

ARKANSAS RICE RESEARCH AND PROMOTION BOARD SPECIAL CALLED MEETING

Minutes

December 1, 2025

2:00 p.m.

The Arkansas Rice Research and Promotion Board held a Special Called meeting via Zoom only.

Member(s) present via Zoom: Jay Coker, David Gairhan, Scott Matthews, Carl Phillips, Jeff Rutledge, Paul Schwarz, Jim Whitaker, Charles Williams

Member(s) absent: Becton Bell

Chair Jim Whitaker called the meeting to order and welcomed all members and guests.

Chair Whitaker provided an update regarding the United States Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA) co-funded agreement with the Arkansas Rice Research and Promotion Board. He reminded members that, during the November 12, 2025, board meeting, notice had been received from USDA indicating that, due to the ongoing government shutdown, no projects would be reviewed until the shutdown concluded. As a result, the board was advised to reapply next year. The board had previously voted to commit TRQ dollars in the amount of \$150,000 to invest in the program.

Notice has now been received from USDA that the government shutdown has ended and that they will accept the funding commitment if the board chooses to do so.

Chair Whitaker stated there are two proposals from the University of Arkansas for consideration and asks the board to decide whether they want to consider co-funding one or both proposals through this program. He further noted that the minimum for grant funding is \$150,000 and up to a maximum of \$2.5 million.

Following much discussion, moved by Coker and second by Rutledge, to approve moving forward to consider funding one or both of two proposals from the University of Arkansas.

Motion carried.

Chair Whitaker asked the board to consider the two written proposals and decide if they want to co-fund one or both. The proposals are shown as **attachments 1 and 2**. It was discussed to use general surplus dollars for this funding commitment.

Following much discussion, moved by Coker and second by Schwarz, to write a letter of recommendation to fund both proposals as presented.

Motion carried.

Chair Whitaker stated it is also time to consider 2026 co-funding.

Moved by Schwarz and second by Matthews to approve co-funding in the amount of \$150,000 for 2026.

Motion carried.

Chair Whitaker asked for a volunteer to develop the topic and prepare the proposal for 2026. Amy Lyman, Administrator for the board, noted that the topic must remain confidential until it is published in the request for applications.

Discussion regarding areas of concern during the meeting included concerns about the loss of export markets, which was attributed primarily to issues of quality and the lack of varieties sought by international buyers. Related to this, the decline in domestic consumption to imports. Additional topics raised involved strategies for moving the large volumes of southern long grain rice, as well as challenges associated with post-harvest handling, straw management, and by-product utilization.

Moved by Williams and second by Rutledge to select Matthews to oversee the development of a topic and the preparation of a proposal.

Motion carried.

Lyman stated the proposal for 2026 must be submitted by January 20, 2026.

Meeting adjourned.



Jim Whitaker, Chairman

Attachment 1

OMB Number: 4040-0001
Expiration Date: 11/30/2025

APPLICATION FOR FEDERAL ASSISTANCE SF 424 (R&R)

1. TYPE OF SUBMISSION <input type="checkbox"/> Pre-application <input checked="" type="checkbox"/> Application <input type="checkbox"/> Changed/Corrected Application		3. DATE RECEIVED BY STATE []	State Application Identifier []
2. DATE SUBMITTED []	Applicant Identifier []	4. a. Federal Identifier []	b. Agency Routing Identifier []
5. APPLICANT INFORMATION		c. Previous Grants.gov Tracking ID GRANT13997413	UEI: WJNTJ7LBL823
Legal Name: Division of Agriculture of the University of Arkansas System			
Department: []			
Division: []			
Street1: 1371 W. Altheimer Dr.			
Street2: []			
City: Fayetteville		County / Parish: []	
State: AR: Arkansas		Province: []	
Country: USA: UNITED STATES		ZIP / Postal Code: 727046898	
Person to be contacted on matters involving this application			
Prefix: []	First Name: Joshua	Middle Name: []	
Last Name: Boice		Suffix: []	
Position/Title: []			
Street1: 1371 W. Altheimer Dr.			
Street2: []			
City: Fayetteville		County / Parish: []	
State: AR: Arkansas		Province: []	
Country: USA: UNITED STATES		ZIP / Postal Code: 727046898	
Phone Number: 4795029827	Fax Number: []		
Email: jboice@uada.edu			
6. EMPLOYER IDENTIFICATION (EIN) or (TIN):		621712458	
7. TYPE OF APPLICANT: H: Public/State Controlled Institution of Higher Education			
Other (Specify): []			
Small Business Organization Type <input type="checkbox"/> Women Owned <input type="checkbox"/> Socially and Economically Disadvantaged			
8. TYPE OF APPLICATION: <input checked="" type="checkbox"/> New <input type="checkbox"/> Resubmission <input type="checkbox"/> Renewal <input type="checkbox"/> Continuation <input type="checkbox"/> Revision		If Revision, mark appropriate box(es). <input type="checkbox"/> A. Increase Award <input type="checkbox"/> B. Decrease Award <input type="checkbox"/> C. Increase Duration <input type="checkbox"/> D. Decrease Duration <input type="checkbox"/> E. Other (specify): []	
Is this application being submitted to other agencies? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> What other Agencies? []			
9. NAME OF FEDERAL AGENCY: National Institute of Food and Agriculture		10. ASSISTANCE LISTING NUMBER: 10.310 ASSISTANCE LISTING TITLE: Agriculture and Food Research Initiative (AFRI)	
11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT: Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice			
12. PROPOSED PROJECT: Start Date: 08/01/2026 Ending Date: 07/31/2029		13. CONGRESSIONAL DISTRICT OF APPLICANT: AR-003	

14. PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR CONTACT INFORMATION

Prefix: First Name: Middle Name:

Last Name: Suffix:

Position/Title:

Organization Name:

Department:

Division:

Street1:

Street2:

City: County / Parish:

State: Province:

Country: ZIP / Postal Code:

Phone Number: Fax Number:

Email:

15. ESTIMATED PROJECT FUNDING

a. Total Federal Funds Requested	<input type="text" value="299,382.00"/>
b. Total Non-Federal Funds	<input type="text" value="0.00"/>
c. Total Federal & Non-Federal Funds	<input type="text" value="299,382.00"/>
d. Estimated Program Income	<input type="text" value="0.00"/>

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?

a. YES THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:
DATE:

b. NO PROGRAM IS NOT COVERED BY E.O. 12372; OR
 PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. By signing this application, I certify (1) to the statements contained in the list of certifications* and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances * and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 18, Section 1001)

I agree

*The list of certifications and assurances, or an Internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

18. SFLLL (Disclosure of Lobbying Activities) or other Explanatory Documentation

19. Authorized Representative

Prefix: First Name: Middle Name:

Last Name: Suffix:

Position/Title:

Organization:

Department:

Division:

Street1:

Street2:

City: County / Parish:

State: Province:

Country: ZIP / Postal Code:

Phone Number: Fax Number:

Email:

Signature of Authorized Representative	Date Signed
<input type="text" value="Completed on submission to Grants.gov"/>	<input type="text" value="Completed on submission to Grants.gov"/>

20. Pre-application

21. Cover Letter Attachment

AFRI PROJECT TYPE

Instructions:

Who completes this form: Each project director (PD) applying to the Agriculture and Food Research Initiative (AFRI) Request for Applications (RFA).

How this template is completed:

- Select the appropriate Project Type box and Grant Type box(es) (For FASE Grants, select an appropriate sub-category).

Project Type

Research
 Education
 Extension
 Integrated

Grant Type

Standard
 Coordinated Agricultural Project (CAP)
 Planning / Coordination
 Conference
 Food and Agriculture Science Enhancement (FASE)
 Predoctoral Fellowship
 Postdoctoral Fellowship
 New Investigator Seed
 New Investigator Standard
 Strengthening, if selected choose from the following:
 Sabbatical
 Equipment
 New Investigator Strengthening Seed
 New Investigator Strengthening Standard
 Strengthening Seed
 Strengthening Standard
 Strengthening CAP
 Strengthening Conference

Other:

Supplemental Information Form

OMB Number: 0524-0039
Expiration Date: 08/31/2025

Please complete this form in conjunction with the SF-424 Application for Federal Financial Assistance.

1. Funding Opportunity

Funding Opportunity Name

Agriculture and Food Research Initiative Competitive Grants Program Foundational and Applied Science Program

Funding Opportunity Number

USDA-NIFA-AFRI-011134

2. Program to which you are applying

Program Code Name

AFRI Commodity Board Co-funding Topics

Program Code

A1811

3. Type of Applicant

H: Public/State Controlled Institution of Higher Education

4. Additional Applicant Types

1862 Land-Grant University

5. Supplemental Applicant Types (Check all that apply)

- Alaska Native-Serving Institution
- Cooperative Extension Service
- Hispanic-Serving Institution
- Historically Black College or University (other than 1890)
- Minority-Serving Institution
- Native Hawaiian-Serving Institution
- Public Nonprofit Junior or Community College
- Public Secondary School
- School of Forestry
- State Agricultural Experiment Station
- Tribal College (other than 1994)
- Veterinary School or College

6. ASAP Recipient Information

Does the legal applicant have an active Automated Standard Application for Payments (ASAP) Recipient Identification Number for NIFA awards?

Yes No

What is the ASAP Recipient ID (which corresponds with this applications's DUNS and EIN) to be used in the event of an award?

1137468

7. Key Words

rice quality; competitiveness; U.S. market assessment.

8. Conflict of Interest List

COI - All PN 13512.pdf

Add Attachment

Delete Attachment

View Attachment

CONFLICT OF INTEREST LIST

Name: Alvaro Durand-Morat

Instructions:

- Who completes this template: Each project director/principal investigator (PD/PI) or other person that the Request for Applications (RFA) specifies
- How this template is completed:
 - List alphabetically – with last name first – the full names of the following individuals:
 - All co-authors on publications within the past three years, including pending publications and submissions
 - All collaborators on projects within the past three years, including current and planned collaborations
 - All thesis or postdoctoral *advisees/advisors*
 - All persons in your field with whom you have had a consulting/financial arrangement/other conflict-of-interest in the past three years
 - Indicate the person's relationship to you (Co-Author, Collaborator, etc) with an "x".

Additional pages may be used as necessary.

Note: Other individuals working in the applicant's specific area are not in conflict of interest with the applicant unless those individuals fall within one of the listed categories.

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Ala-Kokko, Kristiina	X			
Alam, Mohammad Jahangir	X	X		
Andrade, Robert	X	X		
Bairagi, Subir	X	X	X	
Bassole, Henri	X	X		
Bazzani, Claudia	X	X		
Bonatti, Michelle	X			
Codjo, Simon	X		X	
Crandall, Phil	X			
De Steur, Hans	X	X		
Demont, Matty	X	X		
Diagne, Mandiaye	X	X		
Espino, Luis	X	X		
Fragallo, Ligia	X			
Han, Joohun	X	X	X	
Gallego, Sonia	X	X		
Graterol, Eduardo	X	X		
Kovacs, Kent	X			
Loaiza, Katherine	X	X		
Luckstead, Jeff	X	X		
Massey, Joseph	X			
McFadden, Brandon	X	X		
Mottaleb, Khondoker	X	X	X	

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Mozzoni, Leandro	X	X		
Mulimbi, Willy	X	X	X	
Nalley, Lanier	X	X		
Nayga, Rodolfo	X	X		
Nkegla-Asi, Lilian	X	X		
Okpiaifo, Glory	X		X	
Oswalt, Sara	X		X	
Peterson-Wilhelm, Bailey	X			
Phillips, Jullian	X		X	
Popp, Michael	X	X		
Putman, Ben	X			
Rivera, Tatiana	X	X		
Roberts, Cristina	X			
Roberts, Trent	X			
Saha, Indrani	X		X	
Sharp, Misty	X	X	X	
Shear, Hannah	X	X	X	
Shew, Aaron	X			
Tack, Jesse	X			
Thoma, Gregg	X			
Thompson, Jada	X	X	X	
Thompson, Wyatt		X		
Tran, Dat	X	X	X	
Tsiboe, Francis	X			
Wang, Ya-Jane	X	X		
Watkins, Brad		X		
Westhoff, Patrick		X		
Wiseman, Taylor	X		X	
Zheng, Zhihao	X	X		

This file MUST be converted to PDF prior to attachment in the electronic application package.

CONFLICT OF INTEREST LIST

Name: Brandon R. McFadden

Instructions:

- Who completes this template: Each project director/principal investigator (PD/PI) or other person that the Request for Applications (RFA) specifies
- How this template is completed:
 - List alphabetically – with last name first – the full names of the following individuals:
 - All co-authors on publications within the past three years, including pending publications and submissions
 - All collaborators on projects within the past three years, including current and planned collaborations
 - All thesis or postdoctoral *advisees/advisors*
 - All persons in your field with whom you have had a consulting/financial arrangement/other conflict-of-interest in the past three years
 - Indicate the person's relationship to you (Co-Author, Collaborator, etc) with an "x".

Additional pages may be used as necessary.

Note: Other individuals working in the applicant's specific area are not in conflict of interest with the applicant unless those individuals fall within one of the listed categories.

