More than a Grain

Traditional Rice Cultivation in Maroon Communities in Suriname and French Guiana

Nicholaas M. Pinas

Propositions

1. The negative effects on rice diversity of the Surinamese Civil War in the Cottica area outweigh the benefits for all parties involved.
   (this thesis)
2. *In-situ* conservation is insufficient for safeguarding all rice diversity in Maroon communities.
   (this thesis)
3. Yield alone is a wrong measurement of sustainable agricultural output.
4. Changes in cultural and religious practices lead to changes in agricultural practices.
5. Migrants enrich the food and crop preferences in their new host country.
6. To withstand climate challenges, agricultural practices worldwide require traditional crop landraces.
7. Voice messages through WhatsApp greatly improved communication between literate and low-literate communities.

Propositions belonging to the thesis, entitled

More than a Grain; Traditional Rice Cultivation in Maroon Communities in Suriname and French Guiana.

Nicholaas M. Pinas

Wageningen, 30 April 2025

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More than a Grain

Traditional Rice Cultivation in Maroon Communities in Suriname and French Guiana

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Thesis

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Saamaka rice farmer Mariona Tiapu in her field.

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Summary

Maroons, descendants of enslaved Africans who escaped slavery in Suriname and settled in the forested interior of Suriname and French Guiana, cultivate many traditional rice varieties. They grow African or black rice (*Oryza glaberrima*), domesticated some 3500 years ago in West Africa, and Asian rice (*O. sativa*), domesticated c. 10,000 years ago in Asia. In the early 16th century, Portuguese traders introduced Asian rice to West Africa. The transatlantic slave trade (c. 1550-1850) brought rice species to the Americas.

For centuries, traditional farmers worldwide had selected many genetically diverse rice landraces for different traits such as taste, stickiness, ability to grow on poor soils, and aroma. After the Green Revolution in the 1950s, plant breeders developed modern cultivars with higher yields, leading to more production and the need for much more fertilizers and pesticides. The focus on modern cultivars led to genetic erosion, a loss of landraces worldwide, and exposed vulnerabilities such as less adaptability to climate change and biotic and abiotic stresses.

The Maroons cultivate one African and many Asian rice landraces in a slash-and-burn farming system where agrochemicals are seldom used. Their landraces provide food security and independence but also hold genetic resources that can help rice breeders develop more sustainable rice cultivars. It is important to document the motivations of Maroon farmers to continue cultivating rice, and their practices to maintain this diversity.

Between 2017 and 2023, 99 Maroon farmers (mostly women) were interviewed, and over 300 rice varieties were collected in four Maroon communities in Suriname and French Guiana. We wanted to know each farmer's number of varieties, how they tell them apart, and whether they recognized and incorporated new varieties from spontaneous crossings. We also asked why they planted rice and how and when they obtained or exchanged their varieties.

To measure growth periods and yields of traditional rice varieties, we followed several Maroon women who planted 28 traditional varieties and two commercial cultivars and measured ripening periods and yields. To understand the contradicting information about the magic status of African rice and the role of both rice species in rituals, we asked about special stories or songs on rice, when and how the ancestors obtained rice, from where this rice came, how rice Fig.d in myths, and how it was used in offerings and (ritual) medicine. Finally, we discussed the results of our interview data with Maroon intellectuals and traditional authorities and reviewed historical and anthropological literature on the Maroons.

Our result shows that Maroon farmers cultivate an astonishing number of Asian rice landraces and one type of African rice. The rice is mostly cultivated for food security and food sovereignty, but cultural and spiritual practices are also strong motivators for rice cultivation. We encountered farmers who had up to 20 varieties in their fields. The diversity is robust and climate resilient, as the rice varieties differ in their preferences for certain soils and water levels. This high level of agrodiversity ensures a stable yield, despite unexpected changes in precipitation or temperature.

Maroon women tell their rice varieties apart by giving them unique names. Many of the rice varieties are named after women and pay homage to the female ancestors who are remembered for their exceptional role in bringing food crops to their communities during the struggle for freedom in the days of slavery. Details on the lives of these female ancestors may have been forgotten, and they do not appear in archival documents, but their names remain attached to rice varieties.

The yields of the 28 Maroon landraces we measured were mostly higher than the previously assumed 700-1000 kg/ha mentioned in the literature. Some varieties produced more

than 2000 kg/ha. Only varieties with very small seeds yielded below 1000 kg/ha. The two commercial cultivars performed very badly in Maroon fields and were heavily attacked by birds. This shows that Maroon rice is well adapted to the Amazonian environment in which it was selected, and commercial cultivars are not adapted to the Maroon agricultural system.

Maroons have a complex relationship with African rice, and there are diverse beliefs and practices surrounding its use as food, medicine, offerings, and rituals. The unique characteristics of African rice, such as its ability to become feral, compete with weeds, grow on poor soil, its shattering seeds, and attractiveness to birds explain how a fully domesticated African crop could revert to a semi-wild state in the open swamps in the interior of Suriname and French Guiana. The ancestors of several (but not all) Maroon groups found African rice in the wild and developed different myths about its origin.

Farmers' motivations for maintaining rice fields are varied: common reasons included ensuring food security, asserting sovereignty and independence, and facilitating participation in funeral-related activities. Its taste, quality, and health benefits compared to store-bought rice were also significant factors, along with honoring ancestral practices. Rice is a cultural keystone crop for the Maroons, reflected in its intense and multiple uses, specific naming and terminology in the local languages, its role in narratives and ceremonies, its persistence and memory of use amid cultural changes, its unique cultural significance, its difficulty in being replaced by other staple foods, and its (small) role in income generation. As they are strongly woven into cultural and spiritual practices, Maroon rice cultivation systems are also vulnerable. These cultural and spiritual values can change or disappear over time, due to migration to urban areas, the influence of Christianity, and a shift towards other sources of subsistence, such as gold mining.

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Chapter 1: Introduction

Rice species, landraces, and cultivars

Rice is one of the world's most consumed grains and the staple food for half the world's population (Gnanamanickam 2009). It is a relatively cheap source of carbohydrates, vitamins, and minerals such as calcium, vitamin D, and riboflavin (Rohman et al. 2014). Rice has been domesticated on two continents. The well-known *Oryza sativa* L. or Asian rice was first domesticated in China approximately 10,000 years ago, while the lesser-known *O. glaberrima* Steud. or African rice was domesticated along the Niger River in Mali some 3500 years ago (Stein et al. 2018). African rice is generally characterized by its few-branched panicle, short and rounded ligule, and glabrous, red to very dark red, close to black, husks. The seeds of this species tend to shatter and often have a red pericarp (bran) around the kernel (Burkill 1985; Van der Zon 1992). African rice is primarily grown in West Africa and the varieties are landraces (Temudo 2011). In certain areas, the most important factors in the continued cultivation of African rice are ecological, while in others cultivation of African rice is primarily for cultural and religious purposes. In other cases, ecological, socioeconomic, and cultural factors interact (Teeken et al. 2012). However, in general, African farmers today grow much less African rice than before (Temudo 2011).

In contrast, *O. sativa* has a much longer and pointed ligule, and generally a highly branched panicle, generally straw-colored husks, and most modern cultivars have a white pericarp (Sweeney and McCouch 2007). The Portuguese introduced Asian rice from the Philippines and Malaysia to West Africa around 1520 (Nawani 2013; Gilbert 2015). During the transatlantic slave trade, both rice species were shipped to the Americas. In this thesis, I will focus on land races of both species grown in traditional settings in the interior of Suriname and French Guiana.

In contrast to the homogenous modern rice cultivars grown today for mass production, the varieties used in by smallholders are often landraces: traditional, farmer-developed varieties that are genetically variable and adaptable to local differences in climate, soil conditions, and cultural preferences (Zeven 1998). Modern cultivars are based on plant breeding techniques that have largely bypassed African rice. Landraces selected and maintained by small farmers throughout the centuries led to an enormous crop diversity. Every traditional rice farming community selects varieties that meet their needs and environments. In West Java, for example, it is common to encounter many varieties of glutinous and non-glutinous rice in one farmer's garden (Iskandar et al. 2018). In many places, landraces disappeared after the Green Revolution of the 1960s. Commercial farmers and rice breeding institutes shifted their focus from diversity to uniformity, developing high-yielding cultivars, suitable for large monocultures. Although yields are much higher nowadays than before the Green Revolution, modern cultivars depend heavily on agrochemicals and are vulnerable to unpredictable environmental fluctuations, reduced soil fertility, pests, and diseases (Nie and Peng 2017).

Landraces on the other hand have various advantages, such as resistance against biotic and abiotic stresses, the capacity to absorb nutrients from poor soils, endure climatic fluctuations, pests, and diseases. These qualities of landraces result in a stable, intermediate yield under low-input agricultural systems as typically found in communities of small-holder farmers (Westengen et al. 2014). Additionally, landraces may hold genetic and climatic adaptations that could benefit world food security in the future: they possess an untapped genetic resource for breeding new, more resilient cultivars (Wang et al. 2018). The Global Assessment Report of Biodiversity and Ecosystem Services (IPBES 2019) urgently called for

the conservation of landraces, as these are genetically variable and thus adaptable to local climate, soil conditions, and cultural preferences.

Landraces have not entirely disappeared in modern times. Many smallholder rice farmers still grow landraces, sometimes in combination with modern cultivars. Much effort has been made to safeguard rice landraces *ex-situ* in germplasm banks such as the International Rice Research Institute (IRRI) making their genetic resources available for crop breeders (Seck et al. 2012). Most studies on rice genetic diversity use landrace accessions obtained from germplasm banks, with limited data on traditional knowledge from the farmers who selected and cultivated them (Wang et al. 2018). *In-situ* conservation of landraces within traditional farming systems has been neglected worldwide, so dynamic processes of crop evolution under farmer management are hardly documented (Maxted et al. 2016). Moreover, the full range of rice diversity is underrepresented in germplasm banks (Thrupp 2000). *In-situ* conservation of traditional crop landraces is therefore a necessity, as traditional agriculture is under great pressure worldwide (IPBES 2019). Ethnobotanical inventories are powerful tools for detecting traditional crop diversity and understanding the social and cultural aspects involved in generating and maintaining their diversity and distribution (Ardenghi et al. 2018).

The subject of this thesis is the traditional cultivation of rice landraces by small-scale Maroon farmers in Suriname and French Guiana. It is part of the larger research project *Hidden Crop Diversity in Suriname: tracing the Origins of Maroon Rice by Integrating Ethnobotany and Genomics*. This project combines ethnobotanical surveys, archival research, and advanced genomic analysis of traditional Maroon rice varieties to analyze their geographical origins, migration history, and the methods and motivations of rice farmers to maintain this unique diversity (https://www.nwo.nl/projecten/ocenwklein419).

Both in colonial and post-colonial times, Maroon agriculture has long been viewed as a destructive and low-output system (Lobach 2023). An overview of the short sketches about Maroon agriculture reported by government postholders and missionaries between 1770 and the 1960s was compiled by Van der Kuyp (1961). This overview mentions a great diversity of cultivated crops, wild-collected edible plants and animals, and traditional dishes, and cites sources that the Maroons are healthy and well-fed. Still, there are also many negative remarks that ‘the Maroon does not care about the future’, he lives ‘poorly and miserably’, and ‘does not make any effort to plant decent provision fields’ (Van der Kuyp 1961). During a visit to the Okanisi Maroons along the Marowijne River, Geijskes (1955) classified their provision fields as a ‘wasteful land use’ and ‘primitive’. Budelman and Ketelaar (1974) proposed that their dryland rice landraces should be replaced with modern wetland cultivars with a focus on trade and export. They regarded shifting cultivation as archaic because the evolution of Maroon communities had halted at a primitive level, due to people’s incapacity to incorporate new techniques. Recently, Nascente and Kromocardi (2017) and Sewnarain (2021) mentioned that low grain yields were problematic for the Maroons, as they relied on rice as their staple food. They viewed the rice yields as insufficient to meet local demands and advised replacing Maroon landraces with modern Brazilian upland cultivars to increase grain yield and meet food security needs. Despite their negative descriptions, no detailed description on their rice cultivation was provided by any of these authors. A few studies have focused on more aspects of Maroon agriculture. Fleskens and Jorritsma (2010) studied ways to improve Saamaka soil management and Van Andel et al. (2016) made an inventory of the crops of African origin cultivated by Saamaka and Okanisi. Anthropologists Hurault (1965) and Fleury (1993, 2012, 2016) described some of the farming practices of the Aluku communities.

Rice and the plantation society of Suriname

In the centuries of the transatlantic slave trade (c. 1520-1864), colonial authorities, plantation owners, and slave ship captains had to provide food for the enslaved people, soldiers, and other personnel. The diet of the enslaved Africans mostly consisted of crops they were acquainted with in their motherland. Slave traders and ship captains soon recognized the importance of stocking African crops, believing it led to fewer mortality on ships bound for the Americas (Carney and Rosomoff 2011). Crops such as yam, beans, sorghum, millet, plantains, bananas, and rice were increasingly cultivated near slave trading sites and bought on local markets by ships heading towards the Americas (Carney and Rosomoff 2011; Dragtenstein 2020). African and Asian rice, cultivated by local farmers soon after the Portuguese introduced it to West Africa (Nawani 2013; Gilbert 2015), were shipped with enslaved Africans to the Americas from the 1530s onwards (Carney 1998).

Rice cultivation started in Suriname in the second half of the 17th century. The first reference to rice grown in Suriname in the Dutch archives comes from a letter written by the Zealand commander Abraham Crijnssen in 1668. The letter shows that the colony dealt with subsistence problems from the beginning. Crijnssen saw rice cultivation as part of the solution. A few decades later, the Society of Suriname ordered plantation owners to grow rice as food for the enslaved and the soldiers in the colony (Elfrink et al. 2024). It is therefore almost certain that rice was one of the crops on the plantation provision fields maintained by enslaved peoples. Food production on plantations generally took two forms. Plantation owners reserved fields for producing food, often urged by colonial regulations, to ensure basic dietary needs, the so-called 'plantagekostgronden' (plantation provision fields). On these fields, enslaved people cultivated several starch-rich crops such as plantains, cassava, and other root and tuber crops. The other form consisted of small gardens ('negerkostgronden'), where enslaved people worked at their discretion, growing various crops, many of which were introduced from different continents (Carney and Rosomoff 2011; Van Donselaar and Van der Sijs 2013). On these small provision fields, where enslaved people could only work in their free time, they cultivated their preferred crops, such as rice (Maat et al. 2023).

Rice and marronage

One of the consequences of the harsh colonial system of slavery is the emergence of Maroon communities. Marronage, the act of self-emancipation or escape from slavery, was common in the Americas during the plantation period (Price and Price 2022). Since the early days of slavery in Suriname, enslaved Africans fought against the colonial humiliation for their freedom. They often escaped in small groups and formed larger communities over time, initially with native Americans who sheltered them (Dragtenstein 2002). Conducive environments were necessary for these communities to survive and thrive (Thompson 2006). Farming was also fundamental for those who escaped slavery, building Maroon communities in places that were out of reach for plantation militia, and colonial armies (Maat et al. 2023).

Plantation owners who lost their workforce due to marronage organized armed expeditions to chase the runaways in the forest and destroy their provision fields (Dragtenstein 2002). In many military expedition reports describing the discovery and destruction of Maroon settlements, rice is mentioned among the crops grown on their provision fields (Stedman 1988; Dragtenstein 2002). As early as 1712, soldiers discovered large rice fields in runaway settlements along the Saramacca River (Van Andel et al. 2023). The abundance of rice fields encountered around these runaway settlements suggests that rice must have been one of the crops grown by enslaved plantation workers in unsupervised fields (Maat et al. 2023). The Scottish mercenary John Gabriel Stedman, who served in several military actions against the Boni Maroons in the coastal

Cottica swamps, wrote in his diary on August 20, 1775: "*At 10 o'clock we met a small party of the rebels, with each a green hamper on his back, who having fired at us, without we returned it, let drop down their bundles and took to their heels, back toward their village, and whom we, since learned, were transporting rice to another settlement to subsist Boney's people. The green hampers which were most curiously plaited with the manicole leafs. Our men cut open with their sabres, from which actually burst forth the most beautiful clean'd rice, that I ever saw*" (Stedman 1988:404). Stedman also made drawings of these large rice fields and reported on the abundant stocks of cassava and yam tubers in the temporary settlements of the runaways.

On plantations, enslaved men and women were tasked with different forms of labor. Heavy labor such as weeding, forest clearing, and trench digging were assigned to men, while women were more involved in crop harvesting, preparing meals, and other household-related tasks. After marronage, the division of labor prevailed and extended to farming practices. Women had (and still have) a pivotal role in rice farming (Price 1993; Van Andel et al. 2023). Maroon men were involved in the guerilla war with the colonial authorities and the armed plantation troops during the time of marronage (Price 1983; Dragtenstein 2002, 2023), which allowed them little time to practice farming with their wives. Another reason for this gender-specific division of labor may be the local environmental conditions: harvesting rice (a woman's task) and felling trees for new fields (a man's job) both take place in the dry season (Van Andel et al. 2023).

From 1650 onwards, Maroon men raided many plantations freeing other enslaved people, taking weapons, food, and tools, and often setting fire to buildings or killing the owners (Dragtenstein 2023). They caused so much nuisance and financial losses that the colonial government decided to make peace with them (De Beet 1981; Price 1983; Dragtenstein 2002, 2023). Peace treaties were signed in 1760, 1763, and 1765 with three Maroon communities: the Okanisi, Saamaka, and Matawai respectively. In these treaties, Maroons promised to cease their attacks on plantations and bring back new runaways, in exchange for substantial amounts of trade goods on an annual basis (Dragtenstein and Band 2009).

Nowadays, six Maroon groups are distinguished in Suriname and French Guiana (Fig. 1.1): Saamaka (also written as Saramacca(ns), estimated population size ~82,500), Okanisi (also known as Okanisi or Ndjuka, ~82,500), Matawai (~6,800), Paamaka (or Paramacca(ns), ~11,000), Aluku ~11,000) and Kwinti (~1,000). The majority still live in the forested interior of both countries, except for the Matawai and the Kwinti, who have largely migrated to Paramaribo, the capital of Suriname (Price 2013).

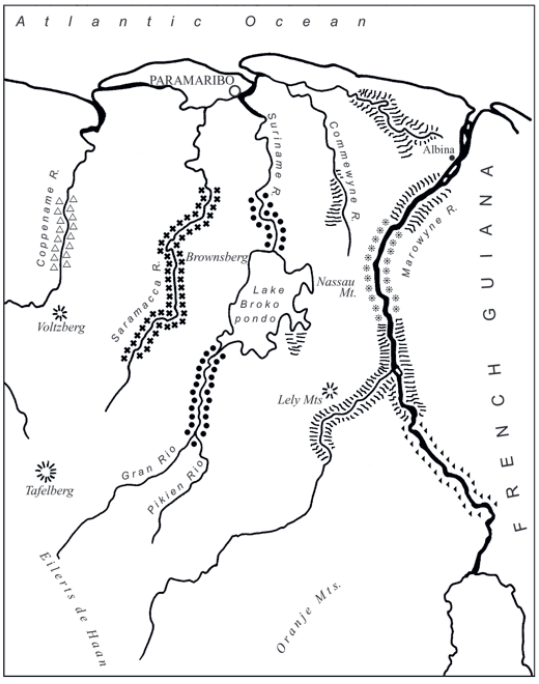

Fig. 1.1 Map of Suriname (left of the Marowijne River) and French Guiana with locations of the Maroon communities. ΔΔΔΔ Kwinti, ●●●● Saamaka ١١١١ Okanisi ✱✱✱✱ Paamaka **xxxx** Matawai ◄◄◄◄ Aluku. Map made by Hendrik Rypkema, Naturalis Biodiversity Center.

Maroon agriculture

A pilot project along the Marowijne and Lawa Rivers in 2017 suggested that Maroons cultivate a high number of rice varieties, including many types of Asian rice and one African rice (Van Andel et al. 2019). Apart from one single landrace of African rice that our research team traced back to the Ivory Coast (Van Andel et al. 2016), the provenance of the other Asian rice varieties remained a mystery. Understanding how Maroons maintain this rice diversity, documenting their cultural and ethnobotanical knowledge, and their motives for rice cultivation would provide a solid basis for conserving this agrodiversity.

Before 2017, when our research group started focusing on Maroon rice cultivation, there were only a handful of voucher specimens of Maroon rice stored at herbaria in Suriname, French Guiana, and the Netherlands. Genetic resources of Maroon rice varieties were hardly available online. Via the Surinamese germplasm bank, the Stichting Nationaal Rijstonderzoeks Instituut/Anne van Dijk Rijst Onderzoekscentrum Nickerie (SNRI/ADRON) in Nickerie, three traditional rice varieties were collected in the 1970s and stored in the IRRI seed bank: wanica, gogowierie, and pinde gogowierie (Van Andel et al. 2019). In the late 1990s, an expedition organized by SNRI/ADRON to the Saamaka Maroons resulted in a list of local rice names and the insertion of a dozen rice varieties in the germplasm bank in Nickerie (Baumgart et al. 1998), for which no genomic data was available.

Objectives of this PhD research

Despite the negative stereotypes that dominated the descriptions of the past centuries, hardly any research has been done on Maroon rice cultivation. As rice is an important staple crop of the Maroons, this PhD research aimed to:

1) Collect and describe the different Maroon rice varieties;

2) Translate Maroon rice names to understand their meaning;

3) Analyze the methods and motivations of Maroon rice farmers to maintain their rice diversity;

4) Measure yields and growth seasons of several Maroon rice varieties;

5) Analyze how the social and cultural characteristics of Maroon communities relate to the cultivation of rice.

The specific research questions associated with the objectives of this PhD study are detailed below. These questions and the objectives form the basis of the four thesis chapters. For the collections and description of the diversity of Maroon Rice varieties (objective 1), we wanted to know the number of varieties of each farmer, and whether they recognized new varieties and so-called 'off types', differently looking individuals growing within a patch of one specific variety. To analyze how Maroons tell apart their diverse varieties (objectives 2 and 3), we asked for the specific names for each variety, and if and how they arranged their rice field to keep their varieties separated (or not). To document the motivations of farmers for rice cultivation (objective 3), we asked why they planted rice, why they had more than one type of rice, and how and when they obtained or exchanged their varieties. To test whether previous assumptions of low yields were true, and to verify the different growth seasons (objective 4), we followed several Maroon women who planted 28 traditional varieties and two commercial cultivars and measured ripening periods and yields. Finally, to understand the contradicting information about the magic status of African rice and the role of both rice species in rituals (objective 5), we asked whether there were special stories or songs on rice, when and how the ancestors obtained rice, from where this rice came, how rice Fig.d in myths, and how it was used in offerings and (ritual) medicine.

The overall hypothesis of the larger research project *Hidden Crop Diversity in Suriname* (of which this PhD thesis represents the ethnobotanical part) is that Maroon rice fields reflect 370 years of migration history and skillful adaptation to the Amazonian environment: a highly diverse and dynamic system that combines ancient African landraces with traditional Asian varieties exchanged around 1900 with Indian and Javanese contract laborers, commercial rice cultivars from the 1930s and newly developed hybrids of all these varieties and landraces on Maroon fields. We also expect that rice cultivation is deeply connected to the Maroon way of life, visible in language, ancestral narratives, traditions, and cultural practices. The genomic aspects of this hypothesis are covered by the postdoc project, see Van de Loosdrecht et al. (2024). The ethnobotanical part of the hypothesis will be answered in this thesis.

Methodology

For this PhD project, I collected several hundreds of rice landraces in Saamaka, Okanisi, Paamaka, and Matawai villages, documented their morphological, agronomical, culinary, and cultural properties, and analyzed how and why rice farmers maintained this diversity. Villages and rice farmers were selected based on previous contacts of myself, Van Andel, my family ties, invitations by Maroon authorities, the aim to provide a representative sample, and snowball sampling (Martin 2010).

Living seeds of the collected rice varieties were conserved in the germplasm collection of SNRI/ADRON for duplication, phenotyping, and storage. In this way, they are available to farmers who have lost their traditional landraces or want to try out other Maroon rice varieties. The varieties are also available for scientific research. Duplicate samples of the collected Maroon rice varieties are deposited in the Svalbard Seed Vault in Norway as part of the BOLD (Biodiversity for Opportunities, Livelihoods, and Development) project. This is a 10-year project to strengthen food and nutrition security worldwide by supporting the conservation and use of crop diversity. Led by the Crop Trust, in partnership with the Norwegian University of Life Sciences and the International Treaty on Plant Genetic Resources for Food and Agriculture, the BOLD Project is funded by the Norwegian Government (Crop Trust 2024). Our research group, the Crop Trust, and SNRI/ADRON duplicated Maroon rice varieties at the facilities in Nickerie and let Maroon rice farmers choose the varieties that they wanted to grow and established community rice fields in Brokopondo Centrum (lower Suriname River) and Santigron (lower Saramacca River).

We collected whole rice plants in the fields to make herbarium vouchers. Fieldwork was scheduled during the months that the rice was ripe or ripening. The aim was to have a few representative samples of each named rice variety, but also collect off-types and varieties for which people did not have names. When a variety with a known name looked different than previously collected ones under that name, it was also collected. One duplicate was deposited at the National Herbarium of Suriname (BBS) in Paramaribo, Suriname, and the other at the Herbarium of Naturalis Biodiversity Center in Leiden, the Netherlands. When no living plants were available for specific varieties, we collected seeds from rice stored in people's outdoor granaries. Non-viable seed samples were deposited at the Economic. Botany collection of Naturalis Biodiversity Center.

DNA samples were taken from fresh leaves or recently sprouted seeds of 360 Maroon rice varieties we collected. Postdoc Van de Loosdrecht characterized the genomic variation in the Maroon rice landraces and compared these to modern and historic rice accessions and crop wild relatives from the Guianas, West Africa, Asia, and the US, using whole-genome sequencing. Single nucleotide polymorphisms (SNPs) were used to quantify diversity within Surinamese landraces and assess their genetic and geographical origins (Van de Loosdrecht et al. 2024). The next step is to use advanced genomic and bioinformatic methods to detect specific genetic traits for which these landraces were selected.

To meet the objectives of the ethnobotanical part of the project (this PhD thesis), I collected information from farmers using conducting semi-structured interviews. Fieldwork was carried out in 2017 (by Van Andel) and between 2021 and 2023 by myself and Van Andel in c. 62 locations of Saamaka, Okanisi, Matawai and Paamaka rice fields across Suriname and the western border of French Guiana. Interviews held by Van Andel in 2017 were also used in my analysis. Participants were recruited through snowball sampling (Martin 2010). We used a questionnaire to interview 99 rice farmers to infer the number of varieties grown, cultivated area, variety loss and acquisition, seed distribution, seed sources, field selection, and variety names and meanings. All interviews were held after obtaining prior informed (oral) consent from each farmer. We also interviewed several Maroon intellectuals to discuss our findings and our unanswered questions on the meaning of rice names, and to elucidate myths, songs, and stories on the origin of Maroon rice told by the interviewed farmers.

We did not visit the Aluku communities along the Lawa River in French Guiana, as special permits were needed to do ethnobotanical research with specimen collecting in their territory, which falls within the Parc amazonien de Guyane (https://www.parc-amazonien-guyane.fr). The procedure to request such permits was not yet clear at the time of our fieldwork,

and therefore no research that connected traditional knowledge with specimen collection was allowed in this area of southern French Guiana. Therefore, for information on Aluku rice farming, we relied on the work of anthropologist Fleury (1986, 1993, 2012, 2016). We also consulted digital images of Aluku rice specimens collected by Fleury in the 1980s that are stored in the Cayenne herbarium, French Guiana. We did not visit the Kwinti communities along the upper Coppename River either, because we did not have any prior indication that the few people residing in these villages were still farming rice. More details about research methods are provided in the following chapters presenting the results of this PhD thesis.

A new perspective on Maroon rice

In this PhD research, Maroon rice cultivation is studied in detail for the first time. Using methods from Ethnobotany, Oral History, and Agronomy, I show the importance of rice for Maroon culture, food provision, independence, social cohesion, and spiritual beliefs. I also explain how rice's diversity and cultural and nutritional role differ among Maroon communities. Through our semi-structured interviews, my research is one of the first studies in Maroon agriculture that include the voices and opinions of Maroon farmers about rice cultivation. Various researchers have published some Maroon rice names in the past (e.g. Vaillant 1948; Geijskes 1955; Baumgart et al. 1988; Fleury 2016) or simply listed them in unpublished documents (Hoffman c. 2006; Price 1960s; SNRI/ADRON). In my thesis, these previously documented names and the many other unique names I collected have been translated and analyzed for the first time and reveal a naming pattern that reflects the history of the different Maroon groups concerning rice, the role of their ancestors, and their contact with outsiders.

Although it was recently discovered that African rice (*O. glaberrima*) was already mentioned in archival documents from Suriname in 1686 (Elfrink et al. 2024), the first specimen of this African rice specimen was only collected in 2008 (Van Andel 2010). The exact uses of this type of rice were unclear and surrounded by mystery and contradicting legends. This thesis is the first to unravel these myths, and the specific cultivation practices associated with this rice, and provide an ecological explanation of the spiritual beliefs that surround this rice. To a certain extent, we solved the mystery of how a fully domesticated West African crop could become a wild plant that is cultivated by spirits and that people are hesitant to consume.

Yield and growth durations of Maroon rice landraces were previously measured under experimental settings in Brokopondo (Nascente and Kromocardi 2017) and Nickerie (Sewnarain 2021), which both gave meager results compared to commercial cultivars. For the first time, I measured growth durations and yields of Maroon rice landraces on traditional fields sown, maintained, and harvested by Maroons themselves. In this environment, their performance is much higher and comparable to that of other landraces in Asia.

Many anthropologists and historians have studied Maroon communities (for a bibliography, see Price 2018). In these books and articles, agricultural practices are often mentioned briefly. For the first time, I provide a detailed description of the chain of operations of Maroon rice farming and the diversity management of one crop.

Thesis outline

The common thread across the chapters in this thesis is the management of the diverse rice varieties and motivation for farming in Maroon communities in Suriname and French Guiana. The aims and hypotheses presented in the various chapters seek to unravel the many aspects of Maroon rice farming employed by farmers and the adaptations they made in the past and still make every year regarding rice cultivation.

In **Chapter 2**, I analyzed the naming patterns in Maroon rice farming. Maroon rice varieties have many names. By the time of writing, I had 67 conducted interviews with rice farmers (96% female), collected over 400 rice specimens, and built a database with 284 unique rice names from our fieldwork and previously collected names retrieved from published and unpublished sources. I categorized names referring to morphology, agronomy, animals, names of ancestors, people in general, and rice brought from specific regions or by other Maroons and exchanged with non-Maroon groups. I clarified the role of women in rice names and naming rice and compared the consistency of the names among farmers in the same village, in the same ethnicity, and nationwide. I explained how naming a rice variety is complex but indicates recurrent patterns among the five Maroon groups I studied.

In **Chapter 3**, I shifted the focus to the only African rice variety collected so far in Suriname and French Guiana. Based on interviews with 99 Maroon farmers, of whom 23 cultivated black rice during our fieldwork, I described its diverse uses as (ceremonial) food, offerings, spiritual medicine, and its role during funerals. Furthermore, I compared Maroon's oral history accounts on the origin of African rice differ among and within communities. I analyzed these oral histories and origin myths by using ecological and historical information on African rice and the people who cultivate it.

In **Chapter 4,** I followed the growth and harvest of 28 Maroon rice landraces and two commercial cultivars in Maroon farmer fields, using traditional farming methods, at three locations. Previous authors assumed that all Maroon landraces had low yields (700-1000 kg/ha), but their performance in traditional farming systems had never been studied. I also recorded sowing density and the time each of these varieties took to ripen. Maroons distinguish three categories: short, medium, and long varieties, based on maturation time. I analyzed whether differences between these maturation periods were significant and whether they were related to certain rice varieties.

In **Chapter 5**, I described the chain of operation in Maroon rice farming. A chain of operation is a sequence of activities instrumental in reaching a desired goal. In Maroon rice farming this goal is food security and food sovereignty, but cultural identity also plays a role. I used the data from interviews with Maroon 99 farmers and the collected rice varieties from 106 farmers. I asked about their personal and cultural motivations to cultivate rice, the varieties they had, how they obtained them, the sequence of farming activities, and the role of men, women, and adolescents during these activities. I compared the chain of operation among Maroon communities and the areas they reside to show the factors that influence the sequence of activities.

In **Chapter 6**, I discuss the results and provide the answers to the research questions formulated in Chapters 1 to 5. I address the significance of this research for the culture, tradition, and food security of Maroon communities in the present and future. Furthermore, I discuss how beneficial the current diversity is not only for Maroons but also for rice breeders and research institutes. I close the chapter with the societal impact of this work and recommendations for future research.

2

Chapter 2: Vernacular names of traditional rice varieties reveal the unique history of Maroons in Suriname and French Guiana

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Supplementary files can be found online in the published papers.

