

Rice Farmer's Perception Of Salinity Problem, Their Preferred Varieties And Cropping Environment In Niger

O. Souleymane¹, E. Nartey², B. Manneh³, K. Ofori², E. Danquah²,

1: National Institute for Agronomic Research of Niger (INRAN).

2: School of Agriculture, College of Basic and Applied Sciences, University of Ghana.

3: Africa Rice center (ex-WARDA)/AfricaRice Sahel Station B.P. 96 Saint Louis/Senegal
INRAN (Institut National de la Recherche Agronomique du Niger)/ CERRA de Kollo BP 429 Niamey Niger

Corresponding author: Souleymane Oumarou: Email: umarsou@gmail.com

Abstract

Participatory rural appraisal (PRA) was conducted in 3 regions in March 2012. A total of 197 farmers were randomly selected from 11 villages in irrigated ecology. The PRA tools included group discussion, individual interview, and field visit. Twenty composite soil samples have been collected from irrigated and non irrigated fields. Soil pH, electrical conductivity, exchangeable bases, cation exchange capacity, sodium adsorption ratio, and sodium potassium ratio have been determined. The results showed that lack of fertilizer, diseases and salinity problems, lack of good varieties are the main production constraints. 90% of the farmers are aware of salinity problem and the coping strategies are the use of manure and or ashes, use of straw, the avoidance of urea. The farmers preferred traits are high yielding ability, resistance to stress, the height and high tillering. Soils were acidic, the cation exchange capacity (CEC), electrical conductivity (EC) and sodium adsorption ratio (SAR) were significantly higher in irrigated fields than non-irrigated ones.

Key words: Rice, farmers 'perception, salinity, soil, participatory rural appraisal (PRA), Niger.

Introduction

Niger is a landlocked country in the heart of West Africa with a total area of 1,267,000 sq km, but only half of this is habitable due to adverse climatic or soil conditions (Hohenheim, 2000). Agriculture is the mainstay of the country's economy, with most families relying on subsistence farming (FAO, 2011). Rice production is estimated to be 10% of the total cereal production. Irrigated rice is about 80 to 90% of national rice production (Issaka, 2000). The national average yield is decreasing from 3.96 t/ha in 2000 to 1 t/ha in 2012. This led to a decrease of national total production from 78400 t in 2000 to 5,400 t in 2012 (INS and Mda, 2012). Information on characteristics of rice production environment and the role of various stakeholders is important

to identify factors to be considered in strategies to improve production. Key among these factors include the importance of rice among other crops in the area, rice production constraints, causes of low adoption of improved varieties, causes of abandonment of the adopted improved varieties, and farmer's preferences. Rice in this area is essentially cultivated under irrigation. Irrigation schemes, especially under arid and semiarid environments, are experiencing increasing levels of salt-affected soil because of mismanagement of the soils, irrigation and drainage principles, poorly designed and managed irrigation infrastructures, excessive and irrational use of irrigation water and global climatic change (Kashenge-Killenga, 2010). Therefore, it is important to know the characteristics of rice production environment, to identify farmers' needs and preferences and to establish the impact of salinity among other production constraints in rice production area of Niger.

Methodology

The study was conducted in three regions of western Niger, located in the semi-arid zone where rice is cultivated (FAO, 2007). These regions were: Gaya, Niamey, and Tillabery.

Sampling procedure

A stratified random sampling was used for villages sampling. The first stratum was where irrigation has been practiced for equal or more than 30 years. This is equivalent to at least sixty seasons under irrigation (2 seasons per year). The second stratum was where the irrigation has been practiced less than 30 years. Random samples of 30% of villages were taken in each of the two strata. This led to a sample size of 11 irrigated schemes. This includes 3 irrigated schemes less than 30 years and 8 more than (or equal to) 30 years old. The work was done with all the participants together in one group, if the number was less than 15, but if the participants' number was beyond this, they were split into two or more groups of eight to twelve farmers. A total of 197 farmers have been used in all the villages.