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Adhikari, Saroj	X			
Ahn, Sunjin	X			
Allen, Craig		X		
Anderton, Brittany	X			
Atungulu, Griffiths		X		
Andrade, Robert	X			
Banerjee, Simanti		X		
Bass, Daniel			X	
Befus, Kevin		X		
Bernard, John	X			
Bonatti, Michelle	X			
Bovay, John	X			
Bresnehan, Ryan	X		X	
Borsen, B. Wade	X			
Brownback, Andy		X		
Buzas, Jeffery		X		
Cahoon, Edgar		X		
Campbell, Ben	X	X		
Chen, Xqui	X			
Clemente, Thomas		X		
Colclasure, Blake		X		
Costanigro, Marco	X			

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Cummins, Cierra	X			
Daniels, Mike		X		
Davidson, Kelly	X			
Dilley, Andrew	X		X	
Demirel, Yasar		X		
DeMuth, Benjamin	X			
Dhoubhadel, Sunil		X		
Dilley, Andrew			X	
Dobbs, Page		X		
Dong, Diansheng		X		
Durand-Morat, Alvaro	X	X		
Dweikat, Ismail		X		
Dyment, Madison	X			
Ellison, Brenna	X			
Ferraro, Paul	X			
Folta, Kevin		X		
Gallego, Sonia	X			
Gao, Zhifeng	X			
Gardner, Sara			X	
Ge, Yufeng		X		
Goddard, Ellen		X		
Gould, Hannah	X			
Griep, Mark		X		
Gundersen, Craig	X			
Hecht, Kristen	X			
Henry, Christopher		X		
House, Lisa	X			
Hu, Yang	X			
Huang, Qiuqiong		X		
Hyink, Jillian	X		X	
Jacobs, Benjamin	X			
Jeevan, Adithi	X			
Kecinski, Maik	X			
Kelly, Patrick	X			
Kemper, Nathan		X		
Keshwani, Jennifer		X		
Khachatryan, Hayk		X		
Khan, Samee		X		

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Kilasy, Pius			X	
Kilders, Valerie		X		
Kolodinsky, Jane		X		
Kovacs, Kent	X	X		
Kowalkowski, Brian	X	X		
Krasovskaia, Elana	X			
Langer, Melissa	X			
Li, Sherry		X		
Lin, Hongfei		X		
Loethen, Katie	X			
Lusk, Jayson	X			
Luu, Khoa		X		
Maguire, Mac		X		
Maharjan, Bijesh		X		
Malik, Asad		X		
Malone, Trey	X			
Mark, Tyler		X		
Matlock, Marty		X		
May, Caroline	X		X	
McKay, John		X		
Meyer, Sarah	X			
Messer, Kent	X	X		
Miller, Henry		X		
Millerschultz, Alexis	X			
Mitchell, James	X			
Moretti, Marcelo		X		
Moss, Logan	X		X	
Moss, Elica		X		
Mullally, Conner	X			
Muraleetharan, Kawsheha	X			
Nalley, Lawton	X			
Nayga, Rodolpho	X			
Nedunuri, KrishnaKumar	X	X		
Neuhofer, Zachary	X			
Oswalt, Sara	X		X	
Ouncap, Tracy	X			
Palm-Forster, Leah	X			
Park, Yunsun	X			

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Patel, Niyati	X			
Phipps, Brandy		X		
Pollack, Adam	X		X	
Popp, Michael	X			
Price, Madison			X	
Qiao, Bijesh		X		
Rabinowitz, Adam	X	X		
Rhin, Alicia	X			
Rickard, Bradley	X			
Riga, Ekaterini		X		
Riss, Jason	X			
Rivera, Tatiana	X			
Robertson, Christopher	X			
Rosselle, Macy	X			
Rossi, Waldemar	X	X		
Rumble, Joy		X		
Saha, Rajib		X		
Santra, Dipak		X		
Schaefer, Aleks	X			
Scheitrum, Dan	X			
Schlichtig, Emily	X		X	
Schluttenhofer, Craig		X		
Shafquat, Madiha	X			
Shear, Hannah	X			
Shew, Aaron		X		
Silwal, Pratikshya	X			
Smyth, Stuart	X			
Snell, Heather	X			
Staples, Aaron	X			
Stark, James	X			
Stofer, Katie	X	X		
Thiel, Robert	X			
Thoma, Greg		X		
Turner, Savannah	X			
Verbeke, Wim	X			
Walters, Cory		X		
Warner, Laura	X			
Wei, Xuan	X			

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Weiland, Jerry		X		
Wiersma-Mosley, Jacquelyn	X	X		
Wilkins, Mark		X		
Wilson, Norbert	X			
Wimpy, Luke			X	
Wescott, Jeremy	X	X		
Wolf, Christopher		X		
Xuqi, Ricky	X			
Yang, Wei	X			
Yu, Xiaohua	X			
Yun, Seong		X		
Zasada, Inga		X		
Zheng, Yuging		X		

CONFLICT OF INTEREST LIST

Name: Lawton Lanier Nalley

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Adabrah-Danquah, Vera	X		X	
Ahmed, Zobaer	X	X	X	
Ala-Koko, Kristiina	X		X	
Anderson, Brooke	X		X	
Anderson, John	X	X		
Ashworth, Amanda	X	X		
Atungulu, Griffiths	X	X		
Bailey, Michelle	X			
Barkley, Andrew	X	X	X	
Brizmohun-Gopual, Roshini	X	X		
Brye, Kris	X	X		
Burris, Lexie	X		X	
Callouet, Olivia	X		X	
Chaminuka, Petronella	X	X		
Clark, Dustin	X	X		
Cole, Matthew	X		X	
Crandall, Phil	X	X		
Dalmini, Thula	X	X		
De Lange, Job	X		X	
De Steur, Hans	X	X		
Dewaide, Anne	X		X	
D’Haese, Marijke	X			
Dickson, Ryan		X		
Dixon, Bruce	X	X		
Durand, Alvaro	X	X		
Farmer, Amy	X	X		
Farmer, Erin	X		X	
Gaduh, Arya	X	X		
Green, Steve	X	X		
Ghosh, Anni	X			
Goodwin, H.L.	X			
Hill, Laura	X			
Henry, Chris	X			

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Huang, Qiuqiong	X			
Jagdish, Krishna	X	X		
Kemper, Nathan	X			
Kidd, Mike	X	X		
Kovacs, Kent	X			
Luckstead, Jeff	X	X		
Lusk, Jayson	X	X		
Makgopa, Tshehla				
Massey, Joe	X	X		
Matlock, Marty	X	X		
Mavunganidze, Zira	X	X		
McFadden, Brandon	X	X	X	
Moldenhauer, Karen	X	X		
Mulimbi, Willy	X		X	
Maledzani, Zira	X			
Nayga, Rudy	X	X		
Norsworthy, Jason	X	X		
Ogudele, Simon	X		X	
Okpiafio, Glory	X		X	
Owens, Phillip	X			
Parajuli, Ranjan	X			
Pede, Val	X	X		
Popp, Jennie	X	X		
Popp, Mike	X	X		
Putnam, Ben	X			
Richardson, Matt	X		X	
Roberts, Cris	X		X	
Roberts, Trent	X	X		
Rojas, Clemencia	X	X		
Schmidt, Axel	X	X		
Shew, Aaron	X	X	X	
Smith, Harrison	X	X	X	
Snell, Heather	X	X		
Tack, Jesse	X	X		
Tester, Colson	X		X	
Thoma, Greg	X	X		
Tsiboe, Francis	X	X	X	
Tsvakirai, Chezida	X	X		

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Turmel, Mike	X			
Valent, Barbara	X	X		
Wailes, Eric	X			
Wasson, Laura	X		X	
West, Grant	X	X		
Wilhelm, Bailey	X	X	X	
Worthington, Margaret		X		
Yadav, Sudir	X	X		
Yang, Wei	X	X		
Zhaou, Shane	X	X		

Project/Performance Site Location(s)

Project/Performance Site Primary Location

I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name:

UEI:

* Street1:

Street2:

* City: County:

* State:

Province:

* Country:

* ZIP / Postal Code: * Project/ Performance Site Congressional District:

Project/Performance Site Location 1

I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name:

UEI:

* Street1:

Street2:

* City: County:

* State:

Province:

* Country:

* ZIP / Postal Code: * Project/ Performance Site Congressional District:

Additional Location(s)

RESEARCH & RELATED BUDGET - Budget Period 1

OMB Number: 4040-0001
Expiration Date: 11/30/2025

UEI:

Enter name of Organization:

Budget Type: Project Subaward/Consortium

Budget Period: 1 Start Date: End Date:

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary (\$)	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
						Cal.	Acad.	Sum.			
Dr.	Alvaro		Durand-Morat						0.00	0.00	0.00

Project Role:

Additional Senior Key Persons: Total Funds requested for all Senior Key Persons in the attached file
Total Senior/Key Person

B. Other Personnel

Number of Personnel	Project Role	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
		Cal.	Acad.	Sum.			
<input type="text"/>	Post Doctoral Associates	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Graduate Students	12.00	<input type="text"/>	<input type="text"/>	18,000.00	918.00	18,918.00
<input type="text"/>	Undergraduate Students	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	Secretarial/Clerical	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Total Number Other Personnel						18,918.00
Total Salary, Wages and Fringe Benefits (A+B)							18,918.00

C. Equipment Description

List items and dollar amount for each item exceeding \$5,000

Equipment item	Funds Requested (\$)
<input type="text"/>	<input type="text"/>

Additional Equipment:

Total funds requested for all equipment listed in the attached file
Total Equipment

D. Travel**Funds Requested (\$)**

1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	16,000.00
2. Foreign Travel Costs	
Total Travel Cost	16,000.00

E. Participant/Trainee Support Costs**Funds Requested (\$)**

1. Tuition/Fees/Health Insurance	
2. Stipends	
3. Travel	
4. Subsistence	
5. Other <input type="text"/>	
<input type="text"/> Number of Participants/Trainees	
Total Participant/Trainee Support Costs	

F. Other Direct Costs

		Funds Requested (\$)
1.	Materials and Supplies	10,000.00
2.	Publication Costs	
3.	Consultant Services	
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	GA Tuition	9,000.00
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
Total Other Direct Costs		19,000.00

G. Direct Costs

	Funds Requested (\$)
Total Direct Costs (A thru F)	53,918.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)
MTDC	47.00	44,918.00	21,111.00
Total Indirect Costs			21,111.00

Cognizant Federal Agency

(Agency Name, POC Name, and POC Phone Number) Denise Shirlee DHHS 214-767-3261

I. Total Direct and Indirect Costs

	Funds Requested (\$)
Total Direct and Indirect Institutional Costs (G + H)	75,029.00

J. Fee

Funds Requested (\$)

K. Total Costs and Fee

	Funds Requested (\$)
Total Costs and Fee (I + J)	75,029.00

L. Budget Justification

(Only attach one file.) [Budget Justification A1811 Durand-Mora](#) [Add Attachment](#) [Delete Attachment](#) [View Attachment](#)

RESEARCH & RELATED BUDGET - Budget Period 2

OMB Number: 4040-0001
Expiration Date: 11/30/2025

UEI:

Enter name of Organization:

Budget Type: Project Subaward/Consortium

Budget Period: 2 Start Date: End Date:

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary (\$)	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
						Cal.	Acad.	Sum.			
Dr.	Alvaro		Durand-Morat						0.00	0.00	0.00

Project Role:

Additional Senior Key Persons: Total Funds requested for all Senior Key Persons in the attached file
Total Senior/Key Person

B. Other Personnel

Number of Personnel	Project Role	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)	
		Cal.	Acad.	Sum.				
<input type="text"/>	Post Doctoral Associates	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
<input type="text" value="2"/>	Graduate Students	12.00	<input type="text"/>	<input type="text"/>	36,000.00	1,836.00	37,836.00	
<input type="text"/>	Undergraduate Students	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
<input type="text"/>	Secretarial/Clerical	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
<input type="text" value="2"/>	Total Number Other Personnel						37,836.00	
						Total Other Personnel	37,836.00	
							Total Salary, Wages and Fringe Benefits (A+B)	37,836.00

C. Equipment Description

List items and dollar amount for each item exceeding \$5,000

Equipment item	Funds Requested (\$)
<input type="text"/>	<input type="text"/>

Additional Equipment:

Total funds requested for all equipment listed in the attached file
Total Equipment

D. Travel**Funds Requested (\$)**

1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	16,000.00
2. Foreign Travel Costs	
Total Travel Cost	16,000.00

E. Participant/Trainee Support Costs**Funds Requested (\$)**

1. Tuition/Fees/Health Insurance	
2. Stipends	
3. Travel	
4. Subsistence	
5. Other <input type="text"/>	
<input type="text"/> Number of Participants/Trainees	
Total Participant/Trainee Support Costs	

F. Other Direct Costs

		Funds Requested (\$)
1.	Materials and Supplies	15,500.00
2.	Publication Costs	
3.	Consultant Services	
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	GA Tuition	18,000.00
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
Total Other Direct Costs		33,500.00

G. Direct Costs

Total Direct Costs (A thru F) Funds Requested (\$)
87,336.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)
MTDC	47.00	69,336.00	32,588.00
Total Indirect Costs			32,588.00

Cognizant Federal Agency

(Agency Name, POC Name, and POC Phone Number) Denise Shirlee DHHS 214-767-3261

I. Total Direct and Indirect Costs

Total Direct and Indirect Institutional Costs (G + H) Funds Requested (\$)
119,924.00

J. Fee

Funds Requested (\$)

K. Total Costs and Fee

Total Costs and Fee (I + J) Funds Requested (\$)
119,924.00

L. Budget Justification

(Only attach one file.)

Budget Justification A1811 Durand-Mora

Add Attachment

Delete Attachment

View Attachment

RESEARCH & RELATED BUDGET - Budget Period 3

OMB Number: 4040-0001
Expiration Date: 11/30/2025

UEI:

Enter name of Organization:

Budget Type: Project Subaward/Consortium

Budget Period: 3 Start Date: End Date:

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary (\$)	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
						Cal.	Acad.	Sum.			
Dr.	Alvaro		Durand-Morat						0.00	0.00	0.00

Project Role:

Additional Senior Key Persons: Total Funds requested for all Senior Key Persons in the attached file

Total Senior/Key Person

B. Other Personnel

Number of Personnel	Project Role	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
		Cal.	Acad.	Sum.			
<input type="text"/>	Post Doctoral Associates	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Graduate Students	12.00	<input type="text"/>	<input type="text"/>	18,000.00	918.00	18,918.00
<input type="text"/>	Undergraduate Students	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	Secretarial/Clerical	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Total Number Other Personnel						18,918.00
Total Salary, Wages and Fringe Benefits (A+B)							18,918.00

C. Equipment Description

List items and dollar amount for each item exceeding \$5,000

Equipment item	Funds Requested (\$)
<input type="text"/>	<input type="text"/>

Additional Equipment:

Total funds requested for all equipment listed in the attached file

Total Equipment

D. Travel

		Funds Requested (\$)
1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)		16,000.00
2. Foreign Travel Costs		
	Total Travel Cost	16,000.00

E. Participant/Trainee Support Costs

		Funds Requested (\$)
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other		
<input type="text"/>	Number of Participants/Trainees	
	Total Participant/Trainee Support Costs	

F. Other Direct Costs

		Funds Requested (\$)
1.	Materials and Supplies	30,000.00
2.	Publication Costs	
3.	Consultant Services	
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	GA Tuition	9,000.00
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
Total Other Direct Costs		39,000.00

G. Direct Costs

		Funds Requested (\$)
Total Direct Costs (A thru F)		73,918.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)
MTDC	47.00	64,918.00	30,511.00
Total Indirect Costs			30,511.00

Cognizant Federal Agency

(Agency Name, POC Name, and POC Phone Number) Denise Shirlee DHHS 214-767-3261

I. Total Direct and Indirect Costs

		Funds Requested (\$)
Total Direct and Indirect Institutional Costs (G + H)		104,429.00

J. Fee

Funds Requested (\$)

K. Total Costs and Fee

		Funds Requested (\$)
Total Costs and Fee (I + J)		104,429.00

L. Budget Justification

(Only attach one file.) Budget Justification A1811 Durand-Mora Add Attachment Delete Attachment View Attachment

RESEARCH & RELATED BUDGET - Cumulative Budget

Totals (\$)

Section A, Senior/Key Person		0.00
Section B, Other Personnel		75,672.00
Total Number Other Personnel	4	
Total Salary, Wages and Fringe Benefits (A+B)		75,672.00
Section C, Equipment		
Section D, Travel		48,000.00
1. Domestic	48,000.00	
2. Foreign		
Section E, Participant/Trainee Support Costs		
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other		
6. Number of Participants/Trainees		
Section F, Other Direct Costs		91,500.00
1. Materials and Supplies	55,500.00	
2. Publication Costs		
3. Consultant Services		
4. ADP/Computer Services		
5. Subawards/Consortium/Contractual Costs		
6. Equipment or Facility Rental/User Fees		
7. Alterations and Renovations		
8. Other 1	36,000.00	
9. Other 2		
10. Other 3		
11. Other 4		
12. Other 5		
13. Other 6		
14. Other 7		
15. Other 8		
16. Other 9		
17. Other 10		

Section G, Direct Costs (A thru F)

215,172.00

Section H, Indirect Costs

84,210.00

Section I, Total Direct and Indirect Costs (G + H)

299,382.00

Section J, Fee

Section K, Total Costs and Fee (I + J)

299,382.00

Budget Justification

University of Arkansas Division of Agriculture

TOTAL FUNDS REQUESTED: \$299,382

Total salary: \$72,000

Salary for two (2) Master students, who will conduct research for this project as part of their thesis. Assumes a stipend of \$18,000 a year for two years for master students in Agricultural Economics.

