AN APPRAISAL OF RICE PRODUCTION AND MARKETING PROBLEMS IN BRITISH GUIANA

by

H. Rouse Caffey, Director
The Rice Experiment Station

and

J. Norman Efferson, Dean
The College of Agriculture

of

The Louisiana State University and
Agricultural and Mechanical College

April, 1965

AN APPRAISAL OF RICE PRODUCTION AND MARKETING PROBLEMS IN BRITISH GUIANA

by

H. Rouse Caffey, Director, Rice Experiment Station
and
J. Norman Efferson, Dean of the College of Agriculture
of
Louisiana State University

April, 1965

This report is the result of a brief study made by the authors on a visit to British Guiana from April 4 to April 10, 1965, of the rice industry of British Guiana. This study was sponsored by The Agency for International Development with the cooperation of The Ministry of Agriculture and other major ministries of the British Guiana Government. The authors received complete and enthusiastic support from all of these agencies and from other private and public groups in the country. The opinions and recommendations expressed herein, however, are solely those of the authors.

The authors wish to acknowledge the special assistance given them while conducting the field work by Mr. Harry Yoe, Country Director, and Mr. Edward H. Stroh, Comptroller, of the Agency for International Development; Mr. Carlson, Consul General, and Mr. Ogg, Vice Consul, of the U. S. Department of State, Office of the Consulate General, Georgetown; Minister of Agriculture The Hon. Llewelyn John, Minister of Works & Hydraulics The Hon. Mohamed Kassim, Minister of

Planning The Hon. D. A. Farnum, and Mr. S. M. Selman, all of the central government of British Guiana at Georgetown; Dr. Harry Paul, Chief Agricultural Officer and Mr. C. P. Kennard, Entomologist, Mr. Albert Agurd, Botanist, and Mr. S. Bisessar, Plant Pathologist, of the Mon Repos Experiment Station of the Ministry of Agriculture; Mr. A. C. Chan, Mr. S. Singh, Mr. Thomas Vonkersammy, Mr. B. Maraj, and Mr. J. Mitchell of the British Guiana Rice Development Company; Mr. J. L. Ching, Divisional Co-ordinator; Mr. Leo Ramotar, District Commissioner for the Island of Leguan; Mr. Jack Alli, Manager, and Mr. H. L. Sobrian, Asst. Manager of the Rice Marketing Board; and Mr. Martin S. Simon, of The Connell Rice and Sugar Company.

In addition, there were numerous other individuals who assisted in making the study educational and interesting; the authors visited the Mon Repos Experiment Station, the Mahaicony/Abary Rice Development Scheme, the rice-growing and milling areas on West Coast Demerara, the Vergenogen project, the rice industry of Leguan Island, the Black Bush Polder and the Mara Development Schemes, the rice industry of the Adventure area and the Anna Regina Development Company rice mill. They also observed and studied rice production and milling on large farms, small farms, single-phase rice mills, multiple-phase-community rice mills, the large Rice Development Company mills, and the rice storage, shipping, packaging, and processing facilities of the Rice Marketing Board in Georgetown. To all of these individuals, the authors are truly grateful.

In Washington, the work of Mr. Charles Howard Thomas II and Miss Patricia Ann Price, British Guiana Desk Officers for the Agency for International Development, was greatly appreciated.

The authors do not consider themselves to be experts on rice in British Guiana, agriculture in general in British Guiana, or on any other aspect of that country. They recognize fully the danger of short-time foreign experts attempting to make long-term recommendations without the necessary background and understanding that is essential to sound planning. Thus, they hope their comments and recommendations will be used as points for discussion to stimulate further thinking and planning, and not as iron-clad facts.

They enjoyed the opportunity of visiting with, and observing the work of, many highly-skilled and dedicated individuals working in all fields of rice production, milling, and marketing, and in other agricultural areas. At the end of the field study period, the authors were more than ever convinced that British Guiana has a large group of enthusiastic leaders and that the country has great potential for development in rice and in other areas of agriculture.

They considered their assignment to be one of applying to the over-all rice and other agricultural problems of British Guiana the accumulated knowledge and skills they had developed through years of experience in working in rice in the United States and in other countries throughout the world. It is their hope that some of these accumulated experiences, including some of their mistakes, can be shared with British Guiana agriculturists and planners to help in a

small way in their rapidly expanding efforts to improve productivity in the rice industry and standards of living for the country as a whole.

Recent Trends and Current Status of the British Guiana Rice Industry

Rice production in British Guiana has increased very rapidly in recent years. For the 1956 to 1960 five-year period, the acreage planted averaged about 160,000 acres; the average yield of paddy per acre was about 1,900 pounds; and total paddy production amounted to around 140,000 tons which produced about 90,000 tons of milled rice. In 1963, the acreage increased to 260,000, which was an increase of more than 60 per cent over the most recent 5-year average. Yields per acre increased slightly and total production of paddy amounted to more than 240,000 tons or an equivalent of about 160,000 tons of milled rice. Acreage planted was down slightly in 1964 due to weather conditions and other factors but indicated acreage in 1965, assuming current levels of price support, is for 270,000 acres.

This substantial increase in rice acreage in recent years has been due to the development of several large governmental land development schemes including land clearing, irrigation systems, etc., and the maintenance of stable, guaranteed support prices for paddy rice to producers at a sufficiently high level so that existing growers have been encouraged to increase production and new growers have been attracted into the business of growing rice.

Mechanization, making possible labor and cost reductions, has been responsible for much of this acreage expansion. The industry has changed in less than 15 years from a largely hand-transplanted, oxen-plowed, hand-weeded, hand-cut, and oxen-threshed operation to a largely mechanized system. This system includes tractor plowing, the broadcasting of pre-sprouted seed in carefully-flooded fields, careful water control during the growing season to control weeds, and harvesting by combines. At present, the industry has more than 3,000 operating tractors and more than 300 large self-propelled combines for harvesting the crop. Current estimates are that no more than 30,000 of the 270,000 acres planted in 1965 will be handled by the old hand methods, while 240,000 acres will be handled under the semi-mechanized approach. Government experiments proving these methods possible followed by government purchase and loan programs and government assistance in the development of mill cooperatives, cooperative harvesting pools, and the like, have been responsible for much of this development in mechanization. On the many government-sponsored development schemes, combine pools are maintained whereby producers can contract to have rice harvested at rates varying from BWI$1.50 to BWI$2.00 per 140-pound bag of paddy harvested, and this practice has spread to privately-operated small farm areas. On some of these developments, contract work for major tractor work, such as plowing, is also possible under various cooperative and private-rate approaches.

