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Suitable Fieldwork Days Required to Plant Arkansas Rice Crop

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Abstract

This paper examines the number of acres planted per fieldwork day and the number of fieldwork days available for planting the entire rice crop in Arkansas using Arkansas's crop progress and condition report data from 1981 to 2022. The average maximum acres planted per suitable fieldwork day in Arkansas rice crop is 58,926, and the average minimum number of suitable fieldwork days required to plant the entire Arkansas rice crop is 23. The average number of weekly fieldwork days for Arkansas's optimum rice planting window (late March through the third week of May) is 4.5 days.

INTRODUCTION

The number of days available to plant rice in Arkansas during the planting season will depend on spring weather conditions each year. Different spring weather every year can make planting decisions difficult for rice producers. Weather dictates the number of days suitable for planting a crop and can lead to a shortened planting window or later planting dates. For instance, in spring 2013, 2019, 2020, and 2022, Arkansas crop producers had excessive rainfall that affected the timing of rice planting and shortened the available planting window. In 2013, 2019, and 2020, Arkansas experienced record-high numbers of rice-prevented planting acres due to excessive rainfall and flooding (Watkins and Gautam, 2021).

A shorter planting window caused by extreme weather variability can negatively affect crop yield potential. Extreme weather events such as excessive spring rainfall and cooler-than-average temperatures can reduce the number of suitable fieldwork days available to producers and push rice planting to later dates. The *Arkansas Rice Production Handbook* indicates that rice planted early generally has larger yields relative to rice planted later and recommends optimum planting dates ranging from March 28 to May 20 in eastern Arkansas (Hardke et al., 2021). Planting rice outside of these dates can significantly reduce rice yields. A late planting season can also lead to delayed harvest in the fall, where rain and dew could lead to reduced rice kernel quality and more considerable drying costs associated with the late harvest (Lu et al., 1995). Technological advances have occurred over time to speed up the planting of rice. For example, grain drills have grown in width over time, allowing more acres to be planted per hour. Planting is one of the fastest machinery operations conducted during the production season. The problem is not so much the speed of planting the rice crop but the ability to enter the field to plant rice in a timely manner.

In addition, crop insurance can also affect planting decisions by dictating when rice may be planted for producers to receive crop insurance or by providing key final planting dates to ensure producers receive the full revenue guarantee. The earliest rice may be planted in Arkansas to receive crop insurance is April 1.

The final planting date for rice to receive the full revenue guarantee in Arkansas is May 25, and the late planting period ends 15 days after the final planting date (June 9). During the late planting period, the revenue guarantee declines by 1% daily (USDA RMA, 2023).

Rice producers purchase revenue protection (RP) and yield protection (YP). However, they tend to purchase these products at lower coverage levels relative to corn and soybean producers in the Corn Belt due to rice being an irrigated crop. They see irrigation as "insurance" against yield risk. The main risks rice producers face are those associated with price variability and those associated with increased input expenses, particularly those related to fossil fuels (irrigation energy expenses, fertilizer, diesel fuel for machinery operations). A large number of rice acres are covered by catastrophic insurance (Mane and Watkins, 2015). Rice producers purchase crop insurance primarily for prevented planting coverage, downed rice endorsement, and replanting coverage. Rice producers often choose YP at 50% buy-up coverage over catastrophic insurance (also 50% yield coverage) due to a larger prevented planting revenue guarantee for the former and because the downed rice endorsement and replant coverage are not available for catastrophic insurance but are available for YP (and for RP). Government payments do not play a role in the rice planting decision, as payments received by rice producers are decoupled. Rice producers accept payments on rice base acres regardless of whether rice or some other crop is planted. Market conditions determine what will be planted on rice base acres (rice, soybeans, or corn), but the planting decision itself is not affected by government programs.

Most farmers grow more than one crop because of crop rotation, diversification, and profitability. However, planting multiple crops on a tight spring schedule can be hectic and challenging. Therefore, reviewing the historical planting progress data for rice crops and figuring out essential metrics that bring imperative knowledge on rice planting decisions for producers is the goal of this paper. This paper aims to estimate the minimum number of days required to plant the Arkansas rice crop based on historical data. We also want to compare the year-to-year variability associated with this number and the likelihood of having sufficient suitable fieldwork days available for planting a rice crop on time. We base our analysis on weekly crop progress and condition report data and annual rice planted acreage data collected from USDA NASS for 1981–2021. This information will give rice producers better information for planting future rice crops.