Total Fringe Benefits: \$3,672

Fringe benefits equal 5.10% of salary for graduate students (current University of Arkansas fringe benefit rate), amounting to \$918 in year 1, \$1,836 in year 2, and \$918 in year 3.

Domestic Travel: \$48,000

Travel for Dr. Durand-Morat, Dr. McFadden, Dr. Nalley, and graduate students to conduct economic field research in selected locations in the U.S.

OTHER DIRECT COSTS: \$91,500

Tuition: \$36,000

Cost of tuition for 2 Master students in Agricultural Economics. \$428 per hour 21 hours per year.

Materials and Supplies: \$55,500

- Implementation of online and face-to-face consumer surveys in the U.S. It includes the cost of compensating participants and the survey team, renting office space, buying materials to conduct the surveys, etc.

Matching: matching is not required since the project deals with scientifically important research, and the grant recipient is unable to satisfy the matching funds requirement.

TOTAL INDIRECT COSTS: \$84,210

Indirect costs are calculated using our negotiated indirect cost rate of 47% DHHS Approved because this rate generates a lower than 30%TFF cap IDC figure.

RESEARCH & RELATED PERSONAL DATA

Project Director/Principal Investigator and Co-Project Director(s)/Co-Principal Investigator(s)

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on sex, race, ethnicity, or disability of its proposed PDs/Pis and co-PDs/Pis. To gather information needed for this important task, the applicant should submit the requested information for each identified PD/PI and co-PDs/Pis with each proposal. Submission of the requested information is voluntary and is not a precondition of award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information received from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. Upon receipt of the application, this form will be separated from the application. This form will not be duplicated, and it will not be a part of the review process. Data will be confidential.

Project Director/Principal Investigator

Prefix:	* First Name:	Middle Name:
Dr.	Alvaro	
* Last Name:		Suffix:
Durand-Morat		
Sex:	Male	
Race (check all that apply):		
<input type="checkbox"/> American Indian or Alaska Native	Ethnicity: Hispanic or Latino	
<input type="checkbox"/> Asian		
<input type="checkbox"/> Black or African American		
<input type="checkbox"/> Native Hawaiian or Other Pacific Islander		
<input checked="" type="checkbox"/> White		
<input type="checkbox"/> Do Not Wish to Provide		
Disability Status (check all that apply):		
<input type="checkbox"/> Hearing		
<input type="checkbox"/> Visual		
<input type="checkbox"/> Mobility/Orthopedic Impairment		
<input type="checkbox"/> Other		
<input checked="" type="checkbox"/> None		
<input type="checkbox"/> Do Not Wish to Provide		
Citizenship:		
Permanent Resident		

Co-Project Director/Co-Principal Investigator 1

Prefix:	* First Name:	Middle Name:
	Brandon	
* Last Name:		Suffix:
McFadden		
Sex:	Male	
Race (check all that apply):		
<input type="checkbox"/> American Indian or Alaska Native	Ethnicity: Non-Hispanic or Latino	
<input type="checkbox"/> Asian		
<input type="checkbox"/> Black or African American		
<input type="checkbox"/> Native Hawaiian or Other Pacific Islander		
<input checked="" type="checkbox"/> White		
<input type="checkbox"/> Do Not Wish to Provide		
Disability Status (check all that apply):		
<input type="checkbox"/> Hearing		
<input type="checkbox"/> Visual		
<input type="checkbox"/> Mobility/Orthopedic Impairment		
<input type="checkbox"/> Other		
<input checked="" type="checkbox"/> None		
<input type="checkbox"/> Do Not Wish to Provide		
Citizenship:		
US Citizen		

Co-Project Director/Co-Principal Investigator 2

Prefix:

*** First Name:**

Middle Name:

*** Last Name:**

Suffix:

Sex:

Race (check all that apply):

Ethnicity:

Disability Status (check all that apply):

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White
- Do Not Wish to Provide

- Hearing
- Visual
- Mobility/Orthopedic Impairment
- Other
- None
- Do Not Wish to Provide

Citizenship:

RESEARCH & RELATED Other Project Information

OMB Number: 4040-0001
Expiration Date: 11/30/2025

1. Are Human Subjects Involved? Yes No

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? Yes No

If yes, check appropriate exemption number. 1 2 3 4 5 6 7 8

If no, is the IRB review Pending? Yes No

IRB Approval Date:

Human Subject Assurance Number:

2. Are Vertebrate Animals Used? Yes No

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? Yes No

IACUC Approval Date:

Animal Welfare Assurance Number:

3. Is proprietary/privileged information included in the application? Yes No

4.a. Does this Project Have an Actual or Potential Impact - positive or negative - on the environment? Yes No

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an environmental assessment (EA) or environmental impact statement (EIS) been performed? Yes No

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place? Yes No

5.a. If yes, please explain:

6. Does this project involve activities outside of the United States or partnerships with international collaborators? Yes No

6.a. If yes, identify countries:

6.b. Optional Explanation:

7. Project Summary/Abstract

8. Project Narrative

9. Bibliography & References Cited

10. Facilities & Other Resources

11. Equipment

12. Other Attachments

PROJECT SUMMARY

Instructions:

The summary is limited to 250 words. The names and affiliated organizations of all Project Directors/Principal Investigators (PD/PI) should be listed in addition to the title of the project. The summary should be a self-contained, specific description of the activity to be undertaken and should focus on: overall project goal(s) and supporting objectives; plans to accomplish project goal(s); and relevance of the project to the goals of the program. The importance of a concise, informative Project Summary cannot be overemphasized.

Title: Addressing Import Substitution Through Domestic Market Expansion For U.S. Long-Grain Rice

PD: Durand-Morat, Alvaro	Institution: University Of Arkansas
CO-PD: MCFadden, Brandon	Institution: Unviersity Of Arkansas
CO-PD: Nalley, Lawton Lanier	Institution: University Of Arkansas
CO-PD: PD/PI 4 Name (Last, First, MI)	Institution:
CO-PD: PD/PI 5 Name (Last, First, MI)	Institution:
CO-PD: PD/PI 6 Name (Last, First, MI)	Institution:
CO-PD: PD/PI 7 Name (Last, First, MI)	Institution:

The U.S. long-grain rice sector faces growing competition from rising imports of high-quality aromatic rice, particularly Thai jasmine, which threatens its position in the domestic market. Because the domestic market is the largest and most critical outlet for U.S. rice, enhancing competitiveness at home is essential. A central challenge lies in grain quality: while U.S. jasmine-type varieties exist, they lack the marketing standards, certification systems, and strong brand recognition that have made Thai Hom Mali rice successful. Further, the widespread practice of commingling long-grain varieties at mills reduces quality consistency and weakens consumer confidence.

To address these challenges, this project will examine whether identity-preserved U.S. long-grain and jasmine-type rice can serve as closer substitutes for imports. Specifically, it will (1) identify domestic varieties with strong competitive potential, (2) assess consumer preferences and openness to quality labeling, (3) estimate the economic value and market shares of domestic versus imported rice, and (4) share findings with stakeholders through outreach and industry engagement.

With annual contributions exceeding \$34 billion to the U.S. economy and support for more than 125,000 jobs, rice is a cornerstone of rural economies, particularly in states like Arkansas and Louisiana. Therefore, strengthening the competitiveness of U.S. long-grain and jasmine-type rice is an economic priority vital to sustaining communities across the southern United States.

This proposal addresses the following priority scope listed for program area priority 7f. AFRI Commodity Board Co-funding Topics, in the RFA 2025: Determine consumer preferences for southern rice quality characteristics

This file MUST be converted to PDF prior to attachment in the electronic application package.

Executive Summary Project Title: Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice

Project Type: Research project

Grant Type: Standard

Program Area Priority Scope Addressed: This proposal addresses the following priority scope listed for program area priority 7f. AFRI Commodity Board Co-funding Topics, in the RFA 2025:

- Program Area Priority 1: Determine consumer preferences for southern rice quality characteristics.

Distribution of Effort: 100 percent research.

Program Staff and Their Role

Program Director (PD): Alvaro Durand-Morat

Associate Professor and LC Carter Endowed Chair for Rice and Soybeans.

Department of Agricultural Economics and Agribusiness. University of Arkansas.

AGRI 217. University of Arkansas. Fayetteville, AR, 72701.

Co-PD: Brandon McFadden.

Professor and Tyson Endowed Chair in Food Policy Economics.

Department of Agricultural Economics and Agribusiness. University of Arkansas.

AGRI 217. University of Arkansas. Fayetteville, AR, 72701.

Co-PD: Lawton Lanier Nalley.

Professor and Department Head.

Department of Agricultural Economics and Agribusiness. University of Arkansas.

AGRI 217. University of Arkansas. Fayetteville, AR, 72701.

Critical Stakeholder Needs: The U.S. long-grain rice sector faces growing challenges from rising imports of high-quality aromatic rice, particularly jasmine, which directly competes with domestically produced long-grain rice. Although exports remain vital, the domestic market is the largest and most critical outlet for U.S. rice, making competitiveness at home essential for the industry's long-term viability.

Strengthening domestic performance requires a deeper understanding of how grain quality shapes consumer preferences. Given that the majority of the rice produced in the Southern U.S. is long-grain rice, the industry needs to find a way to make domestically produced long-grain rice more competitive against rising imports. Identity-preserved U.S. jasmine-type and other high-quality long-grain varieties could serve as closer substitutes for imports than the domestically commingled rice currently marketed. Promoting these varieties based on their quality traits offers a strategic opportunity to enhance competitiveness against imports and secure a stronger position for U.S. rice in its most important market.

Louisiana and Arkansas currently cultivate several jasmine-type rice varieties that have the potential to serve as viable substitutes for the growing demand for imported jasmine rice. However, the absence of an established marketing standard or certification system limits consumer recognition of the quality attributes of domestically produced jasmine-type rice. Unlike Thai Hom Mali rice, which benefits from well-defined quality certifications and strong brand recognition in global markets, U.S.-grown jasmine-type rice lacks comparable mechanisms to signal its sensory and quality characteristics to consumers. Compounding the quality issue of US rice in the domestic market is the common practice of comingling varieties at the mill, which can result in heterogeneous quality attributes. If a high-quality variety currently produced in the U.S. (either aromatic or non-aromatic) could be identified as being similar in quality attributes to imported rice, there is a potential to curb the current import substitution through its identity preservation and marketing.

Despite these challenges, rice remains economically important for the United States. The industry contributes more than \$34 billion annually to the U.S. economy and supports over 125,000 American jobs. In states like Arkansas and Louisiana, rice is not only a top-five agricultural sector but also a cornerstone of rural economies across the American South. Strengthening the competitiveness of U.S. long-grain rice is therefore more than a trade issue—it is essential to sustaining jobs, communities, and economic growth across the southern United States.

Outreach Plan: Through the project initiatives, we will engage multiple stakeholders. Our outreach plan includes participation in rice field days (e.g., Arkansas Rice Expo, LSU Rice Field Day) and industry forums such as the Rice Technical Working Group and the Rice Marketing and Technology Convention. We will also utilize print, digital, and social media to disseminate information and gather feedback from a wide range of stakeholders, including farmers, processors, rice breeders, and retailers.

Potential Economic and Social Benefits: The results of this project will equip U.S. long-grain rice supply chain stakeholders—breeders, millers, retailers, and traders—with the insights needed to make strategic decisions that enhance the sector's growth and help restore U.S. rice's

competitiveness. By aligning U.S.-grown varieties with domestic consumer preferences and directing research investments toward the quality traits most valued domestically, the industry can maintain and even strengthen domestic market share, capture new opportunities, and secure a more resilient future for U.S. rice.

Stakeholder Engagement: Several stakeholders from the U.S. rice industry, including the Arkansas Rice Research and Promotion Board, the U.S. Rice Federation, the U.S. Rice Producers Association, and Riceland Foods, have provided significant input to the proposal. The research team will invite the Arkansas Rice Research and Promotion Board to serve as the Advisory Board for this project, which will provide feedback and guidance to the research team to ensure the project's goals are met.

Introduction

Statement of the long-term goal

The U.S. long-grain rice sector is increasingly under pressure from growing import competition and declining export performance. While approximately half of U.S. long-grain rice is exported annually, the domestic market remains the single most important market for U.S. long-grain rice. Imported rice into the U.S. has surged, particularly of high-quality aromatic varieties (jasmine), which are widely regarded as close substitutes for domestically produced long-grain and aromatic rice. This rapid growth of imports is reshaping the domestic market and poses a direct threat to the long-term viability of the U.S. rice industry.

The long-term objective of this project is to strengthen the growth and competitiveness of the U.S. rice sector by deepening understanding of how grain quality influences domestic market performance. Specifically, the study will test the hypothesis that identity-preserved long-grain rice varieties—such as U.S. jasmine-type cultivars (e.g., Aroma 22) or other high-quality non-aromatic varieties with attributes comparable to Thai Hom Mali, the leading aromatic rice imported into the United States—are closer substitutes for imported aromatic rice than the commingled long-grain rice currently sold domestically. If supported, this hypothesis would imply that marketing identity-preserved U.S. long-grain rice with superior quality traits could enhance its competitiveness relative to imports and thereby improve the overall position of U.S. rice in the domestic market.

Our specific objectives are to:

1. Through quality analysis, identify the potential of specific U.S.-grown rice varieties to compete more effectively against imported aromatic rice among U.S. consumers through collaboration with agricultural researchers and rice industry leaders.
2. Evaluate the socioeconomic and rice consumption characteristics of U.S. consumers, particularly individuals who have recently incorporated imported aromatic rice into their diets, and assess willingness to accept alternative labeling schemes for high-quality U.S. long-grain and jasmine-type rice, as measured through a nationally representative consumer survey.
3. Estimate both the economic value (willingness to pay) and market shares for imported aromatic rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, and U.S. jasmine-type rice, and “certified U.S. jasmine-type” rice using experimental auctions.
4. Disseminate project findings to U.S. rice stakeholders—including researchers, agricultural scientists, millers, and traders—through active participation in industry and professional conferences, rice field days, and other outreach events, as well as by producing accessible printed and digital resources tailored for diverse media platforms.

