 'female-headed households', in which women gained some decision making authority as men left to do migratory work. At the same, women took on the burdens of clearing land, tending to farms, and harvesting – work that previously had been shared with men.

Colonialism and land tenure:

Colonialism laid the foundation of modern Senegalese land tenure systems that give ultimate power to the state while still imposing a European patriarchal paradigm onto customary systems of governance. A 2016 study on land inheritance practices among the Serer people of Senegal noted that traditionally, Serer people had both matrilineal and patrilineal forms of inheritance in their governance structure (Evans 2016). However, the colonial process of codifying customary law discouraged matrilineal inheritance and pushed them into patrilineal forms of both inheritance and property holding, reducing women's access to land (ibid.). There is some evidence in the literature from Ghana that women's access to land has historically been greater in matrilineal systems (Amanor-Wilks 2009). While matrilineal inheritance does not guarantee women's land access, the enforcement of strict patrilineality under colonialism surely weakened women's land rights among some communities in Senegal. Additionally, systems of land stewardship that did not fit neatly into the colonial paradigm of individual property rights were forced into this model, which usually meant assigning previously collective ownership of land to men.

Colonial policies also influenced Senegal's mandate that almost all land officially belongs to the state. The French administration first codified customary law for land tenure, but eventually mimicked Australia's Torrens system, named after an 1858 law that declared territory occupied by indigenous Australians to be "res nullius" or nobody's property (Niang et al. 2017). Starting in the early 1900's, this concept was applied to French West Africa, and colonial authorities claimed that all land was vacant and ownerless (ibid.) This was the framework for Senegal's current land law. The 1964 Law on National Lands classifies 95 % of Senegalese land as national domain to be administered by the state (Sutz et al. 2019). As will be discussed further on in the section on land tenure, this has paved the way for land grabs from private

transnational companies. In practice, most rural land in Senegal is distributed under customary law, but the state can overrule this distribution and sell land that is in the national domain.

Colonial Irrigation Schemes:

Large scale, industrial irrigation schemes, especially in the Senegal River Valley, were first introduced by the French colonial government. These projects were gender biased; they did not consider women and directly targeted men as the decision-makers for rice operations and beneficiaries of irrigation schemes. In doing so, they enormously intensified women's workloads across many ethnic groups. For example, Mandinka women have historically been responsible for the majority of rice production tasks. So, when irrigation schemes allowed producers to start double cropping, or growing rice not only in the rainy season but also in the dry season with irrigation, this effectively doubled women's labor obligations (J. Carney 1993). Male heads of household were recruited to clear land for irrigation infrastructure and were then granted control over the property, despite their lack of participation in many of the tasks of rice production:

“The irrigation projects were predicated on the capacity of household labor resources, male and female, to meet year-round cropping schedules. Yet the development missions, obsessed with the technical aspects of irrigation, largely ignored the Mandinka social relations of production. Each mission assumed that farm families adhered to a joint utility function in which men and women labored equally for mutual household objectives, never questioning whether they would share the labor burden or income benefits.”(J. Carney and Watts 1991).

Some ethnic groups had more balanced divisions of labor in rice, but the overarching impact of these gender blind infrastructure schemes was to give men end rights to the improved parcels of land and the income that they generated, while increasing women's obligations and undervaluing their labor. As will be discussed in the section on gender bias in agricultural

research and development, this is part of a long history of conceptualizing women as free labor in households that continues up to today.

Setting the foundation for import dependency and forming consumer preferences:

Before colonialism, rice was produced for household consumption in rural areas, but shared the role of staple food in Senegal with other grains such as sorghum and millet. However, as they pushed farmers to switch from rice to growing peanuts for export, the French began importing cheap broken rice from Asia in large quantities to keep food prices under control, since the loss of domestically produced rice would have led to a shortage (Demont et al. 2013). Broken rice is rice in which the grains have been broken apart during processing, so they are much shorter than long-grain rice. It is generally cheaper to process broken rice than long-grain rice. This imported rice was also necessary to feed a growing population of seasonal migratory workers who were recruited to work on commercial export operations (Meunier 2017).

This changed the consumption preferences of the Senegalese population, especially in urban areas; despite its reputation as the cheapest and lowest grade form of rice in global markets, Senegalese consumers continue to prefer broken rice from Southeast Asia over other varieties (Colen, Demont, and Swinnen 2013). Trade policies encouraging imports of rice continued after independence, and have been a key factor in the continued import dependency that the government of Senegal is trying to escape with its National Plan for Self-Sufficiency in Rice.

Trade Liberalization and Structural Adjustment (1980's and 1990's)

In the wake of colonialism's political, and economic destruction, depleted from decades of resource extraction, newly independent governments borrowed from international financial institutions to rebuild and keep their economies afloat. This led to a debt crisis in former colonies in the 1970's and 1980's (Decker and McMahon 2020). In addition, in the early 1970's the Sahel

region including Senegal experienced severe and devastating droughts and famines which pushed them further into debt (Mousseau, Frederic 2011). In the 1980's and 1990's, economists at the International Monetary Fund (IMF) and World Bank enforced neoliberal free trade policies in former colonies by making these political reforms contingent to debt forgiveness. This process, called structural adjustment, has been criticized heavily for its impacts in Africa with scholars asserting that in this era, "Foreign governments and international institutions replaced imperial powers as the puppet masters of African economies" (Decker and McMahon 2020).

The trade liberalization policies enforced by the IMF and the World Bank entailed dismantling agricultural protections like subsidies, tariffs, or other government programs to shelter Senegal's rice producers from global competition. A 2001 press release from the IMF explained how international financial institutions shaped government policies in former colonies:

"The debtor country will need to demonstrate the capacity to use prudently the assistance granted by establishing a satisfactory track record [...] the IMF and IDA [International Development Association] grant interim relief, provided that the country stays on track with its IMF- and IDA-supported program" (International Monetary Fund 2001).

In Senegal, the Agricultural Sector Adjustment Program eliminated all price control policies and all agricultural subsidies, to be phased out by 1989 (A. Seck 2016). The state stopped its rice processing and marketing programs in 1994 and liberalized its trade policies in 1995 (Colen, Demont, and Swinnen 2010). Structural adjustment deepened Senegal's import dependency on rice as domestic rice farmers went out of business. Unsubsidized farmers in Senegal could not compete with large scale, subsidized and mechanized rice farming in Southeast Asia (J. Koopman 2012b; A. Seck 2016). These policy changes intensified the phenomenon of urbanization as farmers left untenable agricultural operations to pursue work in cities (Bezemer and Headey 2008).

Structural adjustment also, when dismantling programs in agriculture, intensified a disbalance in government allocation of resources between rural areas and cities in Senegal. This is called urban bias, and it has shaped the economies of most former colonies who went through the structural adjustment process (ibid.). Urban bias led to policies that supported rice imports to keep prices low for urban consumers, at the expense of the livelihoods of rural producers (Demont et al. 2013). Promoting rice imports to ensure the food security of the urban poor is a strategy that would fail, however, during the 2007/2008 global food price crisis.