Abstract
Rice is a keystone crop in all Maroon communities in Suriname and French Guyana today and they cultivate hundreds of traditional varieties. Historically, rice can be considered an indicator crop for successful marronnage in the Guianas. Unraveling local variety names can reveal the history, farming systems, spiritual significance, and probably the diversity of rice in Maroon communities. We interviewed 67 rice farmers (96% female), collected over 400 rice specimens, and built a database with 284 unique rice names from our fieldwork and previously collected names. The process of naming a rice variety is complex, but there are recurrent patterns among the five Maroon groups we studied. We categorized names referring to morphology, agronomy, animals, humans, and rice brought from specific regions or by other Maroon and non-Maroon groups. Very few names are shared between Maroon groups. When we showed farmers six rice varieties from outside their village, all recognized African rice (*Oryza glaberrima*) and *pende* (*O. sativa* with spotted husks). When a variety was unknown, an initial name was given based on its morphology. Maroon rice names are truly unique as they reflect the available varieties, the history of plantations and marronnage, climate aspects that influenced the selection of farmers, the many separate groups of runaways joining the Maroons, the adaptation to the Amazonian ecosystem, and their contacts with outsiders. Our results show that unraveling Maroon rice names leads to a better understanding of the close connection between the process of marronage, locally developed agricultural practices, and connections to West Africa. These historical origins continue, forming a unique Maroon system of variety exchange, farm management, and crop diversity.

Introduction
Rice is the most consumed staple food in the world, and has two domesticated species: Asian rice (*Oryza sativa* L.) and African rice (*Oryza glaberrima* Steud.). Apart from the many commercial cultivars, several thousands of traditional rice landraces exist in Asia, Africa, and the Americas (Li et al. 2014; Stein et al. 2018). Although widescale commercial rice farming increasingly replaces traditional varieties, small farmers have been conserving their self-developed rice diversity for their potential tolerance against flood, drought, and salinity and their nutritional, culinary, and cultural values (Gopi and Manjula 2018). By using separate names for rice varieties, farmers are effectively segregating phenotypes. Over time this segregation can bring forth botanical significance. Another important aspect is that cultural knowledge of varieties helps to transmit crop knowledge, both widely in a community and specialized within sub-sectors of the community (Eyzaguirre 2003). Vernacular names in Gambia reflect specific farm management practices employed by farmers and, vice versa, analysis of names helped explain on-farm genetic diversity and locally-specific crop improvement strategies (Nuyten and Almekinders 2008). In Laos, rice names often indicated particular morphological features or other unique characteristics. Also, local rice names reflected the resistance to or tolerance for commonly occurring stress factors like drought, floods, lodging, birds, weeds, and soil adaptation. This information helped to select germplasm for rice improvement (Rao et al. 2002).

In Suriname, rice is a major part of the dietary intake of every household (Kennedy et al. 2002). While coastal citizens consume rice grown on commercially exploited wetland polders, traditional rice varieties (both *O. sativa* and *O. glaberrima*) are important crops for Maroons living in the forested interior (Price 1993; Van Andel et al. 2019). Maroons, descendants of enslaved Africans who escaped the plantations in the late 17th and 18th centuries and established independent communities in the remote interior, are found in Suriname and French Guiana. Nowadays, six Maroon groups are distinguished in this region: Saamaka (estimated population size ~82,500), Okanisi (or Ndjuka, ~82,500), Matawai (~6,800), Pamakkas (~11,000), Aluku (~11,000) and Kwinti (~1,000). The majority still lives in the forested interior of both countries, except for the Matawai and the Kwinti, who have largely migrated to Paramaribo, the capital of Suriname (Price 2013).

Maroons practice slash and burn agriculture, and their rainfed provision fields contain multiple crops such as cassava, okra, plantain, sugarcane and rice, planted near of each other (Hurault 1965; Counter and Evans 1981). Trees that they cut are not removed, and as the burned trunks decay over time they provide nutrition to the crops. After rice is sown, farmers never apply fertilizer as the charcoal from burned organic materials functions as such. Insecticides or herbicides are not used. Most rice is sown in the short dry season from March till April and harvested in the long dry season from July to September (Van Andel et al. 2019). In Maroon society, rice functions not only as a staple food, but also plays an important spiritual role, as it is present is most offerings to ancestors and Gods (Herskovits and Herskovits 1934). In the past, indigenous peoples in the Amazon have collected wild rice (e.g. *Oryza latifolia*, O. *glumaepatula*) for consumption (Hilbert et al. 2017). These species have not (yet) been encountered in the vicinity of Maroon rice fields.

The first official accounts by the Dutch about rice in Suriname date from 1687 and discuss the planting of rice destined as bulk food for the enslaved and soldiers (Oudschans Dentz 1944; Van Andel et al. 2022). Plantations records hardly mention rice, but rice was likely grown widely on food plots not administered by plantation owners. Even though information on quantities is missing, accounts of rice appeared more frequently by the late eighteenth century. Historical records of military expeditions, sent out to capture Maroons, mention the first Maroon provision fields with rice as early as 1712 (Dragtenstein 2002; Van Andel et al. 2022). Once settled safely in the interior, rice became the main staple crop of the Maroons (Hurault 1965; Price 1993).

Accounts of varietal diversity in the Maroon rice fields appeared from the second half of the twentieth century. Anthropologist Sally Price (personal communication) recorded vernacular names in the Saamaka language for 74 varieties in the 1960s, Geijskes (1954) listed 21 local varieties among the Pamakkas and Okanisi along the Marowijne River, Hurault (1965) counted a dozen varieties planted by Okanisi and Aluku in French Guiana, and Hoffman (personal communication) listed 29 varieties farmed by the Saamaka between 2003 and 2006. Unfortunately, none of these scholars collected specimens or provided detailed (morphological) descriptions of the rice varieties. More systematic studies of the Maroon knowledge and practices regarding wild and cultivated plants were done by ethnobotanists, initially mostly on wild and medicinal plant species (Van Andel et al. 2011; van 't Klooster et al. 2022). Collection of names and samples of Maroon rice varieties are from recent studies (Van Andel et al. 2019) and the current study is the first attempt to sample rice diversity across all Maroon communities. The research questions addressed in the paper are: Which rice variety names exist and what do they refer to? Why does a variety have the name that it has? Do the Maroon communities share rice names? Do Maroons recognize each other's rice varieties? What is the process for naming

varieties? Is this naming pattern similar for all Maroons and is it comparable to other crops in Suriname, Africa or elsewhere?

Marronnage happened from different plantations over a timeframe of more than 100 years (Dragtenstein 2002). Since a substantial proportion of enslaved Africans in Suriname were rice farmers in Upper West Africa (Carney 2005), elements of a rice naming pattern may already had been established in Africa. What we argue in this paper is that the Maroon rice naming pattern is based on a combination of cultural and agroecological associations with distinguishing morphological features and that the cultural associations in rice names refer to ancestral origins. A study on rice names in Gambia revealed a naming system based on morphological, agronomic and culinary traits, specific persons, the geographical origin of the rice, and in rare cases, animals (Nuijten and Almekinders 2005). Moreover, this study suggests that relatively recent varieties that are widely used initially get named after the person who is considered to have introduced the seed first, and subsequently these varieties are renamed based on agro-ecological or botanical features: Naming a variety after the person who introduced it can be perceived as giving credit to that person. After a period of about 20 years, the variety gets a new name based on its distinctive morphological, agronomic, or culinary traits. Possibly, when varieties get more widely diffused, the actual origin loses its meaning and is forgotten (Nuijten and Almekinders 2005).

Our results show that Maroon communities continue to name rice varieties after women who escaped from the plantations in Suriname more than two centuries ago. Stories about heroic escapes, and surviving persecution by plantation militias and armed forces the colonial government employed to destroy Maroon villages are deeply engrained in Maroon culture (Price 1983). This, together with the key role of women in food production, results in a wide presence of variety names referring to ancestral women who first escaped the plantation regime (Van Andel et al. 2022). Our results thus suggest a strong role for cultural memory in the naming of Maroon rice varieties.

Material and Methods

We conducted semi-structured interviews in five regions in March-April and July-August 2021 and March-April and July-August 2022 (Fig. 2.1): the Tapanahoni River (Okanisi), Marowijne River (Pamakkas and Okanisi), French Guiana (Okanisi, Pamakkas and Saamaka), Upper Suriname River (Saamaka), Cottica River (Okanisi) and Upper Saramacca River (Matawai) and Lower Saramacca River (Matawai and Saamaka).

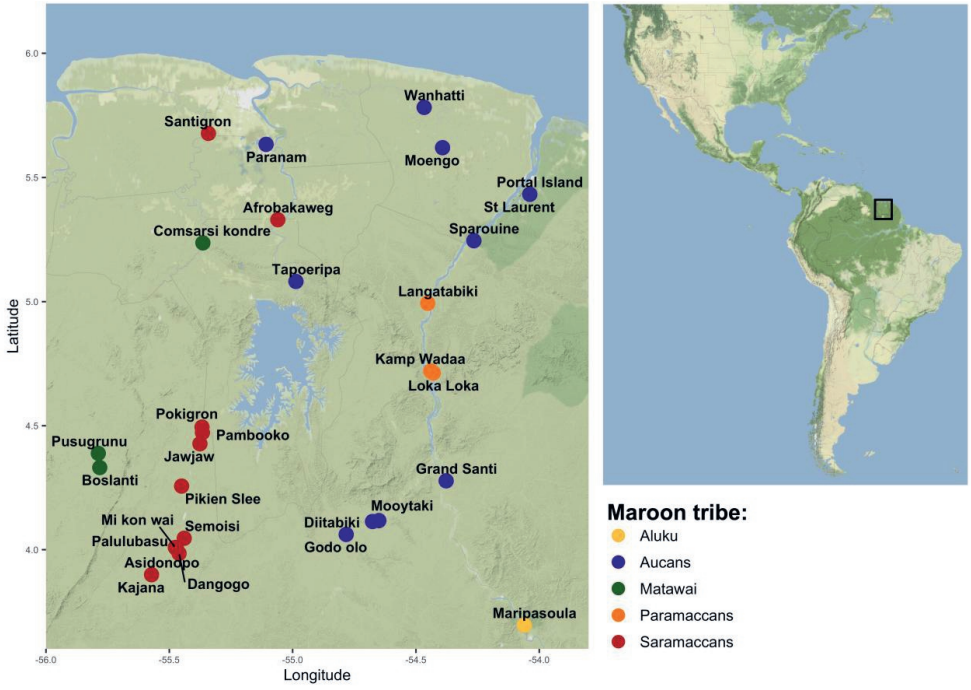

Fig. 2.1 The Map of Suriname shows major sites for each Maroon group where rice names were collected.

We administered a questionnaire to rice farmers to infer the number of varieties grown, cultivated area, variety loss, seed distribution, seed sources, field selection, and variety names and meanings. All interviews were held after prior informed (oral) consent. We also interviewed five Maroon intellectuals on the meaning of rice names. In conjunction with this questionnaire, farmers were asked for seed samples and/or whole rice plants to make herbarium vouchers. One duplicate was deposited at the National Herbarium of Suriname (BBS) in Paramaribo, Suriname and the other in the herbarium of Naturalis Biodiversity Center in Leiden, the Netherlands. When no living plants were available for specific varieties, we collected seeds from rice stored in people's outdoor granaries. Seed samples were stored in paper envelopes: one living duplicate of each variety was deposited at the SNRI/ADRON germplasm bank in Nickerie, Suriname for storage and phenotyping, while the other (dead seeds) was stored at Naturalis Biodiversity Center.

Furthermore, we interviewed paramount chiefs Albert Aboikoni of the Saamaka, Lesley Valentijn of the Matawai, and Bono Velanti of the Okanisi. After the first author clearly explained the nature of our research to these traditional authorities (in their language), all three permitted us to research rice, document and publish traditional knowledge, and collect specimens. As rice is a domesticated species, no further collection permits were needed to collect specimens in Suriname and French Guiana.

In our analysis, we included rice names collected previously by other researchers: Ramdayal (2020) among Saamaka, Van Andel et al. (2016, 2019) among Okanisi, Vaillant (1948) among Aluku and Okanisi, Price (unpublished 1960s) and Hoffman (unpublished 2006)

among Saamaka, the SNRI/ADRON seed bank (unspecified Maroon communities), Geijskes (1955) among Okanisi and Pamakkas and Fleury (2016) among Aluku. Additional Maroon rice names were collected from specimens in the herbarium collections of Naturalis and the Herbier du Cayenne in French Guiana. No rice names have yet been documented for the Kwinti Maroons, so this group was not included in our analysis.

Initially, we constructed a database with more than 800 names, after which we merged the different spellings and misspelled names, following the dictionary of the Summer Institute of Linguistics (SIL 2013). We unraveled the meaning of the names with the help of the farmers we interviewed, the SIL dictionary and our Maroon interpreters Edith Adjako, Vinije Haabo, John Jackson, Tolin Alexander, Annastacia Prisiri- Samson and Kenrich Cairo. We then scored the (meaning of the) rice names based on their morphological characteristics (color, size, shape and presence of an awn), agronomic characteristics (threshing quality and preferred place of growth), reference to animals, females (person's names, female body parts, etc.) or males (names and body parts), geographic origin, people or groups from which rice was received, and other features.

Maroons often recognize more than one type of the same variety, and for these they use binary names. For example, a red Rexora, white Rexora or spotted Rexora. In this case, we counted the variety name ('Rexora') as one, but scored an additional morphological category (red, white or spotted). An exception was made for those varieties for which color is explicitly mentioned in the variety name and no other types are recognized within that variety. One example is *baaka alisi* ('black rice'), which is a single variety of *O. glaberrima*, and therefore was assigned its own category. We then sorted names based on the Maroon group where the sample was taken and calculated frequencies of all categories. An UpsetR diagram (Conway 2017) was created to show unique and shared names among the five Maroon groups, using R studio. A map of Suriname and Fig.s were created using the "get_stamenmap()" and "ggmap()" functions of the ggplot2 package (Wickham 2016) in R-studio were created using Microsoft Excel.

To verify how well farmers knew rice from other communities and how names were invented in the field, we made a 'rice quiz': a paper with five samples of local rice varieties secured under transparent tape. The varieties we selected were: *baaka alisi* (the only *O. glaberrima* variety in Suriname to date), *pende fisi* ('spotted fish', with spotted husks), *masaa alisi* ('master's rice', with red bran), *Ma Paanza alisi* ('Mrs. Paanza's rice', a rice named after a Saamaka female ancestor), *puspusi* ('cat') and *Carolina gold* (a recently developed, modern cultivar from Anson Mills, Columbia, US). We included the 'new' Carolina gold cultivar (https://ansonmills.com/products/23), allegedly similar to historic Carolina Gold varieties that were exported to Suriname in the late 18th century.

Results

Shared Names

Overall, we interviewed 67 rice farmers (96% female): 26 Okanisi, seven Matawai, four Pamakkas and 30 Saamaka, and collected over 400 rice samples. The number of rice varieties grown per farmer varied from 1 to 21. Some rice variety names mentioned by farmers were not encountered in the field. We constructed a database from our fieldwork data and written documents with 284 unique names for rice varieties: 143 from the Saamaka, 66 from the Okanisi, 16 from the Matawai, 13 collected from the Aluku and eight from the Pamakkas (see Supplementary file 2.1). Of the 284 unique names, a total of 38 names were shared among two or more groups and only four names were found in all groups (Fig. 2.2).

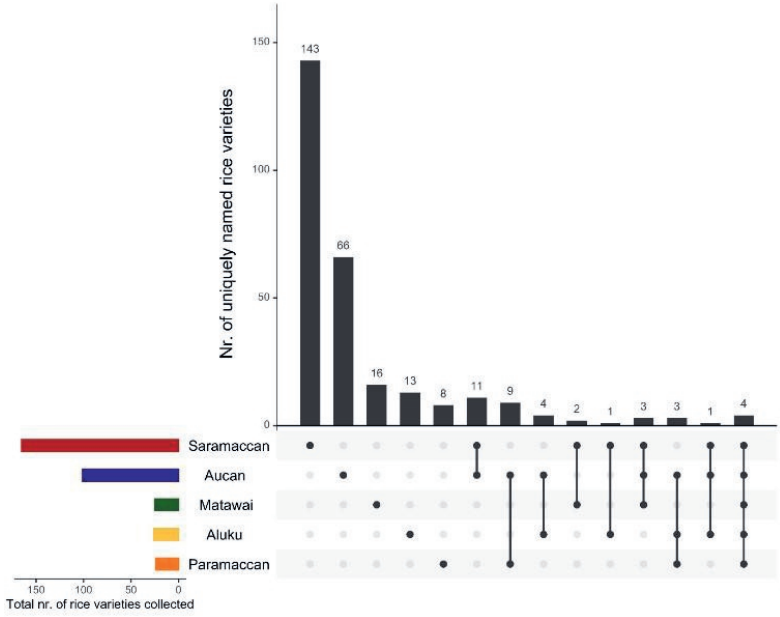

Fig. 2.2 UpsetR diagram showing the number of unique and shared vernacular rice names of the five Maroon groups.

The majority of the unique rice names are found among the Saamaka and Okanisi, the two largest Maroon groups with the most villages. These groups have more unique names than names shared with other groups. The Pamakkas have fewer unique names than names shared with other groups, most prominently the Okanisi and Aluku. The Pamakkas are small in number and live along the same river as the Okanisi and Auluku. The Matawai share more than half of their rice names with the Saamaka. The two groups started as one and split around the 1740s (Price 1983).

Of all the rice variety names, just four were found in all five Maroon groups: *alekisoola* ('Rexora'), *baaka alisi* ('black rice'), *pende* ('spotted') and *alulu* ('it rolls'). *Alekisoola* is identified as locally adapted version of *Rexora*. This glabrous-hulled cultivar was developed in 1926 in Louisiana (Rutger and Mackill 2001), introduced to Guyana in 1932 (Codd and Peterkin 1933), and widely grown in coastal Suriname by 1938. According to Stahel (1944), a bale of *Rexora* rice was sent to the Saamaka village Ganzee in 1936. The name *baaka alisi* is the only variety of black or African rice, and known by all Maroons as a spiritual rice (Van Andel et al. 2019). The name *alulu* (*a bon*) means 'it rolls (from the tree)' as it is a shattering type. Aucan farmers see shattering as a positive trait, since it facilitates the threshing process. The name '*pende'* refers to varieties with spotted husks.

Naming categories

Based on the information obtained from rice farmers and previous research, we identified six naming categories. Names were given based on the rice morphology, agronomy, resemblance to animals, associations to males or females, geographic locations or other Maroon and non-Maroon groups. Fig. 2.3 shows that rice names referring to morphology account for almost 40%, which is the highest for all categories. The binary naming pattern accounts for this: if we

look only at the non-binary (simple) names, the morphology category drops to 24%, making the female category (28,6%) the category with the most rice names.

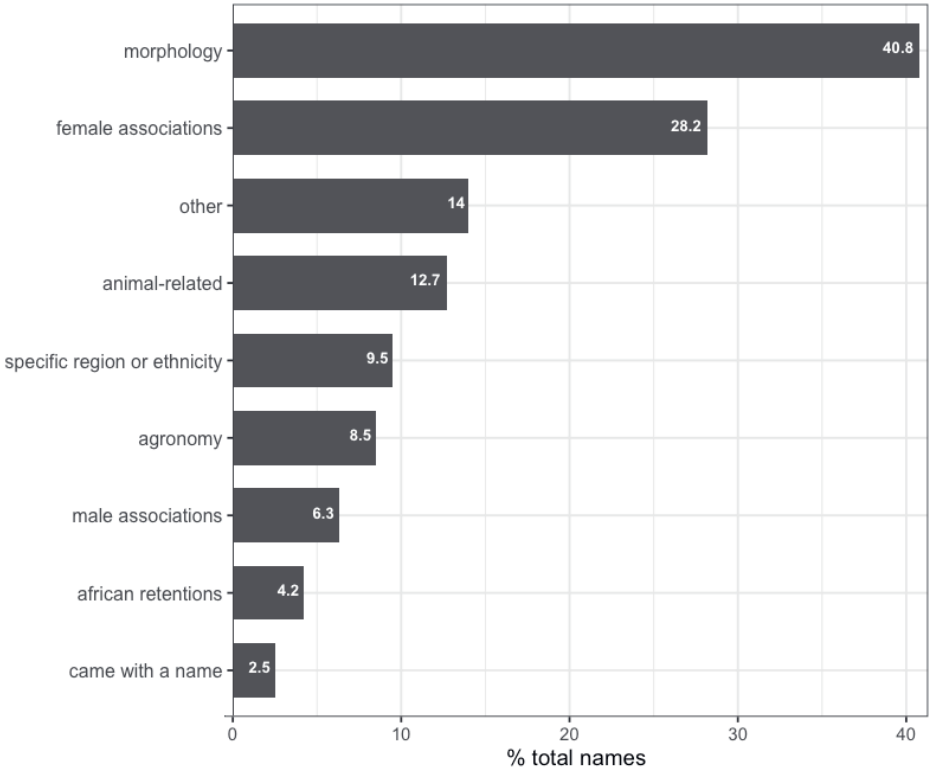

Fig. 2.3 Percentages of rice names in each naming category. Percentages add up to more than 100 % since we scored 76 binary names in more than one category.

Morphological characteristics

Most Maroon rice names refer to the morphology of a specific plant part, such as grain shape and color, husk color, plant shape and size, panicle structure, awn color, and shape. Names such as *lebi alisi* in Aucan and *bë alisi* in Saamaka both mean 'red rice' and describe the husk color of this variety. The Saamaka name *hánza-a-bandja* means 'wings on the side', and refers to the long outer glume on each side of the grain that is a typical morphological character of this variety (Fig. 2.4A). The Saamaka name jööödjööö (long hair) is given to a variety with very long awns (Fig. 2.4B).

A B

Fig. 2.4 A. The Saamaka traditional rice variety *hánza-a-bandja* (‘wings on the side’, NP 220). The long outer glumes are visible. B. the Saamaka variety jööójööö (‘long hair’, NP137). Pictures: Nicholaas Pinas.

Agronomic characteristics

Approximately 9% of all rice names were connected to agronomic characteristics, such as a preference for swampy soil, a tendency to lodge, etc. Our field surveys revealed that Maroons mostly cultivate upland rice varieties, but also some varieties that prefer wet soils or even permanent swamps, such as baka suwámpu (‘behind the swamp’, see Supplementary file 2.1). Names such as *awéi máun* (Saamaka and Matawai for ‘making the hands tired’) refer to the heavy panicles that cause exhaustion during harvesting time. *Kaasihánsi* (Saamaka for ‘itching hands’) refers to the irritating hairs on the leaves or grains and *alulu* (*a bon*).

Reference to animals

Almost 13% of all Maroon rice names refer to animals, most of which are native to the Amazonian rainforest. The names *pingo puuma* (bush pig hair), refers to the collared peccary (*Dicotyles tajacu*), while *djampö* and *pakia* both refer to the white-lipped peccary (*Tayassu pecari*), both common wild pig species in the Amazon forests. Rice varieties associated with these peccary species all have long awns that look like the pigs’ hair. The variety named *watadagu* (‘river otter’) has stiff awns that resemble the whiskers of the river otter, while the variety *puspusi* (‘cat’) has softer awns that look like a cat’s tail.

Apiikutu (futu), translated as ‘green-rumped parrotlet (feet)’, is a rice variety that is often destroyed by this bird (*Forpus passerinus*), as it descends on the rice to feed on it and squeezes the panicles with its feet. Aucan chief Bono Velanti explained that one time this specific parrotlet had eaten a lot of rice in the field, and farmers had caught and killed it. When gutting the bird, the farmers found that its stomach was full of rice. They had taken the seeds to be sown again and named the variety after the parrotlet. Lastly, one rice name refers to a bird species from West Africa. The name *toke* for a variety with dark brown patches on the husk refers to the Guinea fowl (*Numida meleagris*), a West African bird that was introduced to Suriname on slave ships (Benjamins and Snelleman 1917).

Male associations

A small number of rice names are connected to men. The variety *Adongote konde*, meaning ‘Adongote’s place’, is one of them. A farmer said that Adongote loved this rice so much that it used to be the only variety he farmed. When he passed away, the villagers decided to name this

variety after him. *Ston taka* is a name referring to male pubic hair, as it has a curly black awn that falls off easily. The Aucan rice variety *mesti* ('teacher') is named after a teacher of the first boarding school established in the Marowijne River, shortly after World War II. He handed out rice to the mothers of the pupils, whose descendants appreciate the variety until today (Van Andel et al. 2019).

Reference to places and other Maroon and non-Maroon groups

A limited number of rice names refer to places, such as *Abenaston*, a Saamaka village. We think that the researcher who collected this name either invented it without discussing it with the farmer, or it arose from a misunderstanding between the two, or the farmer preferred to mention a village rather than a specific name. Names in this category also refer to other Maroon groups, such as *Aluku paansu* (Aluku seeds), *bë djugá* (red Aucan), and *Ndyuka alulu* (Aucan roller), which suggests seed exchange between two Maroon groups. Naomi Eva, a Matawai farmer living in Comsarsikondre (Saramacca river) from whom we collected *Ndyuka alulu*, said she received this rice from Aucan people. Notably, Okanisi themselves never labelled their own rice as *Ndyuka*. It seems that exchange of varieties among the groups rarely happens.

In the post-emancipation period, the Maroon groups also exchanged rice with non-Maroon groups, such as indentured laborers from India (Hindustani), who were brought to Suriname from the late 1870s onwards. A variety that named *kuli kuli,* for example, has a clear reference to coolies, the derogatory term used for indentured laborers from India. The Dutch colonial government also arranged recruitment from Java. We encountered a glutinous (sticky) rice variety named *katam*, a name strongly resembling *ketan*, the Indonesian word for stickiness. In 1975, Hmong refugees from the northern mountains of Laos and Vietnam arrived in French Guyana, and Okanisi along the Cottica River cultivate a variety they named either *Hmong* or *anambu*. The latter refers to a water bird with long legs, as the Okanisi said the Hmong people lived on stilt houses above the swamp.

Traces of early runaways

The category 'other Maroon groups' also contains rice names that refer directly to the time of marronnage. Names, such as *Baákápáu tjaka, Agbosótjaka, Mbotombolia* and *Afanti sacca* refer to groups of runaways that joined the Maroons in different time periods. The Baákápáu were a group of people who escaped from the Tout Lui Faut plantation in the 1690s (Price 1983). The term Agbosó probably refers to Fon-speaking people, from A(g)bomey, the capital city of the former Kingdom of Dahomey, currently Benin (Smith 2015a). The Agbo ran away and joined the Saamaka around 1750s (Price 1983). The term Mbotombolia probably refers to a group of runaways that settled along the Boterbalie creek in the Para district, and who were taken along by the Matawai leader Musinga (Price 1990). The (A)fanti or Fante are a subgroup of the Akan people in southern Ghana of whom many were transported to Suriname (Wooding 1979). According to traditional healer Kenrich Cairo, the Afante people escaped from the Tempati region and joined the Aucan Maroons. Our data suggest that all these groups of escaped people had rice with them.

African words in Maroon rice names

Several Maroon rice names contain terms that can be linked to African words, of which the meaning was mostly forgotten or changed over time. The name *pende*, meaning 'dark' or 'dusk' was reported for an *O. glaberrima* variety found in Sierra Leone that was ready to harvest between 80 and 90 days (Richards 1983). We found the name *pende* associated with several *O. sativa* varieties with dark spotted husks, but with a growth season of 4 months, similar to most other Maroon varieties.

The word *saka* is a general word for rice in Mende (Sierra Leone), Gban (Ivory Coast) and several other unrelated African languages, and only occurs near old Portuguese and Spanish trading posts. The root of the word is probably the Portuguese verb *sacudir*, meaning 'to shake up' or 'winnowing rice', used as contact word by slave traders buying rice as bulk food for the trans-Atlantic voyage (Wiener 1920). We found that only few farmers knew what *saka* meant, although the term was shared by the Aluku, Okanisi and Pamakkas. However, the Saamaka rice names *Agbosotjaka*, *Afantisaka*, *tjaka Ma Jaa* and the Matawai name *atjakati* also seem to carry this same word (*saka*).

The name *böngö* is also another general name for rice, particular in the Saamaka community. The best translation is probably 'seeds' or 'seedling', but also 'children' or 'offspring'. Among the Okanisi, we heard the term *bongo* only in a rice song that was sung when farmers were finished with sowing. They hoped that by singing it the harvest would be plenty. *Bongo* probably comes from the Central African word *m-boóngo* in the Kintandu language, meaning 'descendants', 'planting material', 'seeds', and 'offspring' (Smith 2015b).

Non-translated and other names

Almost 15% of the Maroon rice names we could not translate, or none of our interviewees could explain or remember their meaning. Names also refer to other objects or things that do not fit in a category. Names such as *kamu*, *topi-topi* and *adjekwaman* were collected by other researchers, but they did not ask the farmers for the meaning of these names. The name *kamasondu* was collected by us, but the farmer who grew it could not recall what the name meant, and we could not find another person who knew its meaning. The name *adjádja* (rice crust), was the only variety referring to culinary use.

Rice is a woman

Finally, the names referring to women make up almost 30% of all names. Rice is in a symbolic sense considered to be a woman, and the reasons for this are diverse. Saamaka farmer Mariona Tiapoe explained to us: 'It is women who plant the rice, and [like a woman] one rice seed can bring forth a lot of children'. The great majority of the Maroon farmers are women. It seems that when they invent rice names they refer to their own gender, such as the Saamaka names *gaán bóbi* (big breast), *longi longi mujëë* (very tall woman), *koto mujëë* (cold woman), *limbo mujëë* (clean woman) and Aucan names such as *moi uma* (beautiful woman) and *tjantjan poena* (old ladies' pubic hair, after its thin white awns). These names refer to women in general, but the majority of rice named associated with females refer to specific female individuals (Fig. 2.5).

In Maroon oral history, there is a claim that women escaped from the plantations with rice braided in their hair (Carney 2004). Although the early Maroon history is complex and contains reiterant exchanges between plantation slaves and Maroons, the women had a crucial role in the cultivation of food crops. Rice varieties carry names of women that allegedly were the first to bring rice to the Maroon villages (Van Andel et al. 2022), such as *Ma Paanza* (Mrs. Paanza). Saamaka paramount chief Albert Aboikoni explained that *Paanza* escaped with rice from a plantation named Stenenberg. She took the rice to Baakawata, a village that does not exist anymore along the Pikin Lio. A similar story documented by Price (1983) is attributed to the variety *alisi Seei*, meaning Seei's rice, named after an enslaved Ghanaian woman who escaped in 1690 from the plantation Waterland. She fled together with her daughter Yaya, after which the rice variety *tjaka Ma Jaa* was named (Van Andel et al. 2022). Rice names such as *Anoussa*, *Amessina* and *Alena* refer to women whose history is probably forgotten, as the farmers could not recall anymore who they were, probably because they had only limited impact in small communities.

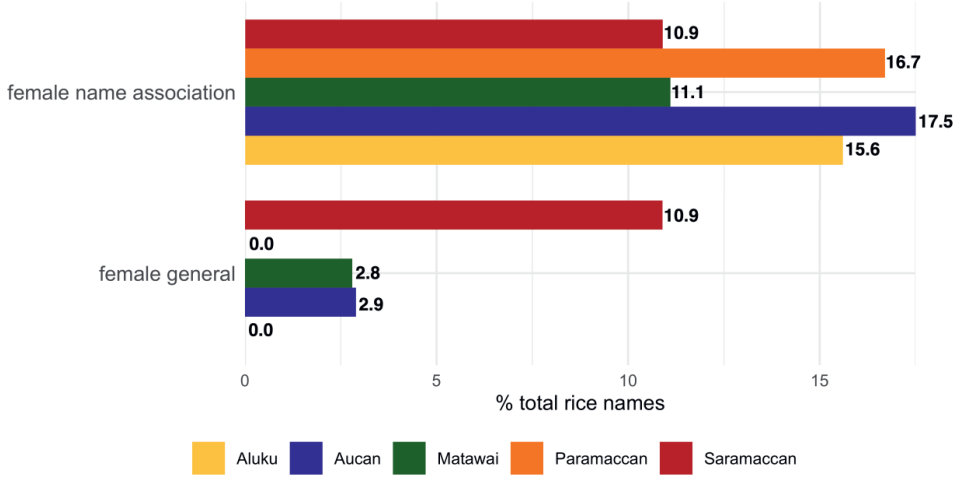

Fig. 2.5 Percentage of rice names referring to women (n=80), split in general female associations and referral to specific female persons in all five Maroon groups.

Varieties named after specific women do not only refer to the time of marronnage, but also persons that recently died or are still alive. *M'kono alisi* (M'kono's rice) was collected from her neighbor, shortly after *M'kono* passed away. *Odina konde* (Odina's place) was encountered on the field of Odina Aboikoni in Dangogo 2, the uppermost village on the Pikin Lio (Fig. 2.6). She had not seen this variety before, and her mother decided to name it after her. New women's names have been invented over the centuries, because new varieties are continuously appearing on farmers field, or names are forgotten and rice is renamed after its farmer.

Fig. 2.6 Odina Aboikoni with her mother Sabel, threshing her rice in Dangogo 2. Picture: Nicholaas Pinas.