To achieve our objectives, we propose to use a multi-method approach to elicit the economic value of different rice quality attributes and measure the market opportunities for high-quality U.S. long-grain rice (including jasmine-type rice) to better compete with imported aromatic rice. We will employ consumer surveys and experimental auction methodologies to investigate the rice consumption patterns of U.S. households, with particular attention to consumers who currently purchase imported aromatic rice. These approaches will further

enable us to estimate the relative competitiveness and market potential of high-quality U.S. long-grain rice within the domestic market.

Findings from these objectives will be integrated to deliver actionable insights, including:

- Assessing the U.S. market potential of identity-preserved high-quality U.S. long-grain and jasmine-type rice.
- Identify priority areas (such as specific quality traits) for domestic rice breeding programs aimed at developing varieties that can compete more effectively with imported aromatic rice; and
- Determine the characteristics of current and potential consumers to develop marketing strategies to enhance the competitiveness of U.S. rice within the domestic market, including exploring the impacts of the certification logo for U.S. jasmine-type rice.

Our project is innovative because it shifts the discussion of competitiveness from the historical metric of price to the emerging metric of quality. Currently, U.S. long-grain rice is more price-competitive than imported aromatic rice in the domestic market, so cost is not a driving factor behind increased imports. Instead, we propose that aromatic rice and long-grain rice function as close substitutes, with aroma being just one of several quality traits that influence consumer preferences and demand. This study will assess the extent to which aroma, alongside other intrinsic quality attributes, influences consumer purchasing behavior, both in terms of rice type selection and willingness to pay.

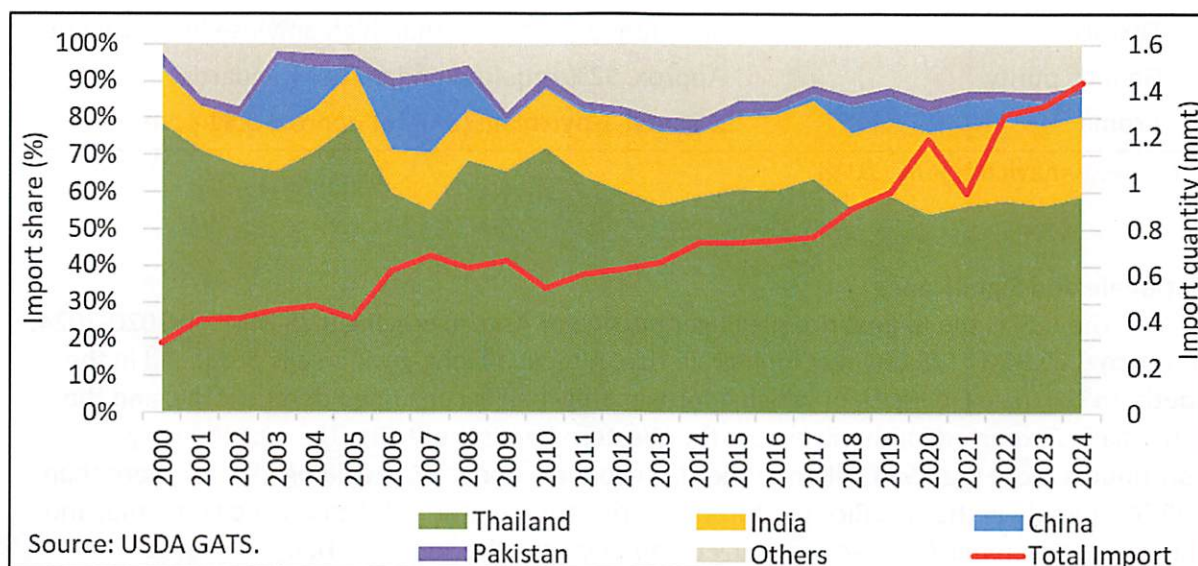
Our team brings unparalleled expertise and networks. The PI has experience analyzing the global rice market and conducting specific market assessments in the U.S and abroad. Dr. McFadden has a strong background in quantitative methods applied to marketing agricultural products and experience conducting consumer research nationally and internationally. Dr. Nalley has over 100 peer-reviewed publications, many of which focus on rice economics, and extensive experience conducting research overseas. Collectively, our team combines scientific expertise, economic insight, and trusted industry relationships to deliver actionable results for the U.S. rice sector.

Background information

While the United States consistently ranked among the world's top five rice exporters, rice imports grew rapidly from 300 TMT in 2000 to 1.43 MMT (milled basis) in 2024 (see Figure 1). To put these numbers in perspective, rice imports in 2024 amounted to roughly the combined production of Louisiana (899 TMT on a milled basis) and Missouri (564 TMT on a milled basis), or 44% of Arkansas' rice production.

The bulk of the rice imported is aromatic rice, primarily jasmine rice from Thailand, as well as basmati rice from India and Pakistan. Imports of non-aromatic long-grain and medium-grain rice have grown slightly in the last 20 years (primarily to serve the Puerto Rican market). Hence, for U.S. long-grain rice to compete with imports, the industry must identify and market U.S. varieties that share similar characteristics of the rice being imported.

Figure 1. Evolution of U.S. rice imports and import market share by source.



Aromatic rice can be classified into two general types: basmati and jasmine. Basmati rice is characterized by translucent, extra-long, and slender kernels, with a length-to-width ratio of between 3.5-4.5 or more, that elongate up to two times when cooked. Basmati rice is non-sticky when cooked due to its intermediate to high amylose content. Aside from the aroma differences, basmati rice is much more slender than the long-grain rice varieties grown in the U.S., including jasmine-type rice, which makes U.S. long-grain rice a less likely substitute for imported basmati rice.

Jasmine rice is the main type of rice imported into the U.S., most of which is a variety known as Thai Hom Mali (Thai official variety name: Khao Dawk Mali 105, or KDML105). Table 1 below shows the main quality characteristics of Thai Hom Mali rice. Jasmine's physical characteristics are closer to domestically produced long-grain rice, both in its raw and cooked form, than basmati rice. Moreover, many long-grain varieties used in the U.S. fall within the same ranges of physical (e.g., length, length-to-width ratio) and chemical or cooking (e.g., amylose content, gelatinization temperature) characteristics of jasmine rice. Thus, a high-quality long-grain rice variety that shares most of the quality attributes with jasmine rice should be a closer substitute compared to long-grain rice currently offered in the market, which is mostly a mix of many domestic varieties, including rice hybrids.

Table 1. Quality profile of Thai Hom Mali rice (Khao Dawk Mali 105, or KDML105)

Attribute	Value/Characteristics
Grain length	Approx. 7.5 mm
Length/Width ratio	Approx. 3.4:1 (slender long grain)
Appearance polished grain	translucent, pearly, glossy exterior
Amylose content	14-18% (low to intermediate)
Gelatinization temperature	6-7 alkali spreading value (medium)

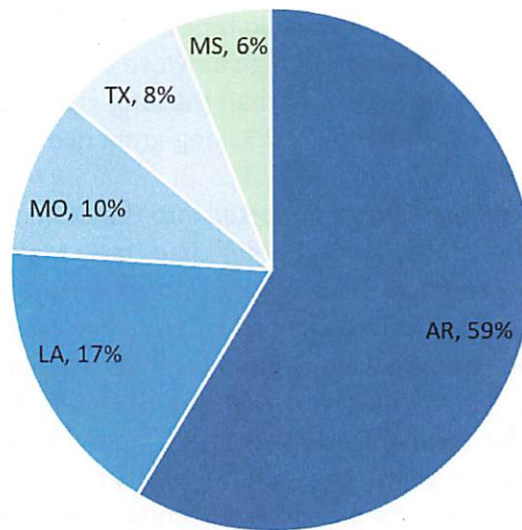
Texture	Soft, tender. Less firm than high amylose long-grain rice
Genetic purity	Approx. 92% required under Thai standards
Aroma	2-acetyl-1-pyrroline (2AP) of approx. 0.81 ppm

Source: Vanavichit et al., 2018.

Rationale and Significance

The U.S. is the largest rice producer outside of Asia, averaging 9.25 MMT in 2020-2024, of which 6.99 MMT (75.6%) was long-grain rice. Almost all long-grain rice is produced in the southern U.S. (see Figure 2), of which approximately half is consumed domestically, and the other half is exported, primarily across the Western hemisphere. The U.S. rice industry contributes more than \$34 billion to the U.S. economy annually, providing jobs for more than 125,000 people in the U.S. Rice is a top-five agricultural sector in Arkansas and Louisiana, and the driving economic force across many communities in the southern U.S.

Figure 2. Share of U.S. long-grain rice production by state, 2020-2024.



Source: USDA, 2024.

The heavy reliance of U.S. long-grain rice in the domestic market underscores the need to ensure its competitiveness by better understanding consumer demand, particularly when it comes to the factors driving consumers to choose imported aromatic rice over domestically produced long-grain rice.

Once regarded as the global benchmark for quality, U.S. long-grain rice has seen its reputation erode in many of its key export markets, potentially including the domestic market. Restoring consumer trust begins with a clear understanding of their quality preferences and the ability to deliver products that meet those expectations.

This project represents the first systematic effort to economically assess U.S. consumer

preferences for imported aromatic rice and U.S. long-grain rice, including domestically produced jasmine-type rice. The project entails evaluating the quality profiles of leading (in terms of currently produced acreage) U.S. long-grain rice varieties (including currently produced domestic jasmine-type varieties) to identify those that more closely resemble the characteristics of imported aromatic rice and estimate their market value and potential as a substitute for imported aromatic rice. Moreover, this project proposes to analyze the socioeconomic characteristics of U.S. rice consumers with special emphasis on those consuming imported aromatic rice to identify patterns that could be used for developing marketing campaigns aimed at better promoting high-quality U.S. long-grain rice. The project also proposes assessing the impact of different labelling options for the U.S. high-quality long grain rice developed as a close substitute for imported aromatic rice. Currently, there is no domestic certification or standard to label a product as jasmine-type rice, which may leave consumers confused, given the various names currently given to domestically produced jasmine-type rice. This study will explore whether a certification would increase market share for domestically produced jasmine-type rice. Consumer choices are influenced by several variables aside from the intrinsic quality of the rice. Packaging and labelling options will be developed by the research team in consultation with industry leaders and evaluated to ascertain consumers' attitudes and the market potential of alternative labelling.

The findings will provide valuable insights, informing both research (e.g., setting new breeding objectives, optimizing milling processes) and marketing strategies (e.g., identity preservation, pricing schemes, labeling options tied to varietal marketability). Together, these efforts aim to strengthen the competitiveness of U.S. long-grain rice and support sustainable growth across the sector.

Our project directly addresses FY 2025 7f: AFRI Commodity Board Co-funding Topics, Program Priority area 1: Determine consumer preferences for southern rice quality characteristics, by investigating how U.S. long-grain rice quality affects its competitiveness in the domestic market vis-à-vis imports. In doing so, the project aims to enhance the competitiveness of U.S. rice and expand its domestic market share.

Approach

Key Personnel and Roles

The research team consists of agricultural economists with expertise in rice economics (production, demand, trade) and consumer behavior. The research team's combined expertise will effectively address the project objectives:

Objective 1: To analyze the quality characteristics of the main long-grain rice varieties grown and consumed in the U.S., as well as the main imported jasmine varieties (e.g., Thai Hom Mali rice).

Dr. Durand-Morat will lead Objective 1 with the assistance of Dr. Nalley. Dr. Durand-Morat has vast experience in rice production and trade research. In these areas, he has published research on rice consumption patterns by demographics (Mulimbi et al., 2024), the assessment of consumer preferences for different aspects of rice quality, including fortification (Durand-Morat et al., 2024), physical quality attributes (Phillips et

al., 2024; Peterson-Wilhelm et al., 2023; Saha et al., 2021) and credence attributes (Okpiaifo et al., 2020), and the trade impact of rice technology such as different irrigation systems (Nalley et al., 2022), herbicide technology (Durand-Morat et al., 2018), and rice breeding (Shew et al., 2018).

Dr. Nalley has vast experience in rice economic research, in which he has published in areas such as the impacts of rice quality genetics on food security (Nalley and Durand-Morat, 2023), the impact of broken rice percentage on international rice trade (Richardson et al., 2022), quality determinants of rice purchasing (Peterson-Wilhelm et al. 2021), economic impacts of sustainable rice production (Shew et al., 2021; Shew et al., 2019), and the economic impact of enhanced rice breeding (Nalley et al., 2016; Nalley et al., 2017).

Objective 2: Estimate the potential of high-quality long-grain rice grown in the U.S., including jasmine-type rice such as Aroma 22, to compete with imported jasmine rice in the domestic rice market.

Dr. McFadden and Dr. Durand-Morat will lead Objective 2 with the assistance of Dr. Nalley. Dr. McFadden has vast experience in consumer preference research. In this area, he has published research using online choice experiments (McFadden et al., 2023; McFadden et al., 2021), lab experiments (Neuhofer et al., 2023; Neuhofer et al., 2020), field experiments (Langer et al., 2022; Pakseresht et al., 2017), sensory experiments (Flowers et al., 2019), and auctions (McFadden et al., 2022).

While all personnel are committed to assisting with all study objectives and research needs, Table 2 presents their specific roles and time contributions.

Table 2. Key personnel involved and their roles.

Key personnel	Affiliation	FTE	Roles and responsibilities
1. Alvaro Durand-Morat (Lead) Associate Professor and LC Carter Chair for Rice and Soybeans	University of Arkansas (UofA), Fayetteville	0.10 (Research: 80%, Extension: 20%)	- Develop and implement the strategy to conduct the proposed research. - Assist in the evaluation of rice varieties, developing and conducting surveys, stakeholder interviews, and outreach strategy.
2. Brandon R. McFadden (Co-PI) Professor and Tyson Chair in Food Policy Economics	UofA, Fayetteville	0.05 (Research: 90%, Extension: 10%)	- Lead the consumer preference assessment, using state-of-the-art preference valuation methods. Assist with outreach strategy.
3. Lawton Lanier Nalley (Co-PI) Professor and Department Head	UofA, Fayetteville	0.05 (Research: 90%, Extension: 10%)	- Assist in conducting consumer preference assessments, using state-of-the-art preference valuation methods. - Assist with outreach strategy.

Research Objectives and Methods

Table 3 lays out the key objectives and the activities proposed to achieve them.