The 2008 Food Price Crisis

The 2007/2008 food price crisis was a turning point for agricultural policy in West Africa. It broke through the enduring legacy of structural adjustment as governments realized the failures and consequences of extreme trade liberalization and urban bias. In turn, it brought food self-sufficiency to the forefront of policy agendas, particularly for staple foods that the urban poor depend on like rice (Mousseau, Frederic 2011). In 2007 and 2008, rice prices in West Africa rose by rates ranging from 50 to 100 % (Mbaye et al. 2018). The price of imported rice in Dakar rose from 220 CFA per kilogram in August 2007 to 469 CFA per kilogram in September 2008: more than doubling (Takahashi 2011). This led to increased food insecurity and violent riots in Dakar (Babou Diallo and Dierke Köpp 2011). This crisis was caused by a confluence of factors outside of the control of countries like Senegal, such as: ethanol subsidies in the United States which diverted grain away from world markets, driving prices up; and rice exporting countries applying export bans in order to protect their own self-sufficiency in staple foods (Anderson and Nelgen 2012). Scholars like Jennifer Clapp argue that it was caused in large part by the increasing commodification of agricultural goods in global financial markets, so that speculation in these markets intensified price volatility (Clapp 2012).

This crisis revealed the fragility of a rapidly urbanizing country's food system under extreme import dependence on its most important staple food. In 2008, Senegal was importing

80 % of the rice that it consumed (J. E. Koopman 2009). The government, seeing world rice prices skyrocket, quickly subsidized fuel and fertilizer for rice by 70%, which resulted in a 60% increase in production for the 2008 dry season (ibid.). This was the first time since structural adjustment that the government had so heavily subsidized its rice sector. In direct response to the 2008 food price crisis, the Senegalese government launched the National Plan for Self Sufficiency in Rice (PNAR) as part of its Grand Agricultural Offensive for Food and Abundance (GOANA) (Takahashi 2011; Hathie 2011). PNAR was designed to increase rice production in order to escape import dependency and avoid a repeat of 2008.

Dzodzi Tsikata and Dede-Esi Amanor-Wilks wrote in *Feminist Africa* as the crisis was happening:

“The discourses on the crises have identified rural women and the poor as those likely to experience its worst effects [...] What is different this time, though, is the growing recognition that the removal of subsidies on agricultural inputs, the closure of state-owned crop marketing agencies, the low level of public investment in the food sector and agricultural infrastructure, the lack of attention to access and equity in market-led reforms in labour and land tenure policies – all policies instituted in the early 1980s – cannot deliver agrarian transformation and industrialisation” (Tsikata and Amanor-Wilks 2008).

This history was not restricted to Senegal. By 2008, many countries in West Africa had become import dependent on rice after being colonized and then going through structural adjustment, including Nigeria, the country with the largest population in Africa. In an early push for rice self sufficiency, Nigeria first banned rice imports from 1986 to 1995 (Rahji and Adewumi 2008). They lifted the ban in 1995 because of its ineffectiveness in the face of illegal trade in imported rice between Nigeria and its neighbors, but also because:

“There was extended pressure from the international financial organizations, such as the World Bank, World Trade Organization, and the International Monetary Fund (IMF) who

argued that the ban on rice was not in consonance with the liberalization position of the government” (Emodi and Madukwe 2008).

Nigeria re-introduced its rice import ban in 2003/2004 under President Obasanjo (Rahji and Adewumi 2008). However, it was still ineffective in securing rice self-sufficiency. The costs of policing borders were enormous, and despite Nigeria banning rice imports from Benin in 2004 and from all of its neighbors in 2016, illegal, informal trade in imported rice has continued to this day (Orjinmo 2019). In 2019, the World Bank reported that informal re-export and transit trade with Nigeria represented 20 % of Benin’s gross domestic product (ibid.).

Both Nigeria and Senegal have faced regional pressure to liberalize their trade policies in rice. Founded in 1975, the Economic Community of West African States has played an important role in regional trade agreements and the alignment of its member states’ economic policies. ECOWAS has implemented member agreements for the free movement of goods over borders in West Africa and for common external tariffs for goods like rice (Mousseau, Frederic 2011). Since 2000, Senegal has adhered to the ECOWAS common external tariff of 12.7 % for rice imports (Colen, Demont, and Swinnen 2010). In contrast, Nigeria implemented a tax of 70% on imported rice in 2013, and broke ECOWAS free trade agreements when they banned rice imports from Benin and others. In 2014, Benin lowered its tariffs on rice imports from 35% to 7%, and the large differential between their tariff level and Nigeria’s made illegal trade in rice imports even more lucrative (Orjinmo 2019).

It became clear after the 2008 food price crisis that isolated protectionist price policies like import bans and high tariffs were not effective in reducing import dependency when surrounded by countries with open borders. However, the problem remained that domestic producers could not compete with highly subsidized and mechanized rice farmers in Southeast Asia. In a 2008 volume of *World Development*, Dirk Bezemer and Derek Headey wrote, “Urban biases originating within LDCs [least developed countries] are compounded by protectionism in the international trade regime resulting from an ironic “rural bias” in the political economy of

OECD countries [member countries of the Organisation for Economic Co-operation and Development]” (Bezemer and Headey 2008).

Thus, West African governments were called to action for rice self-sufficiency after the 2008 crisis but were unable to effectively block imports. Thus, they moved forward with a strategy of subsidizing their domestic rice sectors to produce enough rice to compete with exporting countries.

The Green Revolution for Africa and National Plan for Self Sufficiency in Rice

Starting in 2008, Senegal’s National Plan for Self Sufficiency in Rice focused its immediate goals on increasing rice area under production and yields to meet domestic consumption demand. Senegal is still not self-sufficient in rice, but production has enormously increased since 2008. The volume of rice produced domestically increased by 119% between 2007 and 2014. The volume of milled rice produced went from 415,000 tonnes in 2014, to 634,000 in 2015 and 750,800 tonnes in 2017 (Commodafrica 2017; Soullier and Moustier 2019; Mohapatra 2017). This policy has consistently evolved and improved over time, but a guiding framework behind it and many other West African countries’ strategies for rice self sufficiency is the Green Revolution for Africa. Senegal, like many other West African countries, openly embraced the Green Revolution for Africa approach by institutionalizing it in regional governing bodies, incorporating it into national strategies and partnering with organizations like the Alliance for a Green Revolution in Africa.

