Fig. 7.4-2: Paddy storage

we are talking about 4 million households. The market already allocates a bigger share of the pie to the farming sector, but after dividing it up, too many farmers only see very small pieces.

In a democracy, power rests with the electorate, and there is always the risk of governments adopting policies that may be popular in the short term, but that may not always be good for the nation in the long term. Market mechanisms are distorted by government price intervention. Inadequate investments in future requirements are traded off for the political expediency of cutting spending now. Thai rice policy today is in danger of being based on political, rather than economic considerations. Excellent roads, good communications and irrigation networks, and other aspects of infrastructure were built up a long while ago to support and sustain the present requirements of the whole rice economy. Today, however, huge funds are allocated to price support which will not leave worthwhile infrastructure or research projects for future generations.

The private sector, too, cannot escape criticism. It is also motivated to build more warehousing to accommodate the ever-growing government stockpiles of rice under the mortgage scheme. Since too much rice is kept inside the country, the cost goes up, and the quality comes down. This myopic investment by the private sector is as wasteful as the government price support scheme itself. One sad result of these policies is that the skilled managers who worked hard to make the country the largest rice exporter in the world, are now tempted to seek a free market environment in which performance is matched by reward and to work elsewhere.

A better option for improving the farming sector would be for the government to invest in more efficient irrigation and land leveling, using GPS technology. This would give Thailand more precision farming, and reduce costs while achieving a higher field yield. In due course, the competition will in any case force us to come up with better seeds, precision farming, harvesting, drying, milling, packaging, and logistics.

The record clearly shows that Thailand prevailed over Myanmar and Vietnam thanks to the free market, and that the neighboring countries lost out because their prices were set by their governments. Now, the neighbors have learned their lessons and have reverted back to the free market, just as Thailand, the traditional champion of free trade, has plumped for government intervention to counter market forces. It is to be hoped that those who have the power and responsibility to shape the future of our rice economy will learn from history and be guided back to the right policy to benefit the nation in the long term.

7.5 Rice Production, Consumption and Milling Capacity in the United States of America

Prof. Terry J. Siebenmorgen

7.5.1 Introduction

The United States produces slightly less than 1.5 % of the world's annual rice crop, with an average production of 216 million cwt (hundredweight) or 9 798 000 t (tonnes) of rough rice (paddy) over the 2009, 2010, and 2011 crops (Tab. 7.5-1). While this is not a large component of the world's production, the United States is annually one of the top five rice exporting countries, as U.S. production far exceeds domestic demand for rice.

The United States currently exports roughly 40 % of the rice it produces, based on recent years' production (Tab. 7.5-1) and export values[34]. Of the U.S. rice exported in 2010/2011, approximately 39 % was exported as rough rice, 44 % as milled, white rice, 7 % as brown rice, 8 % as parboiled rice, 2 % as brokens, and less than 1 % as processed products, with these percentages based on actual product mass[34]. The leading export markets for the United States currently are Mexico, Haiti, Japan, Canada, and Turkey[35].

Despite surplus production, the United States imports a significant portion of its domestic consumption. Averaged over the years 2009, 2010, and 2011, 15 % of the total rice consumed in the United States was imported (Tab. 7.5-2). The predominance of rice imported to the United States originates from Thailand, accounting for approximately 66 % of the total rice imported over the years of 2009 through 2011, with India being the second leading origin, supplying approximately 16 % of the total imported over that same time span[37].

7.5.2 United States Rice Production

Rice is grown and milled in two primary regions of the United States, as illustrated in Figure 7.5-2. The bottom section of Table 7.5-1 indicates that roughly 75 to 80 % of the U.S. rice crop is grown in a region often referred to in the U.S. rice industry as the Mid-South rice-producing region; this region comprises the states of Arkansas, Louisiana, Mississippi, Missouri, and Texas. The remaining 20 to 25 % of the crop is produced in the state of California, located in the western part of the United States. In the Mid-South region, production of hybrid rice has steadily increased since the introduction of this technology in the United States in the 1990s. The reasons for this steady growth include both increased agronomic yield and disease resistance over that of conventional, pureline cultivars. In the state of Arkansas, where nearly half of the U.S. crop is produced, hybrid rice comprised at least 50 % of the rice produced in 2012.