Table 3. Competitiveness pathway of the U.S. long-grain rice sector

Key objectives	Activities
1. Identify U.S.-grown rice varieties with the potential to compete more effectively with imported aromatic rice.	1.1. Identify the quality profile of U.S. long-grain varieties through a literature review and interview with industry experts
	1.2. Cluster and principal component analysis to identify distinct varietal groups
	1.3. Conduct quality analysis of the prospective rice varieties to ascertain their quality and create a long-grain rice with the same quality attributes as Thai Hom Mali rice, except for aroma.
2. Assess the socioeconomic and rice-consumption characteristics of current and potential U.S. rice consumers, consumer preferences for rice attributes, and the impact of alternative labelling for high-quality U.S. long-grain and jasmine-type rice.	Conduct a nationally representative online survey including a hypothetical choice experiment. Estimate hypothetical willingness to pay (WTP) and market shares for rice attributes, estimate the effect of labelling, and define consumer segments based on preferences.
3. Estimate the economic value (willingness to pay) and market shares for imported aromatic rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, and U.S. grown jasmine-type rice.	Conduct experimental auctions using imported jasmine rice and U.S. grown long-grain varieties, including jasmine-type rice. Estimate non-hypothetical willingness to pay (WTP), labelling effects, and implied demand curves for each product to determine market sizes at varying prices.

The following section discusses the details of these specific objectives and outcomes.

Objective 1: *Identify U.S.-grown rice varieties with the potential to compete more effectively against imported aromatic rice.*

Sub-Objective 1.1: *Identify the quality profile of U.S. long-grain varieties through a literature review and interview with industry experts.*

Many long-grain rice varieties have been commercially released and produced in the U.S. in the last several decades. For example, the University of Arkansas’s rice breeding program has released 29 varieties since funding through the Rice Research and Promotion Board began in 1980, LSU has released more than 30 varieties since 2000, and Ricetec® has released more than 10 hybrid rice varieties since the release of the first hybrid rice in 2000. In such a large sample of varieties, there is likely variability in quality profiles, with some varieties potentially fitting the quality profile of jasmine Thai Hom Mali rice better than others.

This part of the research will survey and document the milling and cooking profiles of the long-grain rice varieties released and produced in the U.S. in the last 30 years. The main source of information includes published data from rice breeding programs and seed dealers,

including patent application information, and information from industry experts (e.g., rice breeders, producers, and millers). The primary output of this research activity will be a compendium of long-grain rice varieties, along with their respective quality profiles. The compendium would serve as a valuable resource for both researchers and the rice industry to ascertain the competitiveness potential of existing rice varieties, and the potential paths for breeding long-grain varieties with jasmine-like quality profiles.

We expect to generate extension material to highlight the varietal composition in the selected rice markets.

Sub-Objective 1.2: Cluster and principal component analysis to identify distinct varietal groups

The information collected in sub-objective 1.1 (the rice compendium) will be evaluated for the selected quality attributes using principal component analysis (PCA) and cluster analysis to determine the pattern of variation and relationships among varieties and their quality characteristics. PCA originated with the work of Pearson (1901) and Hotelling (1933) and is a statistical technique for data reduction. It helps reduce the number of variables in an analysis by describing a series of uncorrelated linear combinations of the variables that contain most of the variance. Within the context of this project, PCA will be used to understand the main sources of quality variation among the varieties selected. Cluster analysis attempts to determine natural groupings (or clusters) of observations (Kaufman and Rousseeuw, 1990). While there are various clustering methods, we propose using both partition and hierarchical clustering. Partition methods break the observations into distinct non-overlapping groups, whereas hierarchical clustering creates hierarchically related sets of clusters. The goal of clustering is to find distinctive groups of rice varieties for each quality attribute selected. This allows us to find varieties that have a similar quality for the attribute of interest, which will be an important aid for the U.S. rice industry to identify the market potential of existing U.S. long-grain rice varieties and/or future areas of research to develop rice varieties with the desired quality traits to better compete with imported Thai Hom Mali rice.

We will produce extension materials and scientific publications to present the quality assessment results of all collected rice varieties, including outcomes from the PCA and clustering analyses.

Sub-Objective 1.3: Conduct quality analysis of the prospective rice varieties.

The information generated from sub-objectives 1.1. and 1.2 will be used to identify a set of prospective varieties that more closely resemble the quality profile of Thai Hom Mali jasmine rice, the main rice imported into the U.S. Rice quality attributes can be classified in several diverse ways. For example, attributes can be classified as intrinsic (e.g., shape, chalkiness, aroma) or extrinsic (such as packaging, labeling, or brand). Rice quality attributes can also be classified as search, experience, and credence attributes. Search attributes allow for an evaluation before purchasing and include attributes such as shape, color, price, brand, and packaging. Experience attributes such as texture, stickiness, and aroma can be assessed only after trying the product. Lastly, consumers cannot assess credence attributes directly; instead, they rely on institutions to guarantee their presence, such as organic, regenerative, or fair-trade

labels (Cuevas et al., 2016).

This project will focus on the following search and experience attributes: size (length), shape (length-to-width ratio), color, percentage of broken rice, percentage of chalk rice, apparent amylose content (AC), gel consistency (GC), and gelatinization temperature (GT).

The length, length-to-width ratio, color, percentage of broken rice, and percentage of chalk rice will be determined using a Vibe QM3 Rice Analyzer. The broken percentage represents the amount of broken rice in the sample by weight and is measured as:

$$Broken_i = \frac{WB_i}{\text{weight of working sample } i} * 100$$

where WB_i is the weight of broken rice in sample i (Saha et al., 2021). USDA (2020) defines kernels' chalkiness as whole or broken kernels of rice that are one-half or chalkier relative to the weight of the sample. Therefore, the chalk percentage is measured as:

$$Chalk_i = \frac{WC_i}{\text{weight of working sample } i} * 100$$

where WC_i is the weight of chalk rice in sample i (Saha et al., 2021). The length and width of the rice are measured in millimeters. The length of the kernel in sample i is the average length across the whole sample n . Similarly, the width of the kernel in sample i is the average width across the entire sample n .

$$AvgLength_i = \sum_{j=1}^n \frac{length_{ji}}{n}$$

$$AvgWidth_i = \sum_{j=1}^n \frac{width_{ji}}{n}$$

Color is measured in the CIELAB color space. CIELAB comprises three channels: L^* represents the lightness value of the color; a^* represents green or red respectively; and b^* measures blue as negative and yellow as positive value. *Color* is estimated as:

$$Color_i = \sqrt{L_i^2 + a_i^2 + b_i^2}$$

The higher the value of color, the whiter the rice sample.

Amylose, one of the two starch polymers found in rice, is widely regarded as a key determinant of rice texture (Morrison and Azudin, 1987; Cuevas et al., 2016). Its content is typically measured using iodine colorimetry as described by Juliano (1971). Based on amylose levels, rice is commonly classified into five categories: waxy (0–2%), very low (3–9%), low (10–19%), intermediate (20–25%), and high (>25%) (Kumar and Khush, 1987). Another important trait is the gelatinization temperature (GT), traditionally defined as the point at which most starch granules lose their birefringence—the optical property related to light refraction and polarization (Bhattacharya, 1979). GT is usually determined through differential scanning calorimetry (DSC), which tracks changes in thermal properties to identify the temperature range where starch granules irreversibly melt in the presence of water, acting as a plasticizer. Rice with higher GT requires more water and longer cooking times compared to lower GT

varieties (Juliano, 1971). GT values generally range from low (<70°C) to high (>74°C) (Bhattacharya, 1979).

Objective 2: Assess the socioeconomic and rice-consumption characteristics of U.S. rice consumers, including willingness to accept alternative labelling for high-quality U.S. long-grain and jasmine-type rice.

An online survey of U.S. consumers will be conducted to gather information about rice consumption habits, including perceptions about rice quality, socioeconomic and demographic characteristics, and consumers' willingness to accept alternative labelling options for high-quality U.S. long-grain rice, such as "certified U.S. jasmine-type rice". The survey will be designed in Qualtrics® and administered via Prolific to collect responses from a representative sample of U.S. consumers (i.e., gender, race, income, and education levels from the U.S. Census Bureau (2023)). The target sample size is 2,000 respondents, which provides a margin of error of about ± 2.5%.

A choice experiment (CE) will be used to assess consumer preferences for selected rice labelling alternatives. CEs follow the Random Utility Theory (McFadden, 1973), which states that, given a set of alternatives, individuals choose the alternative that generates the highest level of utility. The conceptual foundation for choice experiments is found in hedonic methods, where demand for goods arises from the demand for attributes (Holmes et al., 2017). Choice experiments have been widely employed in several fields, such as transportation, market research, health, and environmental economics. Utility for participant i can be represented by $U_i = V_i + \varepsilon_i$; where V_i is the observable portion of utility derived from a choice option, and ε_i is the unobserved portion of utility. For example, the observable utility for choice option j can be represented by:

$$V_{ij} = \alpha + \beta_1 Att_j + \gamma_1 Price_j,$$

where Att_j denotes some attribute associated with choice option j , $Price_j$ is the price associated with choice option j , and α , β_1 , and γ_1 are coefficients to be estimated. Assuming the error term ε_i is distributed iid extreme value, a logit model can be estimated and the probability of individual i choosing option j is:

$$\text{Prob(option } j \text{ is chosen)} = \frac{e^{V_{ij}}}{\sum_{k=1}^J e^{V_{ik}}}.$$

Thus, relative choice probabilities are explained by differences in utility. This framework allows us to determine the attributes and attribute levels associated with consumer preferences for rice (i.e., size, shape, color, percentage of broken rice, percentage of chalk rice, apparent amylose content, gel consistency, and gelatinization temperature). All experiments will be created following a D_b -efficient design to extract a D-error representing the efficiency with which the experimental design extracts information from the respondent (Szinay et al., 2021). All econometric modeling (e.g., estimation of multinomial and random parameter logit models) will be conducted in Stata®. Further, this framework allows us to determine the effects of labelling on WTP and market shares, as well as defining consumer segments using latent class analysis.

Objective 3: Estimate the economic value (willingness to pay) and market shares for imported Thai Hom Mali rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, U.S.-grown jasmine-type rice, and rice labeled as certified U.S. grown jasmine-type rice.

The evaluation of the competitiveness of U.S. long-grain rice relative to Thai Hom Mali jasmine rice will be assessed using experimental auctions (EA). EAs attempt to simulate a real market situation in which consumers decide to buy and make the purchase, thus offering participants real products and allowing for the exchange of real money. In this way, the participant may incur actual costs if a bid deviates from their true willingness to pay (WTP), thereby incentivizing them to reveal their true WTP (Lusk and Hudson 2004). Auctions use a set of rules to determine, according to the bids presented by the participating bidders, who the winner of the auctioned good is and the price to be paid (McAfee and McMillan 1987). All econometric modeling will be conducted in Stata®.

We will survey consumers face-to-face and have rice-tasting exercises (sensory analysis) to support the valuation of rice quality. To the extent possible, we will use non-hypothetical valuation approaches. However, in situations where non-hypothetical approaches are unsuitable (e.g., too many attributes identified as relevant, which poses logistical challenges, such as sourcing large quantities of all possible rice products), we propose using cheap talk scripts to address hypothetical bias.

The target sample size is 400 participants. The goal is to develop a sample that is representative of the U.S. rice consumer population. The demographic profile of rice consumers from objective 2 will be used as a sampling frame. We propose to conduct EAs in multiple locations across the U.S. Preliminary locations for consideration include Kansas City, KS (low density of immigrants), Seattle, WA, Portland, OR, or San Francisco, CA (large Asian population), Atlanta, GA (multicultural), and Houston, TX (large Hispanic population).

The Becker–DeGroot–Marschak (BDM) elicitation format will be used. BDM is an incentive-compatible method used in economics and experimental research to elicit a person's true willingness to pay (WTP) for a good or service. BDM is a popular elicitation method because it can capture individual valuations without requiring a group setting. This makes it especially suitable for use outside the laboratory, where gathering participants at the same time is often more difficult (Canavari et al., 2019).

Each EA will consist of two rounds; thus, each participant will offer two bids for each product. In Round 1 (No information), participants will evaluate the unlabeled cooked and raw rice options, taste the cooked rice to assess the quality, and then record their WTP. In Round 2 (labelled), rice samples will be labeled as imported Thai Hom Mali rice, high-quality long-grain rice, standard long-grain rice, and jasmine-type long-grain rice, and participants will record again their WTP for each product. The differences in WTP values from Round 1 to Round 2 estimate the effects associated with labelling; that is, the marginal difference in WTP from knowing what the different rice options are and where they are produced. Additionally, this approach allows us to estimate the implied demand curves for each product to simulate how pricing affects market sizes.

Outreach

Although this is a research-only project with no extension component, working together with the Arkansas Rice Research and Promotion Board, we will create a strategic approach to disseminate the findings of this project to the target audience, that is, members of the U.S. long-grain rice supply chain, from breeders to input suppliers, retailers and exporters, and policymakers. The outreach activities we envision include:

1. Dissemination of findings in rice field days organized by the extension services in the leading rice-producing states, including Arkansas, Louisiana, and Mississippi. Rice field days are excellent venues to promote our project and disseminate the results among farmers, processors, and members of the local communities. We will develop printed material to highlight the findings of our project and provide information on how to access the information online.
2. Organization of a rice quality symposium at the 2027 Rice Technical Working Group (RTWG) Meeting. RTWG meets biennially to provide for continuous exchange of information, cooperative planning, and periodic review of all rice research and extension activities being conducted by the states, federal government, and cooperating agencies. It is an ideal venue to disseminate our project findings among researchers, extension agents, and representatives of the U.S. rice industry.
3. Participation in industry and professional conferences and meetings. We propose organizing a rice quality discussion panel at the 2027 or 2028 Rice Outlook Conference and Rice Market and Technology Convention. These two venues are ideal because they bring together rice industry leaders from the U.S. and Latin America. We also envision presenting the findings of this project in professional meetings such as the Agricultural and Applied Economics Association Meeting.

Project Timeline

Table 3. Timeline of expected project outcomes.

Project Objective	Year 1				Year 2				Year 3			
	Quarter				Quarter				Quarter			
	1	2	3	4	1	2	3	4	1	2	3	4
1.1. Identify the quality profile of U.S. long-grain varieties through a literature review and interview with industry experts (Durand-Morat and Nalley)												
Data collection	■	■										
Interview with industry leaders	■	■										
Development of rice compendium		■	■	■								
Objective 1.2: Cluster and principal component analysis to identify distinct varietal groups (Durand-Morat, McFadden, Nalley)												
Data analysis				■	■	■						
Publication of results					■	■						
Objective 1.3: Conduct quality analysis of the prospective rice varieties (Durand-Morat, Nalley)												
Data analysis						■	■					
Publication of results						■	■					

Objective 2: Assess the socioeconomic and rice-consumption characteristics of U.S. rice consumers, including willingness to accept alternative labelling for high-quality U.S. long-grain and jasmine-type rice (McFadden, Durand-Morat, Nalley)												
Development of research protocols												
Survey implementation												
Data analysis												
Dissemination of results												
Objective 3: Estimate the economic value (willingness to pay) and market shares for imported Thai Hom Mali rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, U.S.-grown jasmine-type rice, and rice labeled as certified U.S. grown jasmine-type rice (McFadden, Durand-Morat, Nalley)												
Development of research protocols												
Survey implementation												
Data analysis												
Dissemination of results												

Potential pitfalls that may be encountered

Managing a project demands effective coordination and execution of activities by all the members involved. Also, respecting the timing of the project outcomes is vital due to the linkages between the different objectives. Any delay in completing the proposed activities will affect the timing of subsequent research activities and the overall project. We will implement a schedule of PI meetings to update each member regularly about the progress on every aspect of the project. The assistance of graduate students assigned to this project will be crucial to defining the content of each meeting. We will also rely on the feedback from our Advisory Board to guide the scheduled meetings.

