

Maintaining or Abandoning African Rice: Lessons for Understanding Processes of Seed Innovation

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Abstract Rice breeding and crop research predominantly emphasize adaptation to ecological conditions. Based on qualitative and quantitative research conducted between 2000 and 2012 we show how ecological factors, combined with socio-economic variables, cultural norms and values, shape the use and development of local technologies related to the cultivation of African rice (*Oryza glaberrima* Steud.) in seven West African countries (Ghana, Guinea, Guinea-Bissau, Senegal, Sierra Leone, The Gambia and Togo). In this region the role of African rice is diverse across ethnic groups. Findings suggest that farmers, through various pathways, are active in the development of promising new varieties based on genetic resources of Asian rice, African rice, or both, as well as in

the adoption of modern varieties. These findings require further research into interactions among ecological, genetic, socioeconomic and cultural factors within farmers' innovation systems and recognition of emergent knowledge and technologies resulting from such interactions.

Keywords *Oryza glaberrima* · West Africa · Technology development · Farmer interspecific rice hybrids

Introduction

West African agriculture is characterized by high agro-ecological and cultural diversity, limited labor availability and access to agrochemicals, and a strong tradition of self-sufficiency. Consequently, farmers in many areas of West Africa have rejected “modern” varieties of rice developed by formal, science-based institutions for use with inputs such as fertilizer and irrigation water since their local varieties often outperform them (Sall *et al.* 1998).

Farmer participatory research stresses that technology development should connect to the needs and priorities of local communities (e.g., Farrington 1988). This approach has led to the formation of institutions such as Farmer Field Schools (FFS). Although the aim of FFS was that farmers would learn optimally from field observations and experimentation, FFS have failed to properly address cultural and social dynamics (Isubikalu 2007; Richards 2007).

The “farmer first” paradigm (e.g., Chambers *et al.* 1989) associated with the rejection of the “transfer of technology” approach was also responsible for new approaches to seed development and dissemination, such as participatory variety selection (PVS) and participatory plant breeding (PPB) (Almekinders and Elings 2001). A role for farmers in varietal development and selection was recognised particularly in PPB. While in PVS farmers select among finished or

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almost finished breeding products (Gridley *et al.* 2002), in PPB most of the breeding process is transferred to farmers' fields (Ceccarelli and Grando 2007). PPB has much potential to valorize farmer varieties, but plays only a minor role compared to PVS. Farmers' varieties are the outcome of a long breeding process shaped by ecological and social factors, but this legacy tends to be neglected in existing participatory seed improvement approaches. This is perhaps because farmer varieties are seen as the product of more or less static "traditional" technologies and suitable only for local conditions, where they are still used only because of lack of better, scientifically developed, alternatives.

Farmers' processes of innovation and variety development continue to remain almost invisible to research and development organizations in the formal seed improvement sector. In the rare cases where it is acknowledged that farmers produce valuable seeds, these are thought to be adopted only on a local scale and thus unsuitable for use together with scientifically developed varieties (Mokuwa *et al.* 2012). There have been no releases of improved African rice varieties.

Although the Consultative Group for International Agricultural Research (CGIAR) and national agricultural research centers have been increasingly integrating participatory approaches in the development and dissemination of new technologies, these approaches are insufficiently informed by recent findings from interdisciplinary research involving social scientists. Cernea (2005) argued that social scientists are still fighting an "uphill battle" against "institutional barriers, scholarly biases from other researchers or some centers' managers, and virtually suffering from constant underfunding" (2005: 73). Additionally, as Davidson (2010) has highlighted, access to farmers' technical capacity can be particularly tricky in societies where this knowledge is deeply bound up with complex communicative strategies. Consequently, local cultural and social determinants of farmer development of seed varieties and acceptance of new varieties remain barely acknowledged in many research and development initiatives (Richards 1996; Okry *et al.* 2011; Temudo 2011). To rectify this it is essential to assess the cultural, social and historical factors that along with ecological factors have shaped local seed technologies and preferences.

The cultivation of African rice (*Oryza glaberrima* Steud.) by many farmers today is a good example of the complex dynamics behind the development and adoption of new local seed technologies, particularly because, to date, scientists have rejected this species as a candidate for improvement. All cultivated varieties of *Oryza glaberrima* are entirely the product of farmer agency. Understanding these processes is given renewed significance by the recent discovery of West African farmer rice varieties with an interspecific background that are the outcome of the crossbreeding of African and Asian rice in farmers' fields in response to agro-ecological and sociocultural selection pressures (Nuijten *et al.* 2009). They are distinct from

the well-known Nerica rices (*O. glaberrima* × *O. sativa* crosses produced by modern breeding techniques).

There is general agreement that *O. glaberrima* was domesticated in West Africa around 3,000 years ago while Asian rice was introduced to the region by European Atlantic traders from the sixteenth century onwards if not earlier through trans-Saharan trade routes. The grains of African rice are generally more glabrous (hence *glaberrima*) and have a red/brownish pericarp. The plant has a particular round and short ligule and its panicles stand upright unlike Asian rice, which has a longer and more pointed ligule and panicles that droop after flowering. Across West Africa, African rice plays an important role in the ritual life of farming communities (Brydon 1981; Linares 2002; Tanzubil *et al.* 2004) and it retains a deep cultural significance among some African diaspora groups in South America (van Andel 2010).

This article analyzes why farmers in different parts of the West African coastal zone either continue to grow or have abandoned *O. glaberrima* as an illustration of local agency in seed technology and innovation adoption in rice farming, in particular in relation to variety development. Five case studies are presented: 1) a detailed comparison among three ethnic groups in the Togo Hills in Ghana and Togo, 2) the Mandinka rice farming system in The Gambia, Senegal and Guinea-Bissau, 3) the Balanta mangrove rice farming system in Guinea-Bissau, 4) the Susu farming system in Maritime Guinea, and 5) a comparison of the Temne and Mende ethnic groups in Sierra Leone (Fig. 1). The results illustrate how farmers' history, culture and organization coproduce and shape important and successful seed technologies in different ways.

We argue that farmers can and should be regarded as research partners in the production of seed technologies with considerable potential to be disseminated and promoted more widely. This would imply that farmers' varieties developed in different places of the world can be transferred successfully to other regions. To support this aim we argue, further, that the epistemological context and the historical trajectories within which farmer varieties have arisen should be more fully researched (see, for example, Mouser *et al.* 2012).