LITERATURE REVIEW

A handful of research articles have been done using historical weekly crop progress and condition report data collected from USDA NASS (Irwin, 2022; Massey, Carpenter, and Gerlt, 2022; Shockley and Mark, 2017; Griffin and Kelley, 2011; Enz, Helm, and Brenk, 1991). Each article focused on suitable fieldwork days for a specific time frame (planting and harvesting), but their research objectives and study regions differed, which makes them unique from each other. Therefore, reviewing some of them and discussing their significant findings in this section is worthwhile.

Irwin (2022) evaluated Illinois's historical corn planting progress data from 1980 to 2021. This paper showed the maximum number of acres of corn planted in Illinois per suitable fieldwork day, the minimum number of fieldwork days required to plant the Illinois corn crop, and the distribution of suitable fieldwork days available per week in the spring for planting the corn crop. The research found no significant trend in the maximum corn acreage planted per suitable fieldwork day, with an average of 800,000 acres per day. This means, on average, the maximum planting rate per suitable day has not increased or decreased over time at the state level. Moreover, no significant trend was found for the minimum days required to plant corn for the entire state, averaging around 14 days. The average number of suitable fieldwork days in Illinois during April and May was estimated at 3.6 per week. These quantitative findings are beneficial for referencing the Illinois corn planting progress when massive weather disruptions happen in the future. Corn producers can compare their numbers to state averages and plan their planting progress according to the critical dates, mainly for crop insurance purposes. Due to most of the rice crops in Arkansas being irrigated, the different protection programs' coverage levels may not be relatively the same as the coverage levels for corn and other crops in the various regions; however, the final planting date for rice crop is a significant decision-making factor in Arkansas.

Massey, Carpenter, and Gerlt (2022) focused on Missouri's suitable fieldwork days from 1977 to 2017. This paper quantified probabilities for the number of fieldwork days available during the April–May period (planting) and the September–October period (harvest). The paper also quantified the average weekly fieldwork days for the state and the state's NASS reporting districts. Missouri farmers may use data from this study to calculate better machinery needs for completing planting and harvesting operations.

Shockley and Mark (2017) conducted similar research on Kentucky's suitable fieldwork days from 1996 to 2016. The paper estimated the percentile in three criteria (15% for bad year, 50% for median year, and 85% for good year). The paper also provided graphical comparisons of the estimated days suitable for fieldwork for corn and soybean crops in Kentucky for bad, median, and good years. The authors stated that farmers might use the data to calculate machinery capacity requirements for farming operations.

Griffin and Kelley (2011) evaluated historical Arkansas suitable fieldwork days. Their data covered from 1975 to 2009 and focused on the likelihood of specific numbers of days suitable for fieldwork for rice, soybeans, and cotton during each respective crop's planting season. The authors also reported the expected days suitable for fieldwork for typical planting windows for rice, soybeans, and cotton. They found that 18.1, 28.3, and 13.2 fieldwork days were available for planting rice, soybeans, and cotton, respectively, during an average year. In bad years, the number of fieldwork days available shrunk to 12.4, 18.4, and 8.8 days for planting rice, soybeans, and cotton, respectively.

Potential fieldwork days were researched in North Dakota in the early 1990s. Enz, Helm, and Brenk (1991) found that the number of suitable planting days in North Dakota averaged around 25 days; however, it varied widely from one region to another and one year to another. Moreover, the southeastern region has the advantage of rapid increase of days due to its suitability in the early spring, early snowmelt, ground thaw, and warmer temperature. This paper's most interesting statement was that the cost of additional or scaled planting equipment necessary for a worst-case scenario is much greater than yield reductions associated with late planting. In other words, adding capital investment to the planting operation can put a massive burden on farm finances compared with low crop yield from late planting.

The papers we reviewed in this section utilized their selected states' or regions' crop progress and condition data, but each paper had its objectives and purposes. Our paper also uses crop progress and condition data; however, it focuses on estimating the number of acres planted per fieldwork day and the number of days available for planting the entire rice crop in Arkansas.

METHODOLOGY

This paper follows the procedures used by Irwin (2022). We base our analysis on weekly USDA crop progress and condition report data for rice in Arkansas (USDA NASS, 2022a) along with Arkansas rice planted acreage data for the period between 1981 and 2022 (USDA NASS, 2022b), supplemented by Arkansas days suitable for fieldwork data from Griffin (2009).