From a milling perspective, the primary classification of U.S. rice cultivars is by the length-to-width ratio of individual, rough rice kernels, classes of *long grain*, with kernels having a length to width ratio of 3.4 (or more); *medium grain*, L/W ratio between 2.3

Fig. 7.5-1: Growing and harvesting Paddy in the United States

Tab. 7.5-1: United States rice production, categorized by rice type and U.S. state. Source: [33].

	Production		
State	2009	2010	2011
		1000 cwt	
Long grain:			
Arkansas	84 162	102 714	61 516
California	330	312	385
Louisiana	25 912	30 245	23 310
Mississippi	16 281	20 756	10 823
Missouri	13 219	16 021	7930
Texas	12 821	13 248	12 456
United States: Long-grain	**152 725**	**183 296**	**116 420**
% of U.S. Total	69.5 %	75.4 %	62.9 %
Medium grain:			
Arkansas	15 702	12 901	16 524
California	43 700	41 410	45 050
Louisiana	3305	2380	3120
Missouri	204	233	378
Texas	380	220	490
United States: Medium-grain	**63 291**	**57 144**	**65 562**
% of U.S. Total	28.8 %	23.5 %	35.4 %
Short grain:			
Arkansas	60	60	60
California	3774	2604	2967
United States: Short-grain	**3834**	**2664**	**3027**
% of U.S. Total	1.7 %	1.1 %	1.6 %
All rice:			
Arkansas	99 924	115 675	78 100
California	47 804	44 326	48 402
Louisiana	29 217	32 625	26 430
Mississippi	16 281	20 756	10 823
Missouri	13 423	16 254	8308
Texas	13 201	13 468	12 946
United States: All rice	**219 850**	**243 104**	**185 009**
United States: All rice (tonnes)	***9 972 000***	***11 027 000***	***8 392 000***

Tab. 7.5-2: United States rice per capita consumption. Source: [36].

August–July Milling year	U.S. population(1)	U.S. rice(2)	Imported rice	Total domestic rice use(2)	Estimated U.S. per capita consumption(3) with pet food	Estimated U.S. per capita consumption(3) excluding pet food
	Millions	million cwt *million tonnes*			lb *kg*	
2003	296	67.9	10.6	78.5	26.5	24.3
		3.1	*0.5*	*3.6*	*12.0*	*11.0*
2004	299	74.6	9.3	83.9	28.1	25.9
		3.4	*0.4*	*3.8*	*12.7*	*11.7*
2005	302	69.6	12.1	81.7	27.1	n/a
		3.2	*0.5*	*3.7*	*12.3*	
2006	305	74.0	14.5	88.5	29.0	26.0
		3.4	*0.7*	*4.0*	*13.2*	*11.8*
2007	308	69.4	16.7	86.1	28.8	25.2
		3.1	*0.8*	*3.9*	*13.1*	*11.4*
2009	310	74.3	13.4	87.7	28.2	25.5
		3.4	*0.6*	*4.0*	*12.8*	*11.6*
2010	313	72.5	13.4	85.9	27.5	25.3
		3.3	*0.6*	*3.9*	*12.5*	*11.5*
2011	315	79.7	12.9	92.6	29.4	27.1
		3.6	*0.6*	*4.2*	*13.3*	*12.3*