The naming pattern across Maroon groups

In the five Maroon groups, the naming pattern seems to be the same. Fig. 2.7 shows the percentages of names in the different categories for the specific groups. Similar percentages are found for all Maroon groups, including for the two most frequent categories: morphology (between 31% and 35% for all groups) and female (between 15% and 22%). For the Aluku, the percentage in the category 'other' is relatively high, because most names collected by Fleury (2016) were not translated, and we did not do fieldwork among Aluku farmers. The Matawai have a relatively high score in the male category, because their awned rice was called *bia bia* ('young man' or 'beard') and we scored this as an association to males.

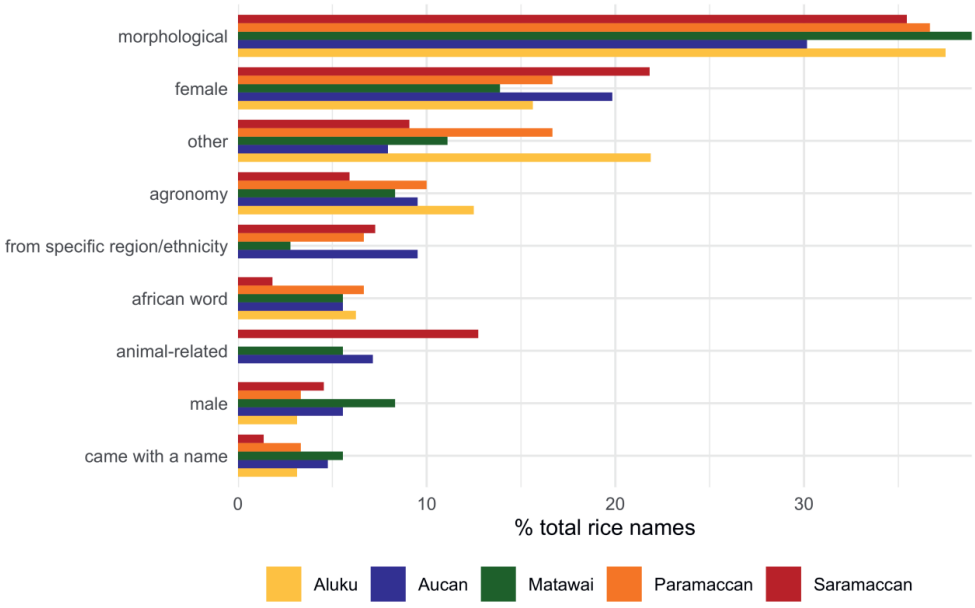

Fig. 2.7 Percentages of names in the different categories for all five Maroon tribes.

Recognizing each other's rice

The six rice varieties that we selected to see how farmers would identify each other's rice were not equally familiar. Black or African rice (*Oryza glaberrima*) was recognized by all 20 farmers who participated in the exercise as *baaka alisi* (black rice) or *matu alisi* (forest rice), because of its dark brown husk and its spiritual significance in Maroon communities (Van Andel et al. 2010). The variety *pende fisi* was also well recognized by 85% of farmers as *pende* or *ahunjön*. These spotted rice types probably are old varieties: the West African name *pende* was first documented by Valliant (1948) along the Marowijne River for rice varieties with striped husks. The origin of the Saamaka term *ahunjön*, which means 'ugly', due to the dark brown spots on the husk, remains unknown.

Masaa alisi ('master's rice') was only farmed by Okanisi living along the Cottica River, probably because the variety needs to grow in swampy areas. The variety had a mix of purple and white grains, and was not recognized by farmers from outside the Cottica. According to Aucan artist Tolin Alexander, Okanisi returning from the Tapanahoni River to the Cottica region used the term *masaa* ('plantation owner') for the descendants of enslaved Africans who remained on the former plantations. After emancipation, the Maroons met their former family members on the plantations they had fled from a century ago. As a token of respect, they addressed these people with *masaa* ('master'). These people were farming rice on the abandoned plantations and they shared their swampland varieties with the Maroons. As *masaa alisi* had red seeds, 20% of the farmers named it *kamasondu*, which is a Saamaka upland variety with red seeds. The other Maroons did not recognize it.

Puspusi was only collected in Semoisi, a Saamaka village along the upper Suriname river. The variety was not recognized by any of the 20 farmers, probably because its name is limited to Semoisi. In the other villages, 85% of the farmers named it after its long awn, so

either *tjantjanpuna* (‘old women pubic hair’), *jöööjöö* (‘long hair’) or *weti hedi mma* (‘white headed woman’). The variety *Ma Paanza* with smooth orange husks, collected in the Saamaka village Jawjaw, was not recognized by any of the farmers. However, Saamaka women from other villages have another type of *Ma Paanza* with hairy husks and red seeds. The modern US cultivar *Carolina gold* was not recognized by any farmer as a foreign cultivar. All 20 farmers considered it a Maroon rice variety and called it names such *lebi alisi* and *bë alisi* (red rice), because of it orange husk.

Inventing names for unknown rice

Farmers looked at the rice varieties we selected for the exercise and came up with names for those they thought they recognized, but also invented names for those they did not know. Fig. 2.8 shows that when an unknown variety had a white husk, farmers incorporated this trait as part of the suggested name only in 20% of the cases. When the husk color was orange, this was incorporated in more than half of the suggested names. Farmers who guessed a name for varieties with an awn used this trait in the majority of the names they invented. When the variety had a red seed, one third of the farmers incorporated this trait as part of the name they invented. So there seems to be a hierarchy in name giving: the awn is seen as a major motivation for inventing a name.

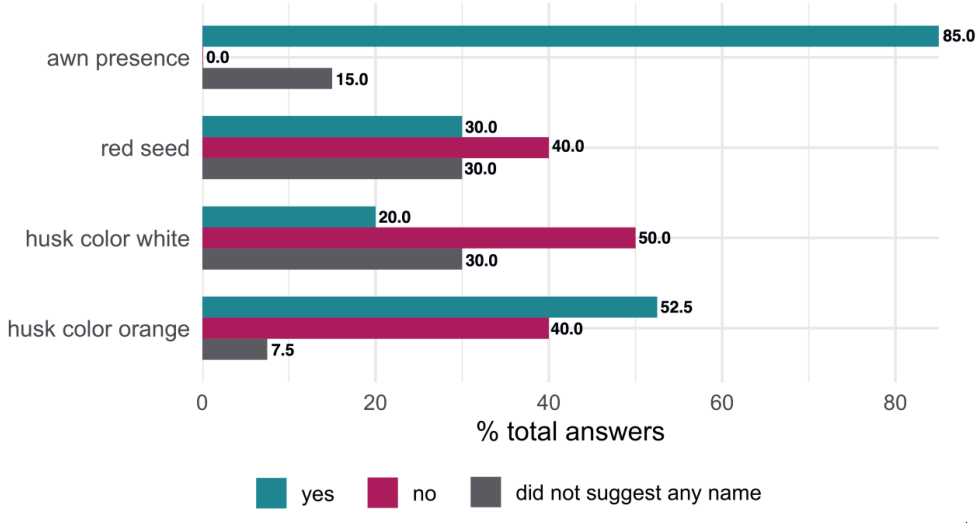

Fig. 2.8 Percentage of farmers (n = 20) who invented names with a morphology component of an unknown variety.

Discussion

Mechanism of naming

From the 284 unique Maroon rice names, a naming pattern was noticed with categories referring to morphology, agronomy, animals, male and female names, and rice brought from specific regions or by non-Maroon groups. As the five Maroon groups had only four to five rice names in common, we can deduce that most names were invented after the enslaved Africans escaped into the forest and formed tribal groups that practiced agriculture in relative isolation. However,

as the Maroon rice naming pattern is similar between groups, this was likely in place before the marronnage.

Rice names were also recorded in many other West African countries, such as Guinea Bissau, Guinea Conakry, Togo, Sierra Leone, Ghana and Senegal (Nuijten et al. 2009; Portères 1965, 1966; Richards 1983). Unfortunately, Nuijten and Almekinders (2005) translated only 20 of the 129 rice names they collected and Portères (1965, 1966) only a dozen of the c. 100 rice names he reported from Guinea Conakry, which makes a detailed comparison with our dataset difficult. If more African rice names had been unraveled, we would have been able to compare the Maroon naming pattern more thoroughly with those of the countries from where enslaved Africans were taken to Suriname. The difference between our findings and the rice naming systems described by Nuijten and Almekinders (2005) for Gambia, Portères (1965, 1966) for Guinea Conakry and by Rao et al. (2002) for Laos are the names referring to the length of the growth season, extension officers, resistance to drought, weeds, development organizations and production ecosystems. These categories are absent in Suriname, as all Maroon rice varieties are ready to harvest within four to five months, production systems are all similar, no extension officers or NGOs are handing out rice, and drought is not a problem. Common aspects of our results with Laos, Guinea Conakry, and Gambia are the names referring to morphology, agronomy, and resemblance to animals, which may be part of a universal naming system for rice or crops in general. In Gambia, some rice names refer to female farmers who introduced a variety into the community. In Laos, there is no mention of either female or male farmers' rice names (Rao et al. 2002).

Due to the naming of rice after specific persons, the Maroon naming pattern has more similarities to the system in Gambia than to the one in Laos probably because lots of enslaved Africans were transported from West Africa to Suriname. Of the few African rice names that were translated by Richards (1983) and Portères (1965; 1966), we see some resemblance between the Maroon and the West African naming pattern. The Mende rice name *helekpoi* ('elephant') in Sierra Leone was a variety that was found in the stomach of an elephant that was killed after destroying a rice field. A similarly constructed name, *apiikutu* in Suriname, refers to rice found in the stomach of a parakeet that had eaten from the crop. In both cases, farmers continued to grow the rice taken from the dead animals. The name *kalembaama*, large jaw bone in Mende, refers to a variety with long outer glumes. Very similar-looking rice grown by Saamaka is known as *hánza-a-bandja*, meaning 'wings on the sides'. *Ngolo-yombo* ('chimpanzee hair') in Mende has a long black awn like the hair of this ape (Richards 1983). Yakisan ('sheep beard'), a rice name recorded in Guinea Bissau, has a long white awn (Portères 1966). The naming of awned rice after hairy animals was also found in Suriname, where Amazonian mammals such as peccaries, otters, howler monkeys and jaguars have taken over the role of their African counterparts. Portères (1965, 1966) reported many rice names linked to specific areas and groups of people, but very few that refer to specific persons. None of the dozens of rice names translated by Portères referred to women.

As people from many different African groups ended up on Surinamese plantations, any African naming of rice varieties that 'survived' the Middle Passage was influenced by the overall Creolization of language and food-producing practices on the plantations and, subsequently, in the Maroon villages. The naming pattern is thus best characterized as a local adaptation of an Atlantic bowl of rice varieties and names to the Surinamese situation. The selection, adaptation, and naming process continued in the post-abolition period.

Women as key agents in rice diversity

Maroon rice names are the most unique in the reference to women. This category accounted for almost one-third of all names. Names refer to women in the more general sense, such as 'red

woman', 'black-haired woman', and 'messy woman', but also to individual people. What makes Maroon rice names truly distinctive are varieties such as *Ma Paanza*, *alisi Seei* and *Ma Jaa*. These were well-known ancestors of the Saamaka who allegedly escaped with rice, but who are not known by other Maroon groups. The general pattern that emerges is that every Maroon tribe seems to have rice names of specific women that are considered as the first to have escaped with rice and commemorated as fundamental to their own survival (Van Andel et al. 2022). We did not yet collect such stories from Pamakkas and the Aluku. These rice names probably have been passed on over many generations, potentially as far as the late seventeenth century. Paanza, Seei and Yaya are said to have escaped their plantation between 1690 and 1739 (Price 1983). The strong presence of female names for rice varieties represents the important role of female farmers in Maroon rice cultivation. Different groups of runaways, such as Agbos, Baákapáus and Boterbalies were mentioned in accounts of Maroon oral history (Price 1983), but merged into different Maroon clans and lost their original names. Our research suggests that they all escaped with specific rice varieties that kept the name of these people. This information is probably lost in oral history and the contemporary archives, but the rice names indicate that they all contributed to the current crop diversity in the Maroon communities.

Shared African heritage

African terms for rice, such as *pende*, *saka*, and *bongo*, known in different forms and spelling, reveal traditional knowledge about this crop among enslaved Africans before marronnage. The same goes for the often-used rice name *alulu* in Aucan communities. The root of this word, *lunlun*, meaning 'to fall apart' or 'crumble' comes from the Ewe language spoken in Benin (Smith 2015a). The fact that all Maroon farmers recognized *baaka alisi*, the only *O. glaberrima* variety, and most knew the name *pende* for spotted rice is probably because these names refer to old morphological traits that are easily recognized. When a variety is not known, a name is given that is first based on morphology and if it does not have striking features such as an awn, it is connected to the woman who first introduces it to others. The question still is whether the many names also reflect a huge genetic diversity. Not every name represents a single variety, some names can include more than one rice type. Other varieties can have more than one name. Future research on the DNA of our Maroon rice samples will reveal to what extent the names are indicative for genetic diversity, and probably reveals the geographical origin of these crop varieties as well.

Names do change

Maroon rice cultivation probably is a dynamic system in which new varieties appear and old ones get lost, and the same must be happening with names. The oldest documented name of a rice variety was *joerka aleisi* ('ancestor spirit rice') by Hostmann (1850), a name which we also reported in 2021. Of the 28 unique rice names collected by Price in the 1960s, however, 40% was no longer heard during our surveys in the same region. We also found names that were not previously recorded, but had the same meaning as names recorded before, such as *amapapi* (1960s), meaning 'with wings on the side' probably refers to the same outer long glumes as the rice that we collected with the name *jesi teke* ('long ears') or *opolani* ('airplane'). Unfortunately, there is no picture or herbarium collection of *amapapi* for us to compare. We believe also that names such as *Aluku paansu* ('Aluku seed') and *Ndyuka alulu* ('Aucan roller') exist because the original name is forgotten (or misunderstood) after it was exchanged with another Maroon group. However, this pattern of changing names is not the same as in Gambia, were varieties that were exchanged immediately got the name of the introducer, but lost this after c. 20 years (Nuijten and Almekinders 2007). Rice names in Maroon communities often still reflect historic introducers and farmers, some of whom lived as long as 300 years ago.

Conclusion

Maroon history is reflected in the names of rice varieties currently grown by Maroons in Suriname and French Guiana. A substantial portion of rice names refers to women who are commemorated through stories about bringing food crops to the community during the struggle for freedom. Furthermore, in the rice names, we found separate groups of runaways that all brought rice with them, although descendants of these people do not have the same name anymore. The other groups of people the Maroon had contact with in the past, such as Asian contract laborers, and the adaptation to the New World environment remains visible in the references to Amazonian animals. The process of naming a variety is complex, but seems uniform in all five Maroon groups studied so far and has a clear but unspecific reference to West Africa.

3

Chapter 3: The Mystery of Black Rice: food, medicinal, and spiritual uses of *Oryza glaberrima* by Maroon Communities in Suriname and French Guiana

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Supplementary files can be found online in the published papers.

Abstract

During plantation slavery, African rice (*Oryza glaberrima* Steud.) was widely cultivated in the Americas but was soon replaced by Asian rice (*Oryza sativa* L.). Maroons, descendants of Africans who escaped slavery in Suriname and French Guiana, continue to cultivate African rice. Genomic research linked this rice to an *O. glaberrima* variety in the Ivory Coast. Based on interviews with 99 Maroon farmers, of whom 23 cultivate black rice, we describe its diverse uses as (ceremonial) food, offerings, spiritual medicine, and its role during funerals. Maroon's oral history accounts on the origin of black rice differ among and within communities: enslaved women brought it from Africa or took it from the plantations where they worked; escaped slaves found it in the savanna; or ancestors encountered it in interior swamps. These multiple and sometimes contradictory accounts of the origins of black rice are related to the diverse ethnic and geographical backgrounds of the Africans brought as slaves to Suriname and their different histories with the crop after marronage. Various characteristics of black rice, including its ability to compete with weeds and grow on poor soils, its shattering seeds, and its visibility to birds explain how this African domesticate survived in the wild in the Amazonian forest. The migration of Maroons to cities, their engagement in gold mining, and their evangelization may lead to the loss of black rice knowledge and practices.

Keywords: African rice (*O. glaberrima*), cultural keystone crop, ritual food, slavery, Maroons, Suriname, French Guiana

Introduction

Rice has two domesticated species: *Oryza sativa* L. (Asian rice) and *O. glaberrima* Steud. (African or black rice). *O. sativa* was domesticated in Asia 9000 years ago and became the world's most important commercial food crop and a primary food source for more than a third of the world's population (Khush 1997). *O. glaberrima* was domesticated about 3500 years ago from its progenitor *O. barthii* A. Chev. in the inland delta of the Niger River (Portères 1962, Purseglove 1976, Wang et al. 2014). African rice is characterized by its few-branched panicle, short and rounded ligule, glabrous grains, and frequently black husks (Burkill 1985, van der Zon, 1992). The seeds of this species tend to shatter and often have a red pericarp (bran) around the kernel (National Research Council 1996, Sweeney and McCouch 2007). *O. sativa* has a much longer and pointed ligule, a highly branched panicle, generally straw-colored husks, and a white pericarp (Sweeney and McCouch 2007).

African rice used to be intensively cultivated but is now used only as a subsistence crop by farmers in West Africa (Teeken et al. 2012). It is being replaced by *O. sativa* by African farmers mainly due to its lower yield, shattering, lodging, the difficulty in machine-milling, and

the pressure of widespread introduction of high-yielding improved cultivars of Asian rice (Ghesquière et al. 1997). Although Asian rice has higher yields it requires much more water, is less drought-tolerant, and its taste is different (Scheider and Ash 2020). The presence of Asian rice in West Africa dates to the early sixteenth century when Portuguese traders introduced tropical *japonica* varieties (*O. sativa* var. *japonica*) from the Philippines and Malaysia (Eltis and Richardson 1995, Nawani 2013, Gilbert 2015).

According to Carney (2001), *O. glaberrima* was probably first introduced to the southern United States between 1685 and 1696 via slave ships from West Africa, when it was shipped as food during the Middle Passage, together with crops such as yams, okra, and bananas (Carney and Rosomoff, 2011). In this period, 'red rice' was among the first types grown in the Carolina colony. Carney argues that this must have been *O. glaberrima* as this species often has a red pericarp that is difficult to remove. However, many traditional landraces of *O. sativa* exist in West Africa that also have a red pericarp (Teeken et al. 2012), so this early 'red rice' in the Americas could also have been *O. sativa*. No written sources referring to the (black) husk color of this 'red rice' and no physical evidence of *O. glaberrima* in the form of archaeological remains or herbarium specimens have been found in the United States.

Evidence of *O. glaberrima* in the Americas was found in botanical collections in El Salvador (Portères 1960) and archival records from Suriname describing the early presence of *O. glaberrima*. Governor Van Sommelsdijck wrote in 1688 that "the rice that grows here is much better than what is sent to us from Holland, of which there are two kinds: a white type and a black type, which is known in the fatherland as red" (Elfrink et al. in press, Fig. 1). The white type was probably *O. sativa*, while the rice varieties with the red pericarp and the black husk can only be *O. glaberrima*. In the 1680s, the first Maroons had already escaped from the plantations and settled in the forested interior of Suriname (Price 1996, Dragtenstein 2023). In 1712, it was observed that Maroons were growing large quantities of rice for their subsistence (National Archives, SVS, nr. 129, NL-HaNA_1.05.03_129_0252-1712; Dragtenstein 2002). However, the color of the rice found in Maroon fields was not mentioned in the archival documents.

Today, Suriname and French Guiana are home to six Maroon groups: the Saamaka (estimated population size ~ 82,500), Okanisi or Ndjuka (~ 82,500), Matawai (~ 6800), Paamaka (~ 11,000), Aluku or Boni (~ 11,000) and Kwinti (~ 1000). All still live in the forested interior except the Matawai and the Kwinti, who have largely migrated to Paramaribo, the capital of Suriname (Price 2013). Every Maroon village has a captain and each Maroon group has its paramount chief.

The earliest written evidence of the presence of black-husked rice in Maroon fields in Suriname was documented by the plantation owner, part-time botanist, and fierce defender of slavery F.W. Hostmann, who wrote that "among the bush negroes, a rice variety with a black husk is found in the wild. It could become important to them if they were not so superstitious because they claim that it was sown by angry forest spirits" (Hostmann 1850: 265). The name for this wild rice was 'joerka aleisi' (*yorka alisi*, spirit rice). Almost a century after Hostmann a rice variety with a black husk and red pericarp was collected in an Aluku Maroon village in French Guiana by the French agronomist M. Vaillant, who referred to a legend that female ancestors had hidden rice in their hair in Africa and thus transported it to French Guiana (Vaillant 1948). An herbarium specimen of it was later identified by Portères (1955) as *O. glaberrima*. Unfortunately, this specimen, first housed at Muséum National d'Histoire Naturelle in Paris, can no longer be located.

The story of a type of wild rice that was present in the interior when the first Maroons arrived has also been documented by later scholars. Anthropologist Richard Price (1983, 1991) mentioned that the Saamaka cultivated *mátu alísi* (forest rice) only for ritual food offerings and that it was first encountered in the provision field of an *apuku* (forest spirit) by a forefather of the Saamaka named Gbagidi. Gbagidi allegedly discovered a mysterious swamp surrounded by wild rice, bananas, and other crops, referred to as *Gaán Goón* behind the village of Dangogo (Price 1983). When special meals were prepared for their eighteenth-century ancestors at the shrine of *awónênge* (African-born ancestors) in the village of Dangogo, it was always *mátu alísi* they offered (Price 1991). Price also wrote that it was unclear from the eighteenth-century missionary documents whether the Saamaka people cultivated this type of rice or gathered it where it grew near swampy places in the forest. He also speculated that, until new rice varieties were brought to their villages around 1739 by a recently escaped woman named Paanza, *mátu alísi* was their only rice (Price 1983).

Anthropologist Marie Fleury (2013, 2016) documented how rice occupied a very special place in the culture of the Aluku Maroons, evidenced by its presence in their offerings to ancestors at the end of a mourning period. According to Fleury's Maroon collaborators, their ancestors had found rice growing wild by the water's edge in savannahs. The Aluku also referred to stories about African women who, before boarding slave ships, hid grains of rice in their hair and thus transported rice from Africa to America, similar to the reports of Hostmann, Vaillant, and Price. Baumgart et al. (1998) reported that *matu alisi* was specifically "thrown for the birds" and planted at the edges of agricultural plots to distract birds from eating the rest of the rice. He described it as poor-quality rice with a red pericarp softened after cooking and set once it cooled.

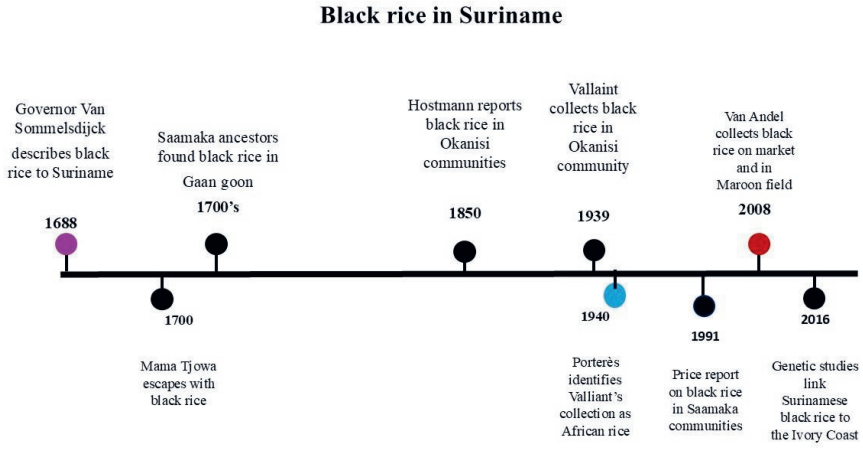

Fig 3.1 Timeline of the reports on African rice (*O. glaberrima*) in Suriname. Our team started rice research in 2017.

In 2008, evidence of the cultivation of *Oryza glaberrima* by Saamaka Maroons in Suriname was provided by Van Andel (2010). She noticed that in Paramaribo *mátu alísi* or *baaka alisi* ('black rice') was sold in small bags at the herbal market for ancestor rituals during which food is offered to deceased family members. Several specimens were collected and

identified by experts as African rice. The Saamaka claimed their forefathers collected this *mátu alísi* first in a mysterious open swamp that belonged to a forest spirit (Van Andel 2010, Van Andel and Ruysschaert 2011). In 2013 and 2017, *O. glaberrima* was collected among Okanisi Maroons in Suriname and French Guiana (Van Andel et al. 2016, 2019).

Genomic analysis proved that the single *O. glaberrima* variety known by Maroons as *matu alisi*, *baaka alisi*, *yorka alisi*, *busi alisi*, or *apuku alisi* is a fully domesticated crop similar to landraces from the Upper Guinean region of West Africa and almost identical to a landrace from the western part of the Ivory Coast (Van Andel et al. 2016, Veltman et al. 2019). Our research describes in more detail the cultivation practices and uses of black rice by the Okanisi, Aluku, Saamaka, Paamaka, and Matawai Maroon communities and we discuss the different legends surrounding the origin of black rice in Maroons' oral history. Figure 3.1 is a schematic timeline of black rice in Maroon communities.

Methods

We conducted semi-structured interviews with 99 Maroon rice farmers in Suriname and French Guiana, about general rice cultivation (almost all women) in 2017, 2021, 2022, and 2023. We collected 10 herbarium and seed specimens of black rice (Supplementary Table 3.1). Saamaka, Matawai, Okanisi, and Paamaka collaborators were recruited through snowball sampling: the only inclusion criterion was that they were rice growers. Here, we present only the data on black rice from those interviews. The other interview data is published elsewhere (Van Andel et al. 2022, Pinas et al. 2023, Maat et al. 2023). Information about black rice among the Aluku was extracted from previously published sources (Valliant 1948, Fleury 2013, 2016). No fieldwork was carried out in Kwinti communities because this group is quite small and mainly lives in the capital. We had no indication of rice being grown by the few Kwinti who still live along the interior Coppename River.

We obtained written permission from the traditional Maroon authorities to conduct our research and oral consent from each farmer. We asked farmers specifically if they had *O. glaberrima* in stock or planted, how they obtained it, how it came into the community, whether they knew specific recipes for ritual dishes or offerings that needed black rice, and what it was used for in daily life and during funerals. Farmers were compensated for their time spent with the researchers. We documented local names, their translations, and meanings, and recorded songs and stories about Maroon rice and its origins on a voice recorder. The stories that Maroon farmers told us varied in detail and length. We later discussed the interview data with the paramount chiefs of the Okanisi, Saamaka, and Matawai Maroon communities and several elder Maroon men and women, including village captains, specialists in traditional music or plant use, both in Suriname and the Netherlands. The story of Saamaka traditional healer Edje Doekoe was collected by personnel of the Saamaka Museum in Pikin Slee (Geeske Verbree, pers. comm.). Data were also retrieved from Ising (2022), an M.A. student participating in this project.

We deposited living seeds of *O. glaberrima* at the SNRI/ADRON rice germplasm institute in Nickerie, Suriname, and herbarium specimens of black rice plants at the National Herbarium of Suriname in Paramaribo (BBS), and Naturalis Biodiversity Center in Leiden (L), the Netherlands. Dead seed samples are deposited in Naturalis' Economic Botany collection.

Results

Morphology and distribution

The African rice we collected in Suriname and French Guiana had single-branched panicles and short and rounded ligules with an average length of 8 mm (Fig. 3.2). All the black rice

samples we collected were morphologically similar. Half of the ripe grains had dark brown husks, and the other half were pale brown. The grains shatter easily from the panicle and have a dark red pericarp (Fig. 3.3). The grains were glabrous with an awn of an average length of 6 mm.

Fig. 3.2 Botanical drawing of African rice (*Oryza glaberrima*) collected in Suriname (after collections Jansen-Jacobs 7075, L.3879365 and Van Andel 5634, L.0840072, See Supp. Table). a. open flower, b. ligule, c. flowering spikelet, d. dehusked grain, e. husked seeds with awns, f. entire plant with panicle. Drawing by Esmée Winkel, Naturalis Biodiversity Center.

Fig. 3.3 African rice grains collected in this study (1) husked seeds and (2) dehusked seeds with red pericarp (seed sample NP339, Naturalis Biodiversity Center).

The average plant height that we measured in 2023 was 160 cm. At this height, they tend to lodge when there is strong wind. We recently measured an average production of 2181 kg/ha on Maroon fields (Pinas et al. 2024), much more than the 700-1000 kg/ha that was estimated previously for Maroon rice in general (Budelman and Ketelaar 1974).

In 2021 we selected six Maroon rice varieties (one *O. glaberrima* and five *O. sativa*) and asked Maroon farmers to identify them. African rice was recognized by all 20 farmers who participated in the exercise as *baaka alisi* or *matu alisi*, while the Asian rice varieties were not always named correctly when they came from outside their village (Pinas et al. 2023). African rice was grown in most Maroon villages where we carried out fieldwork (Fig. 4). It is notable that we did not encounter black rice among the Paamaka Maroons along the Marowijne River or in the Okanisi community residing in the Cottica area. Adriaan Adawde, a well-established Paamaka pallbearer and traditional funeral specialist, explained to us that rice cultivation has been declining over the past 30 years in his community since Brazilian miners settled in the area: "The Brazilians prefer *kwak*, a dry cereal-like food made from toasted yellow bitter cassava flour. Paamaka women nowadays focus on planting cassava to produce kwak and marijuana to sell to the miners."

The Cottica Okanisi had fewer rice varieties than other Maroons, probably due to the violence experienced in this area during Suriname's civil war between 1986 and 1992 (Pinas et al. unpublished data). Most people in the Cottica area fled to French Guiana, leaving their rice fields unattended for several years. Mame Malonti, a farmer from Wanhatti, told us that after the civil war, she did not see many of the rice varieties that they had before. However, some Cottica Maroons remembered that black rice was once found growing wild near a creek in their territory (Fig. 3.4).

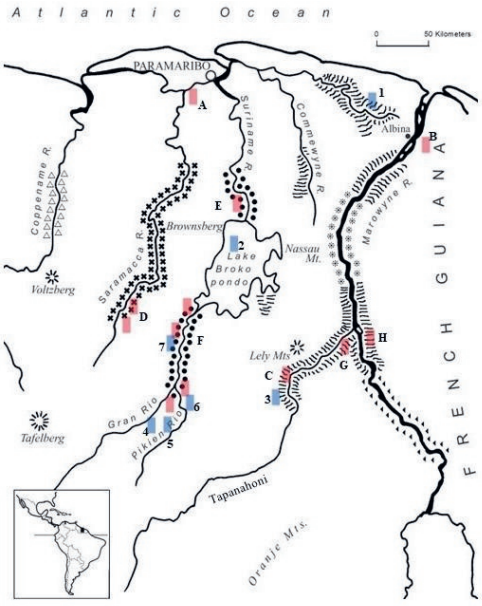

Fig. 3.4 Map of Suriname (left of the Marowijne River) and French Guiana with locations of the Maroon communities. ΔΔΔΔ Kwinti, ●●●● Saamaka ᛁᛁᛁᛁOkanisi ✱✱✱✱ Paamaka **xxxx** Matawai ◄◄◄◄ Aluku. Red squares indicate the Maroon villages where we encountered black rice. Letters represent the names of these communities. A= Santigron, B= Saint Laurent du Maroni, C=Diitabiki, D= Pusugrunu, E= Brokopondo region, F= Saamaka communities along the Suriname River, G= Tyontyon island, and H= Grand Santi. Blue squares indicate the locations where Maroons found black rice in the wild: 1= Mama Mofu Creek, 2= Creek submerged by Brokopondo Reservoir, 3= Tapatosso Creek, 4= Sopu Creek, 5= Pukasa granite boulder, 6= Ananasberg, and 7= Pikin Slee.

Black rice cultivation

Saamaka rice farmer and English teacher Anne Huur explained to us: "Black rice is sacred, so every village must have a black rice field. When it is needed for medicinal or spiritual purposes, you will see that it is readily available. But it is uncommon that villagers or farmers will tell you readily where it is situated." Despite this, 23 of the 99 rice farmers (23%, all women) in the four Maroon groups we interviewed had black rice either in their fields or in stock: among the Saamaka 15 out of 33 women grew it, six out of 55 Okanisi, and two out of seven Matawai. As we recruited our collaborators via snowball sampling, these percentages cannot be interpreted as representative of the different Maroon groups. The Paamaka no longer cultivate black rice, but they did so 30 years ago. Fleury (2016) documented black rice cultivation among the Aluku around 1997 but did not mention the percentage of farmers who had it on their fields or in stock. Although unmilled black rice is widely available in the herbal market in Paramaribo, where it is sold for ancestor offerings, farmer Jeanette Pansa explained that it could not be sold among Maroon community members as "you should not ask money for an ancestor crop."