Based on Irwin (2022), our estimation procedures are as follows:

1. We estimate the maximum Arkansas rice acres planted per suitable fieldwork day for each year by multiplying each week's rice planting progress percentage for a given year by the total rice acreage planted each year, summing the two peak weekly acreages, and dividing them by their respective sum of suitable fieldwork days.
2. We calculate the minimum number of suitable fieldwork days required to plant the rice crop each year by dividing the total planted rice acres by the estimated maximum rice acres planted per suitable fieldwork day.
3. We calculate a frequency distribution to determine historical probabilities for the number of available suitable fieldwork days per week during the week 13 (the last week of March) through week 20 (the third week of May) planting window in Arkansas.

Figure 1 presents Arkansas's 2020 rice planted acres by county. Approximately 95% of the rice acres are planted in eastern Arkansas, with the most significant area being northeast Arkansas, east-central Arkansas, and southeast Arkansas. Some rice acres are planted in the Arkansas River Valley and along the Red River in southwest Arkansas.

RESULTS AND DISCUSSION

Descriptive statistics for the data used in this paper are presented in Table 1. A couple of observations can be gleaned from Table 1. First, the mean number of rice planting days per week for 2011–2022 is numerically smaller than the mean number of rice planting days per week for the other periods presented in the table. The 2011–2022 period experienced episodes of extreme precipitation and flooding and resulted in record levels of prevented planting rice acres for the years 2013, 2019, and 2020 (Watkins and Gautam, 2021). Thus, the average number of days available per week for planting rice is smaller for this period relative to previous periods presented in Table 1. Second, the mean percents of rice acres planted by the end of April are smaller for the 1981–1986 period (29%) and 1987–1998 period (45%) than for the 1999–2010 and 2011–2022 periods (66% and 56%, respectively), implying rice was planted later in the 1980s and 1990s

than in the most recent couple of decades. Based on a conversation with Jarrod Hardke, Rice Extension Agronomist for the University of Arkansas System Division of Agriculture, the earlier planted rice in the 2000–2022 years is mainly due to improvements in seed drill technology (more uniform seed depth and seed placement in furrows). The broader adoption of fungicide and insecticide seed treatment has allowed rice to be planted much earlier in recent decades. In addition, previous studies have shown that early rice planting brings higher yields regardless of seed variety. Due to irrigation technology adaption in the rice acres, most producers can manage the rice yield and plant rice early to some degree.

The maximum rice acres planted per suitable fieldwork day in Arkansas from 1981 to 2022 are presented in Figure 2. The variation in maximum rice acres planted per suitable fieldwork day is noticeably different from year to year, specifically between 2000 and 2014. This variation implies that weather conditions change the number of suitable fieldwork days available for planting rice every spring, which impacts planting progress each year. Therefore, it isn't easy to project what next spring will bring us and what to expect in the next planting season. Based on the graph, the trend for maximum planted rice acres in Arkansas has not noticeably changed over the study period, meaning there is no significant upward or downward trend. Overall, the average stays around 58,926 acres per suitable fieldwork day. Gautam and Watkins (2021) found the trend of total rice acres was reasonably consistent in the past eight census years, staying at around 1.3 million acres since 1982. Irwin (2022) also found no significant trend in Illinois's maximum corn acres planted per suitable fieldwork day from 1980 to 2021.

The minimum suitable days required to plant rice in Arkansas are presented for the period 1981–2022 in Figure 3. In other words, we answer the question of the minimum number of days rice producers need to plant the rice crop in Arkansas each year. Noticeably, the minimum number of days varies greatly by year due to variations in weather, especially between 2000 and 2020. The long-term average number of days needed to plant the rice crop stays at around 23 days, with no significant trend up or down in the past 42 years. Thus, a minimum of 23 suitable fieldwork days are generally needed on average to plant the entire Arkansas rice crop based on historical data. Irwin (2022) also found no significant trend in the minimum number of fieldwork days required to plant the corn crop in Illinois using data from 1980 to 2021. He concluded that at least 14.3 days were needed on average to plant the corn crop in Illinois. Griffin and Kelley (2011) estimated 18.1 days were available for rice planting between April 11 and May 9 from 1975 to 2009 during average years. Our number is likely a bit higher because the Griffin and Kelley estimate is not based on planting all rice acres in a growing season as is our number but rather represents the number of suitable fieldwork days available on average for a specific planting window (April 11 through May 9). In addition, the rice planting in Arkansas today can be much earlier than the early date used by Griffin and Kelley in 2011 (April 11) due to improvements in grain drill seed placement and increased usage of fungicide and insecticide seed treatment that have occurred over time, as mentioned earlier in our paper.