Methods

The Togo Hills of Ghana and Togo: the Akpafu, the Lolobi and the Ewe

We conducted research in 2007 and 2008 in two areas in the Volta Region of Ghana, Akpafu and Lolobi, and one in Togo, the Danyi Plateau. In Akpafu, Lolobi and on the Danyi Plateau, 150, 103 and 148 households were interviewed, respectively, using questionnaires. An additional 18 farmers on the Danyi Plateau were interviewed in depth on rice cultivation practices and all their fields were visited. In-

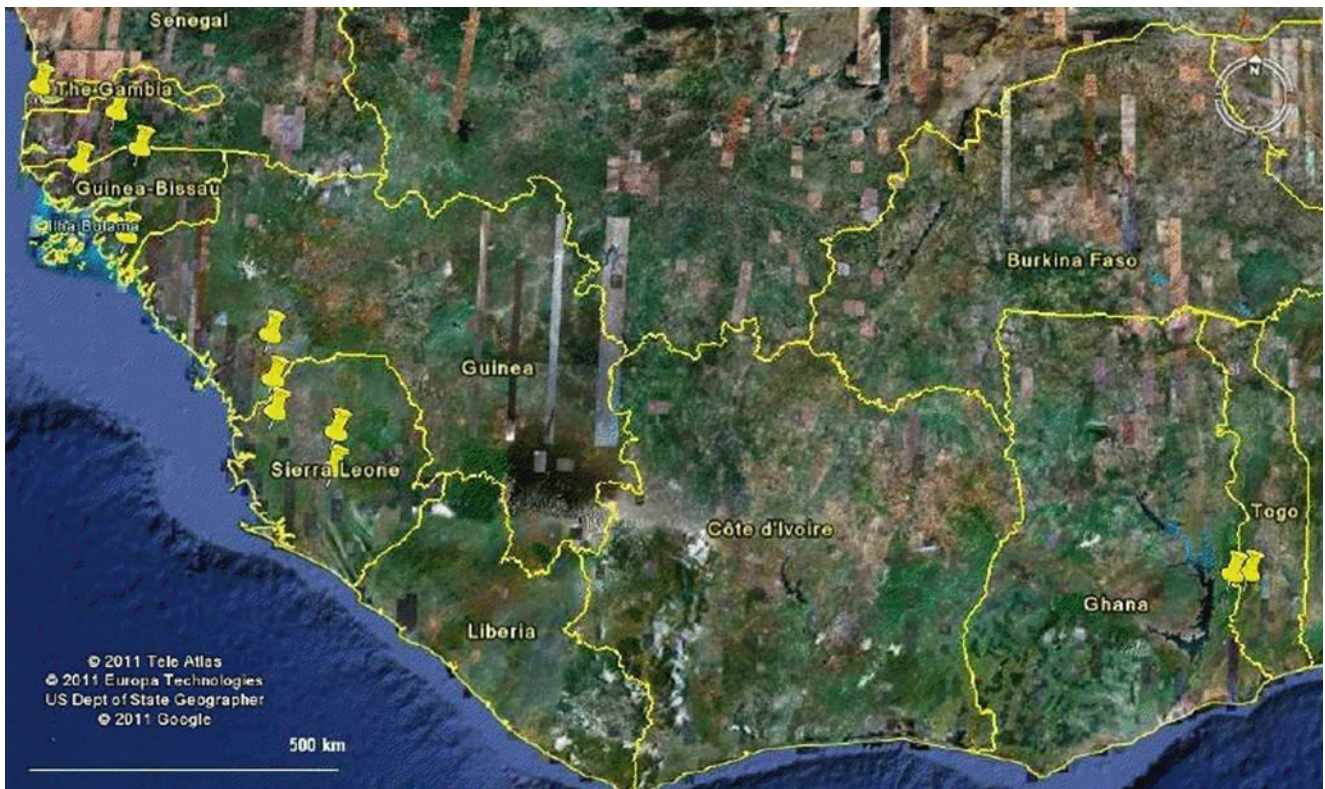


Fig. 1 Case study areas are indicated by pushpins

depth interviewing was combined with participant observation and evaluation of different rice varieties in farmers' fields. In Ghana, research was carried out mainly in the villages Akpafu Odomi and Lolobi Kumasi, 10 and 8 km north of Hohoe, respectively. A few households from the neighboring villages of Lolobi Ashambi and Akpafu Mempeasem were also included. These villages were selected because of their extensive involvement in both lowland and upland rice cultivation and their representativeness for the Akpafu (3 villages) and Lolobi (4 villages) areas.

The Akpafu and Lolobi are minority groups that share languages belonging to the "Togorestsprachen" (Westermann 1954), with little relationship to the regionally dominant Ewe language. These groups all share some history as refugees (Nugent 2002). The Lolobi and the Akpafu were divided during a war with the Ashanti. The Lolobi managed to resist while the Akpafu, located on the other side of a mountain, surrendered. A German Protestant mission from Bremen converted the Akpafu to Christianity around 1800. The missionaries were keen to eliminate local beliefs and were rejected by the Lolobi, who later (1903) converted to Catholicism since the Catholic missionaries showed respect and interest in their local religion and allowed them to continue their traditional practices.

In Togo, approximately 40 km from the Ghana case study villages, data were collected in four Ewe-speaking villages on the Danyi plateau: Elevagno, Xexatro, Mempeasem, and

Dafor. The inhabitants are active in upland rice cultivation on poor and acid soils. African rice is the main rice species on the Danyi Plateau. Although the Ewe are a distinct linguistic group they share a history as refugees in the area (Quarcoopome 1993).

The Gambia, Senegal and Guinea-Bissau: the Mandinka Farmers

Research was carried out in eight Mandinka villages and one Jola village in The Gambia, southern Senegal (Casamance) and northern Guinea-Bissau. Case studies were conducted in Western Division (from 2000 to 2003, 2007 and 2008), Region de Sedhiou (2007 and 2008) and Oio Region (2007 and 2008). In Western Division, The Gambia, in-depth research was conducted in four villages (Tujereng as principle site and Faraba, Janack and Kitti as additional sites), where in total 104 households were interviewed using a diversity of methods. These villages are populated mainly by Mandinka farmers, but also contain considerable numbers of Muslim Jola who fled from the conflict in Casamance that started in 1981 (Linares, 1992). Janack is a Jola village. All were selected because farmers in these villages actively cultivate both upland rice and late millet. The villages in Region de Sedhiou (Bunjadu and Dar Silame) in Casamance and in Oio Region (Kolosar and Djendur) in northern Guinea-Bissau were selected because they are connected through seed and variety exchange networks with the Gambian

villages. In Region de Sedhiou and in Oio Region, 20 and 22 households respectively were interviewed using questionnaires.

Guinea-Bissau: Balanta Farmers

Extensive ethnographic research (a total of 36 months of field work) was conducted in the Cubucaré peninsula of southern Guinea-Bissau (the heart of rice production), not far from the border with the Republic of Guinea. Between 1994 and 2003 up to 244 household heads were interviewed on rice variety selection and innovation processes using semi-structured interviews (Temudo 2011). During this period a total of 1420 interviews were conducted with mangrove swamp rice farmers living in 59 different villages evenly distributed across the region, of which 71 % were Balanta (who practice traditional religion). The remainder (29 %) belonged to other ethnic groups (with a majority of Muslims). In addition, focus group discussions were conducted in 2001, 2009, 2011 and 2012 with farmers from 156 villages across the entire country practicing mangrove swamp rice cultivation to understand variety naming and selection criteria, and to assess the persistence or abandonment of *O. glaberrima*.

