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## **RICE PRODUCTION IN SURINAME: AN OVERVIEW**

D.J. REES, D. HILLE RIS LAMBERS,  
B. BAIDJOE, S. DIPOIKROMO & J.W. VAN DER EB

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## GENERAL

Suriname is known for extra-long grain rice with high quality cooking characteristics, which attracts considerable demand in Europe. Suriname produces most of its rice in Nickerie, but significant production also exists in the districts Coronie and Saramacca. In 1986 rice exports accounted for 11% of total export earnings.

Approximately 50,000 ha have been empoldered for rice production: 850 ha in Regio Oost, 5,500 ha in Saramacca, 3,600 ha in Coronie, and 41,000 ha in Nickerie. Some 11,000 ha are managed by government foundations (Nickerie district). The Ministry of Agriculture estimates that over 80% of the remaining area is under hereditary long lease or land lease, with less than 10% managed on a simple rent basis, and less than 5% owned as allodial property. 12,000 ha are farmed by "small farmers" (1-12 ha), and 18,000 ha are farmed by "large farmers", with over 250 ha land.

Table 1 summarizes 1985-1991 production and export statistics. Cropping intensities (total area planted per calendar year / total rice area) declined from 1.5 in 1985 to 1.2 in 1991. The limited period between seasons demands well-managed irrigation scheduling and machinery, something which was not available in the period 1986 to 1991 due to political instability and shortage of foreign exchange for machinery replacement/ maintenance. As a result paddy production and export of cargo rice declined. 1992 estimates however, indicate an increase in production and export (77000 t cargo exported in 1992), following the partial liberalization of rice marketing, the increase in prices announced for paddy, and the import and sale of approximately 300 tractors. Table 1 indicates an average yield of 4.2 t/ha of wet paddy (18-22 % moisture content).

## SOILS

The northwest corner of Suriname (Nickerie) is a flat coastal plain with an area of several hundred square kilometres. The coastal clay soils of the area (typic tropaquepts in the USDA system, eutric gleysols in the FAO system) derive from marine and estuarine sediments originating mainly from the Amazon area (Pons, 1966). Sand ridges rising above the mud-flats, and sand/silt layers within the sub-soil occur only occasionally in the Nickerie area (Noordam & Blik, 1985). Apart from very small areas of acid sulphate clays, the soils vary relatively little, consisting of partially or deeply ripened young silty clays to heavy clays (Table 2). Bulk densities vary from 0.95 - 1.1 g/cm<sup>3</sup>, with very low saturated permeabilities, less than 0.6 cm/day. The soils are moderately to strongly acid (sea clays pH 4 - 5, acid sulphate clays pH 3- 4), with high cation exchange capacities (24 - 36 me/100 g), high base saturation (50 - 90%, dominated by Mg), relatively high organic matter content (3 - 7%) and medium to high total phosphate content. In general the soils are only slightly saline (electrical conductivities less than 1.0 mS/cm), but some areas have conductivities of 1.5 - 4.0 mS/cm, reflecting lower-lying areas and/or areas that may have been irrigated or flooded with brackish or saline water.

Table 1. Rice production and export values (Ministry of Agriculture &amp; SUREXCO).

	1985	1986	1987	1988	1989	1990	1991
Wet paddy (t)	325,910	326,747	295,860	288,938	284,199	213,500	249,750
Dry paddy (t)	299,185	299,954	271,599	265,245	260,895	195,993	229,271
Available for planting (ha)	49,000	49,400	49,400	49,600	49,600	48,200	48,200
Planted acreage (ha)	74,890	75,136	71,155	69,520	69,860	52,005	60,085
Cropping intensity	1.53	1.52	1.44	1.40	1.41	1.08	1.25
Sowing seed 150 kg/ha (t)	10,485	10,519	9,962	9,733	9,780	7,281	8,412
Animal feed & transport losses (t)	8,976	8,999	8,148	7,957	7,827	5,880	6,878
Dry paddy before processing (t)	279,725	280,436	253,490	247,555	243,287	182,833	213,980
Husk and crushing losses (t)	67,134	67,305	60,838	59,413	58,389	43,880	51,355
Cargo rice available (t)	212,591	213,131	192,652	188,142	184,898	138,953	162,625
Export (parboiled) cargo rice (t)	94,651	91,647	103,743	68,083	83,077	62,006	47,038
Cargo available for processing (t)	117,940	121,484	88,909	120,059	101,821	76,947	115,587
White rice (t)	96,711	99,617	72,906	98,448	83,494	63,096	94,781
Rice polish (t)	21,229	21,867	16,004	21,611	18,328	13,850	20,806
Export (broken) white rice (t)	43,084	6,897	8,877	8,973	2,013	2,936	2,954
Inland consumption and stocks (t)	53,627	92,720	64,029	89,475	81,481	60,160	91,827
<i>EXPORT ACCORDING TO DESTINATION</i>							
EEC (t)	98,584	82,700	101,858	67,637	79,177	60,406	46,588
Caribbean countries (t)	23,396	15,845	10,012	9,346	5,913	4,536	3,404
Other countries (t)	15,755		750				73