Norma Aserie, a farmer from Tapoeripa (Brokopondo district), reserved a dryland patch in her field close to the forest edge specifically for black rice. She explained that birds would

leave other rice varieties alone when black rice was available. This practice was seen also in Abenaston and Nieuw Aurora along the Suriname River by Baumgart et al. (1998). When we asked farmers about their methods to prevent the birds from damaging their rice, they answered: “We don't do anything because birds don't eat everything,” although several people owned shotguns. Some farmers used a net or shot at birds with catapults, but others responded: “Well, even the birds have to feed themselves, they have a role to play in nature.”

Alieni Faandya, a Saamaka farmer in French Guiana, explained: “Black rice is always sown close to the forest edge, so we do not have to walk through it. The leaves are sharp, and they can cause skin cuts. This is the reason we sow it apart from the rest of our crops.” Other farmers planted black rice at the entrance of their fields as an offering and respect for the forest spirits, so the harvest of all other crops would be plentiful (Fig. 3.5A and B). Three Saamaka farmers had an entire field allocated to only black rice, a bit further hidden in the forest, away from their fields of cassava, Asian rice, okra, and bananas. One thing all farmers agreed was that black rice should always be sown on dry land that did not flood, even during heavy rains, in contrast to some Asian rice varieties that could withstand flooding or thrive in moist soil (Pinas et al. 2023).

Fig. 3.5 A. Saamaka farmer standing in her rice field. Asian rice (yellow bent panicles) can be seen in the front, while African rice (dark erect panicles) can be seen near the forest edge. B. Not fully ripe African rice standing in a Maroon field. Pictures: Harro Maat (A), Nicholaas Pinas (B).

When asked whether indigenous people also grew rice, the Maroon farmers responded that they did not know, had never seen it, or simply that they did not. Although surveying Indigenous agriculture was not part of our project, we also asked this question of two Indigenous men whom we met by chance near Maroon villages. An Arawak man from Alfonsdorp (Marowijne district) said that people in his village grew Maroon rice varieties now and then, “especially the black type, as it has lots of vitamins. We just mill in with a mortar and pestle.” A Carib man near St. Laurent du Maroni, French Guiana, said that his ancestors had exchanged rice for cassava with the early runaways, centuries ago. They had grown this rice for a long time on hill slopes. "But recently, our women have been more interested in fancy

clothing and polished nails, so they don't like to work the soil anymore." As far as we are aware, the cultivation of rice by indigenous peoples in the Guianas has not been mentioned before in the literature.

Black rice as food and in rituals

Most of our collaborators were adamant that black rice was not used as food. Nevertheless, 15% of the farmers we interviewed reported that they consumed black rice similarly to white (Asian) rice. According to Jermain Keizer, a Saamaka from Jawjaw, large quantities of black rice were grown in his village and consumed similarly to white rice. Even within Maroon communities, the opinions regarding the consumption of black rice could differ. In Pusugrunu, Saramacca River, Matawai farmer Iris Emmanuel cultivated small amounts of black rice in her field of white rice. She regarded black rice as a medicinal plant and could not agree with her aunt in the same field who told her that black rice was perfectly edible. One Saamaka farmer assured us that because of its stiff panicles, black rice was good for making brooms and that was the reason for keeping it.

Saamaka healer Edje Doekoe also agreed that black rice is edible. "Our ancestors ate it more frequently than we do now. Therefore, we should continue planting it. Especially in times of crisis, it is planted: it can be ripe within three months. All the non-Christian Maroon villages grow it. The birds like it more than the other rice, so you have to keep an eye on it to prevent it from being eaten completely. Cooking is done as all other rice varieties: it does not require special treatment. It is very nutritious when you eat it, you will feel full for a long period. The only downside is that if stands long in a pot it becomes hard. However, if you add some water and heat it, it becomes soft again".

Alieni Faandya also consumed black rice, but she said that there were two different types of black rice. In her opinion, the variety she ate (*baaka alisi*) was not the same as *matu alisi*, which was used for spiritual purposes and consumed solely by traditional healers and priests of the Afro-Surinamese *winti* religion who did not eat any Asian rice. We collected Ms. Faandya's black rice (TvA6839, see Supplementary Table 3.1), but in-depth genetic research is needed to verify whether it is different from the other samples we took. Augustina Henkie, an elder Matawai woman from Pusugrunu, also said that *matu alisi* was not the same as *baaka alisi*. "*Matu alisi* is a grass that grows wild in forest clearings and savannas. It is not edible and is loved only by birds. *Baaka alisi* is edible and cultivated by people." We were not able to verify which species of wild grass Ms. Henkie indicated as '*matu alisi*' (forest rice), but her explanation shows that Maroons do not always connect this term to the domesticated crop *Oryza glaberrima*.

Farmer Emelina Amalia from Godo-olo, Tapanahoni River, said that black rice was consumed by pallbearers. The family of the deceased receives white and black rice for all the funeral activities. In the end, the leftover black rice is given to those who carry the coffin to the grave to take home for consumption. Ising (2022) interviewed 12 Saamaka and Okanisi women and all her collaborators agreed that all types of Maroon rice could be used for traditional dishes. However, when asked directly about black rice as a potential ingredient, only three dishes were mentioned that could be prepared with black rice: *maipa sii alísi* (rice cooked in the fat of *Attalea maripa* seeds), *tan ini uwii* (rice cooked with peanuts and plantain in banana leaves) and *pinda alisi* (peanut rice), and were mostly prepared for death-related gatherings. Ising's interview data suggest that black rice is also included in food offerings such as *tuwë njanjan* (lit: throw away food) that take place during funerals and the closing of the mourning period (*puu baáka*).

Herbal medicine

The majority of collaborators and farmers reported that black rice was a prominent ingredient herbal medicine. However, when we asked whether they could tell us for what health issues it was used, the answers were often vague. Responses such as "for cultural things," "I don't know," "to wash your head or body," "we think for spiritual diseases," "to call a spirit," and "it is used by herbalists and *winti* priests" were common. Our co-author Noeki André Mosis explained: "People do not like to talk about black rice because it is seen as *apuku* [forest spirit] or y*ooka alisi* [rice connected to the spirit of the deceased] and therefore is a sensitive issue."

Even so, we documented a few herbal preparations for physical diseases. For the removal of thorns in the skin, black rice was pounded in a mortar into a smooth powder, applied to the skin, and tied with cloth, causing the thorn to resurface from the skin, making it easier to remove. When someone got burned by fire, black rice was burned to charcoal, ground to powder, and applied to the wounds. This would accelerate the healing process. Mr. Atanso from Gran Santi said that porridge of black rice boiled in a lot of water was used as medicine against diarrhea.

According to Anne Huur, Maroons who practice the *winti* religion believe in reincarnation and that some children are born with a strong connection to their previous life. This was visible in physical symptoms such as sickness or disabilities: "For example, a person with a truncated index finger passes away will be reincarnated into someone with a similar truncated finger." Reincarnation could also be revealed in dreams or visions through a close relative or a traditional healer. To separate the previous life from the current, a healer would prepare an herbal bath consisting of black rice and other herbs. The child would then be bathed at the intersection of two roads at midnight. It was assumed that from that moment on the child would be released from the spirit of the previous person. This separating ritual is known as *prati* or *paati* (Wooding 1979, Van Andel and Ruysschaert 2011).

Offerings

Spirits of the forest, earth, and the ancestors require food offerings known as *njanjan mofu njan* (food for all mouths) (Van Andel and Ruysschaert 2011). Adriaan Adawde explained: "It must be given so the spirits can continue to protect us or sustain the peace." A food offering for an angry spirit that has attacked someone is also known as *paati*. Adawde described the details: "When someone is troubled by an angry spirit, the person will not sleep properly and see visions of a diseased family member, or have a psychosis. A way to cure the person is by performing a *paati* ritual." For this, he needed uncooked plantain (*Musa* sp.), yams (*Dioscorea* spp.), napi (*D. trifida* L.f.), black or white rice, placed in a calabash (*Crescentia cujete* L.). "We will take the person to the forest at the bottom of a hill or mountain and split a piece of *neku* liana (a fish poison, *Lonchocarpus* sp.) in the middle, big enough that the person can walk through it. The *neku* is placed strategically so that the person is facing sunrise before the calabash bowl with uncooked food is thrown over his/her head. Afterward, the person walks through the opening in the *neku* that is then closed with a handspun cotton thread. *Paati* is often performed; you can be walking in the forest and see the remains of food on the ground."

Extensive ceremonies are held for the installation of the traditional leaders. Edje Doekoe explained: "The ancestors are called upon for the newly chosen leader and his or her partner. Prominent in the ceremonies are herbal baths, prepared with black rice as one of the main ingredients. Christian villages do not practice those ceremonies anymore." Black rice is also offered at shrines: wooden statues covered with fabric, often situated in the middle of the village (Fig. 3.6). In Kajana, we saw an offering in which the black rice had already germinated.

Fig. 3.6 Village shrine in the Saamaka village Kajana, Gran Rio. This is the location where most offerings are made, many of which contain black rice. Picture: Tinde Van Andel.

Although black rice is no longer cultivated by the Paamaka, rice farmer Eva Ceder explained that food offerings were still common: "A lot of men work in the forest as miners and loggers, so troubling the forest spirits often happens. To settle this, food offerings are given, and they mostly contain black rice." How the men obtained the black rice remained unclear, but they probably bought it from other Maroons in Saint Laurent.

Funerals

We received contradictory answers to our question on how black rice was used during funerals. Most farmers agreed that homegrown white rice should be taken to funerals, but eight of the 99 farmers (both Okanisi and Saamaka) were certain that black rice could not be brought to a funeral. However, the term 'funeral' in Maroon communities is not one activity of burying a dead person, but a lengthy series of events (Price 1990). According to co-author John Jackson: "When a [Saamaka] person is confirmed deceased in a village by a health worker or a *winti* priest, the elders call a public meeting in the *gangasa* (community center) and inform everyone. In this meeting, pallbearers and gravediggers (*olo man*) will be selected. The mourning period (*go a baaka*) starts right away. Family members, friends, and neighbors will rush to the house of the deceased (*dede oso*) to support the close relatives. Every day, visitors will attend until the burial takes place (*beli dey*). The night before the burial a small wake is organized, during which attendees often dance and sing. A week after the burial the *aitidey* (eighth day) is held to commemorate the deceased. A second commemoration is held after six weeks. The closing of the mourning period is known as *puu baáka*. During the mourning period close relatives and the partner of the deceased can only wear black and white clothes. The mourning period used to be between six months and a year, but now many people have migrated to the city, it is often no longer than four months, and obligatory rules like the cutting of hair and the prohibition on perfume and deodorant have been dropped."

Although living far apart from one another and belonging to different ethnic groups, Okanisi farmer and wife of a chief Eline Apai from Moitaki (Tapanahoni), and Saamaka farmer Maisini Majokko from Kajana both described the same details of black rice use during funeral

ceremonies. “Black rice is always present [at funerals] but it is not used for daily consumption such as other rice varieties. It is kept for the day the deceased will be laid in his or her grave. Just before the coffin is placed in the grave, the pallbearer will cast a handful against the coffin while calling upon the ancestors, so that the deceased may freely enter the afterlife.” Thus, black rice is seen as payment for entrance into the afterlife: a process known as *bai pasi*. In Dangogo, Pikin Rio, Saamaka chief Abini Aboikoni recounted: “Black rice is pounded and at the open grave, when the coffin is already in the hole, a porridge of mashed black rice flour is offered to the deceased”. In Langatabiki, a Paamaka village along the Marowijne River, whole grains of black and white rice are placed in the grave when a paramount chief is buried. For common people, this is not done. During the *puu baáka*, all persons who are officially in mourning are taken to a river or creek to bathe. Black rice is also used on this occasion, but we did not get the details.

Ising (2022) also noted that all traditional rice dishes prepared for a funeral or *puu baáka* are a collective endeavor: the ingredients are brought by close family or acquaintances of the deceased, and cooking is done in a group. Offerings (*tuwë njanjan*) either for a funeral or *puu baáka* should contain rice, including black rice. According to Nelda Majokko: “… food offerings only take place in heathen villages like Kajana,” but when attending a *puu baáka* in the nearby Christian village of Ligorio we saw a secret food offering placed below the Catholic altar. Several Maroons told us that ‘church people’ do not offer rice anymore, and sometimes do not go to funerals where ‘… food is thrown to the ancestors.’

Stories about the origin of black rice

Our Maroon collaborators told several different stories about how their ancestors obtained black rice. While these differed within and among Maroon communities, three themes emerged: enslaved women carrying it in their hair, ancestors finding black rice in the savanna during their flight from slavery, and the discovery of black rice in interior swamps.

Richenel Adama, a Matawai elder from Bethel, Saramacca River, told us how his ancestor Mama Tjowa escaped from slavery around 1700. She found rice seeds that had fallen from a granary on the plantation she was fleeing, but it was impossible to take a whole bundle, as it would have alerted the slave masters of her escape, so she hid a few rice seeds in her hair. When she and her fellow runaways reached safety, Mama Tjowa removed the rice seeds from her hair and sowed them. After four months the rice was ready for harvest, which provided them with both food security and the possibility to move further away from the plantations. Adama could not recall what variety of rice Mama Tjowa escaped with, but Augustina Henkie told us that it was black rice (Van Andel et al. 2023).

Co-author Mosis explained that on slave ships women had more freedom than men. They were tasked with cooking for the enslaved passengers, so they could move around a little. Having access to rice and other crop seeds, they could hide some in their hair or bind it in their clothes. “Even though they were scarcely clothed, for rice you don’t need a lot of seeds. They did not know where they were going, but keeping crop seeds with you has been a practice even in Africa.” Although he was not sure which type of rice variety the enslaved women hid on the slave ships, he knew black rice was one of them, because it had been so significant for Maroons now and in the past. Edje Doekoe’s story of how black rice ended up with the Samaaka people differed slightly. He said that black rice came with his forefathers from Africa in a *kuukuu*, a wicker basket in which people transported important *obias* (spiritual objects): “A *kuukuu* is important to take along, it contains every [ritual] thing that you need.”

Okanisi rice farmer Lucia Pasoe from Nieuw Libi, Marowijne River (French Guiana), also knew that enslaved women hid rice on slave ships, but she was sure black rice was not one of those varieties. “During the escape from the plantation, Maroons had to walk long distances to reach safe places. It was on their way that they came across a savannah and saw black rice growing there.” Eva Alimeti from Portal Island (French Guiana) knew more details of this story. “A long time ago when our ancestors ran away, in a small group of six or seven people, they saw rice plants on a savanna. They were not sure whether it was edible. One man volunteered to try it out, collected the seeds, peeled them, and ate them. They spent the night there. The next morning, when they noticed the man had survived, they realized that they could eat this crop. They decided to take it along to a place where they would be safe. When they finally reached a good spot, they planted the rice and slowly learned how to process it by making a mortar to mill it and a flat wooden plate to winnow it.” This narrative of ancestors finding rice growing wild on a savanna just after their escape was told to us several times by unrelated Maroons.

According to Chief Albert Aboikoni, black rice was found by Gwagidi, one of his forefathers, in the field of a forest spirit. While he was hunting with his dog, Gwagidi discovered a mysterious swamp. “That place had strange vegetation, different than the rest of the forest, we call *it Gado Oso* (God's house). This is not far from Asindohopo where we are now. Gwagidi saw *matu alisi* there, and a type of banana that he had not seen before. He harvested the rice, a bunch of bananas, and a banana sapling, and headed home. Then he realized that his dog was gone, and he was lost in the forest. He apologized to the *apuku* forest spirit for stealing his crops and begged him not to kill him. He said: ‘I have a sister Yaya in the village. Take her if you want.’ Immediately afterward he found his way back home, and the *apuku* possessed his sister in the village. She asked him for the stolen crops, but Gwagidi had hidden the bananas and the black rice. The *apuku* was angry, but with the intervention of a *winti* priest, it could possess a family member for many generations.” Price (1983) recorded a variation of this story among the Saamaka in the 1960s, and we heard it again from several Maroons, but the location of the *apuku* field differed each time (Fig. 4). Thea Paimi, an Okanisi farmer from the Cottica, told us that her father Johannes Paimi lived in Pina Tjaimi, a village not far from Mama Mofu Creek (Fig. 4). “This creek is a well-known spiritual place. Once my father got lost in the forest and ended up in a swamp that was connected to the source of Mama Mofu Creek. It was full of black rice. He decided to harvest some and bring it back to his village. Shortly after he arrived in the village a couple of people were possessed by forest spirits who complained to the elders that their rice was stolen. The village elders asked for forgiveness on Paimi’s behalf, so he could keep the rice, but he swore never to return to that place.” According to Saamaka tree spotter Frits van Troon, there used to be a creek that ran down the Brownsberg mountain and ended in the Suriname River. Its lower banks were full of black rice but have now been submerged in the Brokopondo Reservoir. Other Saamaka told us that there was a similar *apuku goon* behind Pikin Slee.

Bono Velanti, the Okanisi paramount chief, explained to us that black rice was found in the Tapatosso Creek long before he was born. This creek is part of the forest trail to Okanisi communities residing in Sara Creek. “It was on one of these journeys that my forefathers saw black rice and awara (*Astrocaryum vulgare*) which they decided to collect and bring home.” Maroon gold miners now working in that location had not recently seen black rice. Although the Paamaka lost their black rice over the last 30 years, Adriaan Adawde could remember his grandfather’s stories about how his ancestors encountered it. “When the runaways escaped from slavery, they had little food to eat, until they came across an abandoned field filled with black rice. They knew it was given to them by a forest spirit whose name should not be invoked idly”. When Adawde was young, the Paamaka community still organized annual food offerings for

this forest spirit. “Now all this tradition is lost. Maybe this is the reason why so many problems are happening, such as children drowning in the river and the many accidents in the gold mines happening to young Paamakan miners.”

When asked about an *apuku goon* (forest spirit’s field), people described a natural open space in the forest. Saamaka chief Aboikoni explained: “In the dry season, it’s just grass, but in the wet season, it can be like a swimming pool.” Co-author Jackson once traversed the Tumac Humac mountains to the Brazilian border and encountered open grassy fields in the rainforest. He saw that these were granite boulders with thin soil, supporting grass but not trees. He saw no rice or other crops, only grass seeds eaten by birds, but imagined rice could grow there if dropped. Edith Adjako recounted a story from Okanisi healer Ruben Mawdo: “Runaways always had a *bonuman* [ritual specialist] in their group. They used granite boulders to scout for soldiers. Possibly, they left food remains like awara, cashews, rice, and pineapples. Or they grew crops on these places because they did not need to burn the forest, which would reveal their location.”

In July 2022, in our attempt to find an *apuku goon*, Abini Aboikoni and his cousin directed us to a site five kilometers upstream of Dangogo along the Pikin Rio. Although a granite boulder called ‘Okoberg’ is visible on Google Earth (3°.54’N 55°.30’W), we could not locate it after hours of searching, despite seeing flat granite rocks with secondary forest. Our guides then showed us another *apuku goon*, a granite boulder about two kilometers inland from Dangogo (3°.33’N 55°.39’W), which they often showed to tourists. (Fig. 3.7, for a drone video, see https://www.youtube.com/watch?v=yfXQBA8Rgy0).

Fig. 3.7 Slope of the Ananasberg, showing pineapples in the forefront and open, grassy vegetation on granite rock, surrounded by forest. Although Maroons have observed *O. glaberrima* growing wild in similar vegetation types, we did not observe it. Picture: Tinde van Andel.

This mountain is indicated as the *Gaan Goon* (great field) where Gwagidi found his rice in the eighteenth century on a map in Price (1983:64). The slopes were full of small pineapples (*Ananas comosus*) that seemingly grew wild. According to Jabini, they were of a different variety than those cultivated in the village. “You can eat them, but don’t take them home, as the *apuku* will become angry.” The next day, rice farmer Jaai Pansa explained to us that she

once "before the year 2000" encountered the *apuku goon* we went looking for, and it was named *Pukasa* after the creek next to it (Fig. 3). She found cashews, awara, and black rice. "People do not plant it. It just grows there. When it is ripe, you see it, but on other occasions, you don't see it. I took some of these crops home, that's why you did not find the spot yesterday. The *apuku* is still annoyed."

When walking on the *Ananasberg*, we asked Jabini whether birds could also plant crops. He answered that this indeed happened sometimes. "When my mother started to plant cassava in her field before sowing other crops, she saw saplings of pepper sprouting spontaneously. They had been dropped there by birds." According to co-author Mosis, birds were instrumental in distributing rice seeds. "They travel from one region to another with seeds. In a song composed for their Paramount chief Oseisi [1884-1915], you could hear the women's complaints about birds. 'The birds, the birds, oooh. Tata Oseisi, the *andoki* [bird], came and ate all our rice. That is not a big problem, but when they leave, they will spread our rice varieties to other people.' Those women knew that birds were seed distributors!"

Discussion

The stories about black rice that we collected from the five Maroon communities illustrate how deep the connection is between them, their crops, and their ancestors, preserved through their oral history. However, this does not mean that there is no pressure on traditional knowledge and practices regarding (black) rice. The Paamaka and the Cottica Okanisi no longer plant black rice, and ritual practices that were common some 30 years ago are disappearing. The same is probably true for the Kwinti Maroons. This loss of traditional practices is probably related to the migration of young people to urban areas, the presence of Brazilian miners with different food preferences, but also to people's displacement during the Civil War (1986-1992), when normal life was disrupted and has never fully recovered (Hoogbergen and Polimé, 2002). Another pressure on Maroon (black) rice knowledge and practices is Christianity. In villages that renounced the *winti* religion, food offerings, ancestor veneration, and funeral rituals were abolished or frowned upon, although villagers still know about black rice and its use in traditional practices, and some still grew it for commercial purposes. Despite this pressure, 23 of the 99 Maroon farmers we interviewed had black rice in their fields or stock, which indicates that its cultivation persists in the majority of Maroon communities. With the knowledge that people do not always share stories about black rice, we assume that it is cultivated on a wider scale than we were able to observe.

In many South American plantation societies, women escaped slavery with rice seeds in their hair. Carney (1998) reported the Brazilian version of this story, Valliant (1948) and Fleury (2013) noted these accounts in French Guiana, and Price (1983) and Van Andel (et al. 2023) reported this story in Suriname. African rice was present in Suriname as early as 1688, and plantation owners complained that it quickly became a weed and "could ruin a whole plantation" (Elfrink et al. 2024: 14). Marronage started very early in the plantation history of Suriname, where it is estimated that c. 250 enslaved Africans escaped every year from the 1650s until close to emancipation in 1863 (Buddingh 1995). It was common for people to escape in small numbers and join larger groups in the interior. These smaller groups made rice fields that they abandoned when they retreated further. Subsequently, another group of runaways from a different plantation could have encountered rice in such an abandoned field. Rice seeds may have fallen from people's pockets, or more likely, birds could have dropped seeds in swamps close to plantations or in the open white-sand savannah that separates the coastal plantation zone and the forested interior of Suriname. In a study on 383 bird-dispersed plant species in Neotropical forests, most fruits and seeds preferred by birds tended to be black, while colors like brown, yellow, and white were less likely to be dispersed by birds (Wheelwright and Janson

1985). This confirms the observations of Maroon farmers that birds tend to predate on black rice more than other rice varieties with a yellow or white husk.

African rice also shatters much more than Asian rice (Teeken et al. 2012), so we assume that seeds will easily fall from a panicle in the beak of a bird. Because of its broader leaves, African rice is more competitive with weeds, thrives better on poor and dry soils, and has a higher feralization capacity than Asian rice (Teeken et al. 2012). Reports from Sierra Leone mention that African rice also spreads easily in swamps (Richards 1986). All these attributes combine to facilitate the dispersal of African rice by birds in open grasslands: either on coastal savannas, weedy creek edges, or the treeless vegetation on the shallow soils of granite boulders deep in the interior forest. The birds probably also dispersed the other crops (cashew, pineapple, awara) that frequently grow on these *apuku* fields. One unique aspect that we encountered is that in Maroon communities birds are seen as part of nature and not persecuted for crop predation on crops as elsewhere. By 'sowing black rice for the birds' or 'for the forest spirit', people seem to respect the role birds still play in seed dispersion of black rice. This was also illustrated by the song composed for the Okanisi chief in which women were not so much complaining about birds devastating their crops, but rather that they dispersed their rice seeds to other distant communities.

The variety in knowledge, practices, and beliefs regarding black rice among present-day Maroons can be explained by the fact that the enslaved Africans who were brought to Suriname had different ethnic and geographical backgrounds. Some came from rice-growing areas in West Africa (currently Senegal, Sierra Leone, Liberia, and Ivory Coast), and were (more or less) familiar with African and Asian rice varieties. Others came from regions without rice cultivation in Central Africa (Turner 2019) and probably did not recognize it as an edible crop when arriving in Suriname. This was illustrated by the legend of the runaways who did not know whether the rice that they encountered on a savanna was edible.

Within the rice-growing areas in West Africa, people nowadays also have different attitudes and beliefs towards *Oryza glaberrima*. Balanta people in Guinea Bissau recounted that black rice was found growing wild in swamps and brought to their communities by their ancestors (Teeken et al. 2012). Several ethnic groups in Sierra Leone offer rice with red pericarp to local gods of rivers, streams, and trees, and ancestral spirits. In Ghana, The Akpafu only use African rice during marriages and funerals, but not during religious ceremonies, as this is considered a sin in Christian beliefs. Women in Tujereng (Gambia) believed that having some African rice in their fields would lead to a good harvest and bring luck (Teeken et al. 2012). Although many farmers in The Gambia, Guinea Bissau, and Senegal said they would readily abandon African rice as it has low yields, was difficult to pound, and they did not like the red pericarp, the farmers that kept their African rice sometimes told stories almost identical to the ones we collected (Teeken et al. 2012).

Our research was limited to four Maroon ethnic groups. Many collaborators had a unique story on black rice, so we may have missed some stories. It is important to study black rice knowledge and practices among Maroons who have converted to the strict Protestant religion that recently increased its influence in Suriname and French Guiana, as these churches condemn traditional funerals and offerings to the ancestors (Ising, 2022). Little is known about how traditional knowledge is lost among those Maroons who migrated to cities and abroad. Although most Maroon black rice types look identical, further genetic studies could reveal whether Maroons cultivate genetically distinct varieties, and where these varieties originate.

Conclusions

Our research shows the intricate relationship between Maroons and black rice, but also the variations in beliefs and practices concerning its use as a food, medicinal, and spiritual crop. Further research among the Kwinti and Aluku communities on current black rice cultivation and practices is needed, as little is known about these smaller Maroon groups. During times of slavery, enslaved Africans with many different ethnic and geographical backgrounds were brought to Suriname. In this period, different rice varieties were introduced and cultivated on the plantations. Maroon legends illustrate how some ancestors knew (black) rice, brought it along from plantations, and probably recognized it in the coastal swamps or open savannahs, while others were not familiar with rice as an edible crop and hesitated to eat it when found in a grassland or swamp in the middle of the forest. After their escape into the interior, the various runaway groups had different histories with the crop, which resulted in a variety of attitudes towards (black) rice that remains evident in present-day Maroon communities. The special attributes of black rice, such as the ability to spread and compete with weeds, grow on poor soils, either on dry land or in swamps, its shattering seeds, and it preference for birds explain how a fully-domesticated crop could become wild in the forested interior of Suriname and French Guiana. As for some ethnic groups in West Africa, black rice also had a mysterious origin, perhaps some beliefs of black rice did not originate in the Americas. Although we could not unravel the entire mystery of black rice, we can safely say black rice is deeply rooted in Maroons' life.

4

Chapter 4: Yield and growth duration of Maroon rice landraces measured in traditional settings

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Supplementary files can be found online in the published papers.

Abstract

Rice, the most consumed cereal worldwide, has two domesticated species: Asian and African rice. Commercial cultivars, almost all Asian rice, are mostly selected for high yields. Traditional landraces are often selected for different traits, such as time to maturity or resistance against common stress factors, including bird attacks and poor soils. Maroons, descendants of enslaved Africans in Suriname and French Guiana, cultivate a rich diversity of rice landraces. They categorize landraces into short, medium, and long-maturation varieties and maintain that fast-ripening crops with moderate yields facilitated their flight from enslavement, while once settled in a safe place, there was time for landraces with longer ripening periods and higher yields. Previous authors assumed that all Maroon landraces had low yields (700-1000 kg/ha), but their performance in traditional farming systems had never been studied. We followed the growth and harvest of 28 Maroon rice landraces and two commercial cultivars in Maroon farmer fields, using traditional farming methods, at three locations. We show that, in farmer-managed fields, Maroon rice can yield 2600 kg/ha (average 1665 kg/ha), without any agrochemicals or machinery. Contrastingly, the commercial cultivars in Maroon farmer fields had a low yield (625-1205 kg/ha), partly due to bird predation. The maturation time varied between 110 to 183 days, but the three Maroon maturation categories showed significant overlap. Our study indicates that Maroon rice performance can only be fairly evaluated if measurements are taken in traditional Maroon farming systems, since this is the environment in which the varieties were originally selected.

Keywords: Maroons, rice, landraces, Suriname, yield, traditional agriculture, French Guiana

Introduction

Rice is one of the most consumed staple foods in the world and has two domesticated species: Asian rice (*Oryza sativa* L.) and African rice (*O. glaberrima* Steud.). Almost all commercial rice cultivars are Asian rice varieties. African rice is grown in much smaller quantities in West Africa (Teeken et al. 2021), and in small patches in Maroon fields in Suriname, and French Guiana (Pinas et al. 2024). Due to a growing world population, the demand for Asian rice is projected to increase to 567 million tonnes in 2030 (Rahman and Zhang 2023). The variation in most rice fields has been very low, since the so-called Green Revolution when a limited number of varieties were promoted that responded well to mineral fertilizer application (Nguyen and Ferrero 2006, Nie and Peng 2017, Nori et al. 2008). Although much higher yields can be obtained with these varieties, they appeared to be vulnerable to diseases, countered by spraying large amounts of pesticides. Regarding total quantity, rice is one of the crops on which

most pesticide is used in India (Arora et al. 2019). A substantial share of the productivity increase was achieved by reducing the growth duration, improving irrigation infrastructure, and increasing acreage. This was only possible through labor-saving techniques. Machines for direct seeding and harvesting and herbicides for weed control are the main examples (Larsen and Noack 2021, Rao and Madhulety 2005).

Nevertheless, in many rice-growing regions manual transplanting, weeding, and harvesting are still common. Likewise, thousands of different rice varieties are still grown by small-scale farmers in Asia, Africa, and the Americas for home consumption and small-scale trade (Li et al. 2014, Gopi and Manjula 2018, Stein et al. 2018). These traditional crop types are usually labeled as landraces, in contrast to modern, fertilizer-responsive rice cultivars, developed by breeding institutes. Landraces, developed by local farmers, have various advantages, in particular resistance against biotic and abiotic stresses, resulting in a stable, intermediate yield under low-input agricultural systems (Zeven 1998). Rice farmers know about these advantages and select particular combinations of rice varieties or landraces to anticipate ecological differences and social needs. Despite policies of national governments and development organizations to stimulate commercial rice cultivation using modern, fertilizer-responsive cultivars, for many farmers landraces are a better option.

In Sierra Leone, for example, farmers in the 1900s selected *O. glaberrima* landraces named 'pende' that produced ripe seeds within 85-90 days (Hugh 1908, Richard 1986). In the 1980s, these landraces were still cultivated, and considered 'hunger rice', because they quickly produced a small amount of food when other rice varieties were not yet ripe (Richards 1986). Farmers who could cope well with the situation during the Sierra Leone civil war (1991-2002) had mainly grown landraces capable of producing ripe seeds within 90 days, ensuring their communities in hiding had staple food within a short time (Richards 2006). Moreover, landraces are often selected on different merits than yield alone. In Sri Lanka, traditional rice farmers cultivate over 2400 landraces. One variety is grown specifically for breastfeeding women, another is for men going out to work in the fields, while local monks eat a variety with a high protein content (Dharmasena 2010).

In this paper, we focus on rice farming in Suriname, where the contrast between commercial rice cultivars and traditional landraces is very present. Commercial rice farming using modern, fertilizer-responsive cultivars is applied in the coastal zone, by farmers descending from Asian contract laborers brought to the colonial plantations in the late nineteenth and early twentieth century (Young and Angiers 2010). The use of landraces is very prominent among Maroon in the forested interior. Maroons are descendants of enslaved Africans who escaped the plantations in the late 17th and 18th centuries and established independent communities in the remote interior of Suriname and French Guiana (Price 1993). Maroons have continued their distinct rice farming activities, and grow landraces of both *O. sativa* and *O. glaberrima* (Van Andel et al. 2019). Rice is a keystone crop in all Maroon communities: it has been their staple food for centuries, enabling them to survive independently from coastal societies (Pinas et al. 2023, Van Andel et al. 2019). The Dutch colonial government started growing rice as bulk food for enslaved Africans and soldiers in 1688 (Elfrink et al. 2024). Expeditions sent out to capture Maroons mentioned the first provision of fields with rice in 1712 (Dragtenstein 2002). In the Cottica area, where large groups of runaways hid in the swamps behind the plantations at the end of the 18th century, huge rice fields were discovered by the armies sent to trace them (Stedman 1988). These large rice fields suggested that runaways depended on rice for their survival.