(1) *U.S. resident population (including Puerto Rico), plus military overseas personnel. Market year estimate is simple average of mid-month estimates.*
(2) *Food, industrial and residual use. Includes rice used in beer and pet food, as well as consumption of rice in Puerto Rico. Does not include seed use.*
(3) *Includes unreported losses in transporting, processing and marketing.*

and 3.3; and *short grain*, L/W ratio of 2.2 (or less)[38]. Rice production in the United States comprises predominantly long-grain cultivars, ranging from 63 to 75 % of the U.S. total rice production over the 2009 to 2011 crop years (Tab. 7.5-1). Medium-grain cultivars comprised 24 to 35 %, and short-grain cultivars 1.1 to 1.7 %, of the total U.S. production over these same three years. This overall U.S. production distribution by cultivar type does not represent the individual growing-region distributions. Figure 7.5-3, which illustrates the distribution of cultivar types in the Mid-South and in California from 2009 through 2011, shows that in the U.S. Mid-South, 85 to 92 % of the production comprised long-grain cultivars, while 8 to 15 % was medium-grains, and only 0.03 % short-grains. However, in California, practically the reverse is observed in that only 0.7 to 0.8 % of the production was long-grain cultivars, 91 to 93 % was medium-grains, and 6 to 8 % was short-grains from 2009 to 2011. The distributions of long-, medium-, and short-grain cultivars in each region is due primarily to the domestic or export markets served. For example, the high percentage of medium- and short-grain cultivars produced in California is due in large part to California's proximity to Asian export markets where the cooking/textural characteristics of these cultivar classes are preferred.

7.5.3 United States Rice Consumption

As indicated in Table 7.5-2, total rice use in the United States has generally increased since 2003, with a total domestic rice use of 92.6 mm cwt(1) (4 200 000 t) in the 2011 milling year; this equates to an annual per capita consumption of 27.1 lb

(1) *The abbreviation "mm cwt" stands for "million hundredweight", representing 100 000 000 pounds (lb).*

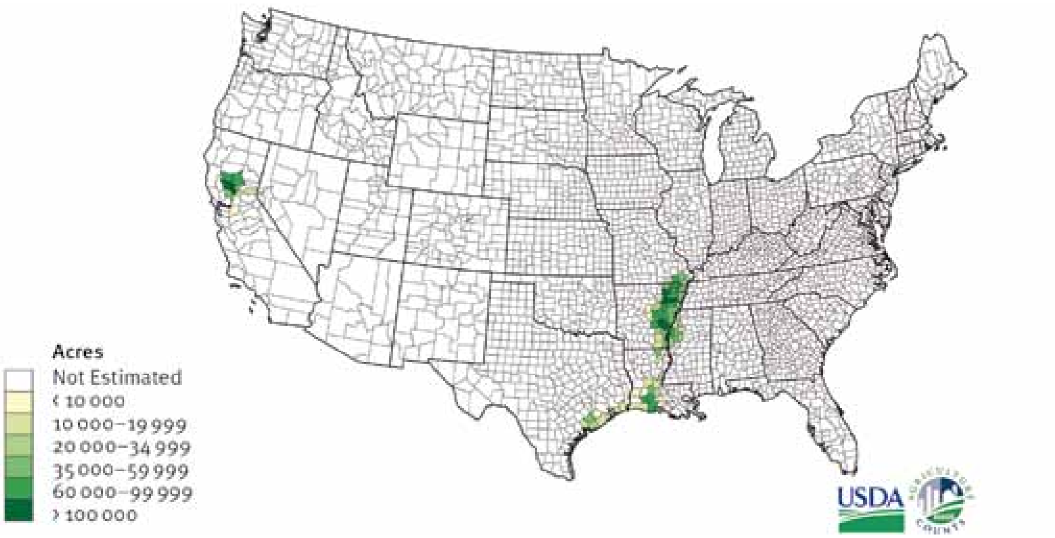

Fig. 7.5-2: United States rice-growing regions (1 hectare = 2.471 acres).

(pounds) or 12.3 kg. The rice per capita consumption in 2011 marked nearly a 2-lb (7 %) increase over the per capita consumption in essentially the previous three years. The 27.1-lb value excluded pet food use; when including rice used for pet food, the annual per capita consumption was 29.4 lb (13.3 kg) in 2011.

Table 7.5-2 also indicates the breakdown of imported vs. domestically-grown rice. Since 2003, the percentage of U.S.-consumed rice that was imported increased to a high of 19.4 % (16.7 mm cwt) in 2007, however, that percentage has declined to a level of 13.9 % in 2011. There are many plausible, speculative factors for this trend, including aggressive marketing campaigns by U.S. rice trade organizations and changing attitudes of U.S. consumers to "buy local".