Composite soil samples from the plough depth (20 cm) were taken from each site. Composite soil samples were also taken from similar soils adjacent the sites which have had no history of irrigation. These latter samples served as control. The soil and water samples were analyzed in the soil laboratory of INRAN (National Institute of Agronomic Research, Niger).

Data collection and analysis

Group discussions were held to obtain community level information. The group of participants was guided by a moderator who introduced topics for discussion and helped the group to participate. The discussions were guided by a semi-structured questionnaire to get information on areas of interest. Preference ranking was used for the determination of the preferences of individual farmers. The pair-wise method was used to identify the preferred crop and the most important constraint of rice production in the area. Individual interviews were made to supplement the findings from the focus group discussion and for in-depth verification of key issues discovered. To verify information from farmers' field visits were conducted on farm. These involved three representative fields with salinity and without salinity problem.

Soil texture was determined using Day (1965) method. Soils pH and electrical conductivity were also determined. Total N of the fine earth was determined by using the Kjeldahl digestion procedure as outlined by Anderson and Ingram (1993). Total phosphorus and cation exchange capacity were determined using Murphy and Riley (1962) method and the available P by Olsen *et al.* (1954) method. The Sodium Adsorption Ratio (SAR) was calculated using (Mohsen *et al.*, 2009) method. The total dissolved ions in the water was measured as the sum of ions present in a sample of water and was used as an estimate of the total dissolved solids (Turf, 2005). SPSS 16.0 software was used for socio-economic data analysis. GenStat 9.2 and Minitab14 software were also used for statistical analysis. T-test and mean difference confidence interval approach were used for data comparison between irrigated and non-irrigated fields.

Results

Rice appeared to be the most preferred crop in the area followed by millet, sorghum and cowpea. All the farmers recognized that rice yield was decreasing over the years but diverged about the causes and extents. Forty-eight (48) percent of the farmers said that yield was reduced about 25% compared to 20 years ago. For twenty three (23) percent the yield reduction was about 50%. Eight (8) percent of the farmers said that it was more than 50% and twenty one (21) percent said that it was less than 25%.

Rice production was constrained by several problems such as lack of fertilizers, lack of good varieties, salinity, diseases, birds attack and flooding. Salinity was the third most serious problem impeding rice production after diseases and the lack of fertilizers. The lack of fertilizer and diseases were the two most serious problems and they were scored 4 and ranked first. Varieties

problem and birds attack were scored 2 and were ranked fourth. Flooding notified in only one village was the less serious problem in the area.

Ninety percent (90%) of the farmers in the area were aware of salt problem while the others were not aware. Salinity was recognized by farmers through its appearance at the soil level (40% of the farmers) and the symptoms on rice plants (50% of the farmers). Farmers also suspected salinity in cases of yield reduction despite applying recommended levels of mineral fertilizer.

According to the farmers that experienced salt problems on their fields, salinity symptoms on leaves of rice plants disappeared after the application of manure. Twenty-seven (27) percent thought that salinity came from soil degradation under irrigation and 32% thought it was inherited.

The yield reduction due to salinity ranged from less than 25% at Sebery to 100% at some abandoned fields of Saga. To improve productivity under salinity various strategies were employed by farmers. These were: the avoidance of urea application (4%), Application of manure (11%) or a combination of manure and ashes (6%) and Application of straw (9%). However, seventy percent (70%) of the farmers use no method to overcome salinity problem.

A number of improved varieties have been released for irrigated rice cultivation. The improved variety IR1529 was used about 20 years ago because of its relatively high yield and good taste. It was abandoned because the decreasing yields due to susceptibility to diseases and the high demand for fertilizer. Other varieties such as Wita 8 and Wita 9 were cultivated because of good yield and ability to grow under low nitrogen conditions. They were abandoned because of their sensitivity to drought, lodging, salinity and birds. BG, NERICA, and Gambiaka, were other improved varieties in use.

The foremost trait preferred by farmers was yield followed by resistance to diseases. The tolerance to salinity was the third preferred trait. High tillering ability was ranked fourth (4). Other farmers preferred traits such as height, earliness and low nitrogen efficiency that were respectively classified fifth, sixth and seventh. Grain quality such as good taste was the last trait preferred by rice growers. However, this was the most preferred traits at Gaya.