Guinea: Susu Farmers

Data were collected in Maritime Guinea. Field research covered three sub-prefectures (local levels of government): Molota, Friguiagbé and Moussayah, located in the prefectures of Kindia and Forecariah. Ten villages were selected and, based on their proximity to each other, were grouped into three research sites. Site 1 villages (Bokariya and Sangaran) were chosen because of their remoteness (about 90 km from Kindia, the regional capital) in order to learn about farmers' seed strategies and varietal selection practices in a situation of poor infrastructure, limited interventions of development organizations and absence of important nearby markets. Site 2 villages (Seifan and Dentègueya) were selected because of their proximity to the rice seed center at Kilissi and the Centre de Recherche Agronomique de Kilissi (CRAK), the national rice breeding unit. Site 3 villages (Kinyaya, Hononkhouré, Tour, Yaya, Dandakhouré and Sinta) were selected because of their proximity to Kindia. The dominant ethnic group is Susu, and the dominant religion is Islam.

Data were collected using focus group discussions, questionnaires and informal interviews. Interviews took place in 2007 and 2008 and covered 91 rice growing households (32, 24 and 35 selected from sites 1, 2 and 3 respectively).

Sierra Leone: the Mende, Temne, Limba and Susu Farmers

Between 2007 and 2009 extensive ethnographic and botanical data collection was undertaken in six chiefdoms: Kamajei, Kholifa, Rowalla, Magbema, Tonko Limba and Bramaia in a

transect from central to north-western Sierra Leone. In 2007, 287 household heads living in six villages were interviewed using questionnaires. Between 2008 and 2009, the sample size was enlarged to 1,575 households. The selection of interviewed households was based on proximity and access to farmland. Four ethnic groups were represented: Mende, Temne, Limba and Susu. The Susu are mainly found in the Kambia district in the north-west of the country along the international border with Maritime Guinea. The Limba and Temne were predominantly sampled in the north-western and north-central part of the country. The Temne share boundaries with the Kpa-Mende, who occupy the central portion of Sierra Leone. The villages were selected in order to analyze how agro-ecological and sociocultural factors impact in village rice variety portfolios and genetic diversity, and to explore the role of African rice under extreme conditions. Islam is the main religion among all ethnic groups, but there is a large Christian minority among the Mende, the Temne and the Limba.

Results

African rice is still actively cultivated in Guinea-Bissau, Guinea, Sierra Leone and the Togo Hills in Ghana and Togo, but was mostly found as a weed in farmers' fields in Casamance (south Senegal) and The Gambia. This section summarizes the different reasons, and the combinations of factors that determine whether African rice is maintained as a crop or is abandoned.

The Togo Hills of Ghana and Togo: Akpafu, Lolobi and Ewe Farmers

African rice used to be the staple food of the Akpafu and Lolobi in Ghana and the Ewe on the Danyi Plateau in Togo, at a time when war and uncertainty forced them to seek refuge in mountainous areas. African rice grows well on hillsides and in the poor soils on the Danyi Plateau and it is usually intercropped with cassava. Its rich nutritive value is mentioned by all farmers, who in general state that African rice and other red farmer varieties are "heavier." The rice is said to stay in the stomach longer and therefore enables one to work longer without getting hungry.

Besides rice production, farmers in the Ghanian foothills of the Togo Hills massif have incomes from cocoa farming and from non-agricultural activities. Farmers on the Togolese side of the Togo Hills (in the hills proper and on the Danyi plateau) do not have many economic opportunities outside agriculture. Coffee tree production, which used to generate income, is no longer lucrative since coffee prices dropped. Farmers grow vegetables for the local market and rice, cassava, yams and maize mainly for subsistence.

For the Lolobi in Ghana African rice is a religious asset. Although most of the rice cultivated in Lolobi and Akpafu now is Asian rice (*O. sativa* L.), African rice (*Boadekamo* in Siwu) is still grown in small quantities for customary rites, marriages and funerals. *Boadekamo* is not a single variety but a mixture of seven different varieties of *O. glaberrima* (Fig. 2).

The Lolobi and the Akpafu cultivate African rice in mixture since they regard the varieties as being the same ancient rice that was cultivated by their ancestors. Asian rice dominates in the form of the variety *Viono* and this actually resembles African rice especially in pericarp color, taste, cooking characteristics and “heaviness.”

White (Asian) rice is also grown (mainly for sale) both by the Akpafu but especially by the Lolobi. It is often consumed mixed with some *Viono*, as red-skinned rice is greatly preferred over white rice. The pericarp of all red rice, be it Asian or African rice, is only partly (about 75 %) removed in preparation. When red rice is used for porridge or to make a thick paste called *fufu*, none of the pericarp is removed. Porridge and *fufu* are considered very nutritious and often used as baby food, as food for pregnant women, and as the basis of meals for special occasions.

According to informants, a farmer discovered *Viono* within another red variety around 1990, and since then this



Fig. 2 Panicles of *Boadekamo*. This variety is constituted of several varieties of African rice (*O. glaberrima*)

variety is said to have spread all over the lower Volta region. At the Kpong research institute (University of Ghana) researchers were not able to classify this variety. Dr. Kofi Dartey (personal communication, 2007), who runs a rice program at the Crop Research Institute in Kumasi, stated that this variety was certainly not introduced by any research institute and belonged to the interesting local varieties found in the Hohoe area. It seems certain that *Viono* has a farmer origin, since scientific research has only very recently been directed towards developing red-skinned varieties (e.g., Nerica 14 and 18). *Aworema* is a second promising red Asian rice variety that was discovered within *Viono*, and is very similar to it. The main difference lies in its erect leaves that protect the panicle against birds (the name *Aworema* means “hiding from the enemy” in Siwu). *Aworema* was discovered in Lolobi around 2006. This also accounts for the small proportion of *Aworema* in Akpafu (Table 1). The preference for red pericarp varieties explains why the farmer hybrid *Untufa* from Guinea-Bissau with an interspecific origin (Nuijten *et al.* 2009) was so positively evaluated by Lolobi farmers in comparative trials; the variety resembles *Boadekamo* in grain and panicle shape and yields very well. Farmers stated that it can therefore be used for customary rites.

Table 1 shows the role of African rice (*Boadekamo*), *Viono* and *Aworema* in rice production in Lolobi Kumasi and Akpafu Odomi. The importance of African rice among the Lolobi is illustrated by the following statement by a farmer (2007):

“The *Boadekamo* is like the chariot of the queen of England, until today they have not replaced the chariot with a car [.....] we change varieties all the time and we abandon varieties all the time so we have to have something that stays the same, something that [would be] recognized by our forefathers.”