Of the U.S. milled rice shipments during the 2010/2011 milling year (August 1, 2010 to July 31, 2011), which totaled 115.8 mm cwt (5 253 000 t) (Fig. 7.5-4), 70.3 mm cwt (61 %) was consumed in the United States and its territories, and the remaining 45.5 mm cwt (39 %) was exported. Figure 7.5-5 categorizes the 70.3 mm cwt consumed in the United States during the 2010/2011 milling year by food use. As shown, the primary use for rice in the United States is "direct food use", which accounted for 61 % of the total. The other 39 % of the rice shipments were to food processors, with major-use categories of processed foods (16 %), pet food (11 %), and beer (10 %).

Another method of categorizing and characterizing U.S. domestic milled rice consumption, the 70.3 mm cwt mentioned above, is presented in Figure 7.5-6. For the 2010/2011 milling year, approximately 37.1 % of the rice consumed in the United States was "white" (milled) long-grain rice, 20.8 % was milled medium-grain, and 0.7 % was milled short-grain. Continuing, 12.9 % was parboiled, 2.8 % was instant/pre-cooked rice, and 3.7 % was consumed as brown rice. Brown rice consumption has steadily increased in the United States since the recent declaration by the U.S. Food and Drug Administration that brown rice may be labeled as a "whole grain". The rice industry has taken advantage of this ruling, as well as recent governmental nutritional guidelines recommending increased consumption of whole grains, to promote brown rice use. Finally, 16.9 % of shipments were classified as brewers/brokens and 2.2 % was rice flour.

7.5.4 United States Milling Capacity

In response to a survey questionnaire prepared by the USA Rice Federation, U.S. rice millers