Table 2. Chemical and physical properties of paddy soils of Nickerie (from Noordam & Blik, 1985. R1 - R7 refer to the soil units marked on the Semi-Detailed Soil Maps of Nickerie, published by the Soil Survey Department of the Ministry of Natural Resources & Energy. Data for soil unit R6 is not available).

	R1	R2	R3	R4	R5	R7
Clay (%)	65.2	60.8	57.0	64.6	51.1	61.0
Silt (%)	34.5	38.4	42.7	35.1	47.4	38.6
Saturated permeability (cm/day)	0.56	0.52	0.27	0.31	0.16	0.50
Bulk density (g/cm <sup>3</sup> )	1.14	1.06	1.0	1.10	0.97	1.08
CEC (me/100 g, pH 7)	29.4	27.3	28.8	25.8	26.8	29.0
Exchangeable bases (me/100 g)	24.2	24.8	22.5	22.4	13.2	23.4
Base saturation (%)	82	91	75	87	50	80
EC (S/cm, 1:2.5)	720	575	2153	1400	1380	2167
Organic matter (%)	2.7	4.6	5.0	3.3	5.6	4.2
Total phosphate (ppm, 25% HCl)	676	469	241	307	506	291
pH (1:2.5 H <sub>2</sub> O)	5.9	5.2	5.2	4.6	5.0	5.0
pH (1:2.5 KCl)	5.1	4.0	4.1	3.8	3.3	4.1

- R1: Eenheid series: deeply ripened clay, e.g. Europolder  
R2: Saramacca series: superficially ripened clay with nearly ripe sub-soil, e.g. Groot Henar Polder  
R3: Saramacca series: superficially ripened clay with half-ripe sub-soil, e.g. Extn. Hampton Court, Prins Bernhard Polder  
R4: Saramacca series: superficially ripened acid sulphate clays e.g. Corantijn Polder  
R5: Clara series: superficially ripened acid sulphate clay, e.g. Clara polder  
R6: Waterland series: ripened clay over clayloam to sand, e.g. Longmay polder  
R7: Krapa series: ripened clays over clayloam to sand, e.g. Corantijn polder

The soil units R1, R2 and R3 are the major soil-types of Nickerie; the acid sulphate clays (R4 and R5) occur only in parts of Corantijn and Nanni polders, near to the Corantijn river, whilst the units R6 and R7 (clay top-soils over clayloam to sand subsoils) are mainly restricted to the Corantijn, Nanni, Clara and Longmay polders. Little systematic difference has been observed in rice yields between the units R1, R2, R3 & R4, whilst R5, R6 & R7 are generally less productive (Noordam, 1985). Phosphate deficiency symptoms have frequently been observed by farmers and Ministry of Agriculture officials on the acid sulphate soils of Corantijn and Nanni polders, parts of Sawmill and Hampton Court (soil units R3), and parts of Longmay (soil unit R6). Application of phosphate fertilizer had little or no effect on rice yields on the R1 soil of Europolder, a moderate effect at Prins Bernhard Polder (soil unit R3) and a large effect at Longmay (Keisers, 1985). These results were in accordance with the relative soil total phosphorus data presented by Keisers (1985). However the soil phosphate data of Noordam & Blik (1985) and of Keisers (1985) show large discrepancies for the same soils, making it difficult to use the soil survey maps except in a qualitative way. The phosphate deficiency symptoms observable in Sawmill and parts of Extension Hampton Court are not explained well by the available soil maps, as these are both shown as R3 soil units. Overall, it should be noted that the areas of phosphate deficiency, although significant, represent only a small percentage of the total rice growing area.