In Lolobi Kumasi, *Boadekamo* plays a very important role in offerings to the ancestors and to local gods. *Viono* and other food crops cannot be used. Offerings are made in the home at the household shrine and to the seven local gods through their priests (*Mabia*), who are consulted by clients seeking prosperity and solutions to pressing problems (Fig. 3). African rice is, in short, an important component of the community’s moral and physical well-being, a link between the domains of production and religion.

In contrast to the Lolobi, African rice is more a cultural than religious asset among the Akpafu, who have largely abandoned family rituals and local gods and are strongly hostile to traditional religion. People who still perform rituals related to these gods are openly stigmatized as “pagans.” However, African rice is still cultivated for cultural reasons (Table 1), such as libations and offerings to the ancestors and gods which are legitimized by the Akpafu

Table 1 Estimated proportion (%) of rice production within agro-ecology in the Lolobi and Akpafu areas in Ghana in 2007 and 2008 (Survey 2008)

Area	Lolobi				Akpafu			
	Upland		Lowland		Upland		Lowland	
	2007	2008	2007	2008	2007	2008	2007	2008
Nr. of farmers	20	36	54	75	10	19	57	82
Red rice	92	100	61	65	93	70	83	85
<i>Boadekamo</i> (African rice)	39	76	9	4	24	13	2	2
<i>Viono</i>	30	10	35	32	69	28	70	81
<i>Aworema</i>	23	14	13	25		5		1
<i>Damansah</i>			4	4		17	4	1
<i>Mateggi</i>							1	
<i>Saka</i>						7	6	
White rice	8	0	39	35	7	30	17	15
<i>Adeisi</i>	8		21	12	7	6		
<i>Akpesse</i>			10	10				
<i>Aqua blue</i>						<0.5		
<i>Kabila</i>						18	4	3
<i>Longgrain</i>				3				
<i>Nerica</i>			2	4				
<i>Perfume</i>			6	7		6	13	12

when done explicitly out of respect for local culture and tradition; to do so in the name of religion would be considered a sin. African rice remains part of funeral and marriage ceremonies and an important ingredient for dishes eaten on all special occasions. Interestingly one of those dishes, *Kamokra*, can today be made with the Asian rice variety *Viono*. African rice is thus a marker of cultural identity but no longer connects religion to the domain of production. Among the Akpafu, *Boadekamo* is assessed as having good taste, high nutritional value, and as a mark of community identity. In interviews, farmers frequently stated that *Boadekamo* has not vanished completely because the older farmers are familiar with cultivating it, and also because outsiders had told them that it was very good rice.¹

For the Ewe on the Danyi Plateau of Togo, African rice remains an important food crop but is used purely for subsistence. Apart from some very small fields of Asian rice in the scarce humid backlands, only African rice varieties are cultivated. Farmers do not have means to acquire fertilizers, and African rice seems to be the only rice that thrives well in the poor soils typical of the plateau. The seven African rice varieties making up *Boadekamo* in Akpafu and Lolobi are cultivated separately here, since by respecting differences in cycle length farmers can get higher yields (Fig. 4). Optimal cycle length can be achieved by planting some varieties earlier and others later. Sowing a short duration variety too early will result in larger vegetative growth, to the detriment of

productive growth. The advantage of respecting the optimal cycle length is no longer valued by the Lolobi and Akpafu farmers, probably because they are no longer dependent on African rice as a basic staple.

Perhaps rather surprisingly, the Ewe of the Danyi plateau do not depend exclusively on African rice for ceremonies and rituals for ancestors. Other crops such as maize, cassava and yams are also used in these contexts. Almost all farmers (146 out of 148) stated that it does not matter what kind of rice variety is used in ceremonies as long as it has been cultivated on their own land. Six interviewees (a fetish priest and other people familiar with performing funeral and

**Fig. 3** Offering to a village god in Lolobi Kumasi, Ghana, in which African rice flour is compulsory

¹ Researchers from the University of Reading, England were mentioned several times (see Dorward *et al.* 2007).



Fig. 4 A field of the African rice variety *Danyi Molni* on the Danyi Plateau just before harvest. Notice the straight panicles

marriage rites) all stated that the local rice (*O. glaberrima*) is necessary. They indicated later, however, that it was not the morphology of the plant that was important but that the rice was cultivated on their land. In detailed semi-structured interviews on rice cultivation with 18 farmers all stated that they would readily abandon the traditional African rice variety should they find a higher yielding one. Such rice could then, without any problem, also be used in ceremonies. African rice, with its specific plant and seed characteristics, has not taken on religious significance as it has for the Lolobi. Although in relation to other crops the area cultivated is relatively small, rice is nevertheless regarded as a key food crop, offering important nutritional value in a diet otherwise consisting mainly of cassava, yams and maize.

The Gambia, Senegal and Guinea-Bissau: the Mandinka

In The Gambia, in the south of Senegal (Casamance) and in the north of Guinea-Bissau, Mandinka farmers have stopped growing African rice. The main reasons given are the red bran or “pericarp” and the difficulty of milling by hand. It is the removal of the red pericarp that makes the pounding difficult. Mandinka farmers (but also farmers from other ethnic backgrounds living in the same region) have a strong preference for white rice. Women indicated that they preferred a white grain color even in the past when they still cultivated Asian rice varieties with a red pericarp.

Another disadvantage of African rice is that its taste is considered good only for certain dishes, like porridge and *munkoo* (small balls made of flour, traditionally made with the first harvested rice, and used for various ceremonies). Other disadvantages mentioned by only a few farmers were low yield, lodging, earliness and tillering among others (Table 2). Yield trials conducted in The Gambia in 2001 and 2002 suggest that African rice does not seem to perform less well than Asian rice

Table 2 Disadvantages of African rice (*O. glaberrima*) mentioned by Mandinka female farmers in three case study areas in 2007

	The Gambia	Casamance	Guinea Bissau	Total
Nr of farmers	21	20	22	63
Seed colour	7	9	13	29
Difficult pounding	4	7	8	19
Panicle does not bend	2	2	4	8
“I do not like it”	1	3	3	7
Bad taste	3	2	1	6
Too early	0	1	0	1
Low yield	0	1	0	1
Needs rain	0	1	0	1
Shatters	0	0	1	1
Itches	0	0	1	1
Few grains / panicle	0	0	1	1
Lodges	0	0	1	1
Does not swell when cooked	0	1	0	1
Does not tiller	0	1	0	1
Unpounded grains remain in mortar	1	0	0	1
Difficult threshing	1	0	0	1
Dominates the seed if not rogued	1	0	0	1
No disadvantage	0	1	1	2
No answer	1	0	0	1

(Nuijten 2005). A survey conducted in the three case study areas in 2007 showed that an increasing number of Mandinka farmers consider African rice to be something bad, unrelated to agronomic or culinary aspects. The negative traits they mentioned included the erect panicle (8 out of 63 farmers) and “they just do not like it” (7 out of 63 farmers) (Table 2). These answers were particularly given by younger women who have never cultivated African rice themselves.