A firm price-support program has stimulated these developments. In 1946 the British Guiana Rice Marketing Board was established by law as the only buying and selling organization for all rice produced in the country. The Board purchases milled rice according to prices by grades fixed from time to time. With the exception of producers who can deliver to the two large mills of the quasi-government Rice Development Company, the price is based on milled rice of a given grade delivered to the Rice Marketing Board at their major warehouse and shipping office in Georgetown. The producers with access to the two large mills of the Rice Development Company have the opportunity to sell paddy rather than milled rice. For most of the rice produced, however, it must be milled and delivered to Georgetown before the producer receives payment for his crop. As a result, most of the more than 200 rice mills in the country operate as toll mills. The toll charge varies according to custom in the region and whether or not the grower takes back the by-products, but is usually around BWI$1.50 per bag of parboiled milled rice produced and BWI$1.80 per bag of raw white milled rice produced when the grower does not take the by-products back for livestock feed, to BWI$2.50 per bag for parboiled or raw white rice when the grower takes available by-products back to his farm. According to general custom and understanding, it takes two 140-pound bags of paddy or rough rice to produce one 180-pound bag of milled rice. This is an over-all 64 per cent yield of milled rice from paddy rice. According to the reports of millers interviewed, this 64 per cent return includes

about 52 per cent whole rice and 12 per cent brokens when parboiled rice is produced and around 24 per cent brokens and 40 per cent whole rice when raw white rice is produced.

The price support program operated by the Rice Marketing Board, although an indirect one for the most part as it is based on milled rice, has served to stabilize and stimulate the production of rice in British Guiana. For the average grade, No. 1, the support price was BWI$9.00 per 180-pound bag in 1950, was increased to BWI$16.00 in 1955, further increased to BWI$17.60 in 1960, and has been maintained at BWI$18.95 in 1964 and 1965. This grade is one containing up to 25 per cent broken and discolored grains and the support price is equivalent to about 5 U.S. cents per pound for paddy and 6½ U.S. cents per pound for milled rice. At this support level, British Guiana rice is being supported at the same level as United States rice of much higher quality and from 20 to 25 per cent above the world price level for rice of equivalent quality.

The recent rapid expansion of rice production at support prices above current world market levels for the type and quality of rice produced in British Guiana has created major problems in the industry. In the 1960-62 period, the country produced around 100,000 tons of milled rice annually. Of this volume, about 40,000 tons was consumed domestically and around 60,000 tons exported to the Islands of the British West Indies under preferential trade agreements dating back to the wartime rice shortage period. All of this

rice was medium-grain, off-white, parboiled rice which, due to the large East Indian population of both British Guiana and the Islands of the West Indies and to long-time consumption habits, was preferred or at least accepted without objections by the mass of consumers in the region.

In the 1964-65 period, total rice production was expanded to an annual level of around 170,000 tons of milled rice. With the increased population in the region, 45,000 tons annually is being consumed domestically, 60,000 tons sold in the British West Indies, and another 5,000 tons to miscellaneous export markets. Thus, a total available market exists for only 110,000 tons of the 170,000 tons being produced, leaving an existing surplus of 60,000 tons yearly. Last year up to 30,000 tons of this surplus was sold to Cuba but so far in 1965, large-scale markets for last fall's poor-quality production plus the spring crop being harvested in March and April have not been found.

All of the mills visited were stacked to capacity with sacked milled rice. The central warehouses of the Rice Development Company and of the Rice Marketing Board in Georgetown were filled. Serious difficulties were being experienced in finding a place to put the small 35,000 acre spring crop then being harvested. Insect infestation of the stored milled rice was becoming very serious and major deterioration has already occurred in some of the stored milled rice from the 1964 fall crop, harvested last October. Unless markets are found in the next few months (before the large 200,000 to

235,000 acre fall crop, planted in April and harvested in October of 1965, is harvested), much of the 60,000 ton surplus now in storage is likely to be almost a total loss.

The problem is accentuated by the fact that most of the rice is stored as milled parboiled rice because the long-time purchasing practice of the Rice Marketing Board has been to pay producers only when milled parboiled rice is delivered. So long as available markets existed for this quality rice in the nearby British West Indies, there were no problems. When production expanded beyond this level, however, other world export markets were not interested in medium-grain, medium-quality, off-white, red-rice-contaminated, parboiled rice. Outside of Asia, mostly India, there is little demand for medium-grain, medium-quality, parboiled rice. The countries importing rice and paying hard currency for their imports are demanding mostly long-grain, high-quality, raw white rice and long-grain high-quality, parboiled rice. There also is some export demand for medium-grain, high-quality, raw white rice. The rice now stored in the warehouses throughout British Guiana does not fit these specifications.

In addition, the large 1964 fall rice crop of British Guiana had a much higher than usual level of insect damage, mostly scarred grains caused by the paddy bug or stink bug. Such damage is very serious for parboiled rice as any grain defect is accentuated when the parboiling process is completed. Also, much of this crop had the odor and discolored grains characteristic of rice which had been

stored as paddy at too high a moisture content or had been improperly dried. These factors have in total resulted in an average quality for the existing surplus stocks of rice which leaves much to be desired. Enroute on their return to the United States, the authors visited rice shops and discussed rice quality with consumers in Trinidad and Jamaica, two of the important markets of British Guiana. The complaint was universal that the current crop of imported British Guiana parboiled rice was lower in quality in terms of color and broken grains and had an outstandingly obnoxious odor. The complaint regarding odor was so widespread (and on checking the samples available for sale, was justified) that it appears that British Guiana must solve this problem if they expect to hold even their existing markets in the British West Indies.

The 1964 parboiled milled rice crop now in storage must be moved quickly if it is to be salvaged. Some of it will have to be re-milled with an approximate 5 to 10 per cent loss before it can be sold at any price because of existing insect contamination. After re-milling, it must be moved in four to eight weeks or it will become re-contaminated because of existing insect eggs that are not removed in the re-milling process.