Maroon provision fields are radically different from commercial rice fields in the coastal area of Suriname. Commercial rice fields are established in open, wet polders on clay soils,

with semi-mechanical sowing and harvesting (Mitro 2010, Ten Have 1967). Commercial rice is grown as a monoculture crop, for which the use of fertilizers, pesticides, and herbicides is a must. Contrastingly, Maroons grow multiple crops, such as cassava, okra, plantain, sugarcane, and rice in one field. Trees are felled to open a field in the forest and are burned rather than removed, and as they decay over time, they provide nutrition to the crops. Farmers do not apply mineral fertilizers and hardly ever use other agrochemicals.

Maroons cultivate many morphologically and genetically different rice landraces (Van Andel et al. 2019, Van de Loosdrecht et al. 2024) with several landraces sown in succession to even out labor during the harvest season (Pinas et al. 2023). It was suggested that during marronnage, short-ripening crops were favorable, as people could travel further once they had a little food (Pinas et al. 2024, Van Andel 2010). Once settled in a safe place there was adequate time for landraces that required a longer ripening but produced higher yields. In addition, a subset of the Maroon rice varieties has long awns. Awns have been proposed to contribute to a higher harvest yield by protecting against bird predation (Bullard 1988, Furuta et al. 2015, Portères 1966) and enable more photosynthesis close to the developing grain to increase the starch storage (Grundbacher 1963). Commercial cultivars generally have no awns because this trait is problematic for mechanical seed processing (Hua et al. 2015).

Maroon agriculture has been portrayed as primitive and unproductive in colonial and post-colonial times (Lobach 2023). Geijskes (1955) classified their shifting cultivation system as ‘wasteful land use’ and ‘primitive’ and considered the Maroons incapable of improving their agricultural methods themselves. Budelman and Ketelaar (1974) proposed that their dryland rice landraces should be replaced with modern wetland rice cultivars that were more profitable for trade and export. Nascente and Kromocardi (2017) and Siewnarain (2021) stated that low grain yields are problematic for the Maroons, as they rely on rice as their staple food. As yields were considered insufficient to meet the demand, they advised replacing the Maroon landraces with modern Brazilian upland cultivars to increase grain yield and meet food security needs. Several of the negative descriptions on Maroon rice production are sustained with Fig.s about an estimated yield between 700 kg and 1000 kg per hectare (Budelman and Ketelaar 1974, Nascente and Kromokardi 2017, Young and Angier 2010). None of these studies mentioned how they came to these yield estimates, and they have measured Maroon rice yield only in experimental settings.

In this paper, we present results from measurements of growth duration and yield of Maroon rice landraces, compared with two commercial cultivars from the coastal region of Suriname, in established fields of Maroon farmers who grow rice under rain-fed conditions without the use of irrigation, pest control, fertilizers, or herbicides. Maroons group rice landraces for ripening duration into short-, medium, and long-duration to even out labor intensity. However, Maroon farmers do not register exact sowing and harvesting dates, but their techniques have not been described. Hence, we aimed to describe sowing and harvesting techniques, and measure the maturation time of the Maroon rice landraces to confirm the maturation-duration classes assigned by the Maroon farmers and compare their yields. Lastly, we aimed to investigate whether the yield is higher for awned compared to non-awned rice varieties of the same Maroon maturation class.

In our study, we address the following research questions:

1) What is the time to maturation of traditional landraces that the Maroons classify as short, medium, or long-duration rice?

2) What is the general yield of these landraces in the traditional farming system?

3) What is the time to maturation and yield of commercial Surinamese wetland cultivars under Maroon farming systems?

We hypothesized that short-duration landraces, favored during marronnage since it allowed the Maroons to travel further with food sooner (Pinas et al. 2024, Van Andel 2010), had low yields. Similar to West African farming systems (Richards 1986) and following Maroon's oral history on marronnage, this 'hunger rice' could bridge the waiting time for the long-duration landraces to become ripe, which we expected to have higher yields. We also expected awned landraces to have higher yields because awns protect against bird predation (Furuta et al. 2015, Grundbacher 1963) and may enhance photosynthesis. As crop varieties will produce best in the ecological environment for which they were selected and developed, we expected that commercial wetland cultivars would probably produce less yield in a Maroon farming system, because they were not bred for this environment without the input of agrochemicals.

Material and methods

Selection of landraces

In 2021 and 2022 we interviewed 67 Maroon farmers, collected over 400 rice samples, and documented information on their agronomic traits (Maat et al. 2023, Pinas et al. 2023). Based on this information, we selected a total of 28 landraces that the Maroon farmers had in stock and which they indicated either as short-duration (ten varieties, ready to be harvested between three to four months), eight medium-duration (between four to five months), and ten long-duration (between five to eight months) (Suppl. Table 1). The ten short-duration landraces for our study were mátu alisi, alisi seéi, alisi seéi bë wojo, jengejenge, kwili kwili, akwandjaa, bë sika sii, weti sika sii, weti alisi, and awéi máu (Fig. 1). The awned mátu alisi (or baaka alisi, Fig. 4.1C) is the only *O.glaberrima* variety that was collected in Suriname thus far (Van Andel et al. 2016). For Maroons, this black-husked rice is of spiritual significance: its short growth season helped their ancestors to quickly produce food during marronnage (Pinas et al. 2024). All other short-duration rice was awnless. Alisi seéi is an *O. sativa* variety with white, hairy husks (Fig. 4.1N) that was named after a Ghanaian enslaved woman who escaped slavery around 1690 (Van Andel et al. 2023).

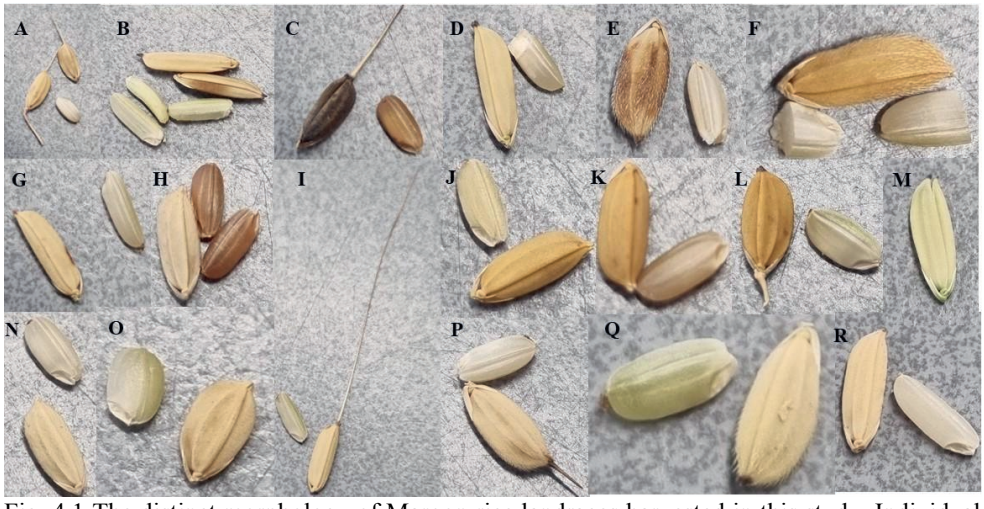

Fig. 4.1 The distinct morphology of Maroon rice landraces harvested in this study. Individual photos are unscaled. A= weti hédi, B= wataa alisi, C= mátu alisi, D= baáka gogo, E=ahunjön, F= kwili kwili, G= alëkisóóla, H= jengejenge, I= djampö, J= fini sii, K= bë alëkisóóla, L=

alëkisóóla baaw ana, M= A125, N=alisi seéi, O= bë sika sii, P= taanga lobi, Q= weti sika sii, R= weti kuli. All landraces are *O. sativa*, except 1C (*O. glaberrima*). Photographs: N. Pinas.

Four of the eight landraces that we selected and that were classified by the Maroons as medium-duration had extremely long awns (weti hédi, fini sii, djampö, and sika sii ku puma, see Fig. 4.1I). We selected them to see whether awned rice had a higher yield than awnless rice. The other four (awnless) medium-duration landraces were bë kuli, weti kuli, and two types of ahunjön. Ahunjön is a Maroon synonym of the term 'pende': an *O. sativa* landrace with spots on the husk (Fig. 4.1E). In the Mende language (Sierra Leone), pende means 'dark' (Hugh 1908) and this name is given to *O. glaberrima* varieties that ripen very quickly (Richards 1986).

The ten long-duration landraces that we selected, all awnless, were masaa alisi, wataa alisi, alëkisóóla, bë alëkisóóla, alëkisóóla baaw ana, weti alëkisóóla, taanga lobi, katam, baaka gogo and bambusi. Alëkisóóla is a popular *O. sativa* variety in Maroon communities with an elongated seed and white husk (Fig. 4.1G). It is related to the USA cultivar Rexora, imported to Suriname in the 1930s and extensively experimented with in the coastal fields (Stahel 1944, Baumgart et al. 1998, Van de Loosdrecht et al. 2024). During our interviews, Maroons often reported that alëkisóóla had a longer ripening period: it is sown as one of the first and harvested as one of the last varieties. Farmers indicated it as a high-yield rice. Masaa alisi is an *O. sativa* landrace cultivated only in the swamps of the Cottica region. Farmers indicated that it was ready for harvest after six to seven months, which would be the longest for all Maroon rice we have collected thus far. It is grown only in deep swamps and is said to be able to compete with grass. It is a very tall variety with elongated seeds, brown hairy husks, and a mix of red and white bran. Wataa alisi is a landrace with elongated seeds (Fig. 1B) that was sown in an area of the field that holds water, as indicated by the farmer. Two other landraces grown in swamps (katam and bambusi) were also indicated as long-duration swamp rice by the Cottica farmer. In addition, two commercial wetland cultivars (A-125 and A-130) developed by the Surinamese Rice Breeding Institute (SNRI/ADRON), of which detailed agronomic information was known, including yield per hectare (Tjoe Awie 2010) were handed out to two farmers for sowing as well.

We collected seed samples and whole rice plants for herbarium vouchers for all the varieties that came to full maturation during our fieldwork. One duplicate was deposited at the National Herbarium of Suriname (BBS) in Paramaribo, Suriname, and the other at the Herbarium of Naturalis Biodiversity Center (L) in Leiden, the Netherlands. Living seeds of each variety were deposited at the SNRI/ADRON germplasm bank in Nickerie, Suriname for storage, phenotyping, and multiplication. Duplicates grown by SNRI/ADRON were later deposited at the Svalbard Global Seed Vault, Norway.

Choice of locations

We selected locations that were easy to reach by car, represented at least two of the major Maroon groups (Saamaka and Okanisi), and also the different soil types on which the Maroon rice is typically grown. Wanhatti is an Okanisi village in the swampy Cottica region, Pokigron is a Saamaka village located in the Sipaliwini district with sandy soil and Diafutu is a Saamaka village near Brokopondo city center (Fig. 4.2). In December 2022, we selected farmers who planned to sow the rice varieties we wanted to study. We already had interviewed these farmers in 2021 and/or 2022 and they confirmed their willingness to participate. Farmers were compensated with on average 20 USD per fieldwork day (500 SRD). The farmers were Mrs. Julia Pomba (Saamaka, Diafutu), Mrs. Anne Huur (Saamaka, Pokigron), and Mrs. Marjorie Kanawi (Okanisi, Wanhatti).

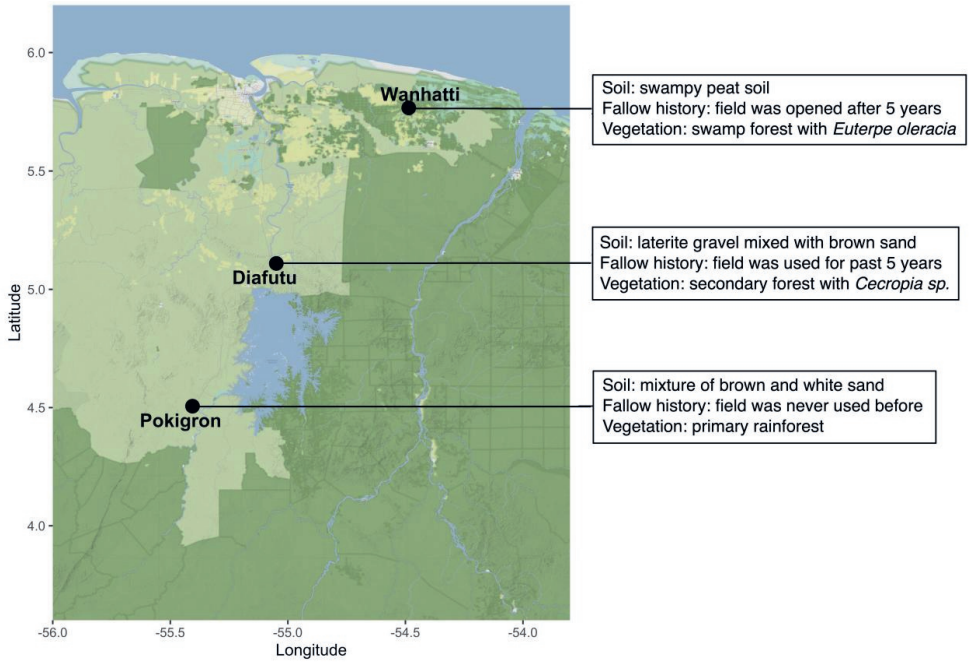

Fig. 4.2 Field locations with agroecological characteristics where Maroon rice performance measurements were conducted.

The husbands or male relatives of the farmers did the field preparation, such as clearing and burning, on their own initiative. Preparing the soil and sowing by hand broadcasting was done by the (female) farmers. We regularly contacted them via WhatsApp to be informed of their activities. Sowing was done in April, the farmers determined and recorded the date. We demarcated three plots of 0.25 square meters with four wooden sticks of 50 cm each forming a square. The location of each variety was marked in the field with a wooden board on a stick and the collection number (e.g. NP 405) of the landrace was written on it with black paint. We counted the number of seeds sown per 0.25 square meter for several varieties, and an average was calculated for each farmer. Three plots of 0.25 square meters were randomly arranged within a part of the field with the same rice variety. Yields may differ within a gradient because of potential differences in organic material in the soil (Gomez 1972). Therefore, if there were height differences within the patch where one variety was sown, we placed a plot on the highest point, one at the middle, and one at the lowest.

Measurements

Measurements for sowing density, plant height, and grain yield were done in July-August 2023. Harvesting started when the farmer indicated that the rice was ripe.

Sowing density: We determined the average sowing density for each farmer by counting the number of seeds sown in each of the three plots and determined an average across all plots and varieties.

Plant height: Plant height was measured as the distance in cm between the soil surface and the height of the tallest panicle on plants when the crop was ripe (IRRI 2013). For each rice variety,

ten plants were randomly selected for plant height measurements within each plot to determine average height (Table S1.A: average plant height [cm]). Based on their average height at maturity, Maroon rice varieties were categorized as semidwarf (<90 cm), intermediate (90-125 cm), and tall (>125 cm), based on the categories for upland rice landraces (IRRI 2013). Commercial cultivars typically fall into the categories semidwarf (<110 cm), intermediate (110-130 cm), and tall (>130 cm), categories that differ from those of landraces (IRRI 2013).

Grain yield: Grain production was measured by hand after the grain reached physiological maturity in each plot. We determined the grain yield of rice by measuring three components:

1) Ten plants were randomly selected for tillers counting within each plot (IRRI 2013).

2) Number of tillers per plot. This was determined by counting all the tillers in the plots and averaging the data (Table S1.A: average # tillers per plot [0.25 m^2]). The conventional perspective is that high-tillering rice plants have a higher yield per individual plant (Mohanan and Pavithran 2007). High tiller-producing cultivars can have between 20 and 25 tillers, of which approximately 10 will be unproductive (Pawar et al. 2016). As such, the number of productive and nonproductive tillers of each variety was counted (Table S1.A: average # productive tillers per plot [0.25 m^2] and average # non-productive tillers per plot [0.25 m^2]).

3) Numbers of fully developed and underdeveloped grains per panicle per plot (Table S1.A: average # productive grains per panicle per plot [0.25 m^2] and non-productive grains/panicle per plot [0.25 m^2]). This was determined by counting the number of grains in ten panicles, randomly sampled in one plot, dividing by ten (Gomez 1972) and the average taken over all three plots.

4) 1000-grain weight. For each variety, all rice panicles were collected from the three plots. The bundles of rice panicles were labeled and transported in bags to the SNRI/ADRON lab facilities. There the unfilled grains from the rice were removed by hand, and the husks of fully developed grains were removed in an electric rice mill. In addition, moisture content was reduced to 14% (IRRI 2013) with a rice moisture dryer (Memmert, UF750). We determined the 1000-grain weight for the milled rice, 14% moisture content corrected grain by measuring 100 grains taken randomly from each plot, averaging over the three plots, and multiplying the average weight by ten (Table S1.A: 1000 grains weight [gr] at 14% water content).

5) Total yield. The total yield was determined by weighing the (milled) grain samples from the three sampling plots from each variety and corrected to 14% moisture (Table S1.A: average milled grain weight 14% moisture [gr/0.25 m^2]). This average yield of the three sampling plots was multiplied by 40,000 to reach an average yield in kg per hectare (Table S1.A: average yield [kg/ha]).

Data analyses and statistics

Data analysis was done in Rstudio with Base-R version 4.3.2. For a total of 24 rice varieties all performance variables could be measured (Pokigron: n=16, Diafutu: n=6, Wanhatti: n=2). Given this modest sampling size we first tested the normality of the data for each of the measurement variables using the Shapiro-Wilk Test (*Shapiro. test()* function, stats package) and made Q-Q plots (*qqPlot()* function, car package) (Table S1.B). We found the data for most variables to have a non-normal distribution (seed density, maturity time, plant height, and total yield).

Each variable was subsequently investigated using nonparametric tests for the effects of the Maroon maturation class (Table S1.C). When a significant effect was detected with a Kruskall-Wallis Test (*Kruskal. test()* function, stats package), we subsequently applied the

Dunn's Test with a Bonferroni correction (*dunnTest()* function, FSA package) to test the medians for all pairwise combinations of the maturation or location groups. We caution that the sample group sizes are asymmetric and (very) small during the statistical testing for differences in yield performance between maturation classes ($4 < n < 8$) and locality ($2 < n < 16$), and as such may affect the reliability of these tests. In addition, with a Mann-Whitney U Test (Wilcox. *test()* function with 'exact = FALSE', stats package) we investigated whether the Maroon landraces as a combined group (n=16) differed from the commercial cultivars (n=4) for each of the performance variables measured (Table S1.D).

Seed density correction for relevant yield measurements. Differences in sowing density may drive differences in observed yield. Therefore, we applied a correction factor to minimize any effects on yield due to differences in sowing density. The correction factor is proportional to the relative difference in sowing density to the site with the lowest sowing density (Diafutu). As such, the correction factors for all grain production measurements are Daifutu: 1.00, Pokigron: 0.86, and Wanhatti: 0.70. This correction factor was applied to the 'Number of fully developed grains per panicle per plot', 'Average milled grain weight with 14% water content' and 'Total yield' variables.

Results

Sowing

From March until mid-April 2023, farmers were busy cleaning, burning, and preparing their fields. Sowing started on April 17th, just after it started to rain, and continued until April 25th. The Maroon farmers did not consult the weather forecast for updates on rainfall, but instead listened to a local cicada named siksi-yuru (*Fidicina mannifera* Fabricius 1803)**.** This insect had to stop 'singing' his loud song, which indicated that it would soon start to rain. We found that farmers made no difference in sowing density between their varieties, but densities differed per farmer. In Pokigron each plot had an average of 92 seeds, in Diafutu 79 seeds, and in Wanhatti 112 seeds.

Harvesting

In July, August, and September the first author harvested twenty Maroon landraces and two commercial cultivars in the three locations. Masaa alisi was harvested in November, outside the fieldwork period. The varieties katam, bambusi, and one type of ahunjön did not sprout: the farmer indicated these were old seeds that could not germinate anymore. Akwandjaa, weti alëkisóóla, awéimáu and sika sii ku puuma germinated, but only reached average heights between 10 and 15 cm. According to the farmer, this happened because the patch of field where those varieties were sown had no charcoal or other burned plant material to nourish the rice plants.

Plant height

Maroons have developed their landraces to a height at which panicles are at the level of the farmer's hands (Fig. 4.3). In this way, panicles can be cut while standing upright, which is experienced as less labor-intensive than bending down. Indeed, we found that all the Maroon landraces were taller than 90 cm at maturity (Table S1.A). The variety weti hédi had an average height of 110 cm and fell in the intermediate category for upland varieties (IRRI 2013). The remaining 19 landraces fell within the tall category with average heights of 132.7-177.6 cm (median 160.0 cm) with wataa alisi (177.6 cm) and alisi seéi bë wojo (176.9 cm) being the tallest.

With average heights of 43.3-60.0 cm (median: 56.6 cm), the two commercial cultivars A-125 and A-130 were categorized as semidwarf (< 110 cm for lowland cultivars) (IRRI 2013).

Notably, their plant height was half the height they reached when grown in commercial rice fields in Nickerie (on average 105 cm) (Tjoe Awie 2004). In addition, we observed a difference in tillers between the Maroon landraces and the commercial cultivars. The median in the 28 Maroon landraces was 1.2 tillers, whereas for the commercial cultivars A-125 and A-130 the median was 4.0 tillers. This higher number of tillers is typical for commercial cultivars (Mohanan and Pavithran 2007).

Fig. 4.3 (A) Mrs. Anne Huur harvesting inside a patch of Maroon rice in Pokigron. The panicles grow at the level of her hands, facilitating the harvesting process. Photo: N. Pinas.

Days to maturity

The median maturation time for the Maroon landraces was 117 days (slightly less than 4 months). The fastest ripening Maroon rice was mátu alisi (*O. glaberrima*) at 110 days (~ 3.5 months) (Table S1.A). The landraces alëkisóóla and weti hédi both took 129 days (~ 4 months) to mature, although Maroons classify alëkisóóla as a long-duration variety and weti hedi as a medium-duration variety. The commercial cultivars, however, were mature between 98 and 100 days (just over 3 months), similar to their phenology data from the SNRI/ Adron (Tjoe Awie 2010). The difference between the earliest maturing (mátu alisi) and most of the long-duration varieties was a maximum of 19 days. The exception was masaa alisi, indicated by Maroons as a long-duration variety, which was harvested at 183 days (more than 4.5 months). Unfortunately, the two other long-duration types, katam and bambusi, did not germinate due to bad seed quality, so we could not verify their maturation time. Notably, none of the Maroon landraces matured within three months, even though this was mentioned to us previously by farmers. Although Maroon farmers classify their rice into short-, medium-, and long-duration ripening varieties, the maturation time for these three categories showed significant overlap (Fig. 4.4) and we did not detect statistically significant differences (Kruskal-Wallis Test: χ^2= 4.069, p=0.131 (Table S1.C). However, the maturation time of the commercial varieties tended to be shorter than that of the Maroon landraces as a group (Mann-Whitney-U Test: p = 0.002, Table S1.D).

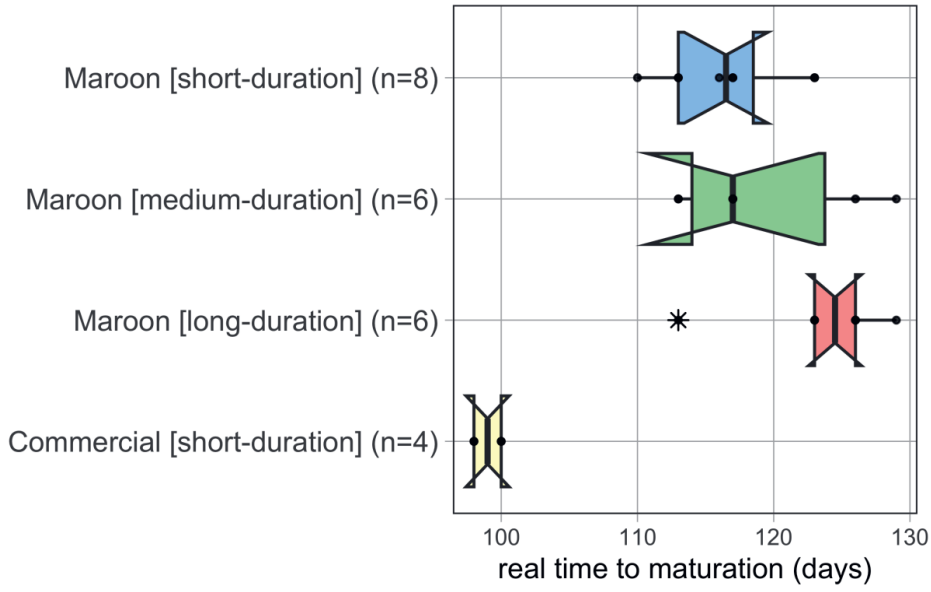

Fig. 4.4 Box plots for the different maturation classes as indicated by Maroon farmers. Every dot represents a Maroon rice landrace. The landrace masaa alisi (183 days) is not shown. The maturation times for the three Maroon landrace categories overlap. See Supplementary Table 4.2.

Grain weight

The Maroon landraces had a median 1000-grain weight of 24.6 gr (Fig. 5). The landraces bë sika sii and weti sika sii had the lowest 1000-grain weight due to their tiny seeds (4-5 x 3-4 mm). Some of the 'alëkisóóla' types (baaka gogo, alëkisóóla, alëkisóóla baaw ana, and bë alëkisóóla) were among the varieties that had relatively the highest grain weights because these thin, elongated rice types were relatively large (9-11 x 3-4 mm) (Fig. 4.5, Table S1.A). Overall, we did not detect a significant difference in grain weight between the maturation classes assigned by the Maroons (Kruskal-Wallis Test: $\chi^2$3.054, p= 0.217) (Table S1.C). The commercial cultivars A-125 and A-130 had a 1000-grain weight of 30.8 gr on Maroon fields (Fig. 5), which appeared to be lower than the average 31.5 gr measured for the same varieties when planted in a commercial field (Tjoe Awie 2010).

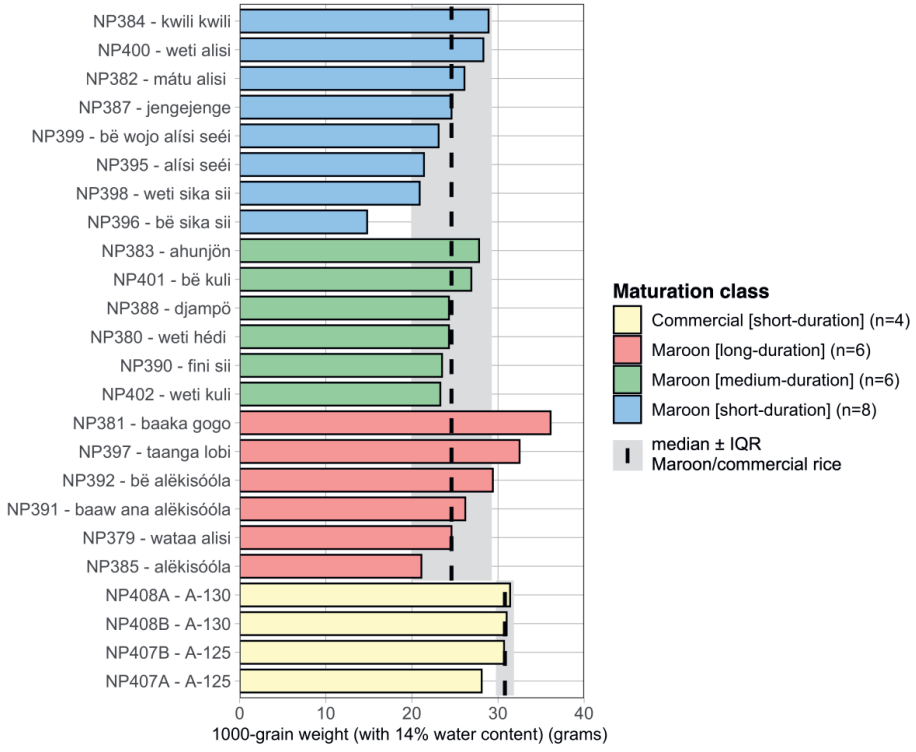

Fig. 4.5 Thousand-grain weight at 14% water content of the twenty Maroon rice landraces. Colors reflect the maturation classes distinguished by the Maroons. The dotted line and grey area mark the median and interquartile (IQR) range for either all the Maroon landraces or the commercial cultivars as a group. Within each maturation class, there is variation in grain weight. See supplementary table 4.2

Total yield of landraces and commercial cultivars on Maroon farms

The Maroon landraces had a median (seed density corrected) yield of 1496 kg/ha (IQR: 736-2255 kg/ha) (Fig. 6). We did not detect a significant difference in yield between the Maroon maturation classes (Kruskal-Wallis Test: χ^2=3.433, p=0.180) (Table S1.C). The Maroon landraces known as sika sii had relatively low yields (max. 872 kg/ha), which was expected due to their small seeds (Fig. 4.6). The reason for the low yield for alisi seéi (676 kg/ha) was unclear, as it had seeds of average length (8 x 5 mm). The Maroon landraces weti kuli, bë kuli, wataa alisi, mátu alisi, and bë alëkisóóla had yields above 1800 kg/ha. Congruently, the farmers we interviewed all indicated that the alëkisóóla types always produced a good yield.

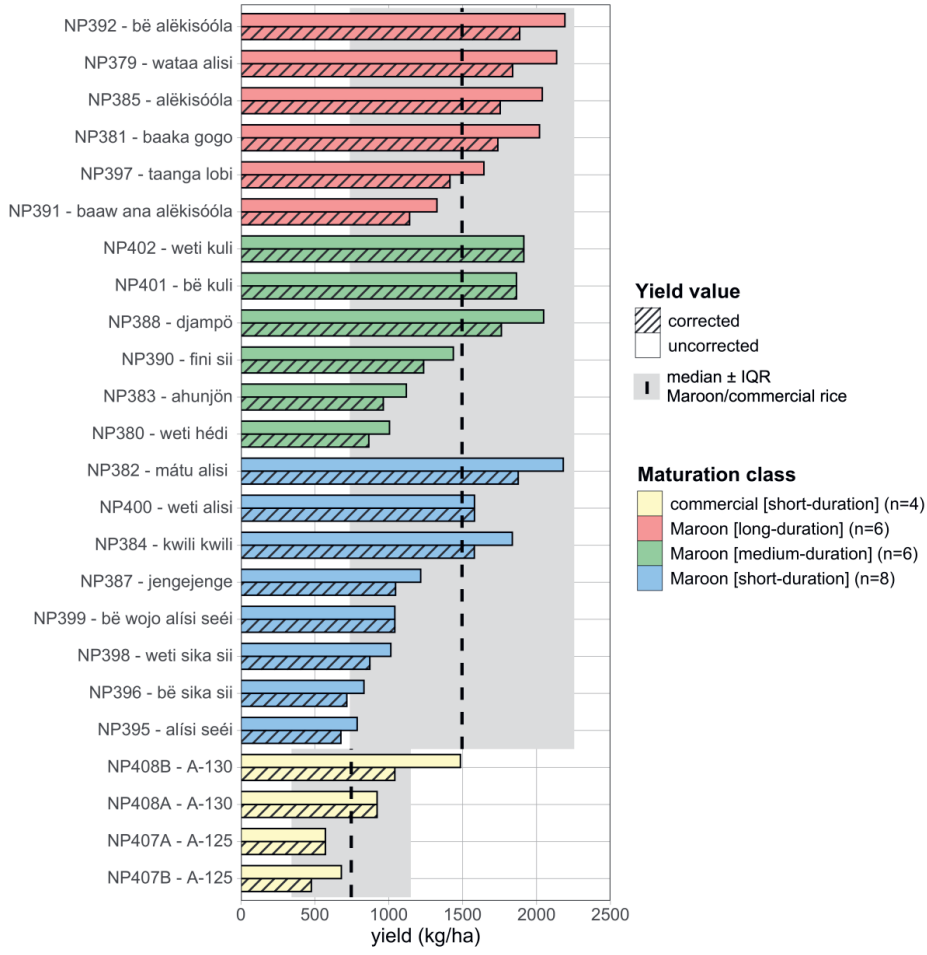

Fig. 4.6 Yield in kilogram per hectare (kg/ha) with and without seed density correction. Colors reflect the maturation classes distinguished by the Maroons. The dotted line and grey area mark the median and interquartile (IQR) range based on the seed density corrected yield varieties for either all the Maroon landraces or commercial cultivars as a group. The Fig. shows that there is no correlation between yield and maturation time. See supplementary table 4.2

In industrial rice fields in Nickerie, the two commercial cultivars A-125, and A-130 can reach yields between 6100 and 6300 kg/ha (Tjoe Awie 2010). In Maroon fields, however, these two commercial cultivars produced much lower yields than in the industrial settings. A-125 and A-130 had maximum yields of only 571 and 1041 kg/ha, respectively (Fig. 4.5, Supplementary Table 4.1). This low yield on Maroon fields is probably explained by the fact that Maroon farmers did not use agrochemicals. These modern cultivars were developed to have a strong response to artificial fertilizers and not to the natural source of minerals available on Maroon rice fields, such as charcoal and decaying plant material. Another plausible reason for the low yield of A-125 and A-130 was bird predation. The birds in Diafutu feasted on both cultivars

(Fig. 4.7), while the Maroon landraces a few meters away in the same field were mostly left untouched.