In the past, the main advantage of African rice was its earliness. Another advantage was the taste of its porridge. In The Gambia older women say African rice was cultivated up to the 1970s. In Casamance women stopped its cultivation only very recently. In most cases they sowed it mixed in fields of Asian rice, because farmers said the African rice does not yield much and it would be a waste of land to sow it in pure stands. Some women, however, say “it is just a saying that it does not yield much.”

Until the 1950s women of the village of Tujereng in the western part of The Gambia preferred pounding African rice instead of “findo” (*Digitaria exilis*), which is even more difficult to mill. However, when men stopped growing findo because of lack of labor and children started going to school, the cultivation of African rice also decreased. Increased turnover reduced the mouldy smell associated with rice sold

in shops. A sharp increase in rice imports around 1970 was another reason for women to stop growing African rice. This coincided with the introduction of the first early maturing Asian rice variety, *Kari Saba*, in Tujereng, one of the first farmer hybrids introduced in The Gambia. The availability of early maturing varieties with a white or brown pericarp color was another reason for women to stop cultivating African rice and it is likely that the availability of these newer varieties, mostly with an interspecific origin, led to a sharp decline in the cultivation of African rice. Nowadays, only a few, predominantly older, farmers grow African rice as a mixture in the field. In The Gambia older farmers say the first rice cultivated was African rice, called *Mani ba* in Mandinka (Nuijten 2005). *Mani ba* means “old rice” and “ba” is also used to indicate respect. Some older women know it is older than all other rice varieties, and that it originates in the *faro* (lowland):

When there was a drought in the *faro*, all rice died and people did not have any seed. The next year *Mani ba* was the only rice to germinate in the field. So people harvested the *Mani ba* and used that as seed again the next year, and so on. That is why *Mani ba* is the oldest rice. This happened a very long time ago.

These women say they only mix *Mani ba* in the seed planted in the upland but not for *faro* (lowland), where it originates and germinates naturally. Nowadays, *Mani ba* is mostly present as a weed in farmers’ fields, particularly in the lowlands and transitional zones. In the lowland areas of the villages of Kitti and Faraba *Mani ba* is much more common than in the uplands of Tujereng and farmers seemed to rather dislike it in their fields. In Kitti and Faraba women call African rice “*Lola*,” which means “standing straight up,” because its panicle stands straight unlike the bending panicle of Asian rice. Many of the older women of Tujereng say they are happy if they see it in their rice field, and some say they mix a few panicles of *Mani ba* in the seed for the sake of tradition. Some older women also said that if you see *Mani ba* in your field, you know you will have a good harvest, it will bring you luck.

Changing beliefs and attitudes may also play a role in the sharp decline in African rice cultivation. In the Region de Sedhiou in Casamance women still maintain some cultural notions related to rice cultivation, such as the idea that mixtures in the field can be sown by “other beings” and should not be removed as this may cause problems in the future when the “other being” wants to collect his/her rice. It is only in recent years that woman in the Region de Sedhiou stopped the cultivation of African rice. This contrasts with The Gambia and northern Guinea-Bissau, where African rice was abandoned several or many decades ago. Interestingly, the men of the Region de Sedhiou are considered very

learned in the Koran, and their wives seem to maintain traditional cultural ideas more tenaciously than rural women in The Gambia or in Guinea-Bissau. It might therefore be suggested that Islam has played a part in the complex decisions among the Mandinka to abandon African rice cultivation (Linares 2002).

Guinea-Bissau: the Balanta

In Guinea-Bissau four different varieties of *O. glaberrima*, each with a slightly different cycle, are cultivated in both inland fresh-water and mangrove swamps but by only a few farmers, mostly Balanta and Jola (or Felupe, one of the smallest ethnic groups in Guinea-Bissau). In terms of husk (not pericarp) color, two varieties have a whitish husk, one has a black husk, and the fourth has a brownish-black husk. At present, only Jola farmers are still using the white husked *O. glaberrima* varieties in propitiatory agricultural rituals, but both the Balanta and the Manjako acknowledge that in former times only African rice varieties could be used in these rituals.

The white husked African rice varieties are said to be the “first rice”² and labeled by Jola, Balanta, and Manjako as either “primordial rice” or rice belonging to that particular ethnic group (e.g., *Malu brasa* meaning Balanta rice). The Balanta have a general name—*N’conton*—for all *O. glaberrima* varieties. This reflects their eating characteristics. Usually the term designates the leaves of edible plants (such as baobab, cassava, sweet potato) when they are old and hard to digest. *N’conton* are eaten during the “hungry gap” before the beginning of the main Asian rice harvest. Any surplus is then set aside to feed laborers, when a very nutritious food that is digested slowly is needed. It is also said that it cannot be eaten at night (the belly swells and hurts), especially by old people or young children, unless it is parboiled and subsequently cooked in a mixture with other varieties.

The majority of the farmers interviewed attribute the origin of African rice to God or the spirits, and only a few could trace any domestication pathway. The following statements of two Balanta farmers encapsulate the folk history that describes decentralized domestication in West Africa³:

In old times people discovered *N’conton* in the swamps. They harvested the seeds, [and] brought them home. Then they sowed it and had a huge output.

² The black husk African rice varieties are reported by Jola and Balanta farmers as being adventitious plants that appeared in the white husks varieties’ fields and that afterwards were selected and propagated.

³ This history contradicts Portères’ (1962) version of a domestication center in the inland delta of the Niger and two secondary centers of diversification.

N'thanthe (*O. barthii* [wild rice]) is *N'conton* (*O. glaberrima*). It was from *N'thanthe* that all *N'conton* varieties came. When you cultivate *N'conton* [for] many years on the same parcel [of land] it turns again into *N'thanthe*.

The Balanta are the main ethnic group in demographic terms in Guinea-Bissau, and they are also the sole producers of rice surplus in the country. Oral and written sources locate the Balanta homeland in a region in northern Guinea-Bissau, between Rio Geba and Rio Casamance (Hawthorne 2003). They later settled the coastal wetland zone, and developed more intensive mangrove rice farming from perhaps the sixteenth century.

In the northern Oio province they today practice upland, freshwater and mangrove swamp rice cultivation according to the mix of agro-ecological conditions found in each village. However, around 1900 when some Balanta migrated to the southern regions of Quinara and Tombali, driven by land scarcity and a desire to escape colonial forced labor, they concentrated exclusively on mangrove swamp rice and related technologies (Temudo 2011). They brought an African rice, *Mal-mon* (black rice), which due to its high salt tolerance is the first to be cultivated in newly created mangrove swamp fields. The seeds are also used as a medicine for hepatitis. The southern Balanta are considered the most skilled mangrove swamp rice producers in Guinea-Bissau, and perhaps on the whole of the West African coast.