Another possible pitfall is the possibility that the current domestically produced jasmine-type rice varieties are so heterogeneous in quality that clustering them into one “jasmine-type” group may not be feasible. It may be that only one or several of the currently produced jasmine-type varieties are suitable substitutes. As with any survey, obtaining a representative sample of rice consumers could be an issue. This will try to be mitigated through screening questions, but the risk still exists.

Finally, we need to obtain approval from the Institutional Review Boards (IRB) of the research institutions involved in conducting activities involving human subjects. Our experience conducting similar activities suggests that IRB approval should not be an issue of concern. Still, there is always a chance that research protocols must be changed to obtain such approval.

Support Letters

The following stakeholders from the U.S. rice industry provided strong letters of support for this project:

Peter Bachmann. President and CEO, U.S. Rice Federation. U.S. Rice Federation is an advocate for all segments of the U.S. rice industry.

Mollie Buckler. President and CEO, U.S. Rice Producers Association (USRPA). USRPA represents rice producers from all six rice-producing states.

Kevin McGilton. President and CEO, Riceland Foods, Inc. Riceland Foods is a farmer-owned cooperative and the largest marketer and miller of rice in the U.S.

Keith Glover. President and CEO, Producers Rice Mill, Inc. Producers Rice Mill is a farmer-owned cooperative and one of the largest marketers and millers of rice in the U.S.

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Facilities & Other Resources

1. Department of Agricultural Economics

The Department of Agricultural Economics at the University of Arkansas offers the resources and facilities needed to conduct the economic assessments for this project, which mainly include computer hardware and software.

The facilities and resources needed to conduct the fieldwork across different markets in the U.S. is going to be sourced through collaboration with partners from other Land Grant Universities.

Equipment

Agricultural Economics and Agribusiness

The equipment required for this project is primarily the computers and software already available for each investigator.



Kevin McGilton
President & CEO

September 25, 2025

To Whom It May Concern,

Riceland Foods, Inc., is a farmer-owned cooperative founded in 1921 and is the largest marketer and miller of rice in the United States. Riceland is active supplying customers in all segments of the U.S. rice market.

The U.S. domestic market is critical demand for U.S. rice farmers and millers. Export markets can be very unreliable due to many factors that are typically out of the industry's control. The domestic market has traditionally been a reliable and stable market for the industry.

Unfortunately, over the last 15 years there has been a major influx of foreign rice into the United States. And in the last 10 years to quantity of imported rice has doubled to 1.4 million metric tons which equals 30% of U.S. domestic rice consumption. Aromatic Jasmine rice from Thailand and Basmati rice from India are the greatest contributors to the rapid increase.

These large quantities of foreign rice coming into the U.S. have driven down demand for U.S. rice which in turn has driven down prices to levels that are not sustainable for the industry.

Riceland supports Dr. Lanier Nalley's efforts to identify and quantify the contributing factors associated with the rapid increases of imported rice into the United States and determining action items the U.S. industry should take to compete in the domestic market.

Sincerely,

A handwritten signature in black ink, appearing to read "K. McGilton", written over a light blue horizontal line.

Kevin McGilton
President & CEO



Keith Glover
President & CEO

September 29, 2025

USDA NIFA Review Committee
National Institute of Food and Agriculture
U.S. Department of Agriculture

On behalf of Producers Rice Mill, Inc., I am writing to express our enthusiastic support for a funding grant for the proposal titled "**Import Substitution and Competitiveness in the U.S. Rice Market**" led by Dr. Lawton Lanier Nalley and Dr. Alvaro Durand from the University of Arkansas System.

The United States (U.S.) domestic rice industry produces approximately 3 million acres of rice each year. Over half of the U.S. grown rice is sold and consumed in the U.S., while about 45% of the total U.S. rice production is exported to other countries.

In 2025, the U.S. is projected to import approximately 1.5 million metric tons of foreign grown milled rice. Imported rice into the U.S. has doubled over the past 10 years. Roughly eighty percent (80%) of these imports are aromatic rice, of which jasmine makes up the vast majority. The U.S. grows a domestically grown jasmine rice. Unfortunately, the U.S. grown jasmine doesn't seem to be substituted for the foreign grown jasmine.

We believe a study is desperately needed to determine why U.S. grown aromatic is not being accepted and where it may be lacking to foreign grown aromatic rice.

The research objectives outlined in this proposal are both timely and essential to the advancement of the U.S. rice industry. Specifically, the project aims to:

1. Identify U.S.-grown rice varieties with the potential to compete more effectively against imported aromatic rice through collaboration with researchers and industry leaders.
2. Assess the socioeconomic and rice-consumption characteristics of U.S. rice consumers through a nationally representative consumer survey.
3. Estimate both the economic value (willingness to pay) and market shares for imported aromatic rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, and U.S.-grown jasmine-type rice, using experimental auctions.
4. Analyze the impact of labeling on consumers' willingness to purchase U.S. long-grain rice versus imported aromatic rice.
5. Disseminate project findings to U.S. rice stakeholders—including researchers, millers, and traders—through active participation in industry and professional conferences, rice field days, and other outreach events, as well as by producing accessible printed and digital resources tailored for diverse media platforms.

Producers Rice Mill, Inc. supports initiatives that advance innovation, productivity and sustainability in the rice industry. We are confident that this project will yield practical strategies and insights, helping U.S. rice compete more effectively in domestic and global markets. We fully endorse this project and respectfully urge USDA to give this proposal full consideration for funding.

Sincerely,

Keith Glover
President & CEO

kglover@producersrice.com

P.O. Box 1248 Stuttgart, Arkansas 72160 USA (870) 673-4444 E-mail: kglover@producersrice.com



September 24, 2025

Alvaro Durand-Morat
Associate Professor and L.C. Carter Endowed Chair
Dept. of Agricultural Economics and Agribusiness
AGRI 213, University of Arkansas
Fayetteville, AR, 72701

Dear Dr. Durand-Morat:

On behalf of the US Rice Producers Association, I am writing in support of your research proposal, "Import Substitution and Competitiveness in the U.S. Rice Market," submitted to the AFRI Commodity Board Co-funding Topics.

Representing rice producers in Arkansas, California, Louisiana, Mississippi, Missouri, and Texas, US Rice Producers Association (USRPA) is the only national rice producers' organization comprised by producers, elected by producers, and representing producers in all six rice-producing states. As such, USRPA knows well both the challenges and opportunities facing our industry. Rice is an important commodity and is the economic backbone of many rural communities in the south-central United States.

With rice imports to the U.S. at an all-time high, it is crucial that we find ways to make U.S. rice more competitive domestically. Identifying and promoting a U.S.-grown long-grain rice with comparable appearance and cooking characteristics to imported aromatic varieties could strengthen domestic competitiveness and help reclaim market share.

USRPA strongly supports your research team's proposal, which is critical to U.S. rice's marketability and competitiveness. Please do not hesitate to contact me if you have questions regarding our support.

Sincerely,

A handwritten signature in black ink that reads "Mollie Buckler". The signature is written in a cursive, flowing style.

Mollie Buckler
President & CEO
US Rice Producers Association

25722 Kingsland Dr., Ste. 102, Katy, Texas 77494 • Phone: 713-974-7423 • usriceproducers.com

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September 24, 2025

Re: AFRI Commodity Board Co-funding Topics

To Whom it May Concern,

USA Rice is the global advocate for U.S. rice farmers, millers, merchants, and allied businesses. We strive toward effective policy and program development to support the growth and profitability of the entire U.S. rice industry, part of which requires strategic investment in research and development opportunities that help the industry address challenges.

A key to the U.S. rice sector's success over the last century has been the ability to competitively export a substantial portion of the crop, but to also maintain a significant domestic market share.

Unfortunately, over the last two decades, a substantial shift has occurred as American consumers have increased imports of fragrant rice varieties to the detriment of U.S. fragrant rice and traditional long grain rice. Quality is evaluated differently according to the specific preferences of each individual market segment, which means that there's not a silver bullet in terms of one variety that could address all of our needs. Some consumers draw lines in the sand for chalk, others for grain length, cooking time, stickiness, aroma, milling yields, etc.

USA Rice believes that it is going to be imperative to the future of our industry if we're going to retain the U.S. domestic market that we evaluate market characteristics and help better inform the U.S. rice growing, milling, and merchandising industries which varieties of domestic rice could potentially be used in lieu of imported specialty varieties. The University of Arkansas proposal "**Import Substitution and Competitiveness in the U.S. Rice Market**" is the perfect project to address these concerns and would have a lasting, significant economic impact on the entire Gulf and Mid-South rice growing regions.

USA Rice supports the important work Dr. Durand-Morat is doing to strategically advance production capabilities for the U.S. rice industry and we encourage you to fund "Import Substitution and Competitiveness in the U.S. Rice Market" to help maintain the long-term economic viability of the U.S. rice industry. We are looking forward to continuing to support this project in an advisory capacity.

Sincerely,

Peter Bachmann

President & CEO

Mentoring Plan

Project Title: Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice

(a) Mentor Training and Credentials

The mentoring team consists of experienced faculty in agricultural economics and food science with established records of research and student supervision.

- **Dr. Alvaro Durand-Morat (PD)** – Over a decade of mentoring graduate students and postdoctoral researchers, with expertise in rice trade, consumer demand, and international field research. Has completed university-sponsored mentor training workshops in inclusive mentoring and responsible conduct of research (RCR).
- **Dr. Brandon McFadden (Co-PI)** – Extensive experience in mentoring graduate students in experimental and behavioral economics. Regular participant in professional development sessions on graduate advising and evidence-based teaching/mentoring.
- **Dr. Lawton Lanier Nalley (Co-PI)** – Department Head with a strong record of mentoring undergraduate researchers, graduate students, and postdocs. Completed leadership and mentoring training programs through the University of Arkansas Faculty Development Center.

All mentors will participate in ongoing mentoring development activities, including peer mentoring discussions, university-sponsored inclusive mentoring seminars, and annual training on culturally aware mentoring to better support diverse student populations.

(b) Categories of Students and Trainees

This project will mentor graduate students, a postdoctoral scholar, and collaborators:

- **Graduate Students (M.S.):** Master students will participate in field research, data analysis, survey design, sensory analysis, econometric modeling, and manuscript preparation.

(c) Mentoring Activities

Mentoring will be structured around project milestones and adapted to the training needs of each group:

Graduate Students

- Development of **Individual Development Plans (IDPs)** with mentors, reviewed semi-annually.
- Advanced training in econometric modeling, survey and experimental design, and rice sensory/quality analysis.

- Opportunities to present at conferences (AAEA, Rice Technical Working Group).
 - Professional development workshops on grant writing, publishing, and academic/industry career paths.
-

(d) Expected Outcomes and Impacts

- **Graduate Students:** Completion of thesis, peer-reviewed publications, enhanced leadership and mentoring skills, and improved job readiness.

Broader Impacts:

This mentoring plan will contribute to building a diverse and well-prepared workforce in food and agricultural sciences. By engaging students and collaborating with research partners, the project will expand research capacity, promote cross-cultural exchange, and generate lasting professional development outcomes that benefit the U.S. agricultural sector.

Data Management Plan

As part of the activities proposed in our project “Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice”, we will gather data on consumer preferences for rice and the socioeconomic characteristics of households. Following is a description of the plan proposed to manage the data generated by this project.

Information collected for Objective 1 does not include information about individuals, but rather information about rice varieties grown and consumed in the U.S., well as information about quality by rice variety. The results from objectives 1.1 (compendium of rice varieties), 1.2 (statistical analysis using principal component and cluster analysis), and 1.3 (quality assessment of selected rice varieties) will be made available to all interested users through the University of Arkansas Cooperative Extension Service and used for scientific and non-scientific publications. The original data will be stored digitally and kept by the project director.

As part of objectives 2 and 3, consumers revealed and stated preference data will be gathered using experimental economic approaches. Several socioeconomic variables such as income and education levels, household size, and rice-eating habits will be gathered. The anonymity of the information is guaranteed since no identifiable information is ever requested from participants. Consequently, we will treat this information as non-sensitive and make the data available to all interested users upon request. The original data will be stored digitally and kept by the project director.

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator			
Prefix:	Dr.	* First Name:	Alvaro
		Middle Name:	
* Last Name:	Durand-Morat	Suffix:	
Position/Title:			
Department:			
Organization Name:	Division of Agriculture of the University of Arkansas System		
Division:			
* Street1:	1120 West Maple		
Street2:			
* City:	Fayetteville	County/ Parish:	
* State:	AR: Arkansas	Province:	
* Country:	USA: UNITED STATES	* Zip / Postal Code:	727046898
* Phone Number:	479-575-2377	Fax Number:	
* E-Mail:	adurand@uada.edu		
Credential, e.g., agency login:			
* Project Role:	PD/PI	Other Project Role Category:	
Degree Type:	PhD		
Degree Year:	2009		
* Attach Biographical Sketch	Biosketch - Durand-Morat 25.p	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/> <input type="button" value="View Attachment"/>
Attach Current & Pending Support	CPS - Durand-Morat 25.pdf	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/> <input type="button" value="View Attachment"/>

PROFILE - Senior/Key Person 1			
Prefix:	*	First Name:	Brandon
		Middle Name:	
* Last Name:	McFadden	Suffix:	
Position/Title:	Professor		
Department:	Agricultural Economics and Agribusiness		
Organization Name:	Division of Agriculture of the University of Arkansas System		
Division:			
* Street1:	1120 West Maple		
Street2:			
* City:	Fayetteville	County/ Parish:	
* State:	AR: Arkansas	Province:	
* Country:	USA: UNITED STATES	* Zip / Postal Code:	72704-6898
* Phone Number:	4795752299	Fax Number:	
* E-Mail:	mcfadden@uark.edu		
Credential, e.g., agency login:			
* Project Role:	Co-PD/PI	Other Project Role Category:	
Degree Type:	PhD		
Degree Year:	2014		
Attach Biographical Sketch	Biosketch - McFadden 25.pdf	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/> <input type="button" value="View Attachment"/>
Attach Current & Pending Support	CPS - McFadden 25.pdf	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/> <input type="button" value="View Attachment"/>

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Senior/Key Person 2			
Prefix:	<input type="text"/>	* First Name: <input type="text" value="Lawton"/>	Middle Name: <input type="text" value="Lanier"/>
* Last Name:	<input type="text" value="Nalley"/>	Suffix:	<input type="text"/>
Position/Title:	<input type="text" value="Professor"/>		
Department:	<input type="text" value="Agricultural Economics and Agribusiness"/>		
Organization Name:	<input type="text" value="Division of Agriculture of the University of Arkansas System"/>		
Division:	<input type="text"/>		
* Street1:	<input type="text" value="1120 West Maple"/>		
Street2:	<input type="text"/>		
* City:	<input type="text" value="Fayetteville"/>	County/ Parish:	<input type="text"/>
* State:	<input type="text" value="AR: Arkansas"/>	Province:	<input type="text"/>
* Country:	<input type="text" value="USA: UNITED STATES"/>		* Zip / Postal Code: <input type="text" value="72704-6898"/>
* Phone Number:	<input type="text" value="4795756818"/>	Fax Number:	<input type="text"/>
* E-Mail:	<input type="text" value="lnalley@uark.edu"/>		
Credential, e.g., agency login:	<input type="text"/>		
* Project Role:	<input type="text" value="Co-PD/PI"/>	Other Project Role Category:	<input type="text"/>
Degree Type:	<input type="text" value="PhD"/>		
Degree Year:	<input type="text" value="2007"/>		
Attach Biographical Sketch	<input type="text" value="Biosketch - Nalley 25.pdf"/>	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/>
Attach Current & Pending Support	<input type="text" value="CPS - Nalley 25.pdf"/>	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/>
		<input type="button" value="View Attachment"/>	<input type="button" value="View Attachment"/>

Alvaro Durand-Morat

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adurand@uark.edu

Education

Ph.D. Public Policy. University of Arkansas. May 2009.