The Green Revolution for Africa is a package of policies, investment areas and strategies for agricultural modernization that has been widely adopted in West African countries since 2008, especially for staple crops like rice (Gengenbach et al. 2018). There is enormous pressure on West African governments to adopt this approach, thanks to the cohesion of regional institutions and the fact that historically, food security has been protected in cases of bad harvests in one country by importing rice from another country in the region (Mousseau,

Frederic 2011). Like colonial policies, this approach supports large scale, industrial contract farming for export. It privileges the private sector and promotes the use of high intensity inputs, often imported themselves from transnational companies outside of Senegal (J. E. Koopman 2009). In this way, although the Green Revolution for Africa platform supports Senegal's objective of rice self-sufficiency, countering free-trade pressure from the World Bank and IMF, it also perpetuates the same extractive economic systems that were established in the colonial era.

Senegal faces both regional and continent-wide pressure to adopt this set of policies and priorities. Founded in 2006 and funded by the Bill and Melinda Gates Foundation and the Rockefeller Foundation, the Alliance for a Green Revolution for Africa (AGRA) has promoted this approach across the continent (Opiyo 2021). AGRA has been led by Agnes Kalibata since 2014 (ibid). Although it has female leadership, I will argue that this institution and the approach that it promotes has largely been gender blind or mainstreamed but not gender transformative. It assumes that its changes to smallholder farming will uplift both men and women, but in fact they have historically continued the process of taking power away from women and given it to men in Senegal's rice sector. Kalibata described the Green Revolution for Africa's impacts in 2021:

“AGRA was designed to help African farmers use scientific knowledge and technologies to improve their lives: increase access to improved varieties, access to soil fertility management and understanding the policy environment where agriculture can thrive and enhance access to markets. [...] We have worked with the private sector and moved into new geographies where farmers never had access to yield improving technologies [...] We have built the African Green Revolution Forum into a continental platform that brings policymakers, scientists, farmers and business leaders together” (Opiyo 2021).

The Green Revolution for Africa utilizes a 'value chain' framework. This means implementing modernization projects for each industry that plays a part as rice is produced, processed, marketed, and sold. This approach is described by John Ulimwengu and co-authors in 2019:

“From processing to packaging, transport, distribution, sales and advertising, and safety and certification services providers, agribusiness value chains have the potential to substantially contribute to the diversification and sophistication of the production structure” (Ulimwengu et al. 2019).

Critics of the Green Revolution for Africa such as Jean Koopman argue that it is trying to deliberately push small scale farmers off of their land, by transitioning them into high risk farming reliant on foreign imports of inputs like fertilizer and herbicide. In this cycle, farmers must go into debt every season to pay for inputs and are financially ruined if an externality destroys their crop. Koopman argues that this cycle bankrupts small scale farmers which then makes room for land grabs by large scale transnational companies (J. Koopman 2012a; 2012b; J. E. Koopman 2009).

Other critics of the Green Revolution for Africa argue that despite overtly focusing on gender, the impacts of its policies and projects have deepened gender imbalances. The Green Revolution for Africa approach has explicitly incorporated gender mainstreaming into its projects and policies. Critics contend that these efforts have not been truly gender equitable or transformative:

“The model rests on linear and functionalist assumptions in which farmers are recipients of, rather than active participants in, value chain construction. It assumes that simply incorporating women farmers into agricultural value chains will boost rural incomes and food security, ignoring varied axes of differentiation among rural women that influence resource access, farm performance, and dietary change. This top-down, monolithic framing of value chain construction leaves little room for the actual conditions and relationships that shape farmers’ decision-making, and renders GR4A [Green Revolution for Africa] initiatives vulnerable to unexpected and unintended outcomes” (Gengenbach et al. 2018).

The Green Revolution for Africa process has mixed impacts on women in the rice sector; it would be disingenuous to pretend that this process will either empower women or entrench inequalities. It will surely do both, and many women will face disadvantages both because of their gender and because of their status as small-scale farmers. There is evidence from rural Senegal that when communities transition from members owning their own land to doing wage work, women earn lower wages than men (Broeck and Maertens 2017). Senegal has seen a rise in private transnational companies in agriculture, such as Italian-Senegalese agribusiness Senhuile, which sparked resistance from pastoralists after buying their traditional grazing lands from the Senegalese government in 2012 (Peyton 2017). Such companies that own land and employ farmers as wage earning employees are changing the nature of agricultural work in Senegal.

Shocks like Climate Change and COVID

Similar to the implications from the shock that occurred with the 2008 food crisis, climate change and the COVID-19 pandemic further highlight the need for increased resilience to shocks for Senegal's rice sector. In light of these increasing challenges, West African governments are moving even further away from the policies of structural adjustment and recognizing the urgency of rice self sufficiency. A 2019 ECOWAS meeting called for both tariff and non-tariff protections for rice sectors in West Africa ("ECOWAS Consultative Meeting on Rice Offensive : West Africa Region's Rice Development Strategy" 2020).

There is evidence that the COVID-19 pandemic has greatly increased rice prices in global markets. In April 2020, rice futures rose to a level not surpassed since 2011 (Fontan Sers and Mughal 2020). Nigerians experienced an 85% rise in prices since the start of the pandemic, and the cost of imported foods has increased by 28% (Bloomberg News 2020). Some economists have downplayed the implications of the COVID-19 pandemic, arguing that global food systems were remarkably resilient, and, " the Alliance for a Green Revolution in Africa

(AGRA) and USAID's Feed the Future Programme, while adapting to the new realities of COVID, are continuing to push for the integration of smallholder producers into international supply chains" (Clapp and Moseley 2020).

No matter how resilient the global food system was to the pandemic, there will surely be more and greater economic shocks as climate change intensifies in the next 50 years. In Senegal, the rice sector must become more resilient, and this means continuing to focus on rice self-sufficiency. It also means promoting farming practices that are adapted to local environments and resilient to drought, and those that are truly gender transformative. The Green Revolution for Africa model, which pushes farmers to depend on imported inputs like fertilizers and pesticides makes them vulnerable to shocks that disrupt global food systems.

Irrigation, Double Cropping, and the National Plan for Self-Sufficiency in Rice (PNAR)

Since the emergence of PNAR thirteen years ago, the Senegalese government has worked towards making PNAR more inclusive and efficient.

In 2017, irrigated rice production represented 70% of the total volume of rice produced in Senegal (Basikiti 2017). Irrigation, and the double (year round) cropping that it facilitates has been a central focus of rice policy in Senegal since the colonial era. Two dams and thousands of village irrigation schemes have been built in the Senegal River Valley, representing over 2 billion dollars in investment (J. E. Koopman 2009). After independence, these projects were funded by international donors or the Senegalese government rather than the colonial administration, and irrigation/double cropping has also been at the center of Senegal's National Plan for Self Sufficiency in Rice. However, the issues of women's time poverty raised by gendered divisions of labor have not been solved, and continued irrigation has contributed to a new problem: excess salinity in the soil.