The number of minimum days available for planting the rice crop varies significantly from year to year due to weather conditions, as shown in Figure 3. The years 1985, 2003, 2007, 2011, 2013, and 2019 all have minimum suitable fieldwork days for planting rice in excess (plus one standard deviation or more) of 23 days. In 1985 and 2007, rice planting was delayed due to unusually cooler temperatures in the early spring. In years 2003, 2011, 2013, and 2019, we had excessive rainfall in spring months at most locations in eastern Arkansas. Alternatively, years experiencing warm, dry weather in the spring (1982, 1992, 1993, 1994, 2002, 2005, and 2017) all had minimum suitable field days for planting rice below 23 days (minus one standard deviation or more). Thus, it makes sense why some years require more suitable fieldwork days to plant the rice crop than others.

The historical distribution of suitable fieldwork days per week for rice in Arkansas from week 12 (late March) through week 20 (the third week of May) is presented for the period 1981–2022 in Figure 4. As expected, there is a wide range in the number of suitable fieldwork days per week, reflecting extremes in weather. For instance, there is a 23% chance of either one, two, or three suitable fieldwork days occurring per week and an almost 50% chance of either five, six, or seven fieldwork days occurring per week. The average number of suitable fieldwork days per week is 4.5. Rice producers may use this information to estimate the number of days available to complete rice planting in years when rice planting has been delayed due to extreme weather. For instance, if most of a producer's rice acres have not been planted by the end of April due to weather conditions, the rice producers have roughly three weeks left to complete rice planting within the optimal planting window. Assuming the average of 4.5 suitable fieldwork days over the next three weeks, the rice producer would expect to

have approximately 13.5 days available to plant the remaining rice acres. The producer then can decide to plant rice or other crops (e.g., soybeans or cotton) based on the economic feasibility.

SUMMARY AND CONCLUSION

Planting windows shortened due to cool weather and excess rainfall in the spring can result in later planting of rice, potentially later rice harvests, and ultimately lower rice yields, reduced rice quality, and reduced profitability. In this paper, we review Arkansas's historical rice planting data for 1981–2022 and quantify critical statistics related to timely rice planting in Arkansas to provide helpful insights to rice producers. The conclusions of our analysis are as follows:

1. The maximum rice acres planted per suitable fieldwork day in Arkansas during the past 42 years has not markedly changed. The overall average is 58,926 rice acres planted per suitable fieldwork day over the study period. The maximum fluctuates yearly due to weather conditions, varying between 35,000 and 94,000 acres per suitable fieldwork day. However, there is no indication of an upward or downward trend in the peak rate of rice planting per suitable fieldwork days in Arkansas.

2. The minimum number of suitable fieldwork days necessary to plant the entire rice crop in Arkansas has historically averaged around 23 days but ranges from 17 to 34 days. It is plausible that excessive precipitation has played the most prominent role in the upper variation of this number. No linear trend exists in the data, suggesting that the minimum number of suitable fieldwork days required to plant the Arkansas rice crop has remained steady over the 23 days on average.

3. Our data indicate that the variation around the means of the previous two statistics has been more pronounced over the past couple of decades (2000–2022). Untimely or extreme precipitation events have significantly delayed impacts on the timing of rice planting during the 2000 and 2022 period relative to the 1980s and 1990s, and our data bear this out.

4. The weekly average number of suitable fieldwork days per week is 4.5 from week 12 (the last week of March) to week 20 (the third week of May) over the study period. However, a wide range of probabilities exists in the number of suitable weekly fieldwork days for the given planting window. Historically over the 42 years, the likelihood of having only one, two, or three suitable fieldwork days per week is 23%, whereas the likelihood of having either five, six, or seven suitable fieldwork days per week is almost 50% during the given planting window.

A shortcoming of this study is that Arkansas crop progress and condition report data are reported only for eastern Arkansas as a whole rather than for specific regions in eastern Arkansas. Due to changing weather conditions, the number of weekly fieldwork days would vary somewhat when moving from south to north. Crop progress and condition data by USDA NASS crop reporting district rather than for eastern Arkansas as a whole could have added accuracy to our analysis if such data were available. This study found no significant trend over time in the number of suitable fieldwork days required to plant the rice crop but did find considerable variation around the mean due to weather. Thus, a potential topic of further study would be to better regress suitable fieldwork days against precipitation and temperature to understand the impacts of weather on available fieldwork days. Finally, our analysis has focused exclusively on rice planting progress in Arkansas. Other crops, such as soybeans, cotton, and corn, are commercially grown in eastern Arkansas, and it would be interesting to investigate their planting progress numbers. Thus a natural extension of this study would be to apply a similar analysis to these other essential crops grown in Arkansas.