Fig. 4.7 Commercial variety A-125 in the Maroon field at Diafutu showing signs of heavy bird predation, 1 August 2023. Empty rice husks are visible on a leaf of a *Cecropia* sapling. Photograph: N. Pinas.

Discussion

Maturation time of Maroon rice

We did not see a clear difference between short- and medium-duration landraces in our study, even though Maroon farmers classified them as such. The approximately three weeks between early and late ripening of Maroon landraces seemed more important for the management of workload during harvest, even when all varieties were sown at the same time. Two farmers said they sowed the distinct landraces on different days to spread the harvesting work more evenly. Other Maroon landraces with shorter ripening times may exist, but because of time constraints, we focused on only 30 of the hundreds of different Maroon landraces. When growth periods of all these would be measured in the environment in which they were selected, a clearer difference in maturation time may appear.

In previous experiments in Nickerie by Sewnarain (2021), the Maroon landraces took between 159 and 194 days to mature, much longer than in our study. Sewnarain also included Maroon swamp rice ('masra') in her experiments, which is probably the same variety as the long-duration masaa alisi in our study. In Nickerie, this swamp rice took 159-181 days to ripen, somewhat shorter than in our study (183 days). However, some of the awned Maroon rice that Sewnarain planted (ajojo and botomboli) had very long maturation times (181 to 194 days). This was probably caused by the heavy clay soils in Nickerie, which are absent in the Maroon communities.

Yield of Maroon rice

The Maroon rice landraces we studied had a median yield of 1496 kg/ha (ranging between 760 and 2255 kg/ha) when corrected for sowing density, without agrochemicals or heavy machinery. This is higher than the previously assumed low yields of 700-1000 kg/ha (Budelman and Ketelaar 1974, Siewnarain 2021). Maroon rice yields today are comparable to the yield obtained by the first Asian contract laborers in Suriname, who harvested 1200-1500 kg/ha, and in the most favorable circumstances 2000 kg/ha, also without agrochemicals, in the coastal wetlands (Benjamins and Snelleman 1914-1917). These mid-19th-century yield data are the only Fig.s available for traditional rice cultivation in Suriname. Rao et al. (2018) measured yields of rice landraces under low nitrogen conditions in India and distinguished high yielders (producing more than 3000 kg/ha in the wet season and more than 2500 kg/ha in the dry season), moderate yielders (> 1500 kg/ha), and low yielders (< 1500kg/ha). According to those categories, ten Maroon varieties can be considered as moderate yielders and ten as low yielders.

We cannot rule out that the locations where we followed and harvested the landraces influenced the maturation time and yield. Although we did not measure environmental components, the same landraces may respond differently to other locations because of variations in rainfall, sun intensity, soil composition and structure, sowing density, availability of charcoal, and farmer practices. It is probable that such location-specific factors also influenced the outcomes of previous experimental research with Maroon rice. In the discussion about traditional crop landraces and yield, it should be taken into consideration under which conditions those varieties were originally selected and developed. If yields and maturation periods are measured under experimental settings outside their traditional environment and without the farming practices under which they were developed, the results should be interpreted with care.

No 'hunger rice' varieties in our selection

Our hypothesis that short-duration Maroon landraces would produce lower yields than long-duration ones was not confirmed by our data. Early-ripening landraces such as mátu alisi (110 days) had a corrected yield of 1876 kg/ha and kwili kwili (116 days) with 1579 kg/ha. While the alëkisóóla types generally took longer to ripen (up to 129 days) and generally produced more than 1700 kg/ha, alëkisóóla baaw ana (123 days) produced only ~1150 kg/ha. The landrace bë alëkisóóla was considered a long-duration type but took only 113 days to ripen and produced more than 1850 kg/ha. The difference in growth periods and yields within the 'alëkisóóla-type' landraces indicate that these varieties are not as similar as their name suggests. We, therefore, reject our hypothesis that short-duration landraces' yields are always lower and long-duration landraces are always higher. This contrasts with the Sierra Leone system as described by Richards (2006), in which 'hunger rice' (varieties named pende) had a low yield but ripened within 90 days. The Maroon rice with the same name (ahunjön or pende) had a moderate yield (963 kg/ha) and took 126 days to ripen, much longer than its West African namesake (90 days). As such, the name retention seemed to refer to the spotted husk rather than its growth duration.

Measuring Maroon rice production

Previous studies suggested that Maroon landraces should be replaced with modern rice cultivars capable of producing higher yields (Nascente and Kromokardi 2017, Power 2015). Our results show that estimating Maroon rice yield depends on the selected landraces: small-seeded rice will generally produce lower yields than landraces with bigger seeds. Maroons generally sow fewer seeds per square meter (c. 375 seeds/m^2) than farmers in commercial settings (c. 500 seeds/m^2), so yields can only be compared when adjusted for sowing density. Under

experimental settings, Nascente and Kromokardi (2017) measured an optimal yield for the Maroon rice landrace topi-topi of 1893 to 2429 kg/ha without agrochemicals. However, as they did not provide data on sowing density, comparing their yield with our data is difficult.

Maroons do not measure their production in kilograms per hectare but generally estimate how long a family can consume their homegrown rice. We interviewed farmers who had sufficient rice for a year on a relatively small field (c. 3 ha) with multiple crops besides rice. We also spoke with farmers who indicated they would consume their harvest within a week, as they only cultivated rice for traditional funeral ceremonies.

Awned versus awnless landraces

Farmers informed us that when birds could choose between glabrous and hairy or awned rice, they would feed on the glabrous varieties. However, our data does not show differences in yield between landraces with awns (e.g. mátu alisi and djampö), hairy husks (wataa alisi), and glabrous and awnless landraces (e.g. alëkisóóla baaw ana). Based on field observations of the first author and Maroon farmers, only the commercial cultivars (A-125 and A-130), which were completely glabrous and awnless, suffered enormously from bird predation. This was especially true for Diafutu, where the rice field was located next to an agricultural plot that had been used for several years. In Wanhatti, the rice field was established in a swamp not recently used for planting, and the commercial cultivars were somewhat less attacked. 'The birds are not yet aware that we made a new field there', the farmer explained. Apart from awns and hairy husks, other traits of Maroon rice plants may play a role in preventing bird predation.

In a previous experiment from the SNRI/ADRON with the glabrous and awnless cultivars A-125, A-127, A-128, and A-130 in Victoria (Brokopondo district) there was no harvest at all, due to heavy bird predation and disease (Tjoe Awie 2013). The sowing date (July 17th) was also outside the sowing period used by Maroon farmers, as there is less rainfall from July to September. Maroon farmers told us that low rainfall negatively affects rice yields, and therefore they sow rice at the beginning of the rainy season in December and in March / April. Introducing commercial wetland rice cultivars from coastal Suriname in Maroon communities should be done with care. Different environmental conditions in the interior such as soil type, rainfall, and bird predation are probably instrumental in the failure of the commercial cultivars that have been experimented with so far.

Loss of seed stock

Seed dormancy and loss were a problem for Maroon farmers, as was shown by the three landraces that were too old to germinate. The most prominent reason for seed loss is poor storage facilities: the presence of moths, weevils, moisture, and rodents influences seed quality. Farmers said that rice must be sown within one year after harvest, because if the seeds are too old and if family members or friends do not have the same landrace in their field or in stock, such a variety might get lost. Farmers who cannot sow because of sickness, a temporary move to the city, or any other misfortunes risk losing all their crop seeds unless family, friends, or neighbors have the same landraces in stock. For these reasons, the recent initiative of the SNRI/ADRON and the Crop Trust to build community seed banks with improved storage facilities is greatly appreciated by the Maroon farmers (Crop Diversity Digest Staff, 2024).

Limitations of this research

Our research depended very much on the farmer's schedule, making planning difficult. Farmers decided the sowing and harvesting dates, as well as what landrace to sow in which part of the field. We were limited to the landraces that farmers already had in stock and they were familiar with. Apart from the two commercial cultivars we did not introduce Maroon landraces that were unknown to the farmers. Therefore, we cannot compare the performance of all the Maroon rice

landraces among the three locations. Our data also represent only one season (March-November 2023). Although it was an average year according to the farmers, we cannot predict the yields of these landraces in years with higher-than-average rainfall (such as in 2022) or exceptional droughts (such as in 2024). We also focused on a fraction of the hundreds of Maroon rice landraces. More research is needed on the relationship between rice yield and soil fertility, rainfall variation, farm size, and socio-economic aspects that influence the amount of rice produced by Maroon farmers. The relationship between awns, hairy husks, and bird predation also requires further study. When different Maroon rice landraces are studied in the same location, by the same farmer, and with similar field preparations, clear differences between yield and growth duration may become visible.

Conclusions

The discussion about traditional crop landraces and yield should consider under which conditions those landraces were originally selected and developed. If yield and maturation periods are measured under experimental settings the results should be interpreted carefully. The Maroon rice landraces we measured had a higher yield than suggested previously. Maroons never calculate their yield in kilogram per hectare, but they estimate how long a family can eat from their rice harvest. In general, we conclude that replacing Maroon landraces with commercial cultivars will most likely result in a decrease in rice yields and therefore lead to less food security. Also notable is that Maroon rice yield is comparable to that of rice landraces in Asia grown under low-input conditions.

5

Chapter 5: From Field to Plate: the Chain of Operation in Maroon Rice Cultivation in Suriname and French Guiana

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Abstract

Maroons, descendants of enslaved Africans who escaped slavery between 1650 and 1863 in Suriname, have a unique rice farming system. Rice is one of their main staple crops, but although previously framed as primitive and destructive, Maroon agriculture has never been studied in detail. Here we analyze the chain of operation of Maroon rice farming, the sequence of activities instrumental in reaching a desired goal, rice production. We interviewed Maroon 99 farmers and collected rice varieties from 106 farmers. We asked about their personal and cultural motivations to cultivate rice, their varieties, how they obtained them, the sequence of farming activities, and the role of men, women, and adolescents during these activities. The operation chain is complex and differs slightly among communities and the areas where they reside. Practices are influenced by seasonality, local environmental conditions, personal conditions, religion, and ethnicity. In Maroon rice farming, the main goal is to maintain food security, sovereignty, and cultural identity, not only in the short term but also in the distant future. As such, our results contrast with previous research that has described Maroon farming practices as inferior, static, and lacking ecological connection to the land.

Keywords: Maroons, Rice diversity, Seed management, Agriculture

Introduction

The interior of Suriname and French Guiana is a dense forest area inhabited by indigenous peoples and Maroons. A common feature of these two groups is the way they grow their food, using a farming method known as shifting cultivation. Farming with this method implies creating a new field, known as a swidden, by slashing and burning trees and other vegetation, after which it is used for a variety of crops for one to three growing seasons. Differences between the farming methods of these groups are provided from either cultural or ecological perspectives. Anthropologists have studied the cultures of these groups, primarily focusing on the various Maroon sub-groups, highlighting cultural differences, and how these relate to certain routines and products from farming, hunting, and fishing (de Groot 1985, Price 1983). The ecological perspective is prominent in studies from agronomists and forestry experts, highlighting how shifting cultivation affects soil fertility and forest recovery. With few exceptions these studies typically reiterate ecological stereotypes about shifting cultivation (Lobach, 2023).

In this paper, we take a closer look at the shifting cultivation activities of the Maroon groups. Growing rice on swiddens distinguishes Maroons from the indigenous groups who do not have a rice-growing tradition. Moreover, rice has been commonly grown by all Maroon sub-groups, from the early years of their formation until today. For the Maroons, rice is a cultural marker crop or what ethnobotanists call a cultural keystone species (Garibaldi and Turner, 2004). A focus on rice thus helps to create a distinction between the main groups practicing shifting cultivation in Suriname and French Guiana without falling back on

ecological stereotypes as well as avoiding the more scattered characterizations of food and farming resulting from ethnographies of Maroon subgroups.

The close interaction between rice cultivation and the value system of Maroon groups can be described as a chain of operation. Also known as the original French concept *chaîne opératoire*, it offers an analytical tool for recording and breaking down a complex process into step-by-step actions that bring raw material from a natural to a manufactured state (Coupaye 2009, Cresswell 1976). Applied to farming communities, a chain of operation also represents the way of life, traditions, and nature of subsistence of communities and how their farm operation is embedded in wider networks of knowledge and technologies (Bray 2020, Coupaye 2009).

Maroons are descendants of enslaved Africans who escaped slavery and built societies in remote places in the forested hinterlands that were difficult to reach for colonial governments and soldiers (de Groot 1985). With their newfound freedom, Maroons practiced agriculture based on their knowledge of farming as brought from Africa by their enslaved ancestors, adapted and extended on plantations, and from contacts with Indigenous groups (Elfrink et al. 2024, Fleury 2016, Maat et al. 2023). Maroon societies developed their agriculture without the direct involvement of the Dutch colonial authorities, and later the Surinamese and French governments. Contact between Maroons and the authorities has been limited for centuries to special occasions, such as the exchange of trade goods and the installments of postholders (Price 1983, Thoden van Velzen 2022).

Nowadays, Suriname and French Guiana encompass six Maroon groups: the Saamaka (estimated population size ~ 82,500), Okanisi or Ndjuka (~ 82,500), Matawai (~ 6,800), Pamakka (~ 11,000), Aluku or Boni (~ 11,000) and Kwinti (~ 1,000). Most of them still live in the forested interior of both countries, but the majority of the Matawai and Kwinti have migrated to Paramaribo, the capital of Suriname (Price 2013).

Rice is one of the staple crops in all Maroon communities and farmers grow many genetically different varieties (Van de Loosdrecht et al. 2024). Maroon rice farming has also been viewed as primitive in post-colonial times. Budelman and Ketelaar (1974) stated that the Maroon dryland rice varieties were not suitable for permanent cultivation, and proposed that they should be replaced by wetland rice varieties that were more profitable for trading and export. Nascente and Kromocardi (2016) stated that rice yields were low and problematic for the Maroons and insufficient to meet their demand. They advised replacing their traditional varieties with modern Brazilian rice cultivars to increase grain yield and ensure food security, which would need costly inputs of fertilizers and herbicides. Despite the criticism of Maroon agriculture from governments and agronomists over the past decades (Lobach 2023), Maroons continued growing rice. Today, some farmers still maintain up to 20 different landraces on one field, some of which go back to the early days of marronage ~375 years ago (Pinas et al. 2023, Van de Loosdrecht et al. 2024).

Here we focus on the chain of operation for rice farming in Saamaka, Okanisi, Matawai, and Pamakka villages. We will look into the techniques, knowledge, tools, crop diversity, seasonality, beliefs, cultural activities, division of labor, pest management, and processing methods. Based on the scantly available literature, we will analyze whether the Maroons have changed their agricultural practices over time.

Methods

In 2017, 2021, 2022, and 2023, we interviewed 99 farmers (three men and 96 women) using semi-structured questionnaires. We collected rice varieties kept in storage or grown on the fields

from 106 farmers (three men and 103 women): seven Matawai, 58 Okanisi, five Pamakka, and 36 Saamaka. For an overview of our sampling locations, see Fig. 5.1.

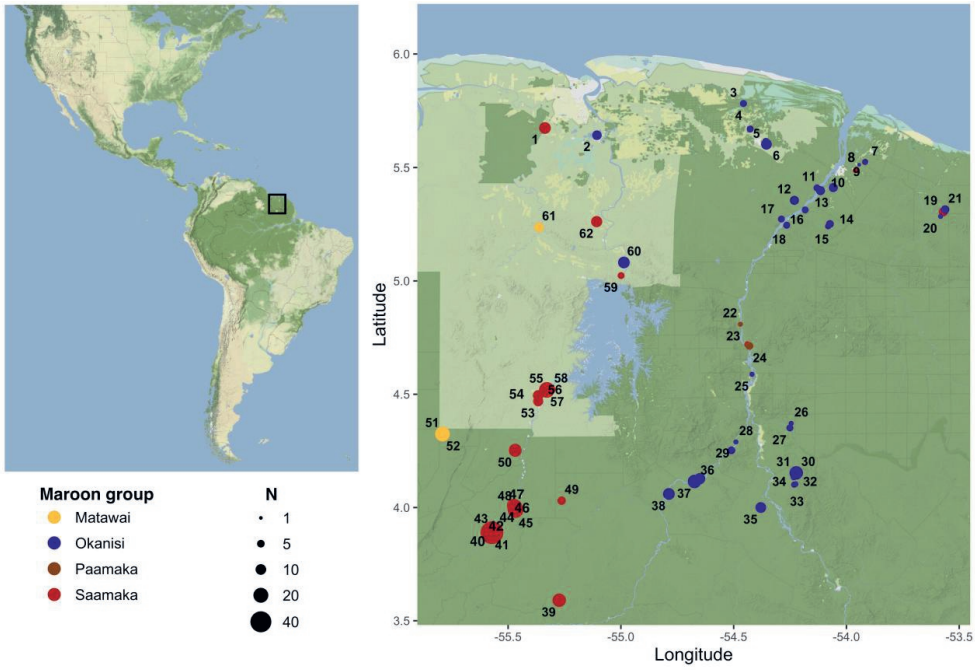


Fig. 5.1 Map showing the Maroon villages in Suriname and French Guiana where farmers were interviewed. 1: Santigron, 2: Paranam, 3: Wanhatti, 4: Ricanau Mofo, 5: Peto Ondo, 6: Peto Hills, 7: Anunu Kampu, 8: Mana Pasi St Laurent, 9: Cayenne Pasi, 10: St Jean Pasi, 11: Bigiston, 12: Moengo, 13: Portal Island, 14: Manjabon, 15: Lemikibon, 16: New Libi, 17: Sparouine, 18: St Laurent du Maroni, 19: Amana Pasi, 20: Crique Margot, 21: Da Bana Pasi, 22: Nason, 23: Kamp Wadaa, 24: Loka Loka, 25: Djakitabiki, 26: Beiman Crique, 27: Danapukampu, 28: Tabiki, 29: Malobi, 30: Gran Santi, 31: Mamaaikampu, 32: Amana Skin, 33: Konsi, 34: Gonini Kiiki, 35: Mofina, 36: Mooi Taki, 37: Diitabiki, 38: Godo Olo, 39: Dangogo 2, 40: Kajana, 41: Ston Uku, 42: Godo Wata, 43: Be Goong, 44: Awai, 45: Somesudu, 46: Mi kon wai, 47: Palulu Basu, 48: Asidonhopo, 49: Semoisie, 50: Pikin Slee, 51: Pusugrunu, 52: Boslanti, 53: Pambooko, 54: Dantabai Pasi, 55: Tamanredjo, 56: Pokigron, 57: Bakaa Boto, 58: Duwata, 59: Brokopondo Centrum, 60: Tapoeripa, 61: Comsarsikondre, 62: Afobakaweg.

We obtained verbal consent from each farmer and written permission from the traditional Maroon authorities for our field research. We asked farmers how many varieties they had, and how they obtained them. We observed the clearing, burning, sowing, and harvesting of several fields. We asked for information about rice harvesting and processing of rice, and the role of gender and age groups in these activities. We also spoke with two commercial Maroon rice farmers (both men) who cultivated rice in small monocultures for the market in Paramaribo. Data on typical Maroon rice dishes were retrieved from Ising (2022). Farmers were compensated for their time spent with the researchers. Living rice seeds have been deposited at the SNRI/ADRON rice gene bank in Nickerie, Suriname, and the Svalbard Seed Vault in

Norway. Rice plant specimens have been deposited at the National Herbarium of Suriname in Paramaribo (BBS), and Naturalis Biodiversity Center in Leiden (L), the Netherlands.

Statistical tests to examine differences in the number of rice varieties among Maroon groups and river basins were conducted in Rstudio with Base-R v.4.3.2. Using the Shapiro-Wilk Normality Test (*shapiro.test()*) from the *stats* package v.3.6.2 we found that the data shows a non-normal distribution ($W = 0.88$, $p = 7.38 \times 10^{-8}$). The data was grouped and the means, medians, and standard deviations were calculated, and visualized with violin density plots using the *ggplot(), geom_violin()* and *geom_dotplot()* functions from the *ggplot2* package v.3.5.1. Subsequently, we investigated using nonparametric tests whether the rice diversity differs between Maroon groups and river basins. We detected a significant effect for both these factors with a Kruskall-Wallis Test (*Kruskal. test()* function, *stats* package), and subsequently we applied the Dunn's Test with a Bonferroni correction (*dunnTest() function*, *FSA* package) to test the medians for all pairwise combinations of the Maroon groups, and river basin groups, respectively.

Results

Field selection

Selecting the best possible location for a new field every year is crucial to rice production. Albert Aboikoni, paramount chief of the Saamaka Maroons, explained that his forefathers divided the forest so every family had an area where their descendants could open a farm field. Naali Ongobe, a Saamaka rice farmer said that during the rainy season in May, June, and July, people go into the forest searching for suitable areas for a new field. "In the rainy season, the water levels are high, and we can see where our crops will survive in the forest. A good field location is partially wet and partially dry at that moment". For rice varieties that need wet soil, patches are chosen close to a small creek, while for those that prefer better-drained soil, a non-flooded part is selected. However, fields are also chosen for their suitability to grow cassava, plantains, and other crops. In the past, before a new field was opened, Maroons would first consult the local *ampuku* forest spirit (Price 1983). As they believed that the forest was the domain of these supernatural beings, asking for their permission was necessary. In the documentary *Stones Have Laws* (van Brummelen and de Haan 2022), Saamaka people showed this ritual: a small patch of forest was cleared where they placed two forked sticks holding a young, manually unfolded palm leaf. If the leaf was still up the next morning the local *ampuku* had agreed to a new field at that location. If the leaf had fallen, the spirit objected, and they had to search for a new location. We no longer observe or hear about this activity, but we cannot rule out that it is still occasionally practiced. This ritual shows the spiritual significance of the forest to the Maroons and the respect they pay to forest entities to be allowed to farm in their territories.

Several farmers indicated that the rainforest soil was fertile, so they did not need to measure soil fertility before choosing a field location. Still, they had techniques to test soil quality: a healthy growing watermelon sown as the first crop indicated fertile soil. Another method was to watch how quickly rainwater would drain from a field. Most rice fields we observed were made of brown and white sandy loam. Red laterite soil is used around Brokopondo. Rice fields in peat swamps were only seen in the Cottica area. Occasionally, women grew rice on white sand or clay riverbanks.

Saamaka women in Bataliba, a group of five villages near the southern bank of the Brokopondo Reservoir, occasionally select the banks of the many islands in the lake as rice fields. These soils are rich in organic matter deposited during the rainy season when these islands are flooded. These banks often become exposed during the dry season and become

overgrown with weeds, which are burnt to make rice fields. These areas need less clearing as there are no trees that need to be felled. However, by farming on these island banks, farmers risk losing the harvest when the water level rises unexpectedly and kills the rice plants. Saamaka farmer Mai Kaise explained that these rice fields were not available every year, as it depended on the water level during the dry season. "What we plant are the common rice varieties that we use every year, and they grow well on both dry soil and flooded land. As long as the culm is above the water, it ripens. We harvest it while standing in the water" (Supplementary file, video 1). In 2020, the Bataliba farmers had a good harvest (Supplementary file, video 2), but in 2021, water levels were very high. Even the fields on dry land were somewhat flooded. Farmers saw that the water level in the lake was already quite high during the sowing season, so they decided not to sow rice on the islands. In March 2022, they did plant rice on the island shores, but the water levels became unexpectedly high during harvest time (NOS 2022), so they lost all their crops.

Okanisi farmer Sonia Sini (Lawa River, French Guiana) was one of the few who made her field on a riverbank. She said it was very fertile soil due to annual sediment deposits from the river. Her rice harvest from a small field was enough for a whole year and she had a surplus to sell on the local market. Although she had to wait until the water level dropped before planting, she said: "This soil is cold, so crops also grow well in the dry and hot season". Despite the high yields on riverbanks, few farmers were willing to take the risk of flooded fields.

Field preparation

In the past, after the *ampuku* forest spirit gave his permission to create a new field, men would start clearing the undergrowth of the forest with machetes and cut down trees with axes (Price 1983, Herskovits and Herskovits 1934). We observed Maroon men creating new fields by felling large trees with chainsaws (Fig. 5.2A) and using machetes to clear shrubs and small trees.

Fig. 5.2 Field preparation. A. Okanisi farmer Carlos Pinas and his cousin cleaned their field on a dry peat swamp in the Cottica area. The intact swamp forest is visible in the distance. B. A cleaned and burned field near Brokopondo centrum.

The process of creating a field in the primary forest around Santigron that we observed took approximately four months. The men started cleaning the undergrowth in July, in August trees were felled, in September the field was burned, and in October all the remaining shrubs and sticks were placed on a heap and burned again. Charred tree stumps and logs lying on the ground are seldom removed, a common practice in slash-and-burn farming, as they slowly release nutrients to the crops (Kleinman et al. 1995).

Fallow periods

In most Maroon communities, fields are cultivated for two years, after which a new one is created. Abandoned fields will be left to grow back into secondary forests, from which some remaining fruits and cassava roots are occasionally harvested. After the soil fertility has been restored for at least five to 10 years it is opened again. A decade ago, Fleskens and Jorritsma (2010) noted that Saamaka farmers in Nieuw Lombé had shorter fallow periods leading to less soil fertility, and extrapolated this to the entire Maroon community. Although we did not ask all farmers, no one indicated using shorter fallow periods than before or complained about the loss of soil fertility. Most farmers preferred a field in the primary forest because those were more fertile than those in secondary forests. Satellite images show a mosaic of provision fields in different stages of regrowth around Maroon villages (Fig. 5.3).

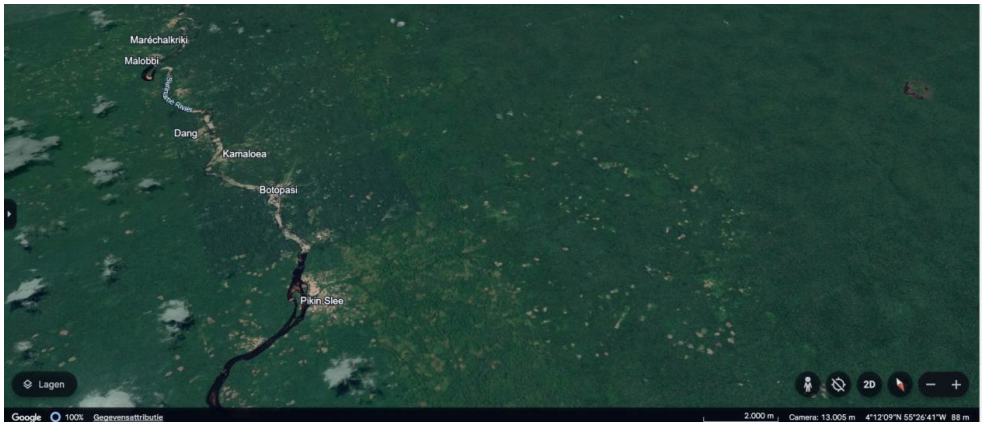


Fig 5.3 Maroon provision fields in the forest around the Saamaka village Pikien Slee (upper Suriname River). Brown circles represent a farmer's field, and pale green circles are abandoned fields growing back to a secondary forest. The primary forest is dark green. Source: Google Earth.

Some farmers had fields up to 10 km from the village, with small sheds in which they could sleep over if needed. John Jackson, a Saamaka representative in the Netherlands, said that as a child in the 1960s, he lived for months with his family in a small house on the fields, combining the harvest of rice and other crops with hunting and fishing.

Seed selection and storage

Generally, farmers start with seed selection during the harvest. Every farmer keeps some of the best stock of her harvest as plant material for the next season. For every variety, at least two bundles or a 2-liter soft drink bottle are kept in an old oil drum covered with a lid to prevent insects and rodents from damaging the grains (Fig. 5.4A). Shattering rice varieties are stored as loose grains in glass bottles or small plastic bags. A plastic drum or large plastic bags were not ideal for storing rice: because of condensation, the rice could become moldy. Another way of storing rice, more adapted to large quantities, is special granaries called *kẽdẽ ósu* (Saamaka) or *pikin osu* (Pamakka), which are built on pillars to prevent rodents and snakes from entering. We encountered sheds made from wood and corrugated iron, the latter were said to be more durable

(Fig. 5.4B and 5.4C). Seeds selected for sowing can be kept for approximately one year in a granary or oil drum.

Fig. 5.4 Different storage methods in Maroon communities. A. covered oil drums in St. Laurent, French Guiana. B. wooden granary in Ston uku, Suriname. C. granary made from corrugated iron in Kayana, Suriname.

One farmer complained that she gave plant material to a neighbor who had lost her seeds, but that woman consumed all and did not sow it. This was seen as unacceptable: the availability of seed stock is seen as a social security system. Marie Huur, a farmer in Pokigron (Fig. 5), explained that she always kept a bundle of each variety for family members and friends in case they lost their rice for whatever reason. Most farmers said they would ask their family or neighbors for sowing material when they had lost their rice. Cottica farmers told us that many of their rice varieties were lost when they had to flee their territory during Suriname's Civil War (1986-1992). They spent years in refugee camps in French Guiana and were not allowed to make provision fields. Some farmers worked illegally in rice fields for the Hmong, refugees of the Vietnam War who settled in French Guiana (Hoogbergen and Polimé 2002, Van de Loosdrecht et al. 2024). After the war, when farmers returned to Suriname, they took the Hmong rice along and depended on gifts from other Maroon communities to build a new rice stock.

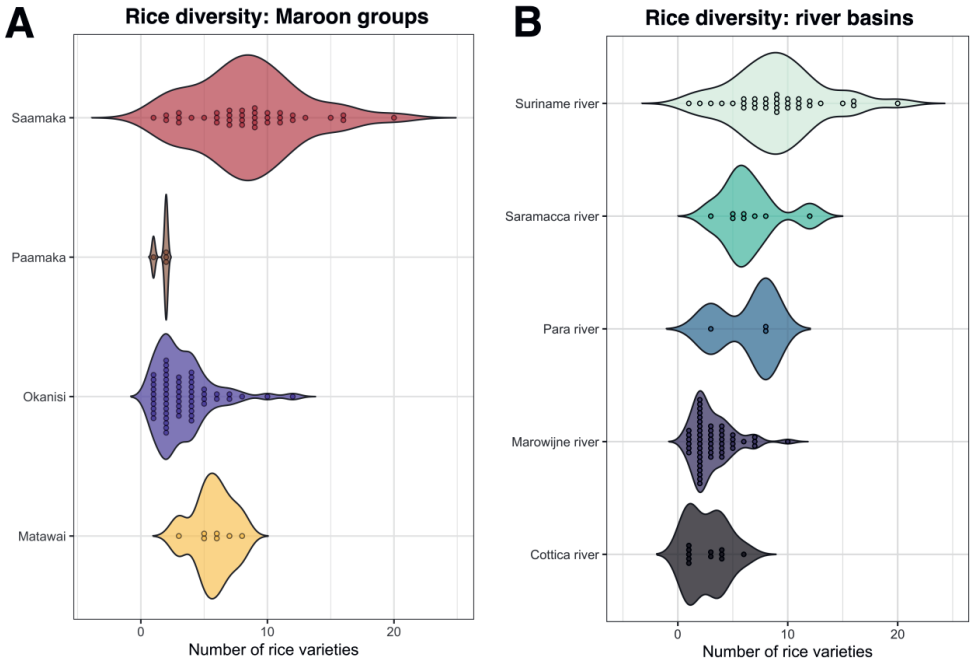
Fig. 5.5 Anne Huur inspects plant material with her cousin Marie a few days before sowing rice.

John Jackson explained that in his youth, a storage method existed that could preserve rice for longer than a year, and was interconnected with the mourning traditions in this village. When a paramount chief passed away, women were not allowed to visit rice fields for three months,

even if this coincided with the sowing period, as it was believed they would lose their rice. “To prevent the rice from losing its germination ability, they would open a *goloe* calabash (*Lagenaria siceraria*) and dry it well. Then they would place the rice seeds in it together with charcoal. They closed the *goloe* and stored it in the granary, but took out the seeds every month, dried them again in the sun, and placed them back in the *goloe*. This method kept the seeds longer viable”. This method indicates that losing rice seeds had to be avoided at all costs. We did not encounter this practice anymore: farmers could not remember it. Although these mourning restrictions are still in place, women can now easily buy rice in shops or travel to open a rice field further away from the village.