Soil characteristics

A huge variability exists within irrigated field soils and among irrigated and non irrigated soils texture. This variability existed also within non irrigated fields. Irrigated soils of Gaya Amont, Gaya Aval, Sokondji, Ndounga Sebery and Ndounga were predominantly composed of clay and

silt. At Saga, Toula and Bonfeba, sand was the main component of the texture. Most of none irrigated fields (NIF) were sandy soils. Irrigated fields soils were significantly different from non-irrigated fields' soils (at 0.001 probability level) in terms of clay content. Significant differences also existed among the two types of fields in terms of sand content (at 0.05 probability level). However, in terms of silt content the irrigated fields were not different from non-irrigated fields. Soils chemical characteristics for irrigated fields (IF) and non irrigated fields (NIF) were mentioned in the table1. Irrigated field fields were significantly different from none-irrigated ones in term of SAR, CEC, EC and Na/K. However pH of irrigated fields was not significantly different from none-irrigated one.

Table 1: Rice fields soils characteristics compared to non-irrigated fields

Sites		pH	SAR	CEC (meq/100g)	EC (dS/cm)	Na/k (%)
Gaya Aval	IF	3.4	2.19	18.99	6.5	34.2
	NIF	3.3	0.96	9.2	3.4	11.2
Gaya Amont	IF	3.2	1.82	14.88	5.7	22.2
	NIF	3.5	1.54	8.68	3.0	31.8
Diambala	IF	4.6	4.91	17.95	5.4	75
	NIF	5.8	1.04	7.73	5.3	7.4
Sakondji Birni	IF	4.4	4.42	13.92	5.2	22.5
	NIF	4.5	1.08	8.9	2.7	71.7
Sagua	IF	4.4	0.83	16.91	7.7	12.1
	NIF	4.1	0.68	11	5.2	16.7
Saga	IF	5.4	11.38	11.94	9.0	118.6
	NIF	5.5	0.94	8.13	2.2	4
Bonfeba	IF	7.2	1.83	19.09	16.5	7.8
	NIF	6.8	1.65	8.98	8.5	28.8
Sebery	IF	5.2	2.46	18.96	5.6	60.8
	NIF	5.6	0.49	17.75	4.6	10.8
Toula	IF	5.1	2.87	19.67	7.9	108.8
	NIF	5.4	0.49	20.2	7.7	5.4
Ndounga	IF	4.4	1.33	23.07	6.9	40
	NIF	5	0.81	10.16	6	6.8

Discussion

Importance of rice and framers' perception of its production constraints

Rice was the most preferred crop in the area because of three main raisons. First, rainfed crops production is constrained by several factors such as drought, pests and diseases and the use inherently low-yielding varieties of crops. Secondly, rice, more than all the others cereals, serves as food and also helps to solve economic problems. The contribution of the irrigated schemes to

the family basic food coverage varies from 30 to 190 percent (IPTRID, 2004). Thirdly, rice is cultivated two times a year giving it an advantage over other crops.

Salinity was the third most serious constraint after diseases and the lack of fertilizers. Farmers considered salt problem as a phenomenon that was imposed by nature and that occurrence can neither be predicted nor prevented. They thought that salt problem unlike the two first is a daily routine constraint that once appeared will remain for no limited time.

Farmers ‘perceptions of the salinity problem, coping strategies and expectations

Ninety percent of the farmers were aware of the salt problem. In all the villages but “Gaya Amont” this problem was mentioned. Yield loss can range from 10 to 100% depending on the salinity level and the cultural practices. Because of soil degradation, farmers realized that their field cannot produce using only mineral fertilizer. In some cases usage of urea was completely avoided by farmers because it was said to burn the rice plants. Straw, manure and ashes were also used in the area to deal with salt problems. Rice glumes and ashes were mostly used in Gaya, while manure was applied in Tillabery. These coping strategies aim to avoid effects of salt on soil structure by providing organic matter. The effects of exchangeable sodium on plants are either direct on plant nutrition or indirect through deterioration of the soil structure, leading to decreased hydraulic conductivity and aeration (Mahmood *et al.*, 2004). Organic matter application would enhance soil structure and reduce evaporation.