Balanta farmers describe *N'conton* varieties of rice as having the shortest growing cycle until recent introduction of modern varieties, well adapted to poor and hard soils (its many roots are said to soften the soil), high tillering capacity, sufficient weed competitiveness to allow direct sowing and to limit weeding required and are drought tolerant and tolerant to pre- and post-harvest pests. They have erect panicles and the seeds shatter and germinate the following year, and plants can be uprooted and transplanted very early. They have hard grains that are difficult to cook and digest, that only slightly expand (due to high amylose content (Futakuchi and Sié 2009)) and have an unpleasant taste. These last qualities can be advantageous in times of scarcity when people would not complain if less than the usual quantity is served and when hard labor demands an especially filling meal. Old women also cultivate it on the dykes for medicinal purposes or to sell. According to other ethnic groups, today, the kinds of varieties that are hard to chew and difficult to swallow are said to be varieties associated with “[formerly] enslaved people.”

The red or brownish pericarp of African rice and some Asian varieties is considered a negative trait by women of all ethnic groups, most of whom still dehusk and polish their rice with a pestle and mortar. Both women and men state that people have always preferred to eat rice varieties with a white

pericarp, or varieties from which the red/brownish pericarp has already been removed. Today, women say that varieties with a red pericarp are “dirty,” and those who do not polish the rice until almost all the red pericarp is removed are considered lazy by their peers. However, while non-Balanta (mainly Muslim) women prefer varieties with a thin, white pericarp (known as “one mortar,” because they only need to be dehusked and slightly polished), Balanta women favor varieties with a thick (usually red) pericarp because the bran is important as pig food. Nevertheless hunger is a great leveler of preferences, and all ethnic groups eat the whole pericarp during the end of the hungry season, when the first panicles have matured and the grain must be parboiled to be dehusked. Until the 1970s varieties of African rice had the shortest growing cycle and during the hungry season could be eaten as whole grain flour mixed with some water and honey or sugar (a practice still observed among the Jola and somewhat similar to *munkoo* eaten by Mandinka). An advantageous characteristic of *N'conton* varieties reported by those farmers who still harvest rice panicle by panicle with a knife as it matures (a practice frequent among the Jola, but now rare among the Balanta) is that if the rains persist the plants ratoon (that is, they produce new tillers with panicles), thus prolonging the harvest for a further 3 months.

After independence, climatic instability increased, and people also began to travel a lot, regularly bringing back new rice varieties. *Mal-mon*, highly praised by southern Balanta farmers, began to be replaced, until only a few farmers still cultivated it. *Caublak* was the main variety adopted by Balanta farmers after independence due to its early maturation (less than 4 months), moderate salt tolerance, fairly stable productivity in different ecologies and climatic conditions and its relatively good eating and cooking qualities (Temudo 2011). In the Cubucaré peninsula, 10.6 % of Balanta (107 of 1008) cultivated *Mal-mon* versus only 0.5 % of non-Balanta farmers, although there were marked variations over the years (Fig. 5). In 1997, irregular rains led to a bad harvest and in 1998 an 11-month civil war began and southern farmers hosted internally displaced relatives and friends. This long period of rice scarcity led to an increase of *Mal-mon* cultivation among the Balanta in 1998 and 1999. In 2001 (and in 2005) exceptionally high tides destroyed many dykes, resulting in food insecurity and an increase in soil salinity leading to the second resurgence in *Mal-mon* cultivation in 2002 (Fig. 5).

Contrary to the situation in Tombali province, which has the highest rainfall in Guinea-Bissau, in the North and in the southern province of Quinara, Balanta farmers prefer the shortest cycle white husked *N'conton* variety, which is drought tolerant and has a high amylose content. This is cultivated in the upper part of the valley side soil catena where the soils dry quickly. Although many prefer the tastier short cycle rice belonging to the *Abulai* varietal complex, or

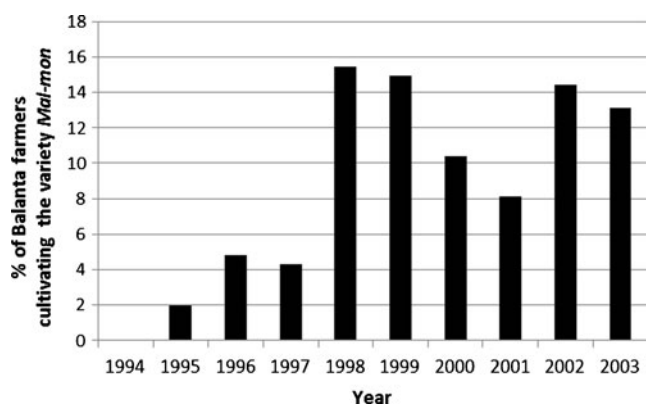


Fig. 5 Percentage of Balanta farmers cultivating the African rice variety *Mal-mon* in the Cubucaré peninsula, Guinea-Bissau, from 1994 to 2003. Source: M.P. Temudo and R. Figueira (unpublished data)

the recently introduced modern variety *Culhi néme*, the extent of African rice production is reported by farmers to be increasing due to its drought resistance and its slow digestive properties.

These facts call for a need to closely monitor the rate of cultivation of *N'conton* varieties and the factors influencing this rate as an indicator for the stability of rice production in the region in particular and in general of adaptation to climate change.

Guinea: the Susu

As in Akpafu Odomi (Ghana), there are few if any ceremonies associated with rice farming in the Susu area of Maritime Guinea because Islamic religious practices not related to rice cultivation are now dominant. However, there is still a strong folk belief that “rice yield” can be stolen by witches, or that the entire harvest might be stolen in the night by thieves. Specifically the African rice variety *Sali fore* is mixed at sowing with other varieties (African or Asian rice) to prevent theft and crop failure caused by witchcraft since it is well known in the area that one should never approach *Sali fore* by night, even when stored at home. No other variety of African rice is regarded as having this property. Farmers mixed on average three rice varieties per field (see Okry 2011). These mixtures,

called *Sumbu*, are made before sowing and should contain at least one African rice variety. However, 10 % of the mixed fields surveyed in 2007 were mixtures of only Asian rice varieties (see Okry 2011). In the other 90 %, African rice represented on average 50 % (min. 25 %, max. 75 %) of the mixture. A mixture of only African rice varieties was not observed in the study area. Farmers reported preparing *Sumbu* for different purposes:

- To protect the field against witches, for which only the variety *Sali fore* is used.
- To assure a stable yield and prevent crop failure. Farmers expect that at least one variety will survive unpredictable rainfall and decreasing soil fertility.
- To reduce the quick consumption of certain Asian rice varieties such as *Samba*, *Pode*, *Dalifode* which are very light but tasty, farmers purposely mix them with African rice varieties, most often *Sali fore* and *Tombo Bokary*. Some upland African rice varieties (*Siiga* and *Saafary*, for example) were not used to make up *Sumbu* but cultivated as stand-alone varieties, as were some of those used in *Sumbu*.