Maintaining rice diversity

Several Maroon rice varieties have morphological traits that are regarded as problematic in commercial agriculture, such as itching leaves, hairy husks, or prickly awns that irritate the hands when touched. Half of the varieties we collected had hairy husks. Many varieties had anthocyanins, a blue ink-like liquid that stains the hands when the stem is cut. This was not seen as an undesirable trait. The median number of rice varieties among all Maroon farmers we interviewed was 5.4, ranging from one to 20 (Fig. 5.6). The Saamaka cultivate a significantly larger number of varieties (median = 8) than the Okanisi (median = 3, $p_{adjusted} = 8.53 \times 10^{-9}$) and Pamakka (median = 2, $p_{adjusted} = 1.59 \times 10^{-3}$) (Fig. 5.6A). One reason mentioned by Okanisi and Pamakka farmers is that they produced *kwak* (a dry cereal-like food made from toasted bitter cassava) as their main staple food. Rice diversity appears to be particularly high along the Suriname River basin (Fig. 6B). Saamaka farmer Okinta Main from Pikin Rio maintained 20 varieties and knew all the names of her varieties and the place or person she received them from. The Okanisi farmers in Tapoeripa, in the same river basin, have the highest rice diversity of all Okanisi with 12 varieties in one field.



Comparison (Dunn's Test)	Z	P-value unadj.	P-value adj. (Bonferroni)	Significance
Okanisi – Saamaka	-6.053	1.42E-09	8.53E-09	****
Paamaka – Saamaka	-3.648	2.65E-04	1.59E-03	**
Matawai – Paamaka	2.475	1.33E-02	7.99E-02	ns

Comparison (Dunn's Test)	Z	P-value unadj.	P-value adj. (Bonferroni)	Significance
Marowijne – Suriname	-6.450	1.12E-10	1.12E-09	****
Cottica – Suriname	-4.727	2.28E-06	2.28E-05	****
Marowijne - Saramacca	-2.882	3.95E-03	3.95E-02	*
Cottica – Saramacca	-2.784	5.37E-03	5.37E-02	ns

Fig. 5.6 Violin density plots for the number of rice varieties found among farmers when grouped for the four Maroon groups (A) and the five major river basins in the Guianas (B). The tables report the statistical test values for the pairwise Dunn's Tests (Z-scores), and their unadjusted and Bonferroni multiple-correction adjusted P-values. P-values ≤ 0.05 indicate a statistically significant difference between the medians of the groups. Asterisks alternatively indicate the strength of the statistical significance: * ≤ 0.05, ** ≤ 0.01, *** ≤ 0.001, **** ≤ 0.0001. Only pairwise comparisons with P-values ≤ 0.05, or adjacent, are shown.

While Asian rice is mostly cultivated for consumption, African rice is grown for cultural, medicinal, and spiritual purposes, although some Maroons eat it as well. Farmers indicated they sowed it as an offering to the forest spirit so they would have an abundant harvest (Pinas et al. 2024).

Sowing methods

The sowing process starts with gathering the rice bundles selected as plant material from the storage. To remove seeds from the stalks, Okanisi and Pamakka farmers place the bundles in old polyethylene bags and invite children to walk on them. Saamaka and Matawai farmers do this differently: they put rice bundles in a wooden mortar and beat it with a pestle until the seeds

come off from the panicles. The loose seeds are placed on a large wooden tray and winnowed to remove straw and empty husks, while bad seeds are handpicked and discarded.

On sowing day, some farmers place seeds in a bucket with water (Fig. 5.7A), so empty husks and bad seeds that were missed during the winnowing would float on the surface and could be easily removed. However, most farmers do not soak their seeds but sow them directly. This is done by broadcasting, but seeds cannot be left unprotected on the soil as birds will pick them from the ground. To protect against the birds the seeds are covered with soil with a hoe, known in Suriname as *tjap* (Fig. 5.7B).

Fig. 5.7 Maroon sowing methods. A: Seed selection by pre-soaking: unsuitable seeds and empty husks float to the surface. B: Covering rice seeds with soil with a hoe.

A different sowing method is *diki olo*: digging a small hole with a hoe, dropping some seeds in it, and covering it with soil. This method is used to sow small patches of rice between other crops. Hand broadcasting and *diki olo* were sometimes used interchangeably. Farmers explained that the preferred method depended on the location of their field. “If you plant rice in an area with lots of birds, then you must cover the seeds with soil. If your new field is made in a primary forest, the local birds might not be familiar with rice, so you can sow without covering”. Some Okanisi farmers sing a special song on the last day of sowing, in which they mention something that died and they buried in the ground.

Sowing season

Suriname has two rainy seasons: the first starts around mid-April and lasts till the end of July and the second starts in December and lasts until the end of March. Sowing is done at the beginning of the rainy season. Okanisi, Aluku, and Pamakka farmers in the southeastern part of the interior (Upper Marowijne, Tapanahoni, and Lawa Rivers), sow rice around December and harvest in April/May. The farmers explained that the weather was too wet in July for rice to ripen and to dry in the sun, so planting a second crop was not possible. The Okanisi along the lower Marowijne River, however, plant rice in April and harvest between July and September, just like the majority of the Saamaka farmers in the Suriname River basin. A few Saamaka farmers along the Suriname River sowed both in December and around April and had two harvests per year.

Generally, farmers wait for the rain to start before they begin sowing. If the soil is too dry, the seeds do not germinate quickly and birds would eat the soil-covered seeds by removing the dirt with their feet. In wet soil, the seeds would germinate within two to three days, hence

minimizing the chances of bird predation. Maroon farmers do not consult the weather forecast for updates on rainfall but instead listen to a local cicada named siksi-yuru (*Fidicina mannifera*). This insect must stop 'singing' his loud song, which indicates that it will soon start to rain (Pinas et al. 2024).

About 70% of the farmers keep their rice varieties separate in storage and in the fields. Every variety has its patch, so during harvest, it is easy to keep culms of the same variety together. Generally, farmers sow some varieties first (mostly the ones that take long to ripen, such as *alëkisóóla*) and the shorter ripening ones later. This is done to even out labor during harvest but also prevents outcrossing, as the different varieties flower at separate moments. About 30% of the farmers mix threshed seeds of different varieties in buckets or oil drums, and thus sow and harvest mixtures without separating them. This facilitates crossings between varieties, as they flower next to each other and at the same time. The sowing density of rice seeds differs per individual farmer. In 2023 we measured sowing density in three locations, which ranged from 314 to 448 seeds per square meter.

Agrochemicals

After rice seeds have been sown and germinated, farmers regularly inspect the young plants and continue planting other crops, such as okra, plantain, and cassava. The decaying wood and charcoal provide the crops with nutrients as they rot over time. John Jackson explained that this has been the practice of Maroons since they escaped slavery. According to teacher and farmer Norma Main from Pambooko, Upper Suriname River, a newly cut field in a primary rainforest produces the highest rice yields. Rice planted for the second year on the same field has a much lower harvest than that of the first year. This is congruent with the observation that organic material in the soil decreases over time due to leaching out (Kleinman et al. 1995).

The farmers we interviewed were adamant that agrochemicals were not part of their rice cultivation practices. We did not observe the usage of synthetic fertilizers like NPK (nitrogen, phosphorus, and potassium). Neither the governments of Suriname and French Guiana nor NGOs hand out any agrochemicals to the farmers to support them. However, in four fields that we visited, we saw empty Gramoxone bottles lying on the edge of the forest. Gramoxone (paraquat) is a strong herbicide, widely used in coastal Suriname, but prohibited in the European Union because of its toxicity. The farmers said that they used it to kill the grass and weeds in the field before sowing, but they did not use it directly on the rice.

Mitigating pests and diseases

Although we did not ask all farmers, those we asked indicated that they did not have any diseases or pests affecting their rice. Albertina Adjako, the Brokopondo regional farmers' coordinator, explained that in the years she has been working in the Maroon community the farmers occasionally complained that parts of their rice fields were not producing well. She said: "I advise farmers to keep their rice diversity, use many different varieties, and continue intercropping with other food plants such as okra, banana, cassava, yams, and taro. It is those activities that keep rice plants healthy". Farmers near St. Laurent du Maroni (French Guiana) complained about *mira udu*, an invasive tree (*Acacia mangium*) that was introduced to reforest old mines in French Guiana (Theys et al. 2023). "*Mira udu* takes away all the strength of my field, and it does not die when you burn it, it just starts growing again and competes with my rice and cassava. Trees only die when you ringbark them completely", said farmer Maneshka Manu.

From our interviews, we deduce that a recurring problem in Maroon rice cultivation is bird predation. Birds pick freshly sown rice from the ground, attack the grains before they are harvested and break rice culms with their feet when eating from the seeds. In every area, several

bird species were active threats. The most common birds mentioned were *baaka ti* or *potokii* (*Molothrus bonariensis*), doves (*Columbina talpacoti*, *Patagioenas cayennensis*), *andoki* (*Volatinia jacarina*), and *apiikutu* (*Forpus passirinus*). Farmers took bird-preventing methods like nets above freshly planted field, shooting birds with catapults or hanging CDs or aluminum pot lids on a thread that would create light flashes or noise in the wind. However, the most frequent answer was: "We do nothing because birds don't eat everything". Sometimes, in a laconic way, farmers said: "Well, even the birds need to feed". Although some Maroons own guns, they do not use them for the mass killing of birds because they believe the birds also have a part to play in nature. Some Maroons even planted a small patch of black rice for the birds, "to distract them from the other varieties". A reason for this attitude may stem from the belief that birds once made (black) rice available to the Maroons by dispersing the seeds in open savannahs that the Maroons crossed during their escape from slavery (Pinas et al. 2024).

Farmers from the Cottica had a similar positive attitude towards capibaras (*Hydrochoerus hydrochaeris*), large rodents that live near rivers and swamps. They believed that capibaras helped to increase rice yields: if they fed on young rice, the plants would produce more tillers. This would later increase the rice yield because every tiller would produce a culm with grains. During our fieldwork, we noticed that both awned, hairy, and glabrous Maroon varieties were much less attacked by birds than commercial cultivars (Pinas et al. 2024). However, it remains unclear what other traits Maroon rice plants have that protect against bird predation.

Ripening

Farmers had different ways of identifying when the rice was ripe. In French Guiana, they said that when the tip of the seed changes its color to black, the rice is ready to harvest. A large part of the Maroon rice diversity possesses these distinctly colored tips. Varieties called *alulu* are harvested before they are fully ripe because they shatter easily, the seeds drop from the ripe panicle when cutting it. The same is true for African rice (Pinas et al. 2023). Varieties called *jengejenge* make a particular bell-like sound when the wind goes through the ripe culms of the rice. Birds feeding on the rice is also a sign that it is ready for harvest. However, the most obvious indicator of ripe rice grains is that their color changes from green to brown, orange, or white. Most Maroon rice ripens between 110 days (African rice) and 129 days (*alëkisóóla*). Small-seeded rice varieties tend to ripe faster than larger-seeded varieties. However, the swamp rice *masaa* in the Cottica region may take more than 180 days to ripen (Pinas al. 2024).

Harvesting

Harvesting plays a central role in Maroon rice farming. Since it requires much labor, family members travel back from the city to offer a helping hand. The rice harvest in July-August coincides with the school vacation period in Suriname and French Guiana, which allows for the participation of youngsters. Harvesting is mostly done by groups of women, who often sing traditional and modern songs during their work (Supplementary file, video 1). Given that so many people are working together, rice harvesting strengthens family ties and cultural bonds.

After harvest, rice panicles are sundried for three to four weeks before being placed in storage. At the time of harvest, some grains fall on the ground because harvesting is done manually and some varieties shatter quickly. These fallen grains sprout again and can be reaped in a second harvest three to four months later, known as *gro baka alisi*. These grains are never included in the planting stock because they tend to be smaller than grains from the first harvest, but they are still consumed.

The majority of Maroon rice varieties at maturity have a length between 110 and 177 cm, much taller than commercial rice (Pinas et al. 2024). Greta Pinas explained that farmers

prefer tall varieties to facilitate manual harvesting: “When cutting panicles, we sometimes stand in the field for eight hours. Imagine we would have to bend over all this time! Thus, we prefer standing. We do have varieties that fall [lodge] easily because of the wind (known as ‘*wintiwaai*’). In that case, we bend to pick up the panicles, but it is only for a short time”. Ripe panicles are often exactly located at the height of a woman’s hands (Fig. 5.8). Of the 284 unique names for rice varieties that we collected (Pinas et al. 2023), three indicated a short rice variety, with Saamaka names such as *asindo atapa* (sit down at a table) and *basu alisi* (low rice). Paramount chief Aboikoni explained that the national rice breeding institute SNRI/ADRON gave him some short, high-yielding varieties a while ago to share with the farmers. These may be the same short varieties we collected near his residence. In general, rice names strongly reflect Maroon culture and history. While some ‘old’ varieties are named after the women who took them along after their flight to freedom, others are named after women in general (‘dancing woman’, ‘white-headed lady’), forest animals, morphological characters, or the person or group of runaways who first introduced the variety to a community (Pinas et al. 2023).

Fig. 5.8 Matawai farmer Sonja Henkie and her nieces harvest rice along the upper Saramacca River. Panicles are at the height of the women’s hands.

During harvest, adults use ordinary kitchen knives (Fig. 5.9) to cut the panicles 15 to 20 cm below the first seeds. Children between 8 and 12 are given wooden knives (Fig. 5.9), made from the petiole of a *maripa* palm (*Attalea maripa*). We observed that the children's participation is for knowledge transfer purposes (learning how to harvest rice) and not so much workload management. When harvesters have a handful of panicles, they bundle them up and tie them with strips of banana leaf (Fig. 5.10). Saamaka farmers usually bind five bundles into a larger one locally known as *gaán máun* (‘large hand’).

Fig. 5.9 Maroon rice harvest tools. A: kitchen knife. B: handmade tool for children.

The ‘green’ rice bundles are placed on metal roofing sheets in the village for a couple of weeks to dry. They are turned once or twice daily so each side faces the sun. Mr. Pai, an Okanisi farmer, explained that his mother used to dry rice in her cooking shed with the heat and smoke from the wood she burned to make a fire. She constructed the roof of her shed with space to place rice bundles on top of the fire. Every two days, she would turn the rice bundles, so they were heated evenly.

Fig. 5.10 Freshly harvested rice in Nieuw Lombe, lower Suriname River, showing the strips of banana leaf used to tie the bundles.

Freshly harvested rice excretes a milky substance when the grains are broken. If this liquid no longer shows when the seeds are squeezed, the farmers know that the rice is well-dried. The bundles are placed in their storage facilities (Fig. 5.4). Some of the best grains are kept as sowing material for the next season, and the rest is used as food. If there is a food shortage during harvest, and people do not have any more rice in stock from the last season, they soak the freshly harvested bundles in hot water. In this way, the 'fresh' husks are easily removed in a mortar and the rice can directly be cooked and eaten.

Rice Processing

Maroon rice processing consists of six phases: threshing (separation of seeds from the panicle), milling (removing the unpalatable husks from the grain), winnowing (eliminating the husks), manually eliminating bad grains, washing, and cooking. These phases are not the same in all Maroon communities. Okanisi and Pamakka separate the grains from the panicles by spreading them out on a sheet of plastic and mashing them with their bare feet in circular movements until the grains come loose from the panicle (Suppl. file, video 4). Saamaka and Matawai tend to separate rice grains from the panicles by holding the dried rice bundles with one hand in a wooden mortar and pounding it with the other with a pestle (Supplementary file, Video 5). Another method is placing the bundles in a polyethylene bag and beating it with a stick.

The Okanisi barefoot threshing is much easier when shattering varieties (known as *alulu*) are used. Okanisi frequently grow shattering varieties, but they do not grow varieties with long stiff awns, as they do not like the awns sticking in their feet during threshing. The few awned Okanisi rice types (e.g. *koko tatai*) have soft and brittle awns that break off easily during threshing. In contrast, shattering varieties are hardly grown by Saamaka and Matawai farmers, but they have many stiff-awned varieties (e.g. *watradagu*, *atjakati*). Milling or dehusking, known locally as *tila* (Saamaka and Okanisi) is done similarly by all Maroons. Women hold the pestle with both hands and pound with increased strength the round side of the pestle on the separated rice seeds (Supplementary file, Video 6). The pounding happens with different levels of velocity and strength. Recently, several villages obtained diesel-generated rice milling machines. Farmers indicated that rice processed by hand is tastier and healthier than milled rice, as more bran (*goma*) is left on the grains. However, the rice mills alleviate them from the hard labor necessary for hand-milling rice.

Fig. 5.11 Rice processing. The mortar (A) and pestle (B) are common tools. C. Albertina Adjako winnowing rice in a wooden tray.

The mortar (Fig. 5.11A) is often made with wood from *kopi* (*Goupia glabra*), *rode kabbes* (*Andira surinamensis*) or *zwarte kabbes* (*Diplotropis purpurea*). Wood from these trees is heavy and does not break easily, even when repeatedly hit with a heavy pestle. The pestle (Fig. 5.11B)

is known as tatí (Saamaka, Matawai) or tiki (Okanisi, Pamakka) and is made from wood locally known as *balata* or *bolletrie* (*Manilkara bidentata*). Chief Waterberg of Santigron explained that this wood is heavy and does not split easily, making it suitable for pounding rice and grinding groundnuts into peanut butter.

Winnowing rice is done by scooping up grains with their loose husks from the mortar on a flat wooden tray known as *paátu* (Saamaka, Matawai) or *tee* (Okanisi, Pamakka). The rice is then thrown in the air so that the wind can blow away the lighter husks, leaving the heavier grain on the wooden tray (Fig. 5.11C, Supplementary file, Video 6). Some grains from the tray are pounded in the mortar again to remove the remaining husks. Removing the few bad-quality grains is the last phase before the milled grains are rinsed three times to remove husks and debris that were missed during the winnowing. The wooden tray is often made from plank roots of *pari udu* (*Aspidosperma* spp.), *ingipipa* (*Couratari* spp.), or the wood of the trunk of *ceder* (*Cedrela odorata*). All rice processing activities take place in the village and are visible to all community members.

Cooking and offering

Most Maroon rice is consumed daily with a sauce containing vegetables and fish or meat. Special Maroon rice dishes, such as peanut rice, *maipá síi alísi* (rice cooked in maripa palm fat), coconut-rice porridge, and *adantámataka* (rice, coconut, and peanut dumplings) are mostly served during funerals and festivities to end the mourning period (Ising 2022). Saamaka and Matawai tend to consume more rice than Okanisi and Pamakka, as the latter also have *kwak* (granulated and toasted cassava) as a staple food. Many Maroon farmers told us that during funerals and festivities around the mourning period, which many people attend, one needs to bring home-grown Maroon rice. This is then hand-processed during the communal cooking activities (Ising, 2022). Several Okanisi farmers said their only reason to grow rice was to attend funerals. Raw and cooked rice is also used for offerings to the ancestors and other spirits. Maroons generally believe that their ancestors preferred home-grown rice and would be offended by store-bought rice. African rice is not used for cooking during festivities, but husked seeds are thrown in the coffin of the deceased so his/her spirit can pay for its passage to the afterlife (Pinas et al. 2024, Van Andel and Ruysschaert, 2011). In the past, Saamaka women offered rice to the spirit of fertility shortly before their marriage (Herskovits and Herskovits 1934).

Gender division of labor

In general, activities related to rice cultivation were assigned according to gender (Table 5.1). We encountered only three men cultivating rice, who were either single or their wives who had permanently stayed in the city. We did not hear of any women felling trees or burning fields. Even those without husbands hired young men to prepare a field or asked family members to help them.

Table 5.1 Activities within Maroon rice farming and the gender that mostly performs it

Activity	**Gender and age division**
Field selection	Men and women
Cutting and burning a field in the forest	Men, adolescent boys
Field preparation	Men, boys, women
Seed selection and storage	Women
Sowing	Women, adolescents
Field management	Women
Harvesting	Women, children, adolescents
Rice processing	Women, children
Cooking	Women, girls
Tool making	Men, adolescent boys

A married woman cannot borrow tools used for rice processing from her neighbors, as these should have been made by her husband. An unmarried woman or widow is helped by close relatives. Chief Waterberg of Santigron explained that Maroons live in communities with relatives nearby, who are willing to help. Boys are trained by their fathers and uncles in toolmaking for their future wives. Nowadays, one can also buy these tools because every Maroon woman must have them.

Teenagers, irrespective of gender, were often tasked with covering rice grains with soil after sowing (Fig. 8B). Harvesting was done in rotation: all healthy females, girls, and boys in the age group 8 to 18 years partake in the fields of family members, such as grandmothers, mothers, and aunts. Table 1 shows the importance of learning, inter-generational, and gender-based activities. By practicing and learning about rice harvesting, young people are reminded of the importance of social relations and Maroon culture. Although women do most of the farm work and cooking, it is not hidden from men or other community members.

Maroon women have the key role of keeping the diversity of their rice stock intact. They are also tasked with organizing labor for all the activities happening in their field, processing and cooking rice. If we asked Maroon men about rice varieties, they said they knew very little about the names of rice, and referred us directly towards women, as they were seen as the experts. The fact that rice varieties are seldom named after men, but very often after women (Pinas et al. 2023) also reflects the key role of women in maintaining diversity and selecting new stock.

Motivations to grow rice

The most frequently mentioned motivations of farmers to keep a rice field were food security, independence, and the ability to attend funeral-related activities. The expensive shop rice and the better taste, quality, and health aspects of Maroon rice also played a role, as well as continuing the ancestral. Farmer Mazo Kaise from Bataliba explained that as a Maroon woman, she could not come to a funeral or mourning ceremony with store-bought rice. Many farmers said that rice farming is their way of connecting and continuing the practices they inherited from their ancestors. Although evangelical churches prohibit people from attending rice offerings, some people said they were “church people” but still cultivated African rice, and some continued cultivating it for commercial purposes. While rice farming is widespread in the Saamaka, Matawai, and some Okanisi communities, it is dwindling in the Pamakka community. They said they farmed far less rice than before and had few fields and varieties left. This had to do with the focus on gold mining of youngsters in the community and Brazilian miners in the

region who preferred to purchase *kwak* from farmers instead of rice. One village elder said the recent accidents with Pamakka gold miners were caused by their disregard for the forest spirits.

Discussion

Comparing past and present practices

Although Maroon farming practices have been sparsely described before, we could detect some changes during the last decades or century. Chainsaws, diesel-powered rice mills, and corrugated iron granaries were hardly used before the 1990s. Most men do not collaborate anymore in large groups to clear each other's fields (De Beet and Sterman 1981), as those who are working in the mining or logging industry do not always have time to return to the community to clear a field for their wives. They now hire men who are residing in the village to assist with this practice. People previously lived with their families on their provision fields for three months. Johan Spalburg, a government postholder and missionary among the Okanisi along the Tapanahoni River, complained that entire families disappeared from his church and school during the rice harvest period in July (Spalburg 1896-1900). Nowadays this appears no longer the case because the children must attend school. Currently, rice is also no longer harvested in July in the Tapanahoni area, only in April.

Farmers have always been open to experimenting with new rice varieties. The cultivar Rexora was introduced in 1939 and readily adopted (Van de Loosdrecht et al. 2024), but varieties that did not perform well must have disappeared. Maroons can be seen as custodians of rice, as they maintain the rice that reflects their own history, but also grow rice that other ethnic groups in the Guianas (e.g. Hmongh, Javanese) may have lost. Some varieties have vanished in one community but are still present in other communities. Also, new varieties are adopted in one community but not [yet] in the others. The prevailing view is that Maroon farming is limited to upland varieties (*hoogland rijst*) that require drained soils (Sewnarain 2021), but we collected several wetland rice varieties planted along creek edges, and in the Cottica deep swamp varieties are popular.

Differences between Maroon groups

We noticed differences in agricultural seasons between the upper Marowijne basin (rice harvest in April), the coastal area (harvest in July-September), and the upper Suriname River basin (sometimes both seasons). This may be caused by differences in rainfall, a reason given by the farmers, or because Okanisi and Pamakka farmers rely less on rice as a staple food and prefer to produce *kwak*. We also noted that differences in threshing methods (barefoot versus sticks) influence the varieties that are cultivated (shattering or awned) or vice versa. Names of rice varieties differ substantially between Maroon groups and reflect their separate histories of escape from slavery and adaptation to the Amazonian environment (Pinas et al. 2023). Maroon rice has a rich genetic diversity: varieties with origins in West Africa, Asia, and early rice breeding stations in the USA (Van de Loosdrecht et al. 2024). Further research is needed to analyze genetic differences in rice between Maroon groups.

The size of rice fields and the number of rice varieties per farmer were highest among the Saamaka along the upper Suriname River basin and among the Okanisi in Tapoeripa, although these communities also had access to store-bought rice. The lowest diversity and smallest rice fields were seen in the Cottica and among the Pamakka. Both groups spent less time and effort to grow rice than in the past. The Cottica Okanisi lost much of their rice in the

civil war but kept their unique deep swamp rice and the Hmong rice. The Pamakka had shifted to commercial *kwak* production but also lamented the decline in rice farming.

Commercialization of Maroon rice

The majority of farmers grow rice for consumption within their households. Self-sufficiency has been central in Maroon communities for centuries (Maat et al. 2023). Nonetheless, we also encountered two commercial Maroon rice farmers (both men) who had huge rice fields and hired local Maroon women to do the manual work. These two commercial farmers mostly grew rice in monocultures: one grew *alekisola* and the other used modern Brazilian cultivars and agrochemicals. They sold their rice as 'Maroon rice' in Paramaribo. In St. Laurent (French Guiana), there is a lack of agricultural land due to urbanization. As a result, the few Maroon women who have rice fields often sell their harvest on the city market, where it is bought by urban Maroons who either consume it or take it to funerals. Bags of unmilled Asian and African rice are sold at markets in Paramaribo to people of various ethnicities to use in offerings.

Differences between Maroon agriculture and other shifting cultivation practices

The shifting cultivation techniques of Maroons, such as clearing, burning, and leaving burned material to provide nutrients, are quite similar to those described for local Indigenous communities (Idoe 2010) and also more or less similar to the traditional shifting cultivation systems in African countries, as long as they take place on similar rainforest soils (Stromgaard 1985). Rice cultivation in mangrove swamps of the Upper Guinea region, however, is very different and requires much more manual labor to drain and desalinate the heavy clay soils (Temudo 2012). The differences between Maroon and indigenous agriculture in Suriname and French Guiana lie mostly in the crops and varieties that they cultivate. Maroons have rice at the center of their farming system, which leads to unique practices, while indigenous farms probably contain a higher diversity of cassava (Idoe, 2010), although these Indigenous crop varieties have not been studied in detail for Suriname and French Guiana.

The cultural importance of rice for Maroons

For Maroons, rice is an essential food, but also plays a role in rituals, funeral activities, mourning ceremonies, medicines, and offerings. The diversity of rice selected for this wide range of purposes makes the Maroon rice farming system unique. Rice can be considered a cultural keystone crop for Maroons in Suriname and French Guiana: it meets most of the criteria mentioned by Garibaldi and Turner (2004). Its intense and multiple uses, complicated naming system, role in ancestor narratives, ceremonies, songs, and memory, the difficulty and reluctance to replace it with store-bought rice, and the extent to which it provides opportunities for earning income all provide evidence for its status as cultural marker. Most information on plantations in Suriname highlights crops such as plantain, cassava, and taro as the main food crops (Maat et al. 2023). Although there is early evidence of experimenting with rice plantations (Elfrink et al. 2024), rice never became the main staple on plantations. For Maroons, growing rice was key to their survival as free individuals and still is a marker of cultural difference. Seed selection, storage, processing, and cooking are activities that are done in the village and between growing seasons. This highlights the cyclical aspect of farming but also shows the connection between fields and villages, on-farm and off-farm. Although women do most of the farm work and cooking, the significance is not hidden from men and other community members. Other Maroon crops may have similar or different cultural connections, but this research still needs to be done.

Pressures

We encountered many highly motivated young farmers who expressed they would continue farming as long as possible. Nonetheless, this does not mean there is no pressure on Maroon

rice farming. Many youngsters are focusing on other ways of life such as gold mining, searching for higher education in cities like Paramaribo and Cayenne, or migrating to Europe. Christianity, and especially the evangelical churches, despise food offerings and label traditional Afro-Surinamese beliefs as 'heathen practices', which may also affect Maroon rice cultivation. On the other hand, the increasing costs of living in Suriname French Guiana have also stimulated Maroons to grow (and sell) more of their food.

Conclusion

Our study indicates that food security, sovereignty, taste, and cultural, and spiritual traditions have been the main drivers behind Maroon rice farming for the past 350 years. The chain of operations in rice farming is complex and differs slightly among communities, ethnic groups, and geographic locations. Contrasting with the view of Maroon farming being primitive and ineffective, our findings advocate for a different perspective. Changes made to the Amazon forest by Maroon agriculture are small compared to those caused by mining and logging companies. Wherever humans settled they made changes to the environment to meet daily needs. Sustainable use of the forest does not mean that nothing has to be cut down or used, it simply means that we treat the forest so that future generations are allowed to use nature as we do now. This has worked out well with the Maroons, given that several communities have been in the same place for over 300 years. Maroons can be seen as custodians of rice, preserving varieties over centuries but also adopting relevant new ones. Rice can be considered a cultural keystone crop of the Maroons, as it is strongly linked to their identity, oral history, and spirituality, but these links differ between communities and ethnic groups. While in some communities flourishing rice fields are omnipresent, in other communities, they are hardly seen.

Supplementary file

Video 1. Saamaka farmers harvesting rice on flooded lake edge, Suriname.
https://www.youtube.com/shorts/Bt9FeKp__R8
Video 2: Freshly harvested rice from the Brokopondo Lake edge, Suriname.
https://www.youtube.com/watch?v=teyFX7NQfRo&list=PLd3o_8j3GPZPaUmIWfKJDyG2qoYpDb4sS&index=20

Video 3. Treshing rice in the traditional Okanisi way.
https://www.youtube.com/watch?v=srwL5GrLLW4&list=PLd3o_8j3GPZPaUmIWfKJDyG2qoYpDb4sS&index=14

Video 4. Threshing rice in the traditional Saamaka way.
https://www.youtube.com/shorts/NipTU1wkWyg

Video 5. Milling rice with a mortar and pestle.
https://www.youtube.com/shorts/KWXIXHhhf4g

Video 6. Winnowing rice with a wooden tray.
https://www.youtube.com/shorts/_5dbhOnqAMU

6

Chapter 6: General Discussion

Rice diversity

We collected over 300 rice varieties, differentiated by farmers on the base of their morphology (Chapter 2). However, morphological difference does not always mean genetic difference (Stotz et al. 2021), and with a few exceptions (e.g. *Rexora*, black rice), the variety names are not very consistent among the Maroon communities. The three genetic studies performed with Maroon rice thus far (Van Andel et al. 2016, 2019, Van de Loosdrecht et al. 2024) are congruent with our outcomes concerning the enormous diversity that Maroon communities keep in their fields to support food security and independence. The environment in which the Maroons reside differs per community: the vegetation, soil types, birds and other predating animals, and water availability vary between villages and Maroon territories. These environmental consequences shape the distribution of varieties to a certain extent. For example, the swamp rice named *masaa* is only cultivated by farmers in the Cottica area. This deepwater variety is well adapted to the excessive water availability in the local coastal swamps. Varieties that require dry ground struggle to produce adequate yields in this region, characterized by impoverished bauxite soils (De Koning 2014). Based on the variety name and the genetic data from Van de Loosdrecht et al. (2024), we did not see this *masaa* rice among farmers who had no connection with the Cottica region. Another driver of diversity is the way of processing by the different communities: Saamaka and Matawai communities thresh their rice with pestle and mortar (Chapter 5). Hence varieties with long stiff awns do not bother them: almost all rice with sturdy awns was collected from these two communities. On the other hand, Okanisi and Pamakka communities thresh their rice with bare feet. The few awned varieties grown by these communities had brittle awns that fell off quickly.

In general, the Saamaka Maroons have much larger rice fields and a higher diversity of varieties than the Okanisi, the Matawai, and the Pamakka (Chapter 5). The reasons for the higher rice diversity in the Suriname River basin compared to other river basins remain a mystery. The higher diversity cannot be linked to the Saamaka people only, as Okanisi people residing in this area also had many different varieties. The hypothesis that a higher rice diversity is present in more remote communities with fewer access to shops does not hold either, because some Saamaka communities with multiple shops within walking distance have larger rice fields and more diversity than those villages in the Marowijne River basis that are almost only accessible by airplanes or long boat trips. Several Okanisi farmers said their only motivation to grow rice was that they wanted to participate in funeral ceremonies and end-of-mourning festivities, where bringing traditional rice is required. For daily consumption, they would buy rice in the shop. Further research is needed on the social, environmental, and economic factors that influence crop diversity among the Maroons.

An analysis of the Maroon rice names

The history of Maroon communities is strongly woven into the names of the rice varieties they cultivate (Chapter 2). We collected 284 unique Maroon rice names, suggesting a high genetic diversity, but we found little overlap between Maroon communities. This is probably caused by the fact that Maroon groups have lived fairly isolated from each other for a long time and most names were given after marronage. Nowadays, Maroons from different groups mostly meet in Paramaribo or St. Laurent, and probably seldom discuss what names they give their rice varieties, as there is not much exchange in rice between groups. The system of naming rice varieties is complex but consistent across the five Maroon communities, with a clear connection to morphological features, women, groups of escapees, other people Maroons encountered, and West African rice terms.