It is important to note that irrigation schemes between independence and PNAR were just as gender biased as those under colonialism. In 1990, a study found that only 6 % of

irrigated plots were given to women. Younger women and divorcees were denied land because they were defined as dependents of male relatives, and no married women were listed as co-owners of farms (J. E. Koopman 2009). This issue of measurement units will be discussed further in the section on gender bias in agricultural research and development, but even in other countries like the United States, research has until very recently used a binary unit to count farm households: one primary producer. If a woman does not consider herself to be the primary producer in a household, she is not counted.

While some early irrigation schemes in Senegal failed, they have also seen much success since the 1980's and have increased yields and incomes for many farmers in the Senegal River Valley (Diagne et al. 2013; Blanc, Lepine, and Strobl 2016). Irrigation schemes have also been an effective way of dealing with inconsistent rainfall brought about by climate change (Bénéfice and Simondon 1993). The amount of rainfall in Senegal has decreased by 30% in the last 40 years, and unarguably irrigation has helped mitigate this issue (Cuff 2019). It is too simplistic to state that irrigation schemes have been either successful or harmful in Senegal; they have been both, and while they will continue to be an important tool to escape import dependency, they can also be reformed so that they are more financially sustainable, ecologically neutral and equitable between genders and farmers at different scales. Irrigation has been a key mechanism for increasing yields, which is still a priority for Senegal; indigenous systems unarguably produce lower yields, but a hybrid approach could keep yields high while mitigating ecological problems.

Salinity, or excessive salt levels in soils, is a growing problem in fields that are irrigated year round with no rotations or periods of fallow (a period of time without any crop). Almost all groundwater that is used for irrigation contains salt, so the continuous flooding of fields raises levels of salt in the soil, whereas rainwater does not contain excess salt levels and does not cause this issue. Some Senegalese rice farmers have already abandoned their plots because of salinity issues (Julien Meunier 2017; Lamine Ba 2019; Blanc, Lepine, and Strobl 2016). Rice

monocropping (only growing rice and no other crops) is a product of the Green Revolution for Africa approach, because it is a strategy suited for contract farming. In this way, even without explicitly aiming to replace local knowledge systems, this approach incentivizes producers to set historical cropping systems that use a diversity of *Oryza Glaberrima* cultivars aside to instead monocrop cultivars like the New Rice for Africa variety developed by the Africa Rice Center (to be discussed in the next section).

Indigenous rice production systems (designed and implemented by women) do not monocrop year round. They use rotations of different crops and build periods of fallow into their production systems, and some harvest salt from fields in the off season to reduce salinity (J. A. Carney 2009). Rotating and allowing fields to fallow lets soils regenerate and salts dissipate. Indigenous rice production systems are diverse, reflecting the broad range of ecological environments in rice growing West Africa, and the knowledge that they are built on needs to be incorporated into modern cropping systems if they are to be continued indefinitely. Pushing forward with more irrigation, double cropping and monocropping will eventually lead to further, intensified salinity problems. A system that uses irrigation but also indigenous strategies of rice production that allow the soil to regenerate is necessary to increase production without creating profound environmental problems. In order for PNAR to succeed economically in the long term, scientists must gather indigenous knowledge about rice varieties and production practices that are resistant to problems of salinity, and put it into practice.

Growth Industries in the Rice Sector

PNAR has evolved over time and no longer tightly focuses its attention on increasing rice cultivation area. Clear priorities for this policy for the last decade have been to: build up rice seed breeding and certification industries in Senegal; invest in agricultural research and development for improved varieties; and improve the rice processing industry to compete with the quality standards of imported rice from Southeast Asia (Ulimwengu et al. 2019; Demont et

al. 2013). These investment areas represent growth industries in the rice sector, in which there are and will be new employment opportunities. However, many of these jobs are highly specialized and require tertiary (post-secondary) education. These investments are still more gender blind than transformative, which could lead to exclusion for women.

Speaking in a High-Level Ministerial Conference on Rice Development in Sub-Saharan Africa in September 2018, Papa Abdoulaye Seck, Senegal's Minister of Agriculture and Rural Infrastructure emphasized that "Self-sufficiency cannot be focused solely on production. If it is, we are making a mistake." [Translated from French] He explained that the steps to transform rice sectors are production, processing, distribution, and consumption, and if governments fail to consider any of these steps, they risk being reductivist (P. A. Seck 2018). In the next section, I will discuss marketing strategies to create demand for domestically produced rice, especially among urban consumers. However, seed, fertilizer, and milling industries are also emerging as focal points of government and international development attention (Council for African Rice Development 2013; Diagne et al. 2013). This reflects the 'value-chain' approach of the Green Revolution for Africa.

After initiating the application process in 2010, in 2015 Senegal was accepted as a member of the Organisation for Economic Co-operation and Development (OECD) seed certification scheme, and in 2016 the government adopted its Strategy for the Reconstitution of Seed Stock, a plan to improve quality control processes, enlarge seed storage capacity, and eliminate commercial malpractices (Gagné 2017). A key component to these seed projects and policies is the promotion of New Rice for Africa (NERICA) seeds, first developed by the West Africa Rice Development Association (WARDA), now called Africa Rice Center, in the 1990's (Traoré 2018). These seeds represent scientific breakthroughs in crossing *Oryza Glaberrima* and *Oryza Sativa*, which are notoriously difficult to intercross. *Oryza Sativa* tends to have higher yields and does not shatter (fall from the rice plant) easily when mechanically milled, while *Oryza Glaberrima* is more adapted to West African soils and can grow better in conditions of soil

acidity, salinity, iron toxicity and phosphorous deficiency (Traoré 2018; J. A. Carney 2009). In a 2020 ECOWAS meeting, the development of new seed varieties that can resist the impacts of climate change was upheld as a priority in member countries' rice policies ("ECOWAS Consultative Meeting on Rice Offensive : West Africa Region's Rice Development Strategy" 2020).

PNAR has also recently turned its attention to formalizing industries for other inputs like fertilizer and pesticides. Under financial support by the United States Agency for International Development, a Feed the Future project called Dundël Suuf (which means "nourishing the soil" in Wolof) is "supporting soil mapping to identify which fertilizer formulas work best for different crops in different areas, help farmers access fertilizers that will work best for them, and improve the fertilizer policy and regulatory environment" (International Fertilizer Development Center 2020). This focus on adapting input technologies to local contexts will necessitate more agricultural research and more extension services, creating specialized jobs that require tertiary education. Thus, if women do not attain higher degrees in agriculture, they will continue to be excluded in many ways from these modernization programs. In addition, women are likely to be the ones applying inputs in rice fields, and thus must be considered as end users so that they do not inadvertently harm their health by using these inputs incorrectly.