Table 3 quantifies the cultivation of African rice in Southern Lower Guinea from 2004 to 2007. African rice accounts for 15 % of the cultivated area. It is also important to note that the size of fields planted with African rice is comparable to those with Asian rice.

Sierra Leone: the Mende, the Temne, the Limba and the Susu

Findings from fieldwork in 2007 and 2008 show that communities within the chiefdoms in the north have fewer rice varieties per farmer compared to those in the south (Table 4). Gravelly and rocky soil may be a partial reason why farmers in the north grow predominantly African rice and farmer hybrids, as both seem to be well adapted to poor soils. For all studied ethnic groups rice with a red pericarp has a positive connotation. Additional research points to an increase in the cultivation of farmer hybrids in northern Sierra Leone during the war, possibly because they require low level of field management and are adapted to poor soils.

Table 3 Characteristics of the use of African rice (*O. glaberrima*) in variety number, percentage of total cultivated area and average field size, in upland rice cultivation in Southern Lower Guinea. (survey 2007 and 2008)

Year	Number of fields measured (N)	Total number of Asian rice varieties	Total number of African rice varieties	Percentage African rice (of total area)	Average field size with Asian rice (ha)	Average field size with African rice (ha)
2004	66	9	4	15	0.61	0.80
2005	86	5	5	18	0.54	0.53
2006	105	10	2	13	0.76	0.86
2007	170	13	5	15	0.69	0.67

Table 4 Average number of varieties cultivated by farmers in case study areas in Sierra Leone in 2008 (survey 2008)

Region	Chiefdom	Ethnicity	Average number of varieties	Standard deviation	Number of farmers (N)
North	Bramaia	Susu	1.15	0.36	112
	Kholifa Rowalla	Temne	1.85	0.63	476
	Magbema	Temne	1.76	0.59	235
	Tonko Limba	Limba	1.37	0.57	263
South	Kamajei	Mende	2.74	0.88	628

The case study areas in the southern part of the country are located within the interior lowland plateau (below 100 m) at the foot of the escarpment, with undulating lowlands. The vegetation is secondary forest “oil palm” bush and derived savanna. There is a strong preference for Asian rice varieties with a red pericarp (Table 5), perhaps because the soils are more suitable for Asian varieties. Traditionally, farmers in this region consider African rice as hunger-gap stand-by, sown early (in mid-April) and harvested late August to early September. These were non-photoperiod sensitive African rice varieties. These have now often been replaced with short cycle Asian rice varieties and farmer hybrids (Jusu 1999), with the advantage that the Asian and hybrid types are easier to thresh and mill. Rice with a red pericarp is also important in ceremonies for community gods of rivers, streams and trees and ancestral spirits that are performed by traditional societies, which are not considered in conflict with Islam or Christianity and are present within all ethnic groups.

Additional research conducted in Susu communities along the international borders with Maritime Guinea shows similar findings to those in Guinea. It is claimed that the African rice variety *Sali fore* has certain protective powers against witchcraft. Among Limba and Susu farmers *Sali fore*

is considered to be one of the oldest rice types and thought to have existed before the early settlers arrived. A widely known story among Susu farmers tells that at the time the original settlers made farms in the area, *Sali fore* germinated a spot where a black (spitting) cobra had been burnt accidentally during the preparation of the field, before the farmers had even broadcasted any seed. *Sali fore* is said to attract (cobra) snakes and caution must be exercised for all on-farm activities involving this variety. It is forbidden to take seeds from the barn during the night for fear of confrontations with the cobra.

Discussion

This paper offers a regional comparison of how socio-economic, cultural, religious and ecological factors shape the cultivation of African rice, based on a number of case studies in West Africa. The data show a range of complex interactions between ecological and cultural factors (Table 6). As a consequence of social and natural factors each region has developed preferences for different rice varieties, different combinations of variety characteristics and different assessments of the value of current and future value of African rice.

In certain areas (e.g., Danyi Plateau) the most important factors in the continued cultivation of African rice are ecological, while in others (e.g., Akpafu and Lolobi in Ghana) maintenance of African rice is almost entirely explained by cultural and religious factors. In yet other cases, such as in Guinea-Bissau, Guinea and Sierra Leone, ecological, socio-economic and cultural factors interact. Among the Mandinka in The Gambia, Casamance and northern Guinea-Bissau, African rice is gaining a new but negative significance. In the case of the Mandinka in The Gambia reduced rainfall

Table 5 Dominant pericarp color and average field size (ha) per rice type for each of the Sierra Leone case study villages 2007 (survey 2007)

Region	Village	(Sub) species	Dominant pericarp color	Average field size (ha)	Number of fields	Std. deviation
North	Bumban	unclear	white	0.611	22	0.329
		Asian rice	white	0.336	9	0.090
		farmer hybrids	red/brown	0.631	47	0.401
	Mayemberrie	unclear	white	0.393	8	0.412
		African rice	red/brown	0.271	32	0.177
		Asian rice	white	0.174	32	0.108
South	Mobai	farmer hybrids	red/brown	0.299	25	0.207
		Asian rice	red/brown	0.328	125	0.222
		unclear	white	0.053	1	
	Mogbuama	Asian rice	red/brown	0.312	162	0.271
		farmer hybrids	red/brown	0.069	5	0.052
		Asian rice	red/brown	0.255	202	0.245

Table 6 Main characteristics of the region concerning rice cultivation in the case study areas

Case study area	Region and country	Latitude	Specific soil conditions	Rainfall (mm)	Ethnic group	Crop cycle length African rice	Way of milling/polishing	Preferred polishing of red varieties	Preferred pericarp colour	Preferred rice species	Dominant factor in cultivating or abandoning African rice
1	Togo Hills Togo (Danyi Plateau)	7° 08'	poor & acid	1500	Ewe / Anhlo	2 months 3 months 4 months	hand	partly/full	red	African	ecology
1	Togo Hills Ghana (Siwu speaking)	7° 08'	rich forest	1200	Lolobi / Akpatu	3–4 months	machine	partly	red	Asian / African	culture
2	Gambia	13° 10'	sandy	<1000	Mandinka	3 months	hand	not cultivated	white	Asian / farmer hybrids	ecology / sociology / economy
2	Casamance	12° 50'	sandy	1000	Mandinka	3 months	hand	not cultivated	white	Asian / farmer hybrids	ecology / sociology / economy
2	Guinea Bissau (Madinaka)	12° 20'	rich forest	>1000	Mandinka	3 months	hand	not cultivated	white	Asian / farmer hybrids	ecology / sociology / economy
3	Guinea Bissau (Balanta)	11° 12'	salty (coast)	>2000	Various	3 months 4 months	hand	fully	white	Asian / African / farmer hybrids	ecology / sociology / economy
4	Guinea West	9° 40'		>2000	Susu	4 months	machine	partly	red	Asian / African / farmer hybrids	ecology / culture
5	Sierra Leone North	9° 10'		>1000	Various	3 months 4 months	hand	partly	red	Asian / African / farmer hybrids	ecology / sociology
5	Sierra Leone Central/South	8° 12'		>2000	Mende	3 months 4 months	hand	partly	red	Asian / African / farmer hybrids	ecology / sociology

during the 1970s in combination with the availability of good-tasting imported white-skinned rice and alternative varieties of short duration with interspecific origin led to a gradual abandonment of African rice.