This rice was purchased from growers at prices ranging from BWI$16.00 to BWI$22.50 per 180-pound bag of milled rice, and averaging about BWI$19.00 per bag. This is the equivalent of US$6.50 per hundred pounds. The current international market price for equivalent rice of this type, "Ngasen, full boiled," produced in Burma, is around

US$4.50 per hundred pounds. Because of transportation differentials the chances are that a competitive price for British Guiana rice of this quality would be around US$5.00 per hundred pounds f.o.b. at Georgetown. This means that if the existing surplus of milled, medium-grain, parboiled rice in British Guiana is to be moved into international markets, the chances are that British Guiana will have to take a loss of from US$1.50 to US$2.00 per bag under what they paid growers for the rice, or a net loss of from 20 to 25 per cent. It is also possible that some of the rice has deteriorated to the point that it can be sold only for brewers rice or livestock feed at prices in the US$3.00 per hundred pound class, or a loss of 50 per cent. For the milled rice now in storage, there is little choice - it is sell it in the next few months or face a complete loss.

The Long-Time Potentials for Rice Production in British Guiana

The authors are convinced that British Guiana can produce high-quality rice efficiently. They are convinced that the country can continue to produce good quality rice for the domestic market and quality rice of the type demanded in their nearby export markets of the British West Indies. They believe that with some adjustments in growing, storing, processing, and marketing practices, that the country can also develop a modest but growing export market for high-quality, long-grain and high-quality, medium grain rice in other export markets.

The reasons for this position are (1) the country has soil types that are well-adapted to rice production; (2) the rice areas are well-adapted to mechanization and skilled mechanization experts are available; (3) because of favorable rainfall and the ingenious use of varying tide levels and other devices, irrigation costs are much less than for most rice countries; and (4) the country has the trained, experienced, enthusiastic personnel to develop and maintain a prosperous efficient rice industry.

The alluvial coastal soils of British Guiana appear to be very well adapted to rice production without major declines, and are of such quality that they respond readily to good management practices, such as fertilization, rotation, and the like. Many of these soils compare very favorably, and in some cases appear more productive, than the high-quality rice soils of the United States, of Burma and Thailand, and of Ecuador and Brazil. In addition to the existing approximately 250,000 acres now available for planting rice, it appears that an additional 100,000 acres of equal-quality soil could be developed at a reasonable cost if increased demands for rice and other adapted crops occur.

The average yield, around 2,000 pounds of paddy per acre, is not high. United States yields average around 4,000 pounds per acre and yields in Argentina, Peru, and Uruguay are in the 3,000 pounds per acre class. This yield picture in British Guiana, however, is not because of poor soils. In view of existing farming practices, the authors were surprised to find average yields as high as they

are. The practice of growing rice year after year on the same land and in some cases taking two crops a year continuously for 40 or more years is one which could continue to exist only under exceptionally good soil and climatic conditions. Combined with this practice is the lack of widespread use of chemical fertilizers, the lack of effective water control, and the lack of effective weed control. Thus, in light of existing farming practices, the yields are higher than they would be under similar production practices in most of the major rice-producing countries of the world.

Some of the coastal soils, however, are not well adapted to rice production. The "Mara" project, for example appears to be one which might better be shifted to crops other than rice. The Vergenogen area, unless it can be reorganized so as to be more adapted to complete mechanization, also appears to be somewhat marginal as a long-time rice area. As new areas are developed, extreme care should be taken to be sure that the soil types and existing water supplies are such that the region will produce good rice yields over a long period of time.

In the area of mechanization in rice, British Guiana leads the entire Caribbean area. The more than 3,000 tractors and 300 combines now in use demonstrate this fact. The shift from ancient hand-planting methods to largely mechanized operations has been more rapid in British Guiana than in any other country in the region. In the process, a large core of trained skilled tractor drivers, combine operators, mechanics, and the like, has been developed. In most developing

countries of the world, such skills do not exist. These abilities provide a firm foundation for continued improvements in rice mechanization, for mechanized agriculture of other types, and for trained workers in urban industry. In the area of training for mechanized skills, the rice industry of British Guiana is contributing greatly to the over-all development of the country.

There are major gaps in the over-all mechanization program in rice in British Guiana which must be filled if the industry is to become more efficient. Although plowed by tractors, the land is now seeded by hand. This can be mechanized. Little or no weed control other than by irrigation is practiced. In some areas, chemical weed control by mechanized means is clearly a possibility for greatly increased yields. Although harvested by combines, the paddy is sacked at the combine, and transported and stored in sacks. Bulk harvesting, transporting, and storage offer great promise in reducing man labor costs and storage and sack expenses. Also, most of the paddy rice and the parboiled paddy is dried by hand on open-air concrete patios. This requires a large amount of hand labor and does a less efficient drying job in comparison with mechanical driers. Other possibilities for mechanization in growing rice include mechanical application of fertilizers, insecticides, and fungicides and tractor land-leveling for more efficient water control. In the area of milling, and especially in the parboiling and drying parboiled paddy process, and in materials handling throughout the milling operation, substantial increases in efficiency are possible. This involves mostly bulk handling rather than the laborious and expensive sacking and re-sacking operation.

Most of the rice areas are extremely well adapted to low-cost irrigation and drainage practices. In many areas, gravity-flow irrigation, without pumping of any type, is a practical reality. In other areas, under large Government-sponsored programs, water is available at very reasonable rates. Although some British Guiana producers were complaining because they were being charged BWI$4.00 to BWI$5.00 per acre per year for water, charges for water in the United States under similar circumstances would be from US$15.00 to US$25.00 per acre. Water costs in other countries of the world where effective artificial irrigation is practiced are generally higher than in British Guiana.

Apparently because of the availability of reasonable water supplies at relatively low rates, irrigation practices are not as efficient as other parts of the production program. In addition to a waste of water, this is resulting in substantial yield reductions. These yield reductions are due to too much water in parts of a given field, flooding out the young rice, and too little water in other parts, stimulating grass and weed growth and giving inadequate moisture for the rice crop. In the recently-developed mechanized areas, such as the Mahaicony/Abary Scheme and the Black Bush Polder Scheme, the attempt to develop large rectangular fields of up to 50 acres in size without ditches or levees has resulted in inefficient water control. Yields could be increased on these fields without interfering with the efficiency of tractor and combine operations with the use of simple broad-base contour levees such as those used in the United

States, Venezuela, Southern Brazil, and other major mechanized rice-growing areas. Also, the new practice of land-leveling in water should be given a thorough trial in British Guiana as it offers possibilities for effective water control and increased yields under certain circumstances.