In order to improve rice processing, the Senegalese government has encouraged private companies to establish large scale operations in recent years. In 2018, a company called the Compagnie Agricole de Saint-Louis (CASL) established "one of the most ambitious rice processing facilities in the world" in Saint Louis (Buhler Group 2019). The facility is fully vertically integrated: they created irrigated paddies using water from the Senegal River, and the company controls the farming, processing, milling, and marketing. They own a packaging factory and sell the end product to Senegalese markets (ibid.). CASL was founded in 2011 and received loans from the African Development Bank and the European Investment Bank (Gagné 2017). Currently, most rice processing in Senegal is done through small scale, informal mills at

the village level (Colen, Demont, and Swinnen 2010). However, companies like CASL are expanding and could be the first of many large scale, vertically integrated operations.

Small scale, informal processors currently process about 75 to 80% of rice produced in Senegal, and the rest is milled by semi-industrial and industrial processors (Mbaye et al. 2018). Currently, large scale mills face buying constraints; a 2014 study of eight industrial and semi-industrial millers found that they were not able to buy enough paddy rice to operate at full capacity and instead operated at between 38% and 75% of their individual milling capacity (Soullier and Moustier 2019). In this same study, small scale, informal millers processed 87% of total paddy rice produced, but their finished rice was broken rice that had impurities, and the quality of the rice coming from the industrial or semi-industrial mills was of higher quality with fewer impurities (ibid.).

In the next section, I will explain the importance of these quality differences, and highlight recent focus on qualitative considerations like rice color and taste. This is evidence that there will be more efforts in the near future to formalize the rice processing sector, which could have implications for women's exclusion. Vertically integrated companies replacing smallholder farmers and processors means a formalization of jobs in the rice sector. Since these companies are buying up large tracts of land in rural Senegal, they are actively displacing smallholder farmers. Women are constrained from participating in formal wage jobs for a myriad of reasons that I will discuss later on, including the gender gap in tertiary education.

Women's Power as Consumers: Qualitative Considerations over Yield

When colonial administrations and post-colonial development projects took power in rice production away from women and gave it to men, they forgot that women also hold power as consumers, since they are the main decision makers when shopping for home-cooked meals in Senegal. Rice-sector modernization projects have first and foremost focused their efforts on expanding production area and increasing yields (Diagne et al. 2013), but there is abundant

evidence that one of the biggest obstacles to escaping import dependency is the quality of domestically produced rice: characteristics such as homogeneity of grains and breakage, absence of foreign matter, absence of grain anomalies, and rice color (Hathie 2011).

People in different areas have different preferences for rice; consumers in Nigeria tend to like it parboiled, in Senegal urban consumers have come to prefer broken rice, in Mali they prefer the taste of domestically grown rice instead of imports (S. B. Fakayode, O. A. Omotesho, and A. E. Omoniwa 2010). Even within Senegal, while urban consumers tend to prefer broken rice, rural consumers prefer whole or mostly whole rice (World Bank 2013). There is a need for better marketing that is specific to the preferences of different market segments, and women must be centered in these efforts: their power as consumers and decision makers around food must be respected if the country is serious about building a self-sufficient rice industry.

Qualitative considerations are a bottleneck in Senegal's journey towards self-sufficiency in rice. Field experiments from 2013 in urban centers in Senegal found that urban consumers are willing to pay quality premiums on rice (Demont et al. 2013). It is not just processing quality, but marketing that is a key obstacle to escaping import dependency, because urban consumers often do not know of the existence of domestic rice brands (Rizzotto and Demont 2010). If women are the main buyers of rice in urban households, advertising needs to target them directly - and would likely be more effective if women had at least equal representation in the marketing teams that do this work. However, this kind of marketing job is in the formal sector and requires higher degrees, which means that women are structurally excluded, as will be discussed in the section on tertiary education.

As Cheryl Doss pointed out in her reflection piece, *Designing Agricultural Technology for Women Farmers: Lessons from 25 Years of Experience*, urban women have opportunity costs for their time. They could be earning wages, so they choose what food to buy based on how long it takes to process or cook; sometimes the processing cost in terms of time is the deciding factor more than the price of a food (Doss 2001). These kinds of considerations must be taken

into account if domestically grown rice in Senegal is to successfully enter urban markets. As will be discussed in the section on agricultural research and development, reducing drudgery could be an effective outcome of new technologies, but this outcome has been underemphasized because of a lack of women's representation in agricultural science institutions.

In the last few years there has been much more recognition of the importance of qualitative considerations over rice yields. Papa Abdoulaye Seck, Senegal's Minister of Agriculture and Rural Infrastructure, argued in September 2018 that improving the quality of domestic rice to be equal or superior to imported rice is crucial. He said that Senegal is particularly behind in the realm of phytosanitary standards; a hint that more investment in agricultural research in this area is imminent (P. A. Seck 2018).

This is not just a Senegalese situation; many countries in West Africa have been through similar histories in rice policy that prioritized yields over qualitative considerations. A 2014 study in Nigeria emphasized not just quality but marketing as obstacles to rice self sufficiency:

"It will not be enough to simply improve the competitiveness of domestic rice through quality and performance. Consumers may still prefer imported over domestic brands simply due to habit or lack of information. Buyers will need to be aware of and become convinced of the value of domestic rice through quality branding and extensive marketing promotions—and this for both standard and premium-quality brands of local rice" (Johnson, Takeshima, and Gyimah-Brempong 2013).

This kind of marketing in particular needs to capitalize on women's power as consumers and decision makers for rice purchases.

Current Barriers to Participation for Women and Efforts to Address Them

There is a deep and rigorous literature on women's access to land and capital in Senegal, and there are many efforts currently underway to address these structural barriers to participation for women in the rice sector. Therefore, I will cover them very briefly before moving

on to a barrier that has received less attention and funding: women's inclusion in agricultural tertiary education. However, underlying all of these structural barriers to participation are gender norms around time use; women's time poverty is both a factor in and an outcome of rice modernization projects since the colonial era.

Land Tenure and Access to Capital

Women's access to capital and to land are highly related, because land is often needed as collateral for bank loans. These issues are also intersectional; a woman's age, marital status, literacy, or other factors can determine whether she has access to land or capital as much as her gender (Soukèye 2003). That being said, there is substantial evidence that overall, women have less access to both land and capital than men in Senegal's rice sector, which excludes them from benefiting from modernization efforts (Linares 2009; Knapman 2015; Evans 2016; Niang et al. 2017). A representative from banking company BNP Paribas, which is currently implementing gender sensitive credit lines in rural Senegal explained, "For the moment these women are completely under the radar in terms of finance [...] They do not have the financial structure that will allow them to borrow money, they do not have individual bank accounts - they are simply out of the system" (Cuff 2019). This is where the Green Revolution for Africa approach exacerbates gender inequalities, because it encourages farmers to intensify their use of inputs like fertilizer or herbicide, requiring them to take out loans before the planting season (J. Koopman 2012a). Without access to these loans, women are restricted in how much they can use such inputs. As will be addressed in the next section on time poverty, lack of access to credit that prevents women from using labor saving technologies can increase their time burden, such as requiring them to weed by hand instead of using herbicide.