REFERENCES

Enz, J.W., J.L. Helm, and P.C. Brenk. 1991. "Potential Field Work Days During Planting and Harvesting." NDSU Extension Service. https://agris.fao.org/agris-search/search.do?recordID=US9174793.

Gautam, T.K., and K.B. Watkins. 2021. "Irrigated Acreage Change and Groundwater Status in Eastern Arkansas." *Journal of the American Society of Farm Managers and Rural Appraisers* 2021: 17–28. https://www.proquest.com/scholarly-journals/irrigated-acreage-change-groundwater-status/docview/2665652516/se-2.

Griffin, T. 2009. "Acquiring and Applying Days Suitable for Fieldwork for your State." *Journal of the American Society of Farm Managers and Rural Appraisers* 2009: 35–42. https://www.jstor.org/stable/jasfmra.2009.35.

Griffin, T., and J. Kelley. 2011. "Days Suitable for Fieldwork in Arkansas." University of Arkansas, Division of Agriculture. https://agris.fao.org/agris-search/search.do?recordID=US201300159376.

Hardke, J., Y. Wamishe, G. Lorenz, and N. Bateman. 2021. "Rice Stand Establishment." In *Rice Production Handbook,* edited by J.T. Hardke. University of Arkansas, Division of Agriculture, Cooperative Extension Service. Accessed August 16, 2022. https://www.uaex.uada.edu/publications/pdf/mp192/mp192.pdf.

Irwin, S. 2022. "What Do We Know About How Long It Takes to Plant the U.S. Corn Crop?" *farmdoc daily* (12): 54.

Lu, R., T.J. Siebenmorgen, T.A. Costello, and E.O. Fryar, Jr. 1995. "Effect of Rice Moisture Content at Harvest on Economic Return." *Applied Engineering in Agriculture* 11 (5): 685–690.

Mane, R.U., and K.B. Watkins. 2015. "An Overview of Federal Crop Insurance Corporation (FCIC) Programs for Rice Producers in Arkansas, 2011 to 2014." In *B.R. Wells Arkansas Rice Research Studies 2014*, edited by R.J. Norman and K.A.K Moldenhauer. Fayetteville, Arkansas: University of Arkansas, Division of Agriculture, Arkansas Agricultural Experiment Station.

Massey, R., B. Carpenter, and S. Gerlt. 2022. "Days Suitable for Fieldwork in Missouri." University of Missouri Extension. https://hdl.handle.net/10355/90929.

Shockley, J., and T. Mark. 2017. "Days Suitable for Fieldwork in Kentucky." University of Kentucky; College of Agriculture, Food, and Environment; Cooperative Extension Service.

USDA NASS. 2022a. Crop Progress & Condition Report. United States Department of Agriculture, National Agricultural Statistics Service, Arkansas Field Office. Accessed January 3, 2022. https://www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Crop_Progress_&_Condition/index.php.

USDA NASS. 2022b. Quick Stats (searchable database). United States Department of Agriculture, National Agricultural Statistics Service. Accessed January 18, 2022. https://quickstats.nass.usda.gov.

USDA RMA. 2023. Actuarial Information Browser. United States Department of Agriculture, Risk Management Agency. Accessed January 5, 2023. https://webapp.rma.usda.gov/apps/actuarialinformationbrowser/CropCriteria.aspx.

Watkins, K.B., and T.K. Gautam. 2021. "An Overview of Rice Prevented Planting Acres in Arkansas, 2011 to 2020. In *B.R. Wells Arkansas Rice Research Studies 2020,* edited by J. Hardke, X. Sha, and N. Bateman. Fayetteville, Arkansas: University of Arkansas, Division of Agriculture, Arkansas Agricultural Experiment Station.