The reasons given by farmers in Guinea for the cultivation and mixing of African rice indicate the influence in more or less equal measures of ecological, religious and/or sociocultural factors. In southern Guinea-Bissau the use of African rice is mainly determined by ecological (salt tolerance and poor soils), cultural and social factors (especially war). The robustness and short maturation period of African rice may have been a factor recommending it to farmers in war-affected northern Sierra Leone. Interestingly, a rice with alleged poor digestibility may be abandoned in some areas but become a preferred variety in others. In Guinea, farmers add the more slowly digested African rice to supplies of Asian rice to slow consumption and safeguard food security. In the Togo Hills partly removing the pericarp is not considered a problem as petrol-fed mills are available in most cases. In Sierra Leone and Guinea, farmers very much prefer unpolished red rice and the labor required for polishing seems not to be an issue. However, in Guinea-Bissau not polishing the red rice seems to be a social marker for laziness.

Across the region farmers commonly describe African rice as filling the stomach for a long time and as “heavier” than Asian rice. This may reflect the fact that African rice varieties in general have a relatively high amylose content, which slows its digestion. Rice varieties can be classified as high (25–32 %), medium (20–25 %) and low (10–20 %) in amylose content. The average amylose content of African rice varieties lies around 27 % (Futakuchi and Sié 2009). Bao *et al.* (2006) have shown that the amylose content of landraces is high when compared to modern varieties. This suggests that some local red and white Asian rice varieties may resemble African rice in terms of slow digestibility. This is in line with the assertion of Guinea farmers that *Saidou Gbeli*, a local red Asian rice, resembles African rice as far as digestibility is concerned. However, further research on amylose content needs to be conducted to provide more information.

In the Togo Hills the red pericarp is left on the seed when the rice is used to make rice flour that is then made into porridge or rice *fufu*, which consequently becomes reddish. When the whole grain is cooked, farmers consider the rice too fibrous to eat if the pericarp is not partly removed, although this rice is always preferred over white or fully polished red rice. This is similar to the preferences in Sierra Leone, although in Guinea-Bissau varieties with red pericarp are often disliked for human consumption among the Balanta, the bran is highly valued as fodder for pigs. Both in the Togo hills and among the Balanta of Guinea-Bissau African rice is said to have curative properties.

There is also variability in the acceptability of farmer varieties of hybrid origin in which pericarp color plays a part. Whereas farmer hybrids with red pericarp developed in the Upper Guinea Coast region are accepted in Ghana because they have red pericarp and look like African rice, they are not accepted by the Mandinka of Guinea-Bissau, The Gambia and Senegal, for precisely the same reason.

Regional differences in the appreciation of African rice can explain farmer responses to new technologies. The cultural and religious factors that maintain African rice within the Lolobi and Akpafu areas have resulted in recently developed Asian rice varieties *Viono* and *Aworema*, both with a red pericarp. This is an important finding as it is often thought that varieties with a red pericarp are “historical” while varieties with a white pericarp are of more recent origins. In Lolobi and Akpafu, religion and culture have opened up specific opportunities for a particular path of technology development.

In Sierra Leone red rice is preferred and African rice is still very much appreciated, although perhaps reduced in cultivation. The farmer hybrids that have become an essential part of rice farming are very similar in morphology and performance to African rice, which may explain their success as well as the abandonment of African rice in certain areas where many hybrids were found (Nuijten *et al.* 2009).

Among the Mandinka in The Gambia, Senegal and northern Guinea-Bissau farmer hybrids with white or light-brown pericarp, resembling Asian rice are very popular (see Nuijten *et al.* 2009). However, like African rice, the farmer hybrid seems to perform very well on poor soils. The Mandinka in northern Guinea-Bissau consider both the erect farmer hybrid type (very much appreciated in Sierra Leone) and African rice weeds.

A better insight into the cultural values and practices impacting the cultivation of African rice also allows us to better understand why farmer hybrids developed along the Upper Guinea Coast but not in the Togo Hills (Nuijten *et al.* 2009). The mixing of African rice and Asian rice remains a common practice along the Upper Guinea Coast but is not practiced in the Togo Hills because of political factors that have caused people to “isolate” themselves in the mountains during times of slave raiding and war (and thus have no access to lowland cultivation). As African rice still is an important identity marker for the people on the Ghanaian side of the Togo Hills, the mixing of African with Asian varieties is still uncommon even though Asian rice is grown in the uplands and lowland farming has been added to their cropping system.

Conclusions

This paper shows that the epistemology present in farmer innovations and preferences is determined by trajectories of

interaction between ecological as well as social factors (see also, Rana *et al.* 2007) that have resulted in specific preferences as well as tailor-made technologies for resource poor farmers. The need to acknowledge such trajectories implies arguing in favor of an endogenous, bottom-up food security revolution. Indeed, there are systemic alternatives to a top-down Green Revolution in Africa (Richards 2006; Offei *et al.* 2010). Together with ecological factors, sociocultural and religious factors all deserve attention in models of technology development and dissemination (Nuijten *et al.* 2012). African rice, across West Africa, embodies important values of historical consciousness and therefore is part of the social structure and order. The case studies presented show that African rice is maintained or abandoned because of different interactions between social and ecological factors. An important and challenging task for future research is to categorize and document and thus validate farmer material while not disconnecting cultural and historic data and data concerning preferences among varieties (Linares 2002; Temudo 2011). In doing so farmer varieties can be tested and disseminated just as has been done with the New Rice for Africa series (NERICA),⁴ probably achieving more successful adoption. West African history and culture have produced valuable mechanisms that have resulted in a great range of valuable farmer varieties and technologies. Doing justice to the “laboratories” of African farmers requires a new approach that takes advantage of subtle interactions between social and ecological factors at the local level to develop a whole new range of opportunities to increase rice production and improve food security.

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⁴ A set of varieties produced by AfricaRice by crossbreeding African and Asian rice.

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