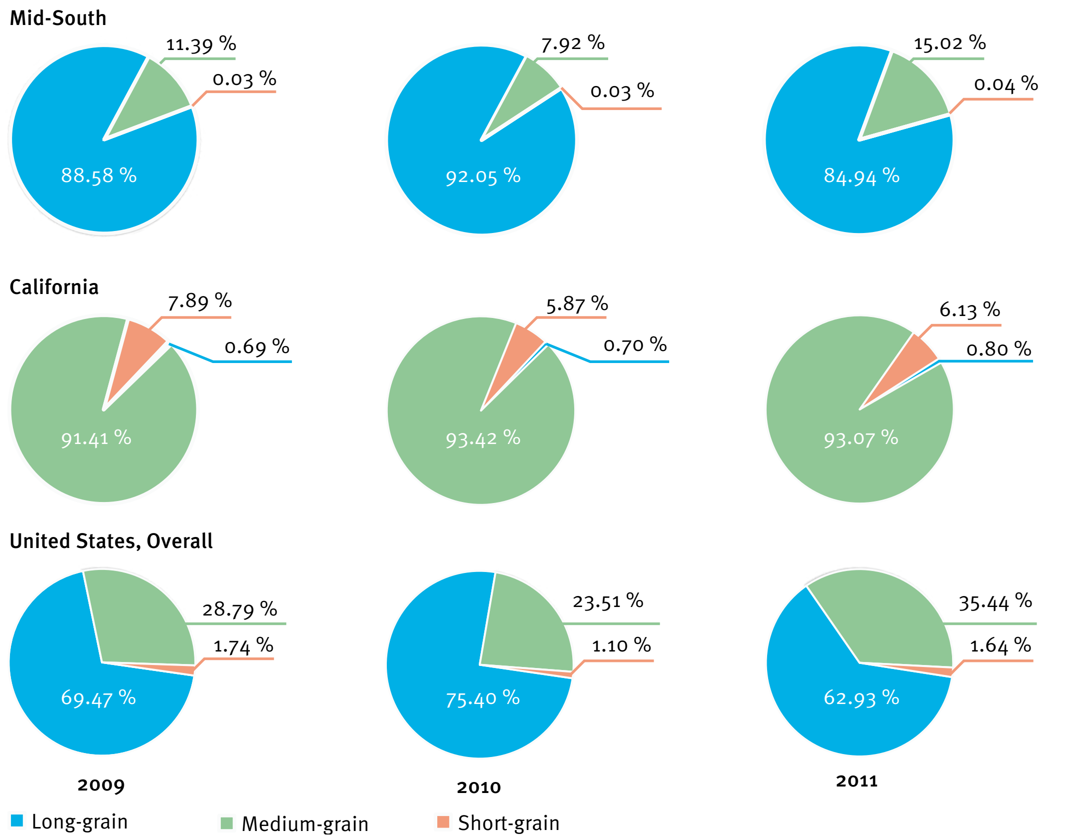

Fig. 7.5-3: Distributions of cultivar types in the total U.S. production, and in the two primary U.S. rice-production regions. Source: [33].

reported a milling capacity for the 2010 milling year of 189.0 mm cwt (8 573 000 t) of rough rice; this capacity was very similar to that reported in 2009/2010[42]. This capacity was based on the questionnaire directive to report "nominal milling capacity if they (the mill in question) operated three shifts, seven days per week, year-round, and allowing for only maintenance and emergency downtime". Twenty-four companies participated in this survey, representing 32 active rice mills; the survey response accounted for an estimated 88 % of shipments from all U.S. rice mills[42]. Thus, the 189.0 mm cwt capacity is a conservative estimate of U.S. milling capacity.

Of the 189.0 mm cwt capacity, 126.1 mm cwt (5,720,000 t) capacity (66.7 %) is located in the Mid-South, with the remaining 62.9 mm cwt (2 853 000 t) (33.3 %) in California[42]. This milling capacity distribution between the two primary growing regions roughly corresponds to the U.S. production distribution with 74 to 82 % of U.S. rice produced in the Mid-South and 18 to 26 % produced in California across years 2009 to 2011 (Tab. 7.5-1).

As cited by the USA Rice Federation[42], the USDA/ERS *Rice Situation and Outlook Yearbook*[43] reported that U.S. rice millers processed 135 mm cwt (6 124 000 t) of rough rice during the 2010/2011 milling year. Based on these values, the U.S. milling industry operated at approximately 71 % of capacity in 2010/2011.

7.5.5 Current Challenges and Issues

The U.S. rice industry, particularly the Mid-South region in recent years, has experienced rice lots with

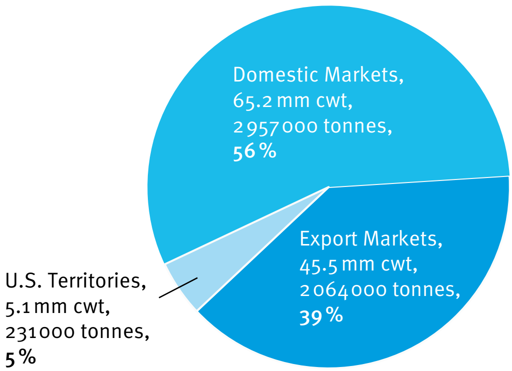

Fig. 7.5-4: United States shipments of milled rice to export and domestic markets for the 2010/2011 milling year (August 1, 2010 through July 31, 2011); milled rice shipments totaled 115.8 million cwt (5 253 000 tonnes), with 70.3 million cwt (3 189 000 tonnes) consumed in the United States and its territories. Source: [39].

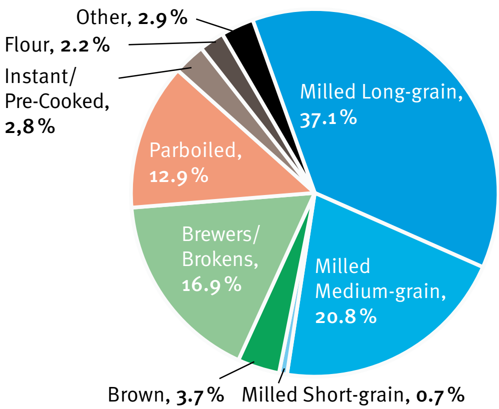

Fig. 7.5-6: Categorization of the 70.3 million cwt (3 189 000 tonnes) of milled rice consumed in the United States and its territories in the 2010/2011 milling year (August 1, 2010 through July 31, 2011) by rice product. Source: [41].