There have been very promising and successful efforts to reduce these structural barriers to participation for women in Senegal's rice sector. United Nations (UN) Women has been an especially important actor for these issues. In 2018 they announced a new 5 million

dollar project called PAFAD which focuses on increasing women rice farmers' land rights, climate-resilient farming skills, access to finance, and access to markets (Cuff 2019). A 2017 article from Reuters interviewed Boury Tounkara, a woman coder in Saint Louis who is developing an phone application to fight gender discrimination in land buying by allowing women to start the buying process without identifying themselves or their gender (Peyton 2017). Legal organizations like the Association of Senegalese Women Lawyers are working to educate women on their rights and help them gain legal recognition of land ownership (ibid.). There are also new women's unions and producer organizations in the rice sector that are working to empower women collectively and help them access land and credit (Glatzel 2018; Coalition for African Rice Development 2015).

In 2010, the Senegalese government adopted a gender parity law that mandates as close as possible to a 50/50 ratio of men and women in government bodies. This applies to all levels of government, including the rural municipal councils that govern land tenure. As of 2015, the number of female municipal councillors in Senegal reached 47% (Sutz et al. 2019). However, a 2019 study found that the land commissions that decide allocation processes technically do not fall under the parity law, and are still dominated by men. Female municipal councillors also reported that "due to socio-cultural constraints, they were unlikely to challenge or vote against the commission's recommendations" (ibid.). Since land commissions are still dominated by men despite the enforcement of the parity law, and land is the single most important source of collateral for loans in rural areas, women are still structurally blocked from taking out loans for agricultural operations.

Time Poverty

Women's time poverty is an important consideration for rice policies in Senegal, because women's predominance in rice means that projects that intensify rice production can increase women's labor obligations. While divisions of labor differ between societies in Senegal, rural

women are almost always responsible for: 1) domestic tasks such as childcare and meal preparation; 2) their own plots to produce food for the household; and 3) tasks on their husbands' plots as part of the conjugal contract (Viroleau 2015; Kuépié 2016; Malta, Martinez, and Tavares 2019; Sall and Thiaw 2019; Oumar BA 2000). In addition, continued rural-urban migration, which has historically skewed male, has depleted much of the male rural labor force in Senegal, at the same time that irrigation schemes have increased labor requirements for rice operations (J. E. Koopman 2009).

This is especially an issue with the promotion of double cropping, because previous obligations to work in rice fields for the wet season are suddenly doubled as women must work in the dry season too using irrigation (J. Carney and Watts 1991). However, even outside of double cropping, intensification of agriculture through new technologies and improved inputs can overburden women. For example, women might need to spend more time weeding when fertilizer is applied, or they might have to spend more time processing increased levels of output (Doss 2001). The ironic aspect of this is that technology has enormous potential to save labor and reduce drudgery. As Dede-Esi Amanor-Wilks wrote in her 2009 editorial in *Feminist Africa*, a lack of focus on female end users has limited women's access to technology that could alleviate their time poverty: "Women continue to rely on the hoe and have little access to labour-saving and productivity-enhancing technology. Lack of access to technology means that African women face a life of drudgery and a lack of options" (Amanor-Wilks 2009).

In terms of formal employment, women's time poverty can be a huge barrier to the attainment of higher degrees, because Senegalese women are pressured to prioritize having children and fulfilling domestic obligations over advancing their careers (Kuépié 2016). These degrees are necessary for jobs in growth industries in Senegal's rice sector such as seed certification and breeding or engineering of agricultural machinery. As long as patriarchal gender norms about women's domestic responsibilities persist, women will be at a disadvantage in

industries that require post-secondary education or demands on their time to keep up with the increased volume of work introduced by new technologies.

Women's Inclusion in Agricultural Tertiary Education

In Senegal, education is free and compulsory for children under 16, and there is no gender gap for primary or secondary education; in fact, more girls than boys have enrolled in secondary school every year since 2017 (Malta, Martinez, and Tavares 2019). However, for post-secondary training or education which can be costly, there have consistently been more men than women enrolled in the last decade. According to World Bank data, in 2015, 35,800 more men than women enrolled in tertiary or post-secondary education in Senegal. In 2019, that difference was 27,600: 111,400 men enrolled versus 83,800 women (World Bank 2021). [Numbers are rounded to nearest hundred.] These national-level statistics could be masking differences between rural and urban areas, especially for enrollment in agricultural degree granting programs; the gender gap for agricultural degrees is likely larger.

One must certainly hold a higher degree in order to enter the rooms in which policies are written and agricultural technologies are developed. Lack of access to tertiary education is a major reason why women are excluded from these decision-making jobs in the formal sector in Senegal. A 2016 study found that in Senegal, 4% of women worked in formal “high status” jobs as compared to 16% of men:

“Access to high job status – scientific, technical and managerial occupations and intermediate administrative jobs – is reserved for a minority of individuals. [...] People who get this type of employment can therefore be considered part of a privileged elite.

Obviously, access to this privilege is more limited among women” (Kuépié 2016).

This persistent gap in tertiary education will exacerbate gender inequalities in the near future, because jobs in growth industries in the rice sector will require degrees. Agricultural research and development will be at the center of investments in the rice sector in the coming decade. A

2017 evaluation of seed certification programs in Senegal found that insufficient human resources (a lack of trained scientists) were an impediment to continued implementation (Gagné 2017). Since seed certification is a priority area for PNAR, there will surely be government efforts to address this. Waly Diouf, the current coordinator of PNAR said in a 2019 interview with Africa Rice Center that a primary goal of PNAR at this stage is to increase the quantity, quality, and certification of rice seeds, and to develop varieties of NERICA that are adapted for each ecosystem in Senegal and tailored to the needs of rainfed producers (*Waly Diouf, Coordinateur, PNAR, L'expérience Réussie de l'Anambé* 2019). These coming investments will create work opportunities in the formal sector, and the only way for women to participate in this new agricultural research and development is if they have higher degrees in agriculture.

Representation is important, but just closing a gap is not enough to realize gender equity. There are current efforts to go deeper and transform gender norms around agricultural science in Senegal under a Feed the Future project called the Senegal Youth in Agriculture Program. Based on the 4-H model from the United States, the program establishes clubs in primary and secondary schools and in some universities to provide vocational training in agriculture. The project uses a positive youth development approach and teaches life skills like confidence, self esteem and leadership as much as technical skills. The clubs have gender balanced ratios, gender equality in access to club resources, and majority women in leadership. Managers include the families of club members in their programming, especially at the village level, to help foster gender norm change. The gender balanced ratios of the clubs also allow young boys to become habituated to seeing girls as colleagues and peers in a science focused space (Guisse, Archibald, and Kane 2021).