As to the final factor, qualified personnel, the authors were very impressed with the quality of the people interviewed at the Mon Repos Research Center, the Government Offices in Georgetown, the Rice Marketing Board, the various production and milling centers of the British Guiana Rice Development Company, the Development Officers in the rural areas, and the many farmers and private millers visited in the different rice regions. Here again British Guiana has a lead over the remainder of the rice-growing areas of the region. With these men to provide the effective leadership, the rice industry has the basic trained manpower to solve the present crisis and to build an efficient competitive industry.

Efforts must be continued, however, to build on this nucleus of trained men. Additional research workers in rice breeding, farm practices, mechanization, drying, and milling are needed. Additional extension officers in the rural areas to disseminate quickly known facts to producers and to help them with their production and marketing problems are needed. An expanded educational program to train more leaders of these types is essential to the continued development of the rice industry and the agricultural program of the country as a whole.

With all these advantages, however, British Guiana faces a current crisis in rice. This crisis is due to overproduction of the quality of rice which they produce for domestic and British West Indies markets, and a failure to find markets for this surplus at prices within the level now being paid growers for all rice produced.

The failure to find markets for the surplus production is due to the low quality of the rice produced combined with a domestic price support level which is from 20 to 25 per cent above the world price level for rice. The remainder of this report will deal with an analysis of the reasons for the low quality rice produced, how high-quality marketable rice can be produced, and how the efficiency of the industry can be improved so that it can compete in world markets and the growers can make a satisfactory return at support prices lower than those now being provided.

Reasons for the Present Level of Quality of British Guiana Rice

Any farm product which must be processed before being consumed is always a subject of controversy between the growers and the processors as to who is responsible for quality variations. For rice, in British Guiana and in the United States, the growers blame the millers for low quality and the millers blame the growers. The truth of the matter is that all are equally responsible and, in the case of British Guiana, equally at fault. The miller cannot mill "super" rice from "No. 3" paddy. Thus, the first step in producing quality rice

is to produce high quality paddy. The miller can, by faulty milling, poor storage, and inadequate packaging, reduce "super" paddy to "No. 3" milled rice. Thus, the second step in producing quality rice is to maintain the initial quality of paddy by careful and efficient storage, milling, packaging, and handling. The relatively low quality of British Guiana's present rice crop is due to factors in growing, harvesting, storing, milling, and marketing, as follows:

1. The rice is highly contaminated with red rice. Practically all of the samples of paddy checked in the mills and on the drying floors were highly contaminated with red rice averaging close to 5 per cent and in some samples more than 10 per cent. In the growing fields, even some of those being maintained for pure seed, heads of red rice were so frequent as to be clearly identified. At least 75 per cent of all samples of rice examined in the field, on drying floors, and in the mills would be classified as below minimum standards for government price support at any level in the United States.

Growers argue that red rice can be removed in the milling process as the grains are white underneath the outer red layer. This is true but it requires such a high degree of milling that the percentage of broken grains increases so much that over-all value is greatly reduced. Also, there are increased milling costs. In addition, the occasional striped grain that slips through is sufficient to reduce the grade, especially in export markets.

A high incidence of red rice is associated with the use of impure seed, contaminated fields where rice has been planted year

after year without rotations, lack of an effective roguing program, ineffective land preparation, and incomplete water control.

2. The varieties are badly mixed. Although more than 90 per cent of the rice grown in British Guiana is reported to be of the medium-grain variety #79, it is apparent that the seed planted is badly mixed with long-grain types, medium-grain types, and short-grain types commonly appearing in practically all samples. It is true that a given sample is predominantly medium-grain, but this usual sample also has other grain types.

Mixtures of the type commonly seen in British Guiana result in a higher percentage of broken grains than is commonly obtained because the milling machinery can be set for only one type, and contrasting types either break or are improperly milled. The results are high breakage and a lack of uniformity in the milled product.

Mixed varieties are usually associated with planting rice year after year on the same land, thus encouraging the development of off-types, the use of impure seed, mechanical mixtures due to failure to clean the combine or the sacks in which seed is stored, and poor cultural practices resulting in a failure to eliminate existing off-types in the field.

3. Much of the rice is damaged in the field due to insect attacks. Insect damage, and especially the damage to grains caused by a sucking insect, the paddy bug or the stink bug, is a major factor reducing the quality of British Guiana rice. Although parboiling results in a more nutritious product and a higher percentage

of whole grains, the process serves to intensify the bad appearance of any grains which have been scarred by the paddy bug. Rice which has been severely attacked by the paddy bug is usually so dark in color when parboiled to be of little or no marketable value.

The authors were informed that paddy bug damage for the 1964 crop was unusually severe because the 1964 disturbances caused farmers to neglect daily observations in their fields; thus, the insect attacks gained a head start before measures were taken to stop the attacks. At any rate, the 1964 crop was badly affected and such attacks must be stopped before they become severe if quality in the future is to be maintained.

Farmers report that the major difficulty is determining the extent of an attack and when to apply insecticides. They imply that by the time the damage is identified, it is too late. This is not necessarily true, except in the case of the stem borer. Although the indiscriminate use of insecticides is not wise, because it results in high costs and the danger of destroying beneficial insects while building up resistance in harmful ones, insecticide applications for paddy bug control are possible in time to prevent major damage. Farmers can be trained to make multiple-sample observations several days each week, and to start insecticide applications when the samples show sufficient insects to justify control.

4. Some of the milled rice shows typical heat damage to paddy. Many samples of the paddy and milled rice examined had the characteristic light-yellow grains and distinct smell that is associated

with heat-damaged paddy. Some of the growers interviewed implied that this discoloration was due to paddy bug damage, but the difference between paddy bug damage and heat damage is clearly identifiable - with paddy bug damage the grain is dark, almost black; with heat damage in paddy, the grain is a light yellow.

An observation of how some of the rice was being harvested along with discussions as to how the large fall crop of 1964 was handled gives some good indications as to the cause of this damage. The usual practice is to combine at 18 to 20 per cent moisture, but moisture checks at the mill indicated that some rice was combined with moisture up to 25 per cent. This rice is then sacked and transported to the mill. If transportation is not readily available, it is left stacked in sacks on the roadside or river bank, sometimes uncovered. Then several days to possibly several weeks later, the rice is delivered to the mill to be checked for moisture and if too high, it is then dried on the open air patios. It appears that large volumes of paddy in certain areas, especially the remote ones with only water transportation, is harvested at excess moisture levels of 18 to 25 per cent and stored in sacks for several weeks before drying. The result, as was evident by the samples examined, is inevitably to be major heat damage.