Noordam & Bliet (1985) speculated that continuous rice cropping could reduce soil phosphate to levels where fertilizer supplements could be required, and this concern has frequently been repeated by farmers and Ministry of Agriculture officials. Continuous rice cropping for many years has not resulted in increased requirements for phosphate fertilizer in South East Asia (Grist, 1993), and the occurrence of phosphate deficiency symptoms in Nickerie does not appear to have changed since the mid-1980s. There does appear to be a need for proper definition of the geographic boundaries of areas requiring phosphate fertilizer, and for determining the best rates and methods of application within those areas, but it is doubtful whether the need for phosphate fertilizer is likely to increase substantially in the near future.

Data on soil nitrogen content are not available, but considerable yield responses to application of nitrogen (urea) fertilizer up to 180 kg/ha N have been reported (Keisers, 1987). Studies on rice fertilizer requirements on the different soils have not been carried out to date.

Noordam (1985) presents data on the degree of flatness of the Nickerie polders. None of the polders had average height differences less than 10 cm (flat), the generally accepted criterion for good water management. All of the polders had average height differences between 10 & 25 cm (nearly flat) apart from three, Nanni, Nanni Bruto and Extension Groot Henar, with average height differences greater than 25 cm (uneven). Noordam (1985) demonstrated a significant negative correlation between paddy yield and a derived index of flatness, suggesting that "nearly flat" fields yielded 600 kg/ha less than "flat" fields in 1985. A more recent survey classified fields into four categories: Good, height difference 0 - 10 cm; Medium, 10 - 20 cm; Poor, 20 - 30 cm; and Very Poor, > 30 cm (Haskoning, 1991). All polders surveyed were classified as Medium to Poor, *i.e.* average height differences 10 - 30 cm, which can be assumed to be a major factor contributing to increased weed, red rice and pest infestation. Actual field research to quantify yield losses and pest problems associated with poor land surface preparation is warranted, to quantify the costs and benefits of precision levelling.

## CLIMATE

Temperatures are fairly constant throughout the year, with monthly average values of 25 - 26 C during January and February, and 27 - 28 C from August to October (Table 3, Appendix 1). Relative humidity, sunshine duration and windspeeds are also fairly constant, averaging 70%, 61% and 5.5 m/s, respectively.

Table 3. Summary meteorological data, Nickerie 5°57'N, 57°02'W (Meteorologische Dienst, Suriname).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave./Tot.
Rainfall (mm)													
Mean	151	94.6	92	166	236.9	269	242	156	75.8	53.6	81	160	1727
Max	427	297	258	454	480	492	397	282	343	182	224	441	2216
Min	17	15.7	1.6	0.3	50.4	82.9	112	29.4	5.8	0.5	6.1	28.9	973.8
S.D.	110	73.5	68	115	100.5	84.1	84.3	69.5	64.7	46.2	53	91.3	325.2
Maximum Temperature (C)													
Mean	28.6	28.8	29	29.4	29.4	29.4	29.7	30.4	31.1	31.1	31	29.3	29.8
Max	29.7	29.5	29.8	30.2	30.3	30.2	30.4	31.3	32.2	32.2	31	30.4	30.4
Min	27.8	28	28.3	28.7	28.6	28.5	28.4	29.5	30.3	29.8	30	28.4	29.2
S.D.	0.6	0.5	0.5	0.5	0.5	0.4	0.5	0.4	0.6	0.6	0.5	0.5	0.4
Minimum Temperature (C)													
Mean	23.5	23.7	24	24.2	24.1	23.9	23.5	23.8	23.9	23.8	24	23.7	23.8
Max	24.2	24.7	24.9	24.9	24.9	24.9	24.4	24.7	24.7	24.3	25	25	24.5
Min	22.5	23	23.2	23.4	23.3	23.3	22.9	22.8	22.7	22.7	23	22.6	23.1
S.D.	0.5	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.5	0.6	0.3
Relative Humidity (%)													
Mean	69.8	66.5	66.7	68.9	72.9	74.4	72.6	69.5	67.3	67.6	69	70.9	69.7
Max	76.6	71.4	75.7	77.4	78.9	78	75.5	75.9	73.6	73.1	75	77.1	73.1
Min	64.9	58.7	60.3	61.6	66.6	70.1	69.3	65.8	63	62.3	61	65.3	66.8
S.D.	4.5	3.8	3.8	4	3.1	1.9	2	2.5	3.1	3	3.4	3	1.9
Sunshine duration (hrs/day)													
Mean	57.1	60.6	60.9	58.2	56.6	56.4	63.9	72.3	76.5	73.9	70	58.1	61.4
Max	74.8	76.8	80.1	80.5	82.7	71.8	80.4	83.4	87.4	90.3	84	75.3	70.8
Min	2.5	4.3	11.1	4.1	21.9	41.4	4.6	8.4	7.3	4.8	4.1	4.2	5.6
S.D.	16.6	15.9	15.5	17.9	12.3	7.4	15	16.2	17.9	17.7	17	15	17
Windspeed (m/s)													
Mean	5.8	5.8	5.9	6.3	6.4	6.4	5.3	4.8	4.3	4.8	5	5.8	5.5
Max	7.3	7.4	7.4	7.5	6.9	7.9	6.2	6	5.5	5.5	5.9	7.3	6.1
Min	4.3	4.4	4.2	4.5	5.1	5.5	4.5	4	3.5	3.6	3.5	4.2	5
S.D.	1	0.8	0.9	0.8	0.5	0.6	0.5	0.5	0.6	0.6	0.7	0.8	0.3
Class "A" pan evaporation (mm)													
Mean	130	142	166	157	132.1	130	142	157	166.5	175	166	140	1801