While this is an example of good gender transformative work, the program does not fund higher degrees in agriculture for female students. There was another program that did this from 2011 to 2018, also funded by the United States Agency for International Development, called the Education and Research in Agriculture Program. This program funded 100 students to get

higher degrees in Senegal and sent 20 to attain higher degrees in the United States. 70% of scholarships went to young women (ibid.). So, there was attention paid to this issue, but on a relatively small scale, and this program ended in 2018. There are also continent wide efforts to bring women into agricultural research and development, spearheaded by the organization African Women in Agricultural Research and Development (AWARD). AWARD not only funds degrees for women, they also help build the capacity of research labs on the African continent so that after graduation, women have the resources to put their education to use. However, AWARD does not have an office or specific projects in Senegal, and they are headquartered in East Africa (“AWARD | African Women in Agricultural Research and Development AWARD” n.d.).

Enrolling the same number of women as men in agricultural degree programs is only one piece of the puzzle. Universities do not just teach and train students, they also produce original research, and the content of this research must also be gender transformative. Women students in tertiary education should not just be passive recipients of agricultural knowledge. There needs to be a focus on funding research that gathers indigenous knowledge and uses women’s knowledge both as rice producers and consumers to tailor technologies to women: technologies that improve qualitative characteristics and reduce drudgery, and management practices that do not unintentionally double women’s workload in rural areas.

For example, industrial milling technologies are designed to be most cost effective at large scales, whereas traditionally women have participated in smaller scale rice processing. Thus, gender transformation could mean designing technologies that build upon or improve existing traditional smaller scale processing techniques, while meeting the quality standards that women set as the primary buyers of rice. That being said, perhaps the single most important body of knowledge that such research could utilize is women’s vast understanding of *Oryza Glaberrima* cultivars. Women were likely the first domesticators of wild rice and were historically responsible for seed selection. The cultivars that they bred can survive in sub-ideal soils, resist

drought brought on by climate change, and match local taste and texture preferences. Their diversity, and the cropping systems designed over thousands of years that rotate different cultivars to avoid problems like excess soil salinity, could be extremely useful for climate change mitigation efforts. Thus, they could make a big difference for food security which is threatened by both the degradation of soil and droughts caused by climate change. Also, they could help foster market demand for domestically produced rice by harmonizing with Senegalese consumer preferences.

The next two sections of this thesis will be about ways to increase gender equity in agricultural research and development beyond just addressing a gender gap in tertiary enrollment.

Gender bias in Agricultural Research and Development

Reducing drudgery as a priority, not just increasing yields

Agricultural research that focuses on women end users can create technologies that reduce drudgery and alleviate women's time poverty. Many current technologies take for granted that women are obligated to provide labor for their husbands as part of the conjugal contract (Soukèye 2003). Technology developers should consider women as beneficiaries and not just as sources of unskilled, free household labor. A 2000 paper on rice management in the Casamance region of Senegal denounced how rice technologies ignored the needs of women:

“Research and extension have not been able to adapt the creation and dissemination of technologies to the specificities of the region. The technologies generated rarely corresponded to local socio-cultural specificities. Thus, technology has continued to be created and disseminated for men in rice growing situations, even in areas where it is women who work in the rice fields” (Oumar BA 2000) [Translated from French].

While things have certainly improved in the last 21 years, this problem of focusing technology on men persists up to today, in large part because of a lack of women's representation in tertiary agricultural education.

The Units we Use

Women are often not considered when deciding on the units for recipients of projects, such as irrigation subsidies going to male heads of household, or extension services disseminating information through farmer cooperatives that heavily skew male. These kinds of project designs go beyond gender blind and become gender biased when they do not consider women and target men. Including women in the rice sector will require gender transformation: changing the units that we use to deliberately be more inclusive of women.

Farmer Cooperatives

Under the National Plan for Self Sufficiency in Rice, the point of entry or units used for extension services, subsidies and management of credit are farmer organizations. In order to access loans from the National Bank for Agricultural Credit in Senegal, farmers must be organized into Economic Interest Groups. Such groups can be several farmers or one larger scale farmer, and members might also be part of larger farmer federations and village level unions (Colen, Demont, and Swinnen 2010; Soullier and Moustier 2018). A 2013 study of the Senegal River Valley found that in most farmer organizations, almost all members were male, but there were a few specifically female organizations that engaged in rice production (Schueppler 2013). The study also found that members of farmer organizations had more reliable access to irrigation, high quality inputs, machinery, and credit. While there are some excellent current efforts to organize women rice farmers (UN Women 2019; Glatzel 2018; Cuff 2019; Coalition for African Rice Development 2015), groups still tend to be segregated into a small number of women's organizations versus the majority of groups which are almost entirely

male. Women in mixed gender producer organizations often find it difficult to be appointed to leadership positions and “women’s groups are outnumbered by family units where men have more say” (Niang et al. 2017).

The approach of using farmer organizations as entry points to more effectively reach the rural poor has been central to development programming in the rice sector in recent years (Adjin and Henning 2020). The gender blindness of this approach has, in practice, excluded women from the benefits of programming. The World Bank and the International Fund for Agricultural Development funded a program from 2000 to 2010 called the Senegalese Program of Agricultural Services and Organizations of Producers (PSAOP). This program targeted community based organizations of farmers (CBO’s). A 2016 evaluation found that:

“PSAOP mainly targeted male decision makers with women being left out. Since Senegalese rural culture is dominated by men, the agricultural advisors trained by the PSAOP confined their attention to that audience. [...] Male membership was reinforced by the PSAOP while female participation went down. This implies that the program disproportionately penalized women, who are the main guarantors of food security in rural Senegal. Thus, in terms of female empowerment, the program may have been counterproductive” (Arcand and Wagner 2016).

A consequence of women’s exclusion from farmer organizations is that they have less access to information that could help them manage the impacts of climate change. A 2015 study on gender and farmer adaptation to climate change in Kaffrine, Senegal found that while 83% of men received information on the predicted start of rains, only 65% of women reported receiving this information; similarly, 38% of men received information on pest and disease outbreaks as compared to 29% of women. The authors noted that, “If women are aware of certain practices, they seem to adopt them just as much as men” (Kristjanson et al. 2015).

Heads of Household and Primary Operators

The United States has recently changed the units that it uses to count farm operators in the official agricultural census, revealing the power of units to include or exclude women from projects and policies. Between the 2012 and 2017 agricultural censuses, the survey questions were changed to allow for up to 4 co-principal operators to be counted rather than one principal operator. The number of female farmers counted in the census went up considerably. For the first time, over a million female principal operators were counted in the census: 1.23 million in 2017, up from 969,672 in 2012 (Pilgeram et al. 2020). This leap was much larger than previous trends in numbers of female operators, suggesting that it was not simply more women engaging in farming but the change in measurement that made the difference. This aligned with previous studies which found that in America, “women are much less likely to identify themselves as “farmers,” even when they are doing critical work on a farm.” (ibid.).