The most preferred rice characteristics were: yield, resistance to diseases, tolerance to salinity high tillering ability and height. Farmers were interested in yield because rice was for the population a source of income and food. All the improved varieties introduced in the region have been adopted because of their relative high yield, and rejected some years later because of their low yielding due to deterioration. The reasons for high preference for tall plants were that the majority of the farmers harvested rice panicles using knives while standing. Tall plants lessened the burden of bending to harvest (Efisue, 2007). Apart from this, tall plants had long rice straws and more biomass. Farmers used straw to feed their animals. Other preferred rice characteristics were earliness, low nitrogen efficiency, and taste. Short duration rice allow farmers to grow other crops or to consecrate their time to others activities. Because of the lack of fertilizer provision, farmers like varieties that can produce more with little amounts of fertilizer.

Rice production environment

Seventy percent (70%) of non-irrigated fields were sandy soils, while eighty percent (80%) of irrigated field soils were clay and silt. The higher percentage of the irrigated fields being silty and clay was due to the fact that these irrigation schemes were located in the low lying areas of the Niger River. These soils have capacity to store and supply water and air for plant growth (Adamu and Aliyu, 2012). Clay soils have a greater water holding capacity than sandy soils. In addition, well drained soils typically have good soil aeration meaning that the soil contains air which is conducive to healthy root growth, and thus, a healthy crop (Berry *et al.*, 2007). Results of non irrigated fields confirmed FAO (1994) report which said that sahelian soils are generally sandy with sand percentage varying between 71 to 99% at the surface layer.

The results showed that the pH of all fields was lower than 5.6 except for Bonfeba. This was too low for optimum development of rice. Most agronomic crops require soil water pH values between 5.7 and 7 for optimum plant growth (Kidder *et al.*, 1988; Kalra, 1995; Miller and Kissel, 2010). Soil pH is among the important environmental factors which can influence plant growth (Reeuwijk, 2002). Soils formed under low rainfall conditions tend to be basic with soil pH readings around 7.0. However, intensive farming over a number of years with nitrogen fertilizers or manures can result in soil acidification (Cliff, 2005). This may be the reason why the irrigated soils pH was more acidic than none irrigated soil. Irrigated Fields EC was too high (16.5dS/cm at Bonfeba and 9dS/cm at Saga) to induce severe yield reduction of rice. In these two areas fields are completely abandoned. This great EC level may partly be due to irrigation because irrigated fields had greater value of electrical conductivity compare to none irrigated one. However, some fields that have never been irrigated had also high EC. This was due to inherent soil salts composition.

The sodium adsorption ratio (SAR) was significantly higher in irrigated fields than non-irrigated ones. Munshower (1994) reported that SAR along with pH, characterize salt-affected soils. When the SAR rises above 12 to 15, serious physical soil problems arise and plants have difficulty absorbing water. The greatest level of SAR was observed at Saga irrigated fields. These fields were abandoned because of salt problem. So the great salt content may explain this high SAR.

Sodium to potassium ratio was significantly higher in irrigated schemes than non irrigated schemes despite application of K fertilizer application in the irrigated rice fields and this could be attributed to the high addition of Na from the irrigation water.

The CEC of irrigated field was significantly higher than for non irrigated fields likely due to their higher clay and organic matter contents. Low CEC soils were more likely to develop potassium and magnesium deficiencies, while high CEC soils were less susceptible to leaching losses of these cations. The lower the CEC, the faster the soil pH will decrease with time.

Conclusion

The results of this study showed that yield, resistance to diseases and salinity, high tillering ability and height were the most farmers preferred traits. The soil pH was low, the electrical conductivity (EC), the sodium adsorption ratio (SAR), the cation exchange capacity (CEC) and sodium potassium ratio were significantly higher in irrigated fields compared to non-irrigated ones. Most of the farmers' rice fields were saline soils.

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