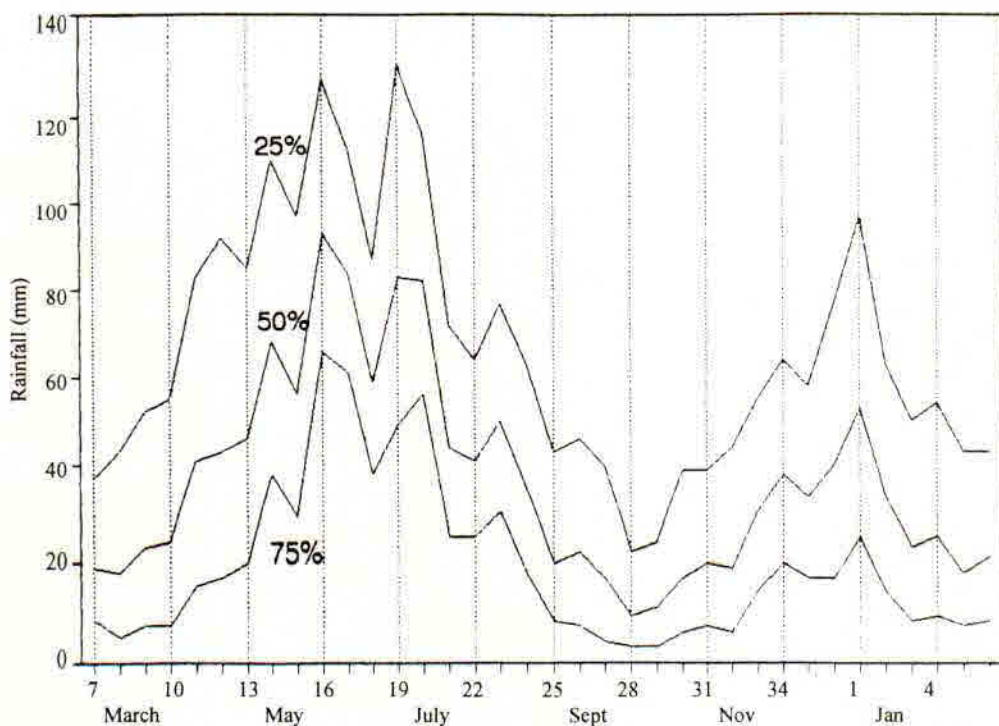


Figure 1. 10-day rainfall totals at different exceedence probabilities, S.E.L. (1963-1992).

Figure 1 presents 10-day rainfall totals at various exceedence probabilities for 30 years daily rainfall records from Prins Bernhard Polder, Nickerie. Two rainy seasons can be distinguished: April to August, with median rainfall of 1005 mm, and rainfalls less than 830 or more than 1218 mm in 10% of years; and November to January, with median rainfall of 373 mm, and rainfalls less than 196 or more than 635 mm in 10% of years (Table 4).

Table 4. Rainfall totals at different exceedence probabilities, calculated from Prins Bernhard Polder (S.E.L.) data (1963-1992) fitted to the incomplete-gamma distribution.