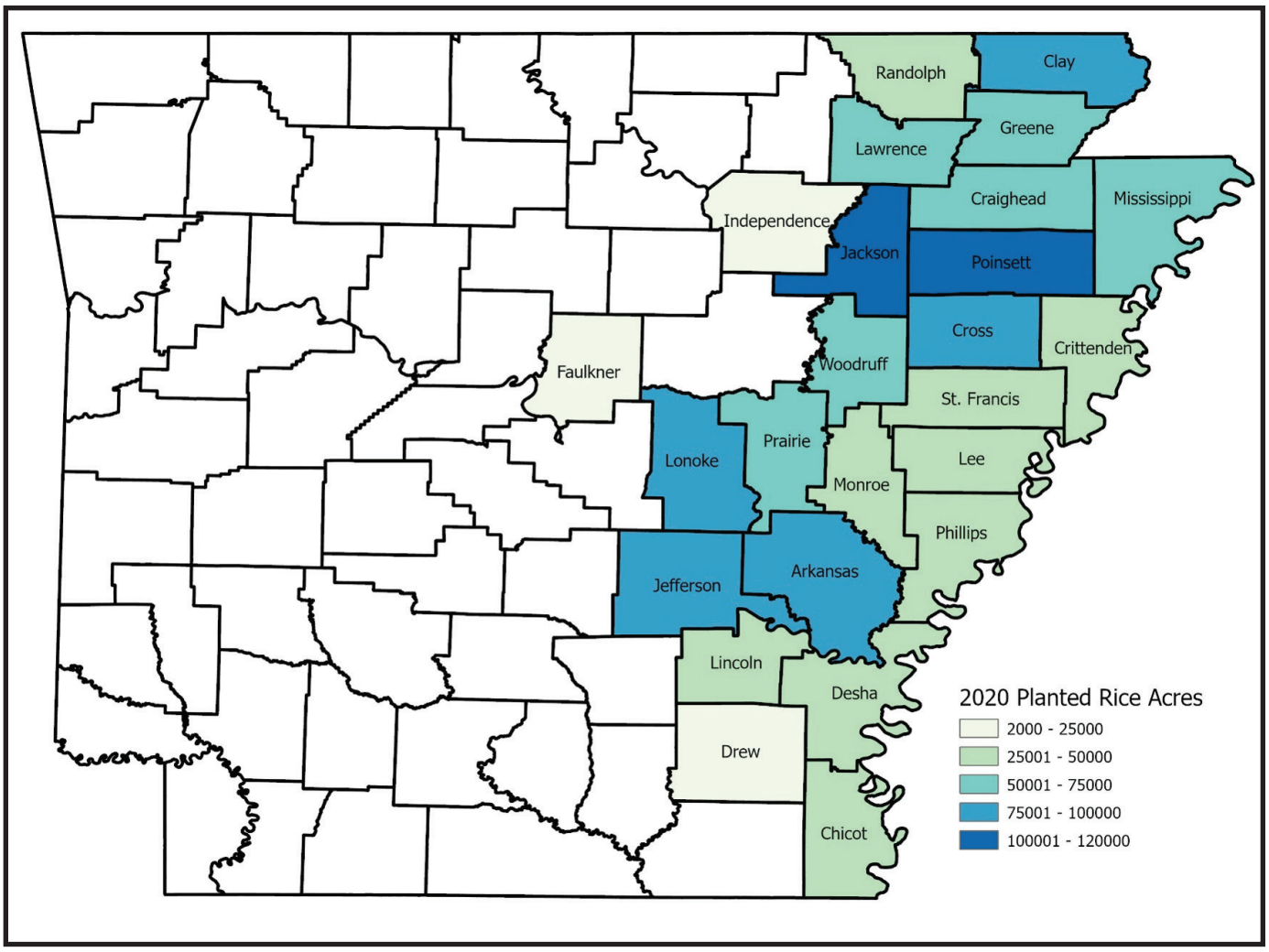

Figure 1. Arkansas planted rice acres in 2020

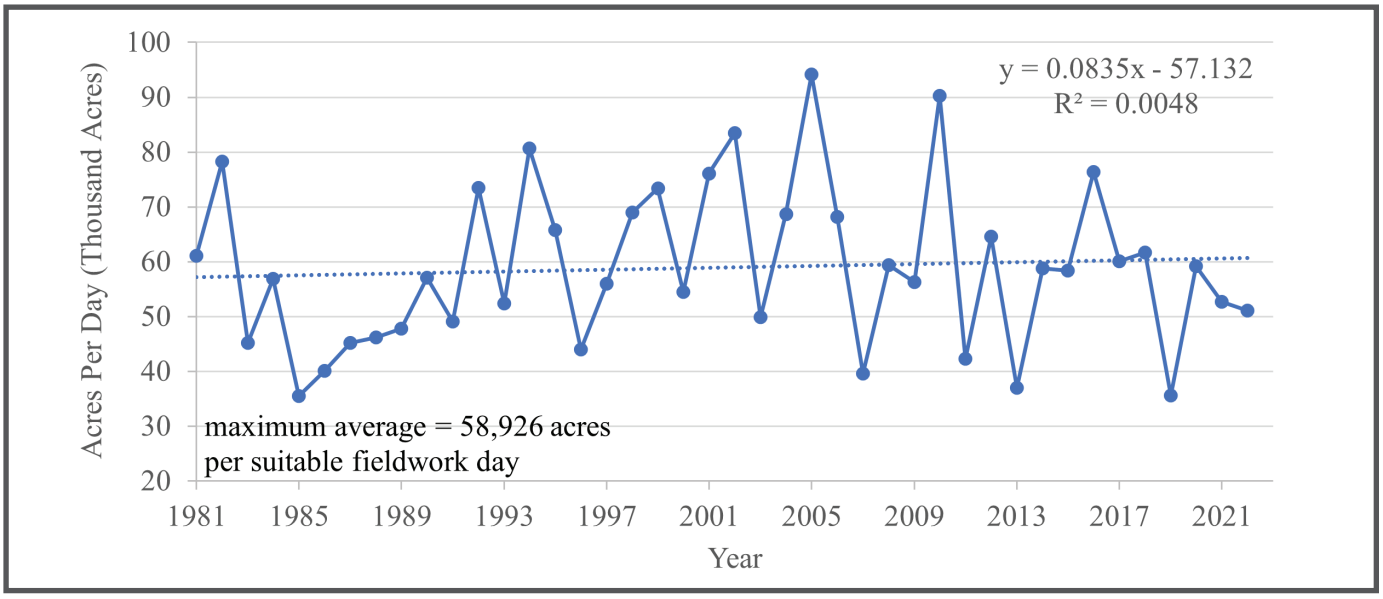

Figure 2. Maximum rice acres planted per suitable fieldwork