Many of the rice names pay homage to women who are remembered for their exceptional role in bringing food crops to their communities during the struggle for freedom in the days of slavery. Many female ancestors may have been forgotten, but their names remain attached to rice varieties. *Baapa*, *Yaba*, *Milly*, and *Alena* are rice names sporadically found in some Maroon communities, but in others they are unknown. For many women, we could not trace whether they lived in times of slavery, short after that, or much later. However, many of these women must have been involved in selecting and growing certain rice varieties, just like the more 'famous' female ancestors for whom more complete stories are preserved, such as *Paanza* and *Tjowa* (Van Andel et al. 2023). Without their efforts, whether escaping, safeguarding seeds, sowing, processing, harvesting, or transferring such skills, rice farming would probably not exist today in Maroon communities. Would the whole process of marronage have been more difficult without a fast-ripening staple food such as rice? This question is difficult to answer, as other short season crops were available to the Maroons, such as peanuts and maize (Makdoembaks 2023). Maroon oral history accounts stress that their ancestors needed crops that could be harvested quickly after sowing, to be able to flee further into the forest (Chapter 4). Still, from the descriptions of colonial military raids about Maroon provision fields we know that the runaways also cultivate crops that took much longer to ripen, such as cassava, bananas, plantains and *Citrus* fruits. Still, present-day Maroon women are well aware of the efforts their ancestors made. Their cultural heritage is a strong motivation for rice cultivation, besides food security and sovereignty (Chapter 5). The rice varieties named after specific female ancestors and women in general (such as 'dancing woman' or 'pretty woman'), and the fact that it produces offspring and feeds her children, support the Maroon concept that 'rice is a woman'.

The rice names also highlight various groups of other escapees who brought rice with them, although the descendants of those runaways no longer have the same group names (Chapter 2). Rice names such as *baákápáutjaka*, *agbosótjaka, afantisaka*, and *mbotombolia* refer to specific runaway groups, such as the Baákápáu and the Agbo (Price 1983), the Afanti (Wooding 1979) and the Boterbalie people (Makdoembaks 2023), who joined various Maroon groups in different time periods.

Whereas several rice names have a clear reference to the pre-abolition period, more precise time indications are hard to establish, because the practice of incorporating new varieties has continued until the present. The historical interactions with groups that arrived in the region after the abolition of slavery, in particular Asian contract laborers are reflected in rice names like *kuli alisi* (Hindostani rice) and *katan* (Javanese sticky rice). The Maroon's adaptation to their new environment is illustrated by the Amazonian plants and animals reflected in the names of rice varieties that somehow resemble them. The connection with West Africa can be seen in general rice names such as *saka* or *tjaka*, with roots in the Portuguese word *sacudir*, often used for rice near slave trading posts (Wiener 1920). The word *bongo*, also a general rice name, means both seed and child in the central African Kintando language (Smith 2015), and *pende* (dark spot in the Mende language) refers to a specific rice variety name in Sierra Leone (Richards 1986).

Growth and yield of Maroon rice

Maroon agriculture and rice farming in particular have long been characterized as inferior (Lobach 2023). However, previous to this PhD thesis, no research had ever been done on the production system of Maroon communities, and measurements of rice yields obtained under traditional settings did not exist. When discussing traditional crop landraces and their yields, it is important to consider the specific conditions under which these landraces were originally

selected and developed. Traditional landraces may perform badly in an environment that is not similar to that in which they have been originally selected by farmers. The results should be interpreted cautiously when yields and maturation periods of landraces are assessed in experimental settings that differ from their original environment. The few experiments that took place with Maroon rice varieties were either done in very different environmental conditions, such as the heavy clay soils in Nickerie (Sewnarain 2021), or outside the Maroon rice growing season in the interior (Nascente and Kromocardi 2017). The yields of the 28 Maroon landraces I measured were mostly higher than the previously assumed 700-1000 kg/ha (Budelman and Ketelaar 1974). Only Maroon varieties with small seeds yielded below 1000 kg/ha, while some varieties produced more than 2000 kg/ha. It is noteworthy that the yield of Maroon rice is comparable to that of rice landraces in Asia farmed under similar traditional conditions (Chapter 4).

I also tested the performance of two commercial cultivars under conditions of the Maroon farming system. These yielded much lower than the Maroon rice, between 571 and 1041 kg/ha. Interestingly, a major cause of the low yield was that these varieties suffered heavily from bird predation. These cultivars do not possess the natural defense mechanism that the Maroon landraces have against pests and diseases, but it is not clear what these mechanisms are (Chapter 4). However, commercial farming implies very different field conditions. In the environment where these commercial cultivars are normally cultivated, the clay polders around Nickerie, with the use of heavy machinery and agrochemicals, and a very high sowing density, the yield of those cultivars becomes close to 6000 kg/ha (Tjoe Awie 2004). Replacing Maroon landraces with commercial cultivars, as was suggested previously by Nascente and Kromocardi (2017), would not make sense without introducing all the conditions that make commercial varieties yields high. Introducing the varieties alone would lead to decreased rice yields, as the soils in the interior are entirely different (sandy, laterite, loamy) from those along the coast (clay). Maroon farmers also do not have the financial means or the expertise to use machinery and agrochemicals.

In discussing yield issues with the Marron farmers, we discovered that they do not calculate their yield in kilograms per hectare. Instead, they estimate how long the rice harvest will feed a family. Maroon farmers use a multi-cropping system, field sizes are not measured in hectares of land. These factors make it difficult to estimate how much rice is produced in the interior of Suriname and French Guiana. Despite earlier remarks that Maroon rice production does not meet the demand (Nascente and Kromocardi 2017, Sewnarain 2021), we received no complaints from the 99 rice farmers we interviewed that their fields did not produce enough food for their families. Farmers who are able and willing to buy their staple food may choose to plant smaller fields. Some farmers mentioned that in times of financial trouble, they would plant more rice and other crops, to avoid having to buy their food.

The mystery of African rice (*Oryza glaberrima*)

Our research highlights the complex relationship between Maroons and African rice, as well as the diverse beliefs and practices surrounding its use as food, medicine, and spiritual traditions (Chapter 3). During slavery, Africans from various ethnic and geographic backgrounds were brought to Suriname (Stedman 1988, Carney 2005), and different rice varieties were introduced and cultivated on plantation provision grounds. Recent archival research revealed that rice both African and Asian rice were present in Suriname as early as 1688. Reports from the late seventeenth century mention white and black husked rice, of which the latter had a red bran. Especially the red-branned rice was mentioned as an obnoxious weed in the coastal plantations and surroundings (Elfrink et al. 2024). Both African (*O. glaberrima*) and Asian (*O. sativa*) rice can have red bran, but only the African rice in Suriname has black husks. Various historians

have used color difference as an indicator for the distinction between African (red) and Asian (white) rice but the bran color alone is not sufficient for distinguishing between the species.

Maroon oral history recounts how some ancestors recognized dark-colored rice from plantations and identified it when they saw it growing wild in coastal swamps or open savannas (Chapter 3). Others, unfamiliar with rice as a food source, hesitantly learned to consume it when found in grasslands or swamps deep within the forest. Following their escape to the interior, different runaway groups developed distinct histories with the crop, leading to varied attitudes towards (African) rice that persist in modern Maroon communities today. The unique characteristics of African rice, such as its ability to become feral, compete with weeds, grow on poor soil (Richards 1986, Teeken et al. 2012), produce shattering seeds (Sweeney and McCouch 2007), and attract birds (Wheelwright and Janson 1985) explain how a fully domesticated crop could revert to a semi-wild state in the forested interior of Suriname and French Guiana. Of the 99 Maroon farmers we interviewed, 23 cultivated black rice, and used it as (ceremonial) food, in offerings for forest spirits or to ensure a good harvest, for (spiritual) medicine, funeral rituals or simply sold it for a much higher price than their Asian rice. Although not frequently consumed, African rice does not seem to be under immediate threat of disappearing, given its importance in rituals and herbal medicine, and therefore its commercial value.

The chain of operation in Maroon rice cultivation

In many Maroon communities, rice is crucial in rituals, medicine, funeral activities, and offerings. However, the most essential is its role as a food crop. The rice varieties chosen for these diverse purposes contribute to the uniqueness of the Maroon rice farming system. Maroon rice meets the many criteria that Garibaldi and Turner (2004) outlined for a cultural keystone crop. These include its intensity and multiple uses, specific naming and terminology in the local languages, its role in narratives and ceremonies, its persistence and memory of use amid cultural changes, its unique cultural significance, its difficulty in being replaced by other staple foods, and its (small) role in income generation beyond the communities. However, rice is not equally important in all Maroon communities. Along the Suriname River basin (home of the Saamaka) rice fields are larger and have more diversity than in the other river basins. Saamaka farmers are the only ones who sow and harvest rice twice a year.

Farmers' motivations for maintaining rice fields are varied. Common reasons include ensuring food security, asserting sovereignty and independence, and facilitating participation in funeral-related activities. Its taste, quality, and health benefits compared to store-bought rice are also significant factors, along with honoring ancestral practices. However, this does not apply to all Maroon communities. The Paamaka community does not cultivate rice as much as in the past. They focus more on cassava cultivation for the production of *kwak* (granulated cassava flour) to meet the demand of gold miners in their area (Chapter 5). This has also led to changes in cultural practices, such as neglecting the offerings to forest and ancestral spirits. Some Paamaka believe this has led to many accidents among young Paamaka gold miners. Okanisi also cultivates less rice than in the past. Several farmers we interviewed only grew rice for funeral ceremonies. The rice they needed for daily consumption was bought in the local store or brought from the city.

Rice, the agent of difference in Maroon communities

The chapters of this PhD thesis together provide important contributions to our understanding of Maroon farming in general and the role of rice within their farming system. Most colonial documents on food supply for the enslaved population of Suriname mention plantain and cassava as the most important carbohydrate source (Douma 1991, Elfrink et al. 2024). Even after slavery ended in 1863, plantain and cassava were still a substantial part of the daily diet for the indentured laborers (Douma 1991). However, Van der Kuyp (1961) described in detail

the different reports of colonial officers and missionaries about the agricultural and food practices of different Maroon groups. In these reports, rice had a more prominent position, next to plantain and cassava. The archival documents of military personnel chasing runaways also mentioned huge rice fields and a wide variety of other crops (Dragtenstein 2002, Elfrink et al. 2024). Scottish mercenary John Gabriel Stedman (1988) even mentioned a village *Alesikondre* (rice village) during his expeditions to destroy the settlements of the Boni Maroons and capture runaways in the coastal swamps in 1775.

Rice was an agent of change, and supported marronage, especially in hiding (Maat et al. 2023). It is harder to escape with plantain suckers and cassava roots than it is to escape with rice seeds. Rice can be harvested in three to four months. For the untrained eyes, rice that does not bear panicles can be mistaken for grass. Botanist Daniel Rolander saw *Oryza sativa* growing on a coffee plantation in 1755, but the plantation owner did not recognize it as rice (Van Andel et al. 2016). Thus, it was possible that enslaved Africans secretly grew rice on plantations without their master's knowledge.

Anthropologists and historians have published extensively about the struggles for freedom of Maroons in Suriname and French Guiana (e.g. De Beet and Sterman 1981, Price 1983, Dragtenstein 2002, 2020, 2023, Thoden van Velzen 2022). These social scientists mostly focused on cultural and (oral) historical aspects (for an overview, see Price 2018). Agriculture of the Maroons, however, was never a subject that had their attention. These researchers left a space that made my research unique: the role of women in these struggles and the position of rice in these newly formed Maroon communities until today. With some exceptions (De Groot 1986, Price 1993), the oral history and traditional knowledge of Maroon women have largely been neglected by anthropologists (Van Andel et al. 2023). Since food production and processing are done by women, the activities they perform to ensure food security and sovereignty were largely undocumented. Ethnobotanical research can help to close the knowledge gaps on food systems and other plant use in communities of African descent in the Americas (Voeks and Rashford 2012). In other parts of the Americas, research has also long focused on Indigenous groups, neglecting Mestizo peasant and Afro-descendant communities, such as in Colombia (Pasquini et al. 2018) and Brazil (Carney and Rosomoff 2024). My research findings can contribute to this recent attention to the influence and agency of Afro-descendant people in agriculture in the Americas.

Impact of this research

The societal impact of this research has been above my expectations. When I started, I had hoped to raise awareness and broaden the knowledge of Maroon rice in Suriname and French Guiana, especially among urban Maroon youngsters who do not practice rice cultivation or are not involved in agriculture at all. My goal was to disseminate information on my social media platforms and present the rich diversity of Maroon rice and everything else connected to it. It became a more elaborate endeavor.

An essential part of my PhD study was to deposit living seed collections at SNRI/ADRON. The Maroon rice varieties were multiplied, phenotyped, sorted, and stored separately in professional storage facilities. Many of these collections were later selected by the director of SNRI/ADRON, Jerry Tjoe Awie, and the Crop Trust BOLD program for *ex-situ* safeguarding at the Svalbard Global Seed Vault. This 1000 m^2 storage center, located under the ice on a Norwegian island, contains more than 1,3 million seeds from more than 6000 plant species that are important to the future of humankind (https://www.seedvault.no). Depositing the Maroon rice was congruent to Crop Trust's mission, dedicated "to conserving and making crop diversity available for use globally, forever, and for the benefit of everyone". In October 2024 three boxes of Maroon rice arrived, to be stored under the ice for future use (Crop Trust

2024a). Before this transfer, in December 2022, I facilitated a meeting between the management team of SNRI/ADRON and Albert Aboikoni, paramount chief of the Saamaka people at his residence in Asidonhopo in the District Sipaliwini to discuss the importance of the unique Maroon rice diversity for future generations. In September 2023, representatives of Maroon communities and the farmers were invited to visit the SNRI/ADRON facilities in Nickerie and learn about the processes of safeguarding their rice varieties (Crop Trust 2024b).

The Maroon rice varieties at SNRI/ADRON are now always available for farmers who somehow lost their seed stock or want to try out new varieties. They are also available for non-commercial scientific research in Suriname and elsewhere. Each rice variety is stored with associated 'passport data' on the individual rice farmer who cultivated it, its local name, location, and further agronomic data, to protect the farmer's intellectual property rights. At the closing ceremony of their meeting in September 2023, Maroon rice farmers were invited to select five varieties from the test fields in Nickerie, which were later multiplied and disseminated among farmers. The Crop Trust then financed the establishment of a community seed bank in Brokopondo Centrum and two test fields: one in Brokopondo Centrum and one in Santigron with more than 100 varieties (Crop Trust 2024b). I had not anticipated the national interest in traditional rice diversity in Suriname.

Another outcome of this project is that Maroon farmers have used the increased awareness of Maroon rice to market their crop as cultural heritage food. The price of Maroon rice has increased: now it is professionally packaged and sold to non-Maroons in Paramaribo and the Netherlands for a much higher price than the rice commercially produced in Nickerie. "Consumers are willing to pay more for rice with a better taste", explained rice farmer and community seed bank manager Albertina Adjako. Commercial production of Maroon rice has been initiated by Johannes Tojo, a Maroon farmer from the Pamakka community, Marowijne River, although some of his varieties are modern Brazilian dryland cultivars. Tojo exports the rice to French Guiana, thereby creating job opportunities for Maroon women who are working in his fields. His customers include urban Maroons in French Guiana that need traditional rice to visit funerals but do not have provision fields. A few other entrepreneurs also have established fields in which they plant Maroon rice for the market in Paramaribo.

Large-scale cultivation of Maroon rice in the interior, however, has to be well-studied before implementation. Apart from the negative aspects of destroying rainforest, aspects such as low soil fertility, pest and disease management, water management, and fertilizer use must be considered, given the vulnerability of rainforest soils to large-scale agriculture (Van Vliet et al. 2012). In Brazil, clearing the Amazonian rainforest for large-scale agriculture has resulted in short-lived production because of the rapid depletion of soil nutrients and has had negative effects on the local and global environment (Moura et al. 2016).

Genetic studies on Maroon rice

Before this PhD research, genetic research revealed that the black rice of the Maroons is indeed African rice (*O. glaberrima*) and very similar to a variety cultivated in the western Ivory Coast (Van Andel et al. 2016). Recently, Van de Loosdrecht et al. (2024) revealed the different geographical sources of 136 rice varieties we collected during this PhD research. Our initial hypothesis was that Maroon rice fields reflect 370 years of migration history and skillful adaptation to the Amazonian environment: a highly diverse and dynamic system that combines ancient African landraces with traditional Asian varieties exchanged around 1900 with Indian and Javanese contract laborers, commercial rice cultivars from the 1930s and newly developed hybrids.

Many of the Asian rice varieties of the Maroons could indeed be traced back to West Africa, from where they were shipped to the Americas during the transatlantic slave trade (c. 1530-1825). Some rice varieties were obtained following interactions with diverse communities and cultural groups that post-date slavery: indentured laborers from Java and their descendants (1890 onwards), USA rice breeders (1932 onwards), and Hmong refugees from the Vietnamese War (1955-1975) who settled as farmers in French Guiana. Between 1986 and 1992, Suriname suffered from a civil war and many Okanisi Maroons crossed the border to French Guiana as refugees. The Hmong rice varieties were probably handed to Maroon farmers who took them to Suriname after the war ended. The Hmong rice varieties grown by Okanisi Maroons in the Cottica clearly show ancestry from Laos, Cambodia, and Thailand (Van de Loosdrecht et al. 2024). Surprisingly, we did not (yet) find any Maroon rice variety with a clear ancestry to India. We had expected that the Maroons also incorporated rice varieties in their portfolio that were exchanged with Indian contract laborers, as they have rice varieties that are named *kuli alisi* (coolie rice), using a derogative term for these Indian migrants. However, Maroon rice varieties that contain the term *kuli* all have an African ancestry (Van de Loosdrecht et al. 2024).

The results of these genetic studies largely coincide with the stories we collected from Maroon farmers, who were certain that much of their rice came from their African ancestors. The Hmong rice varieties kept the name of the people they received it from, just like the historic US cultivar *Rexora*, which was sent to the Maroons in 1936 under this name (Stahel 1944). Although it crossed vigorously with Maroon rice of African ancestry (Van de Loosdrecht et al. 2024), it still lives under the name *Alekisola*, because of its elongated grains and long ripening period (Chapters 2 and 4).

The rice varieties that have a clear ancestry linked to Java, however, are not connected by the Maroons to the Javanese community in Suriname. These varieties, often with stiff awns, are named after animals, not after Javanese. It is possible that the varieties were introduced by Maroon males who were working with Javanese people on coastal plantations in the early 20th century. They took the rice home and their female family members in the interior, who did not witness this exchange, did not make the link between the awned varieties and the communities of origin. It is also possible that the Maroons received the awned varieties with Javanese ancestry through an agent from a rice breeding station (Dongstra 2024), but no written documents are available on this transfer. From the combination of the genomic work (Van de Loosdrecht et al. 2024) and the ethnobotanical study (this PhD thesis), it becomes clear the (geographic) origin of most Maroon rice varieties matches the traditional knowledge of the farmers we interviewed, but not always. Some rice introductions have not been preserved in Maroon's oral history.

Suggestions for future research

We did not visit every Maroon village, did not collect all rice varieties, and certainly did not interview every rice farmer. We acknowledge that this leaves the possibility of us missing information because the oral history of rice cultivation is scattered, and it is impossible to know beforehand who knows what about a certain subject. Rice names we could not translate might be known to some people we did not meet during fieldwork. There are historic women remembered in rice names who we could not trace and details on the use of rice in offerings and rituals that were not divulged to us. With a few exceptions, we did not document what (male) spiritual leaders knew of rice, as we focused our interviews on (female) farmers. There is ample room for further research on the oral history of rice farming among Maroons.

Due to difficulties in obtaining permits that allowed us to collect herbarium vouchers and document traditional knowledge in the Aluku community in French Guiana, we could not

do research with this Maroon group. The agriculture of the Aluku has been partly described by Hurault (1965) and Fleury (2013, 2016), but their oral history on the origin of their rice still awaits documentation. In the Kwinti community, there may be some rice farmers who have similar or different varieties and stories about the origin of rice. They had traditional knowledge of rice cultivation in the past, but very few people inhabit the Kwinti villages along the Coppename River nowadays (PAS 1994).

In Suriname and French Guiana, the oral history of Indigenous women in agriculture is largely undocumented, even though these women are also crucial agents in food security and the transportation and exchange of seeds and planting material. The exchange of crops between Maroons and Indigenous people, both during the escape from slavery and afterward, has never been studied. We have heard anecdotal evidence from Indigenous peoples that rice was exchanged with the runaway Africans in the past and that Maroon rice is sometimes still grown by Indigenous farmers. Still, this topic remains open to further research.

Migration patterns of Maroons from interior villages to urban areas in Suriname and French Guiana or to other countries (the Netherlands, France) will have an impact on their traditional knowledge systems. How does this migration affect their behavior toward cultural practices associated with rice farming? To what extent is this knowledge transmitted if urban youngsters help their family members in the interior with the rice harvest during their summer holidays? There is a need for further research on this subject to predict the future of Maroon rice cultivation.

The increasingly present evangelical churches in Maroon territories rigidly oppose Afro-religious practices and discourage their adherents from visiting funerals in remote Maroon villages, as these are regarded as places of witchcraft (Van Stipriaan 2015, Van Andel et al. 2019). As funerals are core events during which Maroon rice is communally processed, cooked, consumed, and offered to the ancestors, conversion to these types of Christianity threatens the survival of Maroon rice diversity. Landraces can quickly disappear if not sown every few years, and anthropologists have warned of a substantial decline in the number of Maroon rice varieties in the near future (Price and Price 2017). We observed that Maroon farmers who changed their religious orientation from traditional Afro-Surinamese beliefs to Christianity changed their cultural practices, and refrained from offerings to spirits of the forest, ancestors, and recently deceased family members. As several Okanisi farmers only grow rice to attend such funerals and not for daily consumption anymore, the question remains: how this will affect agricultural practices in the future?

Genetic and ethnobotanical research on other traditional crop landraces such as cassava (*Manihot esculenta*), plantains and bananas (*Musa* spp.), okra (*Abelmoschus esculentus*), and chili peppers (*Capsicum* spp.) in Maroon or Indigenous communities might reveal other hidden narratives of (colonial) history, migration patterns, and crop exchange that are currently unknown to scientists, policymakers and the general public.

Climate change is one of the most defining concerns of today and has greatly reshaped or is in the process of altering the earth's ecosystems. Due to anthropogenic activities, soil, water, and air are being polluted. The unprecedented temperature rise has resulted in increased events of droughts, floods, irregular patterns of precipitation, heat waves, and other extreme happenings throughout the globe. Natural disasters alone have caused significant economic losses worldwide in the past few years (AON 2023). The impact of climate change is very comprehensive. Still, its far-reaching effects are now clearly visible in the agricultural sector, which relies on food production and the economy of the world (Arora 2019).

Suriname has a densely populated coast that is exposed to sea level rise. It is vulnerable to climate change in both the physical and governance-related aspects (Collins 2023). These overlapping vulnerabilities have been captured somewhat in the social vulnerability literature on natural disasters and hazards (Cutter et al. 2012), which examines how individual social markers such as race, health, employment status, and income influence or shape the susceptibility of various groups to harm and that also govern their ability to respond. Although climate change effects have not been studied in detail for the forested interior in Suriname, Maroon rice cultivation strategies seem to be resistant to many of these challenges, such as unusual floods and droughts. They have a high rice diversity with different environmental requirements: some can withstand flooding, others are more adapted to dry soils, and some have longer ripening periods than others. The swidden farming system enables farmers to decide every year where to plant a new field and what varieties to sow. In this way, they are flexible in the location and diversity of their agriculture. Although we did not measure the effect of climate change parameters on the yield and growth season of Maroon rice, agronomical research on how Maroon rice farmers adapt their strategies might reveal knowledge that can help to make current agriculture practices more resilient against climate change challenges.

Conclusions

The four chapters of this PhD thesis confirm the hypothesis that rice cultivation is deeply connected to the Maroon way of life, as it is visible in language, ancestral narratives, traditions, and cultural practices. However, this connection is not the same for all Maroon communities: the Saamaka (and a small group of Okanisi) along the Suriname River basin grow the largest amount of rice and the highest diversity. Maroons along the Marowijne River basin have smaller rice fields and cultivate a much lower diversity. It is unlikely that this variation between groups has been stable over time. In other words, different Maroon groups have different patterns of adjustment in response to abolition and the later changes brought by colonialism and the independent state of Suriname. In general, rice farming plays a crucial role in various aspects of Maroon society. They cultivate many different rice varieties, enhancing local food security and independence from the market economy, and providing healthy nutrition. Maroon farmers support their families and communities by preserving agrobiodiversity and cultural heritage that may have been lost otherwise. Their practices are adjusted to the forested environment, using multi-cropping, minimal use of agrochemicals, and swidden farming that allows varieties to grow on different soils and vegetation types. All these aspects make their farming system more resilient and sustainable than the large-scale commercial agriculture in coastal Suriname, which permanently occupies the same fields. Although Maroons do sell some of their produce in the urban areas, they do not have to produce for export, so it is easier for them to put less pressure on their surrounding ecosystem.

Maroons promote rice diversity by sharing seeds among family, friends, neighbors, and sometimes with non-Maroons. They also have a positive attitude towards off-types or spontaneous hybrids they find in their field: they try out all varieties, and those that perform well are kept, and given a new name. They probably have done so since marronnage. The farmers manage and maintain their rice diversity by giving every variety a distinct name, sowing them in sequence, and keeping them separate in the field and in their storage. We found that rice names are also used to indicate where to sow a variety in the field and thus as a diversity management strategy. For example, rice types named *watralanti* (waterland) or *fisi* (fish) need to be planted in wetter soil (e.g. creek edges) than other varieties.

Some Maroon farmers, especially those Okanisi who only grow rice to attend funerals, thresh all rice varieties after harvest and store the loose seeds together in plastic buckets. In these households, the complex naming system has disappeared, and people distinguish rice only

by their husk color (red or white). All varieties are sown together and are not kept separate either in the field or after the harvest. This system stimulates outcrossing between varieties, which leads to new varieties. Later, when these new varieties are exchanged with other farmers who keep all their rice types separate, they can become part of the overall diversity.

Maroon farmers are important custodians of rice diversity and have preserved a unique cultural heritage from a dynamic past that is entwined with the global history of slavery and colonization. In the past four years, with the support of my supervisors, Maroon farmers, and Maroon intellectuals, I unraveled the Maroon rice names and revealed parts of their unwritten history from the time of colonialism to today. I provided data on rice yields of 28 Maroon rice varieties, which I hope can serve as a guideline for future estimations of rice production and debunk prejudices about low yields and the inferior quality of Maroon rice. I documented cultural practices about rice (and specifically of *O. glaberrima*) in Maroon communities that were never before recorded. The results of this PhD thesis and the other publications from our group on Maroon rice highlight the strength and ingenuity of agriculture practices in these communities. However, we also saw the vulnerabilities of the Maroon rice cultivation systems, as they are strongly woven into cultural and spiritual practices. These cultural and spiritual practices can change or disappear over time, and this may lead to the loss of rice farming in Maroon communities, as is currently the case in Paamaka communities. Suriname is the only country in the Americas that has not legally recognized the collective rights of indigenous and tribal peoples to the lands they have occupied for centuries. The future of Maroon rice depends on the persistence of their cultural and spiritual practices and the continued access to their ancestral lands.

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Manager at Invitroplants/ Grassalco 02/2021- 08/2021
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- Involved in planning and developing policies for bettering the life of farmers in the interior of Suriname and managing the department.
- The goal is to identify and train farmers in best practices and NGOs in project management and development.

Head of Labs at Suriname Alcoholic Beverages 08/2013-12/2017

- Involved in the management of lab personnel.
- Created taste-testing training material.
- Chair product taste testing team.

Biochemical Engineer at Diakonessen Hospital Paramaribo 11/2015- 07/2017

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Teachers at Polytechnic College Suriname 10/2014- 03/2018

- Taught the Introduction to Biochemistry course to 'Bachelors of Applied Sciences' students
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TRAININGS

- Global Leadership Summit 09/2013
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- West Indies Rum Producers Association Rum Profile in Trinidad 05/2015
- Scientific Research Center Suriname, Scientific writing 03/ 2019
- Ministry of Health HIV sensitivity testing 05/2017
- Medicinal plant's practical uses in Suriname 09/2019
- Etikettering at Suriname Standaarden Bureau 03/2014

CONFERENCES

- Seminar Maroon Rice Anton de Kom Universiteit van Suriname, oral presenter 07/2022
- Annual meeting Society of Economic Botany and International Society of Ethnobiology, oral presenter 06/2022
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- Maroon Women and gender awareness, keynote speaker 09/2010

MEMBERSHIP

- Student representative of the International Society of Ethnobiology June 2022-2024
- Member of the society for Economic Botany 2022-2024
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- Secretary of the Foundation for Development, Communication and Education 2014-present
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- Chairman of Maroon Student Organization "Boston Bendt" 2005-2007

Awards

- Chinese Scholarship Council Scholarship 2011

Publications

- Luo Sha, Li Qianqian, Liu Shanda, Pinas Nicholaas M., Tian Hainan, Wang Shucai, Constitutive Expression of *OsIAA9* Affects Starch Granules Accumulation and Root Gravitropic Response in Arabidopsis Frontiers in Plant Science. 2015
- Dennis R.A. Mans, Angela Grant, Nicholaas Pinas. Plant-Based Ethnopharmacological Remedies for Hypertension in Suriname. Intech open, 2017
- Dennis R.A. Mans[1], Nicholaas M. Pinas[1], Meryll Djotaroeno[1], Priscilla Friperson[1], Jennifer Pawirodihardjo[1] and Maureen Y. Lichtveld[2], Insight into the antioxidant activities of ten Fabaceae plant species that are medicinally used by the Aucan Tribal Peoples from the Republic of Suriname (South America). GSC Biological and Pharmaceutical Sciences, 2022
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PE&RC Training and Education Statement

With the training and education activities listed below the PhD candidate has complied with the requirements set by the Graduate School for Production Ecology and Resource Conservation (PE&RC) which comprises of a minimum total of 30 ECTS (= 20 weeks of activities)

Review/project proposal (4.5 ECTS)

- Hidden crop diversity in Suriname: tracing the origins of Maroon rice with ethnobotany

Post-graduate courses (8.6 ECTS)

- Resilience of living systems, PE&RC (2023)
- Mixed cropping as a means to sustainable agriculture, PE&RC (2024)
- Redesign agriculture to improve resource use efficiency, PE&RC (2024)
- Introduction to R and R studio, PE&RC (2021)
- Intermediate programming in R, PE&RC (2022)
- Tidy data transformation and visualization in R, PE&RC (2021)
- Advanced statistics course design of experiments, PE&RC and WIAS (2022)

Deficiency, refresh, brush-up courses (6 ECTS)

- Ethnobotany, Biosystematics (2021)

Invited review of journal manuscripts (1 ECTS)

- Journal of Ethnobiology, Biodiversity conservation (2022)

Competence, skills and career-oriented activities (7.09 ECTS)

- Scientific writing, Wageningen in'to languages (2022)
- Scientific writing, Leiden University (2024)
- Start to teach, Education support center WUR (2022)
- Career perspectives, WGS (2023)

Scientific Integrity/Ethics in science activities (0.9 ECTS)

- Ethics in plants and environmental science, WGS (2022)
- Scientific integrity, WGS (2022)

PE&RC Annual meetings, seminars and PE&RC weekend/retreat (1.2 ECTS)

- PE&RC First year's retreat (2022)
- PE&RC Last year's retreat (2024)

National scientific meetings, local seminars, and discussion groups (10 ECTS)

- Bioreps Leiden University three days seminar (discussion leader on day 3) (2024)
- Bioreps Leiden University online seminar (oral presentation) (2024)
- Biosystematics PhD and PostDoc biweekly meetings (2024)
- Maroon rice symposium Anton de Kom University Suriname (2022)
- Seed system analysis of Vegetables and Fruits in Suriname (2024)
- Crop Trust Maroon rice seminar in Suriname (oral presentation) (2023)

International symposia, workshops and conferences (5.4 ECTS)

- Oral presentation economic botany symposium, Jamaica (2022)
- Oral presentation Botanical encounters in Bath, UK (2023)
- Oral presentation Gullah Geechee diaspora conference, USA (2025)

Societally relevant exposure (12 ECTS)

- Suriname television interview STVS (2021)
- The Guardian newspaper article (2024)
- De Ware Tijd articles (four times) (2022/ 2023/ 2024)
- NRC news article (2024)
- VPRO/ NPO1 radio interview (2024)
- Radio Mart radio interview (2024)
- Gala voor de Maatschappij en Wetenschap (2021)
- Dag van de Marrons, Den Haag (presentatie) (2023)
- Bijlmer Park Theater oral presentation, “Sporen van Haar” (2023)

Committee work (3.5 ECTS)

- Naturalis PhD council (2022-2023)
- Student rep International society for ethnobiology (2022-2024)

Lecturing/supervision of practicals/tutorials (1.2 ECTS)

- Ethnobotany WUR guestlecture (2023)
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BSc/MSc thesis supervision (3 ECTS)

- Research topic 1: Traditional Maroon rice dishes in Suriname and French Guiana: its documentation and role in Maroon culture

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