Heat damage is associated with storage in sacks or bulk for periods longer than 24 hours after being harvested at moisture levels in excess of 15 per cent. Such damage is accentuated if the sacked rice is left in the open and is exposed to one or more rains. It can

be eliminated by prompt drying (within 24 hours) after harvesting, either in mechanical dryers or on patio floors if there is no rainfall.

5. Much of the parboiled milled rice has a dark color and a distinctly offensive odor. Parboiled rice is generally classified as "light parboiled" and "dark parboiled." Generally light parboiled, which is only slightly off-white in color in comparison with raw white rice before being cooked and is completely white in color after cooking without special odor, brings a higher price than dark parboiled, which in addition to being light to dark yellow in color has a characteristic and often obnoxious odor. Much of the parboiled rice now being produced in British Guiana and stored in the facilities of the Rice Marketing Board is of the lower-valued dark parboiled type.

High-quality light parboiled rice can and is being produced in British Guiana. At several of the smaller mills visited, good quality very light colored parboiled rice was being produced. At the larger mills, however, the usual production was of the darker-colored smelly type of less value and for which there is little export demand.

There are almost as many different methods of producing parboiled rice as there are rice mills in British Guiana. In the smaller mills where the higher-quality, lighter-colored parboiled rice is generally produced, the paddy is first soaked in cold water for 24 to 48 hours, then placed in 50-gallon oil drums, and steam

introduced at the bottom. When the steam appears at the top of the barrel, some 5 to 7 minutes later, the steam is cut off and the barrel immediately emptied on the patio drying floor. After drying, the paddy is immediately milled to produce the relatively high-quality, light-colored, non-offensive-odor parboiled milled rice. Other mills follow the practice of soaking the paddy in pre-heated water for 18 to 24 hours, then placing the soaked paddy in 50-gallon drums with a perforated pipe in the middle through which steam is introduced for 2 to 3 minutes, and then the drums emptied and the paddy dried on the usual patio drying floors. The quality of this rice based on samples examined at the mills visited was almost as good as that produced by the coal-soak bottom-drum-steam-method with rapid cooling practiced by the smaller mills. For the larger mills, the usual practice is to soak the paddy in hot water with a temperature of 150 degrees F. for 6 to 7 hours, then drain and pass live steam through the large bins for 10 to 12 minutes, and after this process, remove the steamed rice from the bins and dry as soon as possible. The product by this method is one produced in great volume and at less time required than by the slower drum steaming method, but is significantly darker in color and lower in quality as judged by market demand standards.

The major difference in methods between the small slower-processing method practiced by the small mills and the large bulk processes of the larger mills appears to be the difference in soaking time and in cooling and drying time after the steam is introduced.

These variations suggest the need for intensive research as to methods of pre-soaking, steaming, and cooling and drying to produce the type of parboiled rice, the very light colored, non-aromatic type, which is desired by most consumers.

Research conducted by Dr. Harry Paul, Chief Agricultural Officer, has indicated that the development of the offensive smell in parboiled rice may be prevented if the water in the soaking tank is clean and fresh and is changed at least every 12 hours. In addition, this research has indicated that if the soaking and milling processes are being conducted during a period of wet weather, then it will pay to add glacial acetic acid at the rate of 2½ pints per 100 gallons of water used at the beginning of the soaking period. Although proved, this practice is little used in the present commercial production of parboiled rice in British Guiana.

The facts indicate that, given the proper incentives, good quality light-colored, non-odorous, parboiled rice can be produced in British Guiana.

Recommendations

The problems of the rice industry of British Guiana are more than simply that of over-production in relation to available markets. Now that the quantity of rice produced is sufficient for domestic consumption and that required for the British West Indies market, emphasis must be shifted to producing rice of improved quality. The production of quality rice is needed to insure present markets, as some of the traditional customers, such as Trinidad and Jamaica, are

objecting to the present quality delivered and are actually purchasing some of their rice from other sources. Also, improved quality is essential if new markets are to be found for the production beyond long-time markets in the British West Indies.

The responsibilities involved in producing rice of better quality are manifold; the rice grower, the drier and mill operator, the processor, the research and extension team, and the marketing agencies are all involved. Some of the limitations to the achievement of this goal in British Guiana include mixed varieties, red rice contamination, insect damage to growing rice, faulty harvesting and drying, variations in methods of parboiling, storage problems involving insect attacks on milled rice, and the development of acceptable grain types with the cooking quality desired by most export markets.

All of these items are important and a failure in one link in the chain will cause quality losses which cannot be recovered by efficiency in all other phases of the production, processing, and marketing system. Realizing that a short visit to any rice production and processing area is not sufficient to become fully acquainted with all the problems and methods that are being used to help solve the existing difficulties, the authors want to discuss each of the above topics as they observed them in April, 1965. The suggestions offered that might be implemented as means of reducing the degree of each of these limitations to the production of quality rice should be considered in light of the limited time involved in the study and the possibility that there are others equally important to each topic.

Mixed varieties. Upon examining rice from the many different rice regions of British Guiana, one of the most apparent indications in all of the samples studied was the lack of uniformity of grain size. It was evident that the standard variety, No. 79, had not only undergone severe mixing from mechanical means and volunteer plants from the fields, but perhaps some of the variation observed was due to selection practices used by the rice farmers in their seed program. Most of the farmers visited indicated that they saved their own seed for planting the next season. This was done by selecting a small area within their field, sometimes roguing the field or pulling out the red rice, off-types, and weeds, and then harvesting this part of the total field to save the seed for the next crop. If a combine was used to harvest this field, it was not cleaned before harvesting the seed plot, so mixtures from other fields became a part of the "seed" and further contaminated the varietal purity.

Since the Ministry of Agriculture sponsored and promoted "pure line seed," a check was made to attempt to find out why this seed was not better utilized by farmers. There seemed to be two main barriers to the use of this seed, namely: (1) a slight increase in cost over farm-saved seed; and (2) lack of genetic purity even in "pure-line seed" so that they felt there was little to gain by paying the higher costs. The first reason, the higher cost, did not appear to be reasonable. In fact, the usual charge of BWI$2.00 per 140-pound bag of seed rice over the sale price of this same paddy to the mills, was really not enough to pay for the increased costs of

producing pure seed. The second reason was the really valid one. This seed (and especially that produced in the Berbice area) should never have been called "pure-line seed." The "pure-line seed" observed by the authors growing in the fields and stored in the Ministry of Agriculture warehouses was not the kind of seed which would give varietal purity. The reasons for this poor quality were:

1. Poor initial seed source. Some of the varieties used still were segregating; thus a really pure line was not possible.