Similarly, Senegalese women might play an extremely important role in their households’ rice operations, but would not consider themselves as heads of household or principal operators. Thus, they can be passed over as recipients of assistance or targets of extension. Even the push to recognize and study “Female-Headed Households” enforces a sole principal operator framework that can mask nuanced and gendered divisions of labor. Senegal has a history of irrigation subsidies being distributed to male heads of household despite rice being ‘women’s work’, and must allow for more flexible units so that women can be included moving forward. Jean Koopman in her 2009 paper *Globalization, Gender and Poverty in the Senegal River Valley* touched on this issue: “When government agencies allocate land, they must recognize that distributing land by household is a male-biased policy that can eliminate women’s ability to use that land for their own food crops” (J. E. Koopman 2009).

Definitions of Employment

Colonialism entrenched gender norms in which women produce food for household consumption while men produce cash crops, especially for export. This binary is also at the

center of how international institutions measure employment. Women working in subsistence agriculture are not considered to be employed because they are not earning wages, while men who sell cash crops are demarcated as employed. Feminists have long advocated for conceptualizing work in terms of livelihoods rather than employment and unemployment in order to properly give value to women's labor (Tsikata and Amanor-Wilks 2008). However, the reality is that employment statistics are extremely important for policy makers in Senegal. Changes to the rice sector under PNAR have created new employment opportunities, but the way in which they are counted masks women's contributions and participation, supporting a view of women as free, unskilled labor on family farms.

In 2013, the 19th International Conference of Labour Statisticians redefined labor statistics standards to limit the definition of employment to only include work that is for pay or profit. Food production for consumption rather than sale is now reported under a separate indicator of "own use production work" (Gaddis, Isis et al. 2020). Since 2013, these measurement changes have gradually been implemented in national surveys and official statistics around the world. This means that many more women are being counted as unemployed even if they are engaged in full time productive work, with consequences for projects and policies that use employment statistics to measure their success.

Even outside of gender considerations, this binary definition of employment is nonsensical in the face of how smallholder farmers actually manage their operations. There is almost always some food grown for home consumption and some for sale; rarely does a farmer choose 100% one or the other. In fact, a 2020 World Bank study found that farmers are more likely to report intending to produce for sale at the end of the growing season rather than the beginning; thus, the time in which statistics are collected can swing farmers from one side of the binary to the other (ibid.). Projects often have the goal of increasing rural employment, and measure their success by the number of people they can bring into the employed category.

Such projects will face continual difficulties including women, who even more so than men do not fit neatly into the employed/unemployed binary.

Changing the units that we use for agricultural research and development would lessen gender bias and create space for women held indigenous knowledge in the modernization process. It would bring more women into the fold of decision makers as recognized by governments and organizations, whether that means counting women as co-principal operators, employed people (productive workers), or leaders in rice even if they are not part of established farmer cooperatives. By recognizing women's decision making power, very much alive but under the radar of new investments, PNAR would not only become more equitable but would also broaden its base of human capital, which would help it to succeed economically. It would also more accurately reflect the reality of rice production, historically and currently.

Incorporating Indigenous Knowledge into Projects and Policies

Representation is important. Having more women in the room as policies are being designed and technologies are being researched is crucial. This means closing the gender gap in tertiary education, because entry to those rooms depends on having a degree. However, this does not mean sending young Senegalese women overseas to earn their degrees, so that they can learn agricultural practices that are entirely removed from indigenous knowledge about rice, gathered for over 3000 years. Agricultural research institutions and universities need to fund research that captures indigenous knowledge about the enormous variety of *Oryza Glaberrima* cultivars in West Africa and the parallel diversity in management practices tailored to each ecological environment in which rice is grown. This knowledge is primarily in the hands of women, so we need researchers of any gender to focus their efforts on gathering knowledge from women and incorporating it into the modern agricultural research and development machine.

Judith Carney's book *Black Rice* describes the way that many Western scholars and historians assumed until recently that Africans could not have independently domesticated rice (J. A. Carney 2009). This erasure of African knowledge is still echoed today in the paradigm of the Green Revolution for Africa, which focuses on substituting foreign rice varieties and practices for indigenous ones. There has been research on how to adapt *Oryza Glaberrima* to modern standards and consumer preferences, but it has not nearly capitalized on the enormous variety of cultivars that exist in West Africa. NERICA varieties are a good start, but as Waly Diouf explained in his 2019 interview with Africa Rice Center, there is still much work to be done to adapt them to the diverse set of ecological environments used for rice growing in Senegal (Waly Diouf, *Coordinateur, PNAR, L'expérience Réussie de l'Anambé* 2019).

As producers of rice "modernize" in Senegal, they are incentivized to grow aromatic rice varieties from Southeast Asia. In the route to rice self-sufficiency, there must be some producers that grow Asian rice varieties to match the preferences of urban consumers. However, there are also thriving rural markets in which indigenous rice varieties are still preferred over imported broken rice (Colen, Demont, and Swinnen 2013). The government of Senegal has recognized in recent years that there is room for producers to focus on these markets in Senegal's rice sector; there is not one single market to be improved but many.

This recognition of the need for agricultural research and development targeting a wide variety of end users in a range of pathways to market presents an opportunity to specifically fund research projects that learn from the knowledge of women. Judith Carney wrote in *Black Rice*:

"The diversity of available seeds reflects women's keen awareness of local environments and deep familiarity with rice culture. Throughout the Inland Delta, women are the harvesters of wild rice varieties; women's enduring association with seed selection is in fact suggestive that females may have initiated the process of rice domestication. The large number of varieties selected just for milling and cooking attest to the traditional

female role as plant breeders. Seeds are chosen for cooking properties, taste, ease in milling, and storage qualities” (J. A. Carney 2009).

Those seed qualities that she described are precisely the focus of new investments in the rice sector in Senegal, as policy makers realize the power of women as consumers. The ecological landscape for West African rice production is incredibly diverse in every conceivable way, from rainfall to soil type, to salinity, to solar radiation and soil mineral content. Thus, approaches that center on simplistic ‘best practices’ and binary frameworks, that count women as unskilled labor instead of decision makers in rice, will never reach their full potential. It is only through tapping into women held wells of knowledge and tailoring technological advancements to support and empower women in the rice sector that Senegal can achieve its goal of rice self-sufficiency in an equitable and ecologically sustainable way.

Women have been systematically excluded from investments in Senegal’s rice sector since the colonial era. Senegal’s push for self sufficiency in rice needs to include women as workers, scientists, policy makers and sources of crucial agronomic knowledge for it to fully succeed, both economically and in terms of equity. Gender blind and even gender mainstreamed policies have failed to reap the benefits of women’s long standing power in rice production, and it is time for more intersectional and transformative approaches that embrace nuance and break down silos between disciplines.

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