days in Arkansas, average of two peak weeks, 1981–2022

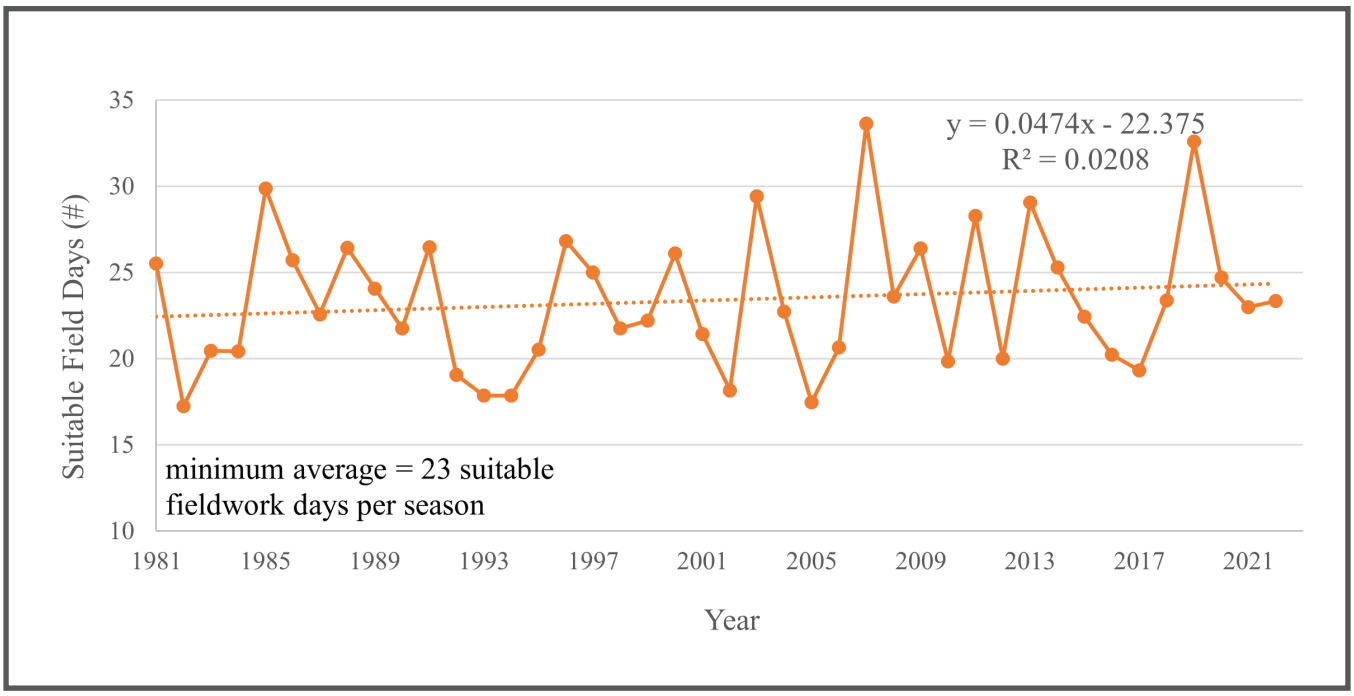

Figure 3. Minimum suitable fieldwork days required to plant rice in Arkansas, 1981–2022