2. Inflexibility in adjusting production practices to changing physical conditions. Line-item budgets were too rigidly enforced and the seed growers were not given the opportunity to adjust to changing weather conditions.

3. Failure to practice crop rotation so that red rice and undesirable mixtures could be controlled. Generally, the seed growers felt if rotations were practiced, someone else might plant the field once it was left fallow for a growing season.

4. The seed was not cleaned because of inadequate cleaning equipment and the poor design of the small amount of machinery available to clean the pure-line seed.

To correct these problems, the system used by the Ministry of Agriculture should be revised to upgrade the nucleus of pure seed of established commercial varieties. The following program, modified if needed according to local conditions, is suggested as an approach to make better seed of known varietal purity available to rice farmers.

1. At the Mon Repos Central Agricultural Experiment Station, make 1000 to 2000 panicle selections each season for each variety for which pure-line seed is desired. These panicle selections should be done by experienced rice breeders for varietal purity and uniformity.

2. Plant these in panicle rows (some plantings by the preflood and transplanting method if possible) and as the plants grow, rogue all those that segregate or are not true to the variety type.

3. Harvest those remaining and bulk the seed. This harvest should be by hand, with extreme care taken that there are no mechanical mixtures.

4. Plant the bulked-head row seed from the above seed source the next season and during the growing season rogue severely for off-types and red rice.

5. Harvest this seed and plant approximately 2 to 4 acres of "Breeder" seed. During the growing season, this planting should be rogued thoroughly and kept free of mechanical mixtures at all times.

6. Plant "foundation" seed (about 40 to 80 acres per variety) depending upon the number of varieties and the demand.

7. Make this "foundation seed" available for increase at each of the three regions now used to produce pure-line seed. Increase it in each region (100 to 200 acres per variety depending on the demand) being certain to keep it free from mechanical mixtures and from red rice and other varieties that might volunteer from the previous plantings on the seed fields.

8. Sell this seed to farmers, along with an educational program to indicate the importance of pure seed in the production of quality rice and why the available seed is pure. The price should be higher than that presently charged, but the farmer would be assured of a superior product which will bring him a higher income.

In order to make the above suggestions effective, there will of necessity be some changes in the existing program for seed production. The first of these is in the land used for seed increases; it will have to be substantially increased. Land for pure seed production should be fallowed for at least two growing seasons after a crop of rice. During this time it should be cultivated to destroy volunteer red rice and weeds. Thus, at the central experiment station at Mon Repos and at each of the three seed production centers, there must be at least three acres of land for each acre planted to rice, with the other two acres being rotated in any given year.

Another important change will be in developing farmer acceptance and demand for this higher priced seed. This eventually will depend upon price differentials received for producing high-quality uniform rice. In the beginning, until the farmers see by the higher prices received that it more than pays to buy this higher-priced pure seed, the extension personnel of the Ministry of Agriculture can help in the promotion of this seed program.

Red rice. Contamination with red rice is perhaps the most serious limitation to the production of quality rice in British Guiana. Most of the fields are infested with red rice and in some fields it

is more abundant than the planted variety. This is also one of the most difficult problems to solve because at least one crop of rice is grown each year on all of the rice lands and on some areas two crops are produced. With such intensive land use to rice, without unusual care and special protective measures, red rice continues to build up in the soil and in the seed.

Red rice not only causes problems in loss of quality, but it descreases both field and mill yields. In the fields, it shatters before the usual commercial varieties mature and, consequently, reduces the yield per acre. It also competes with the planted variety for plant nutrients and water and consequently further reduces yields. In the milling operation, it must be milled harder to remove the red bran. This reduces milling yield by causing a larger percentage of broken grains and a greater relative loss of saleable rice which is removed in the lower-valued bran.

Red rice infestation can be reduced only through good management practices. It is a relatively slow process, but one which must be carefully followed if rice of acceptable quality with efficient yields is to be produced. To achieve this goal, the following approaches should be used:

1. Plant seed that are free of red rice. This is essential even if it is known that the fields planted are severely contaminated with red rice. Planting contaminated seed will only accentuate the problem and planting clean seed is the first step toward reducing the severity of the infestation.

2. Rogue the fields in order to eliminate red rice that is present. Farm labor can be easily trained to recognize red rice plants as they begin to produce heads and destroying these plants before they mature and shatter seed is an effective way to reduce infestation.

3. In British Guiana, water planting, by reducing germination of red rice and by eliminating more of the plants when they germinate, is one of the practices used to control red rice. This practice should be encouraged in areas of severe red rice infestation. The fields should be worked in the water to destroy existing vegetation. If drained after planting, the fields should not be allowed to dry as this stimulates red rice germination. Keeping the field moist until time for flooding the field will assist in reducing red rice production.

4. In extremely bad infestations of red rice, it may be necessary to leave the land out of production for at least one or two seasons. The land should be cultivated during this time, preferably planting to upland or dryland crops, to destroy volunteer red rice plants before they mature and to encourage the germination of seed left in the soil. For rice to be produced for seed, this practice is essential.

5. Regular rotations, including usually one year in rice and two years in other crops, is the most common practice for reducing red rice infestations in most of the commercial rice areas of the world. Under the special conditions in British Guiana, such

	Insecticide	Dosage	Time Limitation before Harvest
Rice paddy bug:	Malathion	½ lb. EC	7 days
	Sevin	1½ lbs. sprayable	14 days
	Methyl parathion	¼ lb. EC	15 days
	Phosphamidon	¼ lb. EC	21 days
Rice water weevil:	Aldrin for seed treatment	¼ lb. EC per 100 pounds of seed	

For the rice stem borer, endrin is recommended as a control, but this must be applied as a preventive insecticide rather than as a corrective measure. If the producer waits until he can observe evidence of stem borer damage, it is then too late to take effective control measures. By this time, the damage has already been done and the application of insecticides is useless.