Dissertation title: "Coping with DR-CAFTA: Assessing the Impact of the Agreement and Designing Adjustment Programs for Sensitive Agriculture in Honduras"

M.Sc. Agricultural Economics and Agribusiness. University of Arkansas. August 2003.

Thesis title: "Impacts of the Asia-Pacific Economic Cooperation Agreement and the Free Trade Area of the Americas Agreement on International Rice Trade."

Agricultural Engineering. National University of Entre Rios, Argentina. December 1999.

Grantsmanship (last 5 years)

Type of Project	As PI		As Co-PI		Total		My Share
	Amount (\$)	Projects	Amount (\$)	Projects	Amount (\$)	Projects	
Federal	756,000	4	0	0	756,000	4	642,000
Non-Fed.	111,000	8	298,000	4	409,000	12	176,000
Total	867,000	12	298,000	4	1,165,000	16	818,000

Research – Summary of publications and presentations

Type of Publication	Total	Since 2021
Refereed articles	45	20
Non-refereed articles	6	6
Book chapters	5	3
Refereed Professional Presentations	82	25
Invited Professional Presentations	26	15

- Eight peer-reviewed journal articles under review (3 in revise and resubmit stage).
- Google Scholar h-index of 18; Hirsch's individual m of 2 (Outstanding).
- 19 publications referenced in Econlit.
- 1,368 Google Scholar citations in total, 1,005 since submitting my tenure package in 2021.
- ResearchGate interest score of 88% (94th percentile of agricultural economists)
- Invited speaker at 25 national and international conferences.

Journal Articles (last 5 years)

27. Oswalt, S., **Durand-Morat, A.**, Rivera, T., Gallego, S., Andrade, R., McFadden, B., & Bonatti, M. (2025). From Deficiency to Demand: Consumer Preferences for Zinc-Biofortified Rice in Colombia. *Journal of Agriculture and Food Research*.
<https://doi.org/10.1016/j.jafr.2025.102034>
26. Han, J., **Durand-Morat, A.**, & Mottaleb, K.** (2025). Vitamin A fortification: key factors and considerations for effective implementation. *Front. Public Health*, 13.
<https://doi.org/10.3389/fpubh.2025.1534375>

25. Tran, D., Le, K.N., **Durand-Morat, A.**, Nguyen, N., Bairagi, S.K., Huynh, M.V., & Tran, T.V. (2025). Is it worth it? Land-fallowing and saltwater intrusion control under uncertainty, *Science of the Total Environment*, Volume 966. <https://doi.org/10.1016/j.scitotenv.2025.178711>.
24. Mottaleb, K. A., **Durand-Morat, A.**, Fatah, F. A., & Sarkar, Md. A. R. (2025). Adoption and abandonment of hybrid rice technology: The case of Bangladesh. *Outlook on Agriculture*, 0(0). <https://doi.org/10.1177/00307270251315473>.
23. Adabrah-Danquah, V., **Durand-Morat, A.**, Nalley, L. L., Diagne, M., Frimpong, B. N., & Yang, W. (2025). Consumer preferences and valuation for sustainably produced rice in Ghana. *Environment, Development and Sustainability*, 1-31. <https://doi.org/10.1007/s10668-024-05893-8>.
22. Mulimbi, W., J. Han, **Durand-Morat, A.**, & K. Mottaleb. Who (Will) Eat Rice in the United States? *Choices*, 39(4), 1-8. <https://www.choicesmagazine.org/choices-magazine/submitted-articles/who-will-eat-rice-in-the-united-states>
21. McFadden, B. R., Nalley, L. L., **Durand-Morat, A.**, Yang, W., & Loethen, K.*** (2024). Potential response of Mexican consumers to a Ban on genetically modified Maize imports. *Food Security*, 1-11. <https://doi.org/10.1007/s12571-024-01483-8>.
20. **Durand-Morat, A.**, Wang, Y. J., Bassole, I. H., Nkengla-Asi, L., & Yang, W. (2024). Market assessment of fortified parboiled rice in Burkina Faso. *Plos one*, 19(3). <https://doi.org/10.1371/journal.pone.0297674>
19. Phillips, J., **Durand-Morat, A.**, Nalley, L. L., Graterol, E., Bonatti, M., de la Pava, K. L., ... & Yang, W. (2024). Understanding demand for broken rice and its potential food security implications in Colombia. *Journal of Agriculture and Food Research*, 15. <https://doi.org/10.1016/j.jafr.2023.100884>.
18. Tran, D. Q., Nguyen, N. N., Huynh, M. V., Bairagi, S. K., Le, K. N., Tran, T. V., & **Durand-Morat, A.** (2024). Modeling saltwater intrusion risk in the presence of uncertainty. *Science of The Total Environment*, 908. <https://doi.org/10.1016/j.scitotenv.2023.168140>.
17. Mottaleb, K. A., & **Durand-Morat, A.** (2024). Interrelationships Among the Rice Export Prices of Major Exporting Countries: In Search of the Leader and Followers. *Journal of Agricultural and Applied Economics*, 56(2):234-259. <https://doi:10.1017/aae.2024.7>.
16. Han, J., Mottaleb, K. A.**, Ng'ombe, J. N., & **Durand-Morat, A.** (2024). Does sin tax on the legal market facilitate the illicit market? An ex-ante assessment on the US cannabis market. *Journal of the Agricultural and Applied Economics Association*. <https://doi.org/10.1002/jaa2.114>.
15. Nalley, L. L., & **Durand-Morat, A.** (2023). The Impacts of Enhanced Rice Quality Genetics on Food Security and Producer Profitability. *Journal of Agricultural and Resource Economics*, 48(3), 600-617. <https://jareonline.org/articles/the-impacts-of-enhanced-rice-quality-genetics-on-food-security-and-producer-profitability/>.
14. Peterson-Wilhelm, B.***, Nalley, L., **Durand-Morat, A.**, Shew, A., Tsiboe, F., & Mulimbi, W. (2023). Quality determinates of rice price in open bag markets in Sub-Saharan Africa. *Journal of Agribusiness in Developing and Emerging Economies*, 13(3), 361-378. <https://doi.org/10.1108/JADEE-02-2021-0038>
13. Nalley, L. L., Massey, J., **Durand-Morat, A.**, Shew, A., Parajuli, R., Tsiboe, F. (2022). Comparative economic and environmental assessments of furrow-and flood-irrigated rice production systems. *Agricultural Water Management*, 274. <https://doi.org/10.1016/j.agwat.2022.107964>.

12. Nalley, L. L., Roberts, C., **Durand-Morat, A.**, Roberts, T., Shew, A. M., Parajuli, R. (2022). Precise nitrogen recommendations improve economic and environmental outcomes in rice production. *Environmental Challenges*, 9. <https://doi.org/10.1016/j.envc.2022.100650>
11. Ala-Kokko, K., Nalley, L. L., **Durand-Morat, A.**, Yang, W. (2022). Impact of disjunctive marking on consumer preferences. *Applied Economics*. <https://doi.org/10.1080/00036846.2022.2139809>
10. Richardson, M., Nalley, L. L., **Durand-Morat, A.**, Crandall, P. G., Scruggs, A., Joseph, L., Chouloute, J. (2022). A Broken Market: Can Increased Access to Broken Rice Decrease Food Insecurity in Haiti? *Food Security*. <https://doi.org/10.1007/s12571-022-01286-9>.
9. Saha, I., **Durand-Morat, A.**, Nalley, L. L., Alam, M., Nayga, R. M. (2021) Rice Quality and its Impacts on Food Security and Sustainability in Bangladesh. *PLOS One*. <https://doi.org/10.1371/journal.pone.0261118>.
8. Wiseman, T., J. Luckstead, and **Durand-Morat, A.** (2021). Asymmetric Exchange Rate Pass-Through in Southeast Asian Rice Trade. *Journal of Agriculture and Applied Economics*. <http://doi.org/10.1017/aae.2021.7>.
7. Shew, A.M., L.L. Nalley, **Durand-Morat, A.**, K. Meredith, R. Parajuli, G. Thoma, C.G. Henry. Holistically valuing public investments in agricultural water conservation. *Agricultural Water Management*, 252, 2021. <https://doi.org/10.1016/j.agwat.2021.106900>.
6. Bairagi, S., Custodio, M.C., **Durand-Morat, A.**, and Demont, M. Preserving cultural heritage through the valorization of Cordillera heirloom rice in the Philippines. *Agric Hum Values* 38, 257–270 (2021). <https://doi.org/10.1007/s10460-020-10159-w>.
5. Codjo, O.S., **Durand-Morat, A.**, G.H. West, L. Nalley, R.M. Nayga, and E.J. Wailes. Estimating demand elasticities for rice in Benin. *Agricultural Economics*. 2021; 52: 343– 361. <https://doi.org/10.1111/agec.12622>
4. Bairagi, S., and **Durand-Morat, A.**. Will Haiti benefit from setting up an agricultural research center? A foresight quantification. *Foresight*, 2020, <https://doi.org/10.1108/FS-11-2019-0100>
3. Bairagi, S., A.K. Mishra, and **Durand-Morat, A.**. Climate risk management strategies and food security: Evidence from Cambodian rice farmers. *Food Policy*, 2020, <https://doi.org/10.1016/j.foodpol.2020.101935>.
2. Kovacs, K.F., and **Durand-Morat, A.**. The influence of lateral flows in an aquifer on the agricultural value of groundwater. *Natural Resource Modeling*. 2020, <https://doi.org/10.1111/nrm.12266>.
1. Okpiaifo, G., **Durand-Morat, A.**, G.H. West, L.L. Nalley, R.M. Nayga, and E.J. Wailes. “Consumers’ preferences for sustainable rice practices in Nigeria.” *Global Food Security*, Volume 24, 2020. <https://doi.org/10.1016/j.gfs.2019.100345>

CURRENT & PENDING SUPPORT

Name: Durand-Morat, Alvaro

Instructions:

Who completes this template: Each project director/principal investigator (PD/PI) and other senior personnel that the Request for Applications (RFA) specifies

How this template is completed:

- Record information for active and pending projects, including this proposal.
- All current efforts to which PD/PI(s) and other senior personnel have committed a portion of their time must be listed, whether or not salary for the person involved is included in the budgets of the various projects.
- Provide analogous information for all proposed work which is being considered by, or which will be submitted in the near future to, other possible sponsors, including other USDA programs.
- For concurrent projects, the percent of time committed must not exceed 100%.

Note: Concurrent submission of a proposal to other organizations will not prejudice its review by CSREES.

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
ACTIVE					
Durand-Morat	US Dept of Ag, Office of Rural Development	75,000	10/2025 - 09/2026	5%	Analysis of Agricultural Markets and Policies
Durand-Morat, Watkins	Arkansas Rice Promotion Board	19,612	04/2025 – 03/2026	5%	Analysis of farm policy programs and competitiveness of Arkansas and U.S. Rice
Watkins, Durand-Morat	Arkansas Rice Promotion Board	63,000	04/2025 – 03/2026	5%	Economics of Arkansas Rice Farms
PENDING					
Durand-Morat, McFadden, Atungulu, Nalley	USDA NIFA AFRI	\$648,769	08/2026 – 07/2029	10%	The Impact of Quality on the Competitiveness of U.S. Long-Grain Rice
Durand-Morat, McFadden, Nalley	USDA NIFA AFRI	\$299,382	08/2026 – 07/2029	10%	Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice
Loy, Rainey, Durand-Morat, Fields	USDA-FAS Emerging Markets Program	\$306,537	09/2025 – 08/2027	5%	Increasing U.S. Rice Exports to Morocco

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Biographical Sketch

Brandon R. McFadden

Professor & Tyson Chair in Food Policy Economics
University of Arkansas
220 AGRI, Fayetteville, AR 72701
(479) 575-2299 / mcfadden@uark.edu
ORCID: 0000-0002-5993-3070

Education and Training

<i>Institution</i>	<i>Area</i>	<i>Degree</i>	<i>Year</i>
University of Arkansas Fort Smith, Fort Smith, AR	Business Administration - Marketing	B.S.	2007
University of Arkansas, Fayetteville, AR	Agricultural Economics	M.S.	2009
Oklahoma State University, Stillwater, OK	Agricultural Economics	Ph.D.	2014

Research and Professional Experience

<i>Years</i>	<i>Position</i>
2022-present	Professor and Tyson Endowed Chair in Food Policy Economics, Agricultural Economics and Agribusiness, University of Arkansas
2021-2022	Associate Professor, Applied Economics and Statistics, University of Delaware
2018-2021	Assistant Professor, Applied Economics and Statistics, University of Delaware
2014-2018	Assistant Professor, Food and Resource Economics, University of Florida

Synergistic Activities

Grants Awarded

<i>Role</i>	<i>Agency</i>	<i>Grant Title</i>	<i>Dates</i>	<i>Award</i>
Co-PI	USDA NIFA	Sustainable Aquaculture Production of High Omega-3-Containing-Fish Using a Novel Feed Additive (Hemp)	9/2021- 9/2026	\$10,000,000
Co-PI	USDA NIFA	Investigating Market Opportunities for Novel Hemp-Based Products	5/2024- 9/2026	\$413,591
Co-PI	USDA NIFA	Understanding nutrition through machine vision	9/2024- 9/2027	\$648,358

Graduate Student Advising (Major Advisor)

- Jameson Evers, MS Agricultural Economics, Expected July 2027
- Luke Wimpy, MS Agricultural Economics, Expected July 2026
- Madison Price, MS Agricultural Economics, Expected July 2026
- Andrew Dilley, MS Agricultural Economics, July 2025
- Jillian Hyink, MS Agricultural Economics, July 2024
- Emily Schlichtig, MS Agricultural Economics, July 2024
- Logan Moss, MS Agricultural Economics, July 2024
- Sara Gardner, MS Agricultural Economics, June 2023

Refereed Journal Publications

1. Oswalt, S., Durand-Morat, A., Rivera, T., Gallego, S., Andrade, R., McFadden, B.R. and Bonatti, M., 2025. From Deficiency to Demand: Consumer Preferences for Zinc-Biofortified Rice in Colombia. *Journal of Agriculture and Food Research*, p.102034.