Exceedence Probability	April-August	November-January	Annual
0.99	750	104	1337
0.90	830	196	1462
0.75	893	270	1561
0.50	1005	373	1735
0.25	1132	499	1929
0.10	1218	635	2059
0.01	1347	926	2252
Mean	1031	398	1775
S.D.	227	164	362

Theoretical crop production schedules, based on a six week sowing scheme and the current 120-125 day varieties, are shown in Table 5. Two crops per year are possible with such a scheme, though the intercrop periods (time between harvesting one crop and sowing the next) are rather short, leaving little time for primary tillage to control pests and weeds. It would also be necessary to start sowing the second crop at a time when rainfall probabilities are rather low, necessitating good irrigation water supply. Poor infra-structure maintenance and shortages of machinery and spare parts have resulted in crop production schedules that fall far short of the theoretical scheme, with an average 12-week sowing scheme (OAS, 1989), resulting in a considerable overlap in the time when some farmers are sowing and others harvesting, and harvesting during the rainy period (Table 5). As a result cropping intensities (the number of crops sown on the same piece of land per calendar year) have declined to 1.1-1.3 from values of 1.8 recorded in the early 1980s (Ministry of Agriculture statistics).

Table 5. Theoretical 6-week sowing scheme, and current crop production schedules.

Season	Seeding Period	Harvesting Period	Intercrop Period (days)
Theoretical schedule			
Long rains	May 05 - Jun 16	Sep 07 - Oct 19	10 to 52
Short rains	Oct 29 - Dec 10	Mar 03 - Apr 14	21 to 63
Current practice			
Long rains	May 15 - Aug 07	Sep 12 - Dec 05	-20 to 64
Short rains	Nov 15 - Feb 07	Mar 15 - Jun 07	-23 to 61

## PRODUCTION PRACTICES

Continuous rice mono-cropping is practiced. Rice production is characterized by low labour input and heavy dependence upon machinery and chemicals. Tractors are universally used for land preparation; most farmers contract sowing by aeroplane, and use combines for harvesting. On larger farms fertilizer, herbicide and pesticide application are contracted out to an aeroplane service. The farming systems of the large and small farms are similar; the smaller farms rely more on manual labour, whilst the larger farms use hired aeroplane services instead.

Since the late 1980s, few farmers carry out primary tillage between crops. Tillage is generally reduced to seedbed preparation (weed-cutting, followed by puddling with disc harrows, and smoothing the soil surface with wooden beams). The evenness of the paddy fields surfaces is not very good (average height differences 10 - 30 cm) which combined with direct-seeding has led to an increase in red rice infestation.

Pre-germinated seed is sown onto flooded paddy fields. In the past, fields were drained immediately after sowing to encourage early emergence and stand development, with re-flooding at 10-15 days after sowing, but since the mid-1980s many farmers have taken



to maintaining the flood from sowing to the first fertilizer application four weeks later as a means of reducing red rice infestation. Standing water is maintained on the paddy fields from sowing or from 10-15 days after sowing until grain-ripening, with occasional drainage periods for fertilizer application, and for application of herbicides and pesticides.

The rice variety of choice for most farmers is Eloni, with other varieties being used only if Eloni is not available. Almost all rice varieties derive from the breeding program of SML at its LON facility. They have been selected for extra-long grains, stiff straw, moderate tillering ability, resistance to rice diseases and pests, and maturity within 115-125 days. The varieties are also characterized by smooth hairless leaves and glumes, desirable during harvest in that smooth glumes reduce wear and tear on machines. Current varieties can also outgrow the water layer that is imposed on the crop as a measure of red rice control. Some farmers also grow a variety (Marshall) not bred by SML, but informally introduced from the region. Its advantage is reputed to be its vigorous growth and competitiveness with weeds. But its quality and straw stiffness are low. The line SML 84011/1 was officially released as variety Groveni in July 1994, having already informally found its way to farmers several years earlier. All the major current varieties derive from the breeding program of SML at its LON facility. Suriname is well-known internationally for its long-grain rices bred for mechanized rice culture. SML's breeding programme has served the rice growing community since 1951. Its releases since 1958 include some 24 varieties, sixteen major ones of which are listed in Table 6. Four of these are still being maintained on a commercial scale. Variety Awini (1971) was the first Suriname variety with semi-dwarf plant type. Varieties have otherwise been characterized by (i) stiff straw, (ii) extra-long grains around 8 mm or more, (iii) very good cooking quality.

Table 6. Rice varieties bred at SML, Suriname, from 1959.

Variety	Year released	Year hybridized	Years lag
Magali	59	54	5
Tapuripa	59	56	3
Apikalo	59	56	3
Alupi	60	57	3
Sml 128-4	61	56	5
Matapi	63	59	4
Acorni	71	66	5
Awini	71	67	4
Apani	71	67	4
Boewani	72	66	6
Ciwini	74	67	7
Ceysvoni	74	69	5
Camponi *	74	70	4
Diwani *	76	68	8
Eloni *	79	70	9
Ferrini *	90	80	10
Groveni *	94	84	10

\* current in 1992.