Because of the proximity of one rice field with another (usually with only a narrow levee to divide them), a most serious limitation in controlling rice field insects is that of getting the adjoining farmer to apply insecticides. Otherwise, the effect of the applied chemical is often of very short duration as the unaffected insects from the nearby untreated fields migrate to the treated field and in a few days the infestation is about as serious as before the application of the chemical.

If a "block" of several farmers with adjoining fields were organized to apply insecticides cooperatively (preferably by airplane

rather than with the present hand dusters), this problem of migration from untreated fields could be solved. Demonstrations of this type could be easily started in concentrated areas such as the Black Bush Polder or the Mahaicony/Abary Scheme. With the production of better quality rice which would bring a substantially higher price, other growers would be encouraged to adopt similar cooperative programs.

Harvesting, drying, and paddy storage. The rice harvest actually starts the processing period. Exercising care at this stage can result in a better quality milled rice. And yet, it is in this period that current practices actually result in some of the poor quality rice that is produced.

Mechanization in British Guiana has been a big factor in the growth of the rice industry. It has also created problems in certain areas. Since most of the 45,000 farmers have only 5 to 15 acres of rice, they cannot individually afford to own combines. Thus, most of the rice is custom harvested. That is, the farmers contract with a combine-owner, either private, cooperatively-owned, or government-owned, to harvest their rice and pay a certain fee per bag for this service, with this fee usually being from BWI$1.50 to BWI$2.00 per 180-pound bag.

The problems resulting from this arrangement include:

1. Harvesting rice at a time when the combine is conveniently available because it is on a nearby farm rather than harvesting at the optimum moisture level for the production of the highest possible

Milling. Not only does the farmer have a responsibility to produce and deliver good quality rice, but the miller must meet the challenge of handling and processing this rice so that it will not lose quality or grade. The paddy must be dried, stored, parboiled, dried, milled, and the milled rice stored by the best possible methods. Even with the usual toll milling practice whereby the ownership of the rice remains in the producers' hands, "experiments" with farmer-owned rice are not advised. There is a need for intensified research involving improved methods of parboiling and drying rice under British Guiana conditions in order to produce the best possible quality of milled rice. Of the many different methods now used by the various mills in producing parboiled rice, some are resulting in relatively high quality rice and others in qualities not acceptable in most markets. The reasons for these variations involve the condition of the paddy before parboiling, the time of the pre-soaking before steaming, the temperature of the water in the soaking process, the speed and the place in the container or bin in which the steam is introduced, the time of exposure of the paddy to steam, the rapidity and methods of cooling off the paddy after steaming, and the practices used in drying the steamed paddy. All of these items play a part in producing the finished product; the relationship of each to producing high quality or low quality rice under British Guiana conditions is not clearly known.

The common complaint of consumers of British Guiana parboiled rice is that it has an obnoxious odor. Dr. Harry Paul, now Chief

Agricultural Officer of the Ministry of Agriculture, conducted extensive tests on this problem several years ago and identified most of the difficulty with variations in the pre-soaking process. He developed methods of successfully eliminating this obnoxious odor. However, the lack of penalties assessed to millers or premiums paid for sweet-smelling rice, have prevented this practice from being widely adopted. Immediate steps should be taken to educate all millers as to the importance of this problem and consideration should be given to assessing severe penalties for milled rice produced with obnoxious odors.

Many of the mills in British Guiana are of the simple single-phase type, producing only two products - milled parboiled rice and a by-product which is a mixture of all the ground-up hulls and all of the bran. Because this by-product is at least three-fourths ground inedible rice hulls high in silicon, it is of little value and brings a relatively low price. The rice bran produced by the more efficient multiple-stage mills, separated from the hulls, is a highly nutritious feedstuff, high in protein, fats, and carbohydrates. In some countries, this material is processed to extract a highly-stable, nutritious edible oil with the remaining residue still being a valuable feedstuff.

The present toll-milling practices and the lack of an educational program on the value and uses of rice by-products such as bran and, in finer separations, the rice polish, have restricted the development of multiple-phase mills. As additional world markets

industry of British Guiana that this price policy be changed so that the rice is stored as paddy rice and is milled only when orders are received for a specific quality and type of milled product. This is the most important single change needed immediately to improve the present situation.

A second practice which needs adjustment to reduce insect losses in storage involves the method of storing both paddy and milled rice. The present practice of storage of all rice in sacks is expensive in terms of sack costs, expensive in terms of labor needed in sacking, sewing the sacks, moving the rice, and re-sacking after every operation, and is a practice which makes effective control both difficult and expensive.

Most of the commercial rice countries of the world have shifted to bulk storage of paddy rice, bulk movement of paddy through the mill, and bulk storage of milled rice until placed in the final containers for delivery to the ultimate consumer. This bulk handling process not only reduces labor and eliminates sack costs, but makes it much easier to detect insect damage and to treat the grain when treatment is needed. Simply moving the bulk grain from one bin to another while treating the moving grain at some point in the process will give complete coverage of insecticides. This is impossible with sack storage of either paddy or milled rice. Although the outer sacks of a given warehouse may be thoroughly treated with insecticides, little or no penetration is made into the center of even the sacks on the outside and no contact is made with the grain

in the sacks in the center of the pile. As quickly as it is economically feasible, it would be desirable that British Guiana shift from sack handling to bulk handling of both paddy and milled rice.

Even with sack storage, some improvements to provide more effective insect control in stored rice are possible. Current practices are to stack the rice as compact, as dense, and as high as possible. In some mills, stacks 50 sacks wide and 30 sacks high were observed. There is no possibility to detect and control insect and rat attacks with such storage practices. In spite of the loss of effective storage capacity, stacking the rice loosely and in two-sack rows with aisles between each row will be found to be profitable because of accessibility so as to control insects and rodents as well as more effective drying due to improved circulation. With better accessibility, the indiscriminate usage of insecticides can be curtailed. At present, milled rice in storage is frequently sprayed or dusted several times in one warehouse, moved to another and the process repeated, and then further treated when it is delivered to the shipping point. The bags on the outside are severely contaminated with excessive dosages of insecticides while the bags in the center of the storage pile are untouched. This could result in some samples of milled rice becoming so contaminated with insecticides as to be dangerous for human consumption.

Development of different grain types. The research personnel at the Mon Repos Experiment Station have a well organized plant breeding program. However, when the authors observed the spring

nursery, there was not much genetic diversity among the nursery plots. In the attempts to develop an acceptable long-grain variety, the emphasis seemed to be placed on a similar plant and growth type as the existing medium-grain types. Consequently, all of the segregating populations observed by the authors appeared to be very similar in appearance.