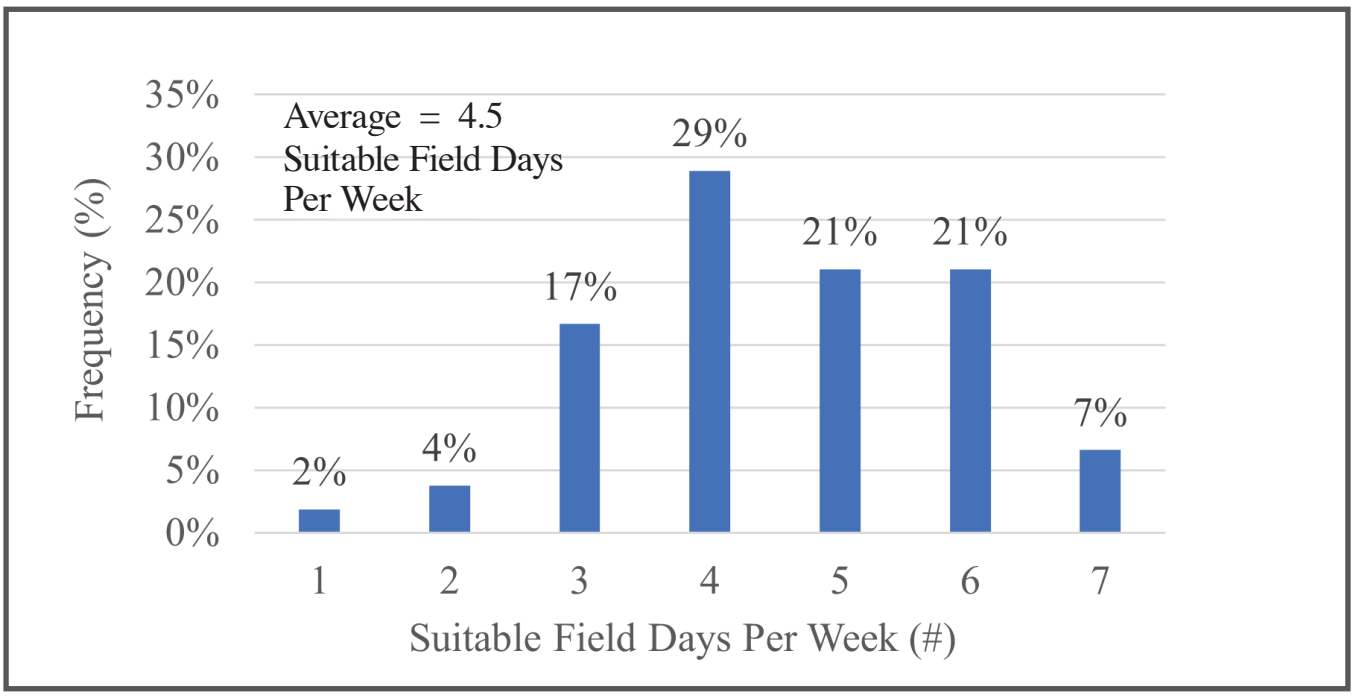

Figure 4. Distribution of suitable fieldwork days per week for rice in Arkansas, last week of March through the third week of May, 1981–2022

Table 1. Descriptive Statistics for Arkansas Rice Planting Days Per Week, Planted Acres Percent, and Total Planted Acres, 1981–2022

Period	Mean		St. Deviation		Minimum		Maximum	
	Rice Planting Days per Week[a]	Percent Acres Planted[b]	Rice Planting Days per Week	Percent Acres Planted	Rice Planting Days per Week	Percent Acres Planted	Rice Planting Days per Week	Percent Acres Planted
1981–1986	4.61	29%	1.24	14%	2.00	14%	7.00	48%
1987–1998	4.85	45%	1.30	22%	3.00	9%	7.00	78%
1999–2010	4.65	66%	1.33	17%	1.20	37%	7.00	90%
2011–2022	4.04	56%	1.40	22%	0.60	33%	7.00	92%
1981–2022	4.50	52%	1.37	23%	0.60	9%	7.00	92%
Acres Planted	1,342,357		191,780		925,000		1,791,000	

[a]*Rice Planting Days per Week* represents the number of suitable field days per week available for planting rice during the week 12 through week 20 planting window (roughly the last week of March through the third week of May).

[b]*Percentage Acres Planted* represents the accumulated percentage of rice acres planted through week 17 (roughly by the end of April).