Biographical Sketch

2. Moss L., McFadden B.R., Adhikari S., Wiersma-Mosley J., Nalley L. and Wilson N., 2025. Consumer Preferences for Value-Added Foods from Black-Owned Food Companies. *Choices*.
3. Rosselle, M., Schaefer, K.A., Shear, H. and McFadden, B.R., 2025. The Effects of Class-Action Lawsuits on California Glyphosate Usage. *Journal of Agricultural and Applied Economics*, pp.1-14.
4. Park, Y., Yun, S.D., Mark, T., McFadden, B.R., Phipps, B.E. and Schluttenhofer, C., 2025. Crop acreage portfolio analysis of introducing more hemp in Kentucky. *Agrosystems, Geosciences & Environment*, 8(2), p.e70122.
5. Dilley, A., Adhikari, S., Silwal, P., Lusk, J.L. and McFadden, B.R., 2025. Characteristics and food consumption for current, previous, and potential consumers of GLP-1 s. *Food Quality and Preference*, 129, p.105507.
6. McFadden, B.R., Lusk, J.L., May, C. and Schlichtig, E., 2025. Assessing public opinion about controversial risks: the effects of allowing an escape hatch on internal consistency and validity. *Journal of Risk Research*, pp.1-12.
7. Adhikari, S. and McFadden, B.R., 2025. Bridging Taste and Health: The Role of Machine Learning in Consumer Food Selection. *International Food and Agribusiness Management Review*, 1(aop), pp.1-16.
8. McFadden, B.R., Muraleetharan, K., Campbell, B., Rabinowitz, A., Mark, T. and Popp, M., 2025. Consumer Confusion About Product Names Commonly Used to Describe Hemp-Based Oils. *Journal of Consumer Affairs*, 59(1), p.e70004.
9. Hyink, J., McFadden, B.R., Adhikari, S., Phipps, B.E., Mark, T., Rossi, W., Schluttenhofer, C. and Yun, S.D., 2025. Consumer perceptions of hemp-fed aquaculture. *Aquaculture Economics & Management*, pp.1-31.
10. Millerschultz, A., Nalley, L.L., McFadden, B.R., Nayga, R. and Yang, W., 2025. Required Informational Barriers to Accessing Groceries from Food Banks. *Food Security*, pp.1-17.
11. Davidson, K.A., McFadden, B.R., Meyer, S. and Bernard, J.C., 2025. Consumer Preferences for Low-Methane Beef: The Impact of Pre-Purchase Information, Point-of-Purchase Labels, and Increasing Prices. *Food Policy*, 130, p.102768.

12. , S., McFadden, B.R., Malone, T. and Lusk, J.L., 2025. Plant-Based versus Animal-Based Proteins: Does It Have to Be Either/Or?. *Journal of Agricultural and Resource Economics*, 50(1), pp.1-20.
13. Shafquat, M., Patel, N., McFadden, B.R., Stark, J.H. and Gould, L.H., 2025. Racial differences in knowledge, attitudes toward vaccination, and risk practices around Lyme disease in the United States. *Frontiers in Public Health*, 13, p.1473304.
14. Hyink, J., McFadden, B.R., Phipps, B.E. and Gundersen, C., 2024. Could measuring factors other than a lack of financial resources help in achieving the zero hunger goal. *Frontiers in Sustainable Food Systems*, 8, p.1412401.
15. McFadden, B.R., Nalley, L.L., Durand-Morat, A., Yang, W. and Loethen, K., 2024. Potential response of Mexican consumers to a Ban on genetically modified Maize imports. *Food Security*, pp.1-11.
16. Kovacs, K.F., Snell, H., McFadden, B.R., and Nayga, R.M., 2024. Lumpy Heterogeneity in Groundwater Service Values and Time Preferences. *Land Economics*.
17. Hyink, J., Bresnahan, R.⁸, McFadden, B.R., Shew, A.M. and Mitchell, J., 2024. Agricultural producer and non-producer perceptions of crop residue burning: a focus on Arkansas. *Discover Sustainability*, 5(1), p.95.
18. Hyink, J., McFadden, B.R., Ellison, B. 2024. "Potential Consumer Response to the Healthy Symbol Proposed by the U.S. Food and Drug Administration." *Heliyon*.
19. Gould, H.L., Stark, J.H., McFadden, B.R., Patel, N., Kelly, P.H., Riis, J. 2024. "Using The Health Belief Model to Understand Intention to Vaccinate for Lyme Disease in The United States." *Zoonoses and Public Health*.
20. Jacobs, B.D., Popp, M.P., Ahn, S., Verbeke, W., McFadden, B.R., Mark, T.B., Rabinowitz, A.N. and Campbell, B., 2024. CBD Oil Concentration and Hemp Flower Drying Preferences of US Consumers. *Research on World Agricultural Economy*, 5(1), pp.82-95.
21. Krasovskaia, E., Rickard, B.J., Ellison, B., McFadden, B.R., and Wilson, N., 2024. Food labeling: Ingredient exemptions and product claims. *Agricultural and Resource Economics Review*, pp.1-22.
22. McFadden, B.R., Rumble, J.N., Stofer, K.A., and Folta, K.M., 2024. U.S. Public Opinion about the Safety of Gene Editing in the Agriculture and Medical Fields and the Amount of Evidence Needed to Improve Opinions. *Frontiers in Bioengineering and Biotechnology*, 12, p.1340398.
23. Kilasy, P., McFadden, B.R., Davidson, K.A., and Palm-Forster, L.H., 2024. Knowledge gaps about micronutrient deficiencies in Tanzania and the effect of information interventions. *Global Food Security*, 40, p.100745.
24. Stark, J.H., McFadden, B.R., Patel, N., Kelly, P.H., Gould, L.H. and Riis, J., 2024. Intention to vaccinate for Lyme disease using the Health Belief Model. *Zoonoses and Public Health*, 71(4), pp.349-358.
25. McFadden, B.R., Rumble, J.N., Stofer, K.A., Folta, K.M. and Dymont, M., 2023. U.S. Adult Attitudes about Biotechnology and Risk Aversion to Gene Editing. *AgBioForum*, 25(2), pp.1-12.
26. McFadden, B.R., Lusk, J.L., Pollack, A., Rumble, J.N., Stofer, K.A. and Folta, K.M. 2023. A randomized group approach to identifying label effects. *Journal of Choice Modelling*, 48, p.100435.
27. Stofer, K., Turner, S., Rumble, J.N., McFadden, B.R., Folta, K., Jeevan, A., Ouncap, T., Hecht, K., Cummins, C. and Thiel, R., 2023. US adult viewers of information treatments

Biographical Sketch

- express overall positive views but some concerns about gene editing technology. *Journal of Science Communication*, 22(4), p.A02.
28. Neuhofer, Z., McFadden, B.R., Rihn, A., Wei, X., and Khachatryan, H. 2023. Association between Visual Attention to Nutrition Priming and Subsequent Beverage Choice. *Food Quality and Preference*, 104, p.104721.
 29. DeMuth, B., Malone, T., McFadden, B.R., and Wolf, C.A., 2023. Choice effects associated with banning the word “meat” on alternative protein labels. *Applied Economic Perspectives and Policy*, 45(1), pp.128-144.
 30. Staples, A.J., Malone, T. and McFadden, B.R., 2022. CBD and THC: Who Buys It, and Why?. *Journal of Food Distribution Research*, 53(3).
 31. McFadden, B.R., 2022. Standards of Identity and Imitation Milk Labeling. *Journal of the Agricultural and Applied Economics Association*, 1(4).
 32. Langer, M.L., Davidson, K.A., McFadden, B.R. and Messer, K.D., 2022. Peer feedback can decrease consumers’ willingness to pay for food: Evidence from a field experiment. *Appetite*, 178, p.106162.
 33. Bass, D.A., McFadden, B.R., Costanigro, M. and Messer, K.D., 2022. Implicit and explicit biases for recycled water and tap water. *Water Resources Research*, 58(6), e2021WR030712.
 34. McFadden, B.R., Messer, K.D. and Ferraro, P.J., 2022. Private costs of carbon emissions abatement by limiting beef consumption and vehicle use in the United States. *PLOS ONE*, 17(1), p.e0261372.
 35. Thiel, R., Rumble, J.N., McFadden, B.R., Stofer, K.A. and Folta, K.M., 2022. Impact of teaching methods on learner preferences and knowledge gained when informing adults about gene editing. *Advancements in Agricultural Development*, 3(1), pp.70-86.

Current and Pending Support

CURRENT & PENDING SUPPORT

Name: Brandon R. McFadden

Date Completed: 09/29/2025

Instructions:

Who completes this template: Each project director/principal investigator (PD/PI) and other senior personnel specified in the Request for Applications (RFA). For Agriculture and Food Research Initiative (AFRI) applications, completion of this is only required for PDs/PIs and CoPDs/CoPIs.

How this template is completed:

- Record information for active and pending projects, including this proposal.
- All current efforts to which PD/PI(s) and other senior personnel have committed a portion of their time must be listed, whether or not salary for the person involved is included in the budgets of the various projects. For AFRI applications, list only projects for which salary is requested.
- Provide analogous information for all proposed work which is being considered by, or which will be submitted in the near future to, other possible sponsors, including other USDA programs.
- For concurrent projects, the percent of time committed must not exceed 100%.

Note: Concurrent submission of a proposal to other organizations will not prejudice its review by NIFA.

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
	Active:				
Phipps et al.	United States Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA)	\$10,000,000	04/2021-04/2025	8.33%	Sustainable Aquaculture Production of High Omega-3-Containing-Fish Using a Novel Feed Additive (Hemp)
Kolodinsky et al.	United States Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA)	\$800,000	05/2024-09/2026	8.33%	Investigating Market Opportunities for Novel Hemp-Based Products
Brownback et al.	United States Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA)	\$650,000	01/2024-12/2026	8.33%	Understanding nutrition through machine vision
Lee et al.	United States National Science Foundation	\$1,000,000	08/2025-07/29	4%	<i>SCH: Large Scale Multi Modality Learning System to Identify Tobacco Addiction and Predictive Analytics via Social Media Platforms</i>
	Pending:				
Kilders et al.	USDA NIFA	\$600,000	01/2025-12/2027	6.25%	Food Mobile Ordering: Economic Implications For Consumers, Retailers, Communities, And Policy
Durand-Morat et al.	USDA NIFA	\$648,769	08/2026-07/2029	5.00%	The Impact of Quality on the Competitiveness of U.S. Long-Grain Rice
Durand-Morat et al.	USDA NIFA	\$299,382	08/2026-07/2029	5.00%	Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice

BIOGRAPHICAL SKETCH

Name: Lawton Lanier Nalley

Title: Professor & Director of Graduate Programs for AGECE

Affiliation: University of Arkansas Dale Bumpers College of Agricultural, Food, and Life Sciences

Contact: University of Arkansas Department of Agricultural Economics, Fayetteville, AR 72701

Email: llalley@uark.edu

EDUCATION AND TRAINING

The Ohio State University, Columbus, OH	Ag and Development Economics. Minors in Development Studies and European History	BS 2002
Mississippi State University, Starkville, MS	Agricultural Economics	MS 2004
Kansas State University, Manhattan, KS	Agricultural Economics	PhD 2007

EMPLOYMENT HISTORY

2024- Present Professor & Head of Department of Agricultural Economics & Agribusiness Director, Fryar Price Risk Management Center of Excellence

2018-2024 Professor, Department of Agricultural Economics and Agribusiness,
University of Arkansas

2013-2018 Associate Professor, Department of Agricultural Economics and Agribusiness,
University of Arkansas

2008-2013 Assistant Professor, Department of Agricultural Economics and Agribusiness,
University of Arkansas

TEACHING EXPERIENCE

Courses Taught

Quantitative Economics (AGEC 5403)

International Development (AGEC 4163)

Introduction to Agribusiness (AGEC 2303)

Mozambique Service Learning Study Abroad (AGEC 401V)

PROFESSIONAL ACTIVITIES

2020 Fulbright Scholar. National University of Laos, Department of Economics. Vientiane, Laos.

Environmental Dynamics (ENDY) Steering Committee 2016-present

Sustainability Curriculum Steering Committee 2015-present

Editorial Board of Applied Economics Perspectives and Policy (AEPP)

HONORS AND AWARDS

2023 Dale Bumpers College, John W. White Research Award

2022 NACTA Teaching Award of Merit Certificate

2021 Dale Bumpers College, John W. White Outstanding Teaching Award

2018 Hoyt Purvis Award for Service in International Education

2018 Fellow of the Agricultural and Resource Economics Association

2017 Dale Bumpers College, Jack G. Justus Award for Teaching Excellence

2017 Southern Agricultural Economics Association Outstanding Teaching of a Course Award

2015 Proceedings of the National Academy of Science (PNAS) "Top 10 stories in 2015" for
"Effect of warming temperatures on US wheat yields"

2015 Fellow of the University of Arkansas Teaching Academy

GRANTS RECEIVED (Last 5 years, selected)

Title: Soilless Long-cane Production of Blackberry
Agency: USDA NIFA
Date: 2023-2027
Amount: \$749,001
Responsibility: Investigator

Title: Enhancing Leadership in Agricultural Economics: A Comprehensive Fellowship Program Integrating International Experience and Industry Mentorship
Agency: USDA
Date: 2025-2029
Amount: \$200,000
Responsibility: Investigator

Title: Segregating Rice Varieties for Milling and Marketing: The Potential Impact on Producer Returns and Export Market Opportunities in Arkansas.
Agency: Arkansas Rice Promotion Board
Date: 2023-2024
Amount: \$35,852
Responsibility: PI

Title: Impact of Cultural and Management Practices on Soybean Yields and Profitability: An Evaluation of the Grow for the Green Participant Data
Agency: Arkansas Soybean Promotion Board
Date: 2021-2022
Amount: \$23,946
Responsibility: PI

Title: Examining the Applicability and Effectiveness of the Reclamation of Abandoned Agricultural Land into a Small Dairy Industry in Mauritius
Agency: United States Department of State
Date: 2021-2022
Amount: \$57,850
Responsibility: PI

Title: Greenhouse Gas Emissions Assessment from Rice Production in Arkansas
Agency: USDA NRCS
Date: 2021-2022
Amount: 162,160
Responsibility: Co-PI

Title: Reducing Food Waste and Food Insecurity through Increased Global Access to Broken Rice
Agency: University of Arkansas, Chancellor's Innovation and Collaboration Fund
Date: 2019-2020
Amount: \$110,931
Responsibility: PI

REFEREED PUBLICATIONS (2020-2025