This similarity may be due in part to the lack of genetic diversity in the parental varieties used in the controlled crosses. It may possibly be due, however, to the process of making selections from the F-2 and other segregating generations with most of the attention being focused on the selection of a particular plant type and grain type.

In British Guiana, there is a need for the production of different grain types with good cooking and processing qualities. With the existing size of the present rice industry, from three to five major commercial varieties, each with different grain characteristics, would give the industry the flexibility needed to meet the varying demands of different rice markets throughout the world.

The variety presently grown on more than 90 per cent of the total acreage, No. 79, is designated as a medium-grain type. By standards used in the United States, it is actually more of an intermediate grain type - neither medium or long - but in between. Because medium grain types usually mill better with less breakage than long-grain types, the British Guiana rice millers seem to be satisfied with the medium grain type now being produced, and they

are skeptical of the introduction of long-grain types because of their assumed problems in milling. However, No.79, this so-called medium-grain type, does not give as high milling yields as some of the long-grain varieties grown in the United States. In fact, even after parboiling, which is supposed to improve milling yields, the over-all milling yield of No. 79 in British Guiana is lower than the average for all United States long-grain rices.

Grain types possessing better field yields and better processing qualities can be developed that will be adapted to British Guiana. High quality long-grain types are produced in nearby Venezuela and in Surinam. They are also produced in the many countries of Central America, in Colombia, in Ecuador, and in Brazil. Some suggestions that may be helpful in establishing a program to develop such varieties are as follows:

1. Test and screen introductions of commercial varieties grown in the United States, nearby countries in South America, Central America, and other rice-growing areas of the world. Some of these may have immediate potential use as a productive variety in British Guiana. If so, arrangements could be made to import pure seed and an immediate production program started until local varieties are available. Varieties which might prove valuable include the Nilo varieties from El Salvador, the recently-developed, long-grain varieties developed in Venezuela, and those developed and released in Colombia. In these selections, attempts should be made to evaluate primarily those known to be resistant to Hoja Blanca and that have

shown resistance to most races of blast.

2. Catalog all introductions as to genetic and agronomic traits. With this catalogued material, these introductions can be used as a source of parental material for controlled crosses seeking the characteristics most desirable for British Guiana.

3. Follow a relatively flexible program in the F-2 selections, keeping promising short-grain selections as well as superior plants of the medium and long-grain types.

4. Evaluate early strains for processing characteristics (milling and cooking quality) as well as for agronomic traits.

5. Combine the desirable characteristics into a variety that will meet some of the needs of the industry. Since the development of a variety from the initial cross to seed distribution will require a minimum of five years, growing two crops a year, the breeder should be acquainted with the demands of the industry and current marketing problems. The breeder should be prepared for the unexpected and should have material in reserve to meet special demands. For example, it is entirely possible that the industry may need a short-grain, pearl-type variety as well as long and medium grain types.

6. After a variety is developed and ready for release, facilities must be made available for a seed increase program so that the pure variety can be properly evaluated.

In any rice-breeding program, a major problem is the availability of land that is free from possible volunteer plants and red

rice from previous rice crops. Land used for breeding plots and variety evaluation should have been planted to other upland or non-irrigated crops or plowed and allowed to remain fallow for at least the previous two seasons, and preferably the previous two years.

Diversification. Further diversification of the coastal lands of British Guiana appears desirable not only from the point of view of improving the quality and the yields of rice, but also from the point of view of increasing the over-all productivity of the many farmers in the region. In the long run, rice of the highest possible quality can be produced only if rice is rotated with upland, non-irrigated crops so that red rice and off-types can be controlled. Also, maximum yields resulting in low-cost rice are most likely to be obtained by such rotations. In addition, the production of one crop of rice annually does not provide full-time employment for a farm family. According to Dumont,[1] the typical 15-acre rice farmer on the Black Bush Polder project actually has only 38 days of work annually in the production of rice. Even with two crops of rice, the total work requirement would then amount to less than 75 days. In most agricultural areas of the world at least 200 days of productive income-producing work is required to maintain a farm family with a satisfactory standard of living. Thus, diversification is also needed to provide gainful work and full-time employment to the many small farmers. No city worker with a job providing employment

[1]Report to the Government of British Guiana on Planning Agricultural Development, by Rene Dumont. F.A.O., Rome, June, 1963.

the equivalent of only one day a week would expect a full salary at the end of the week. Similarly, no farmer with productive work amounting to one-fifth or less of the normal year's work period should expect a satisfactory income.

The commonly expressed opinion of the farmers interviewed on this subject was that diversification in the rice areas of British Guiana was not possible because of the heavy rainfall making drainage difficult and the difficulties of shifting the fields back to rice. These objectives have been overcome in the other rice areas of the world where high-quality rice along with many other crops are produced. In the United States, it is rice rotated with improved pastures, soybeans, and small grains. In Italy, it is rice with legume hay. In Japan, it is rice rotated with a winter crop of wheat. In Brazil, it is rice rotated with pasture used for beef cattle.

It is true that the heavy rainfall and level terrain of most of the rice fields of British Guiana will make diversification difficult. Upland crops can be grown on these soils, however, as is amply proved by the very high yields obtained from sugar cane, which definitely must have good drainage. This is accomplished by special land-forming and cultural practices. Similar practices could possibly be developed so that corn, grain sorghums, bananas, cassava, soybeans, sunflour, other oil crops, and improved pasture grasses such as para and elephant grass could be grown in rotation with rice. Intensive reasearch along these lines, followed by practical

on-farm demonstrations, is a necessity to the long-time development of the agriculture of British Guiana.

Dumont[2] recommends that additional work for farm families be provided by reverting back to hand-transplanting rice and hand harvesting from the present mechanized state. This is not realistic under the existing conditions in British Guiana. With the prevailing wage scales in British Guiana, rice cannot be produced at a cost low enough to sell on export markets by hand methods; to revert back to hand labor methods in producing rice would mean abandoning the export market.

The more realistic approach to the solution of this problem is to improve on the existing mechanization approach to rice production and to use these same lands and same machines in the production of crops or livestock that can be rotated with rice, thus benefiting both sets of enterprises.

---

[2] Ibid.

Reproduced by The Government Printery, Georgetown.

(C.G.P. & S. 2414/65.)