poor milling quality and visual appearance. In particular, the 2010 Mid-South rice crop was generally of much lower overall quality than is typically produced. The predominant reason for this is attributed to record-high ambient temperatures in the Mid-South during rice kernel formation. As detailed in chapter 5, *Assessing Rice Milling Quality*,, high nighttime air temperatures during the starch formation stage of kernel development have been strongly correlated to many visual, milling, and functional properties of rice.

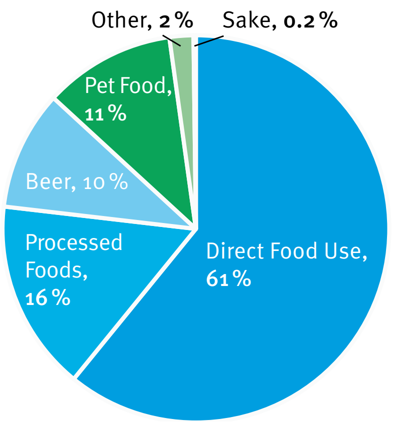

Fig. 7.5-5: Categorization of the 70.3 million cwt (3 189 000 tonnes) of milled rice consumed in the United States and its territories in the 2010/2011 milling year (August 1, 2010 through July 31, 2011) by food use. Source: [40].

The physiological processes leading to nighttime-air-temperature impacts on rice kernel chalkiness and reduced milling yields are not completely understood. However, the general premise is that high nighttime temperatures disrupt the starch formation process during kernel development. Thus, starch structure is altered and the general packing density of starch granules is reduced, creating chalky portions of kernels, with associated changes in physicochemical properties. The reader is referred to the chapter indicated above for a series of studies that elucidate the relationships between nighttime air temperatures during kernel formation and milling yields, chalkiness, and physicochemical and functional properties of rice. Suffice it to say that elevated nighttime air temperatures during kernel formation has been revealed as a major culprit of rice quality reduction by this research, as well as substantial, quantifiable experience by the Mid-South rice industry.

Another issue that is not necessarily specific to the U.S. rice industry, but has nevertheless emerged in the literature and popular press, is the presence of arsenic in rice. While practically all foods contain some level of heavy metals, arsenic has received specific attention. Arsenic can exist in either an organic or inorganic chemical form, with the latter form being classed as a carcinogen[44]. The overall level of arsenic in rice, as well as the distribution of organic vs. inorganic forms, varies considerably[45].

Overall levels of arsenic in rice appear to be determined in large part by the irrigation practices used to produce the grain[45, 46]. Practically all rice production in the United States, and presumptively across the globe, comprises using a flooded culture during critical reproductive stages; this is practiced to achieve maximum grain yields, which includes using the flood as a means of controlling weed growth, as well as fungal and bacterial disease. However, the anaerobic soil condition created by continuous flooding increases arsenic bioavailability and uptake by the rice plant more so than in non-flooded cultures[45, 46].

Research sponsored by the U.S. rice industry is currently addressing this issue through toxicological studies, as well as studies investigating the impact of both production and post-harvest procedures on rice arsenic levels. These studies are being conducted despite the current and historical role that rice has played in feeding the world's population, with its general consideration of being a very nutritious and safe food.

Yet another topic that has generated discussion and research in the rice industry is that of environmental sustainability. Again, because of the flooded culture under which rice is typically produced, some greenhouse gases, most notably methane, can be produced, contributing considerably to rice's carbon footprint. This, along with ever-increasing demands for water, poses challenges for rice production. The U.S. rice industry has, for some time, adopted measures to reduce water consumption and increase overall efficiency of rice production.

All three of the above issues are not confined to the U.S. rice industry. The issues are very briefly introduced here to present a "snap-shot" of current challenges facing the U.S. rice industry, and to perhaps remind the reader of this book on rice processing technology that industry considerations are not always strictly technical, but can be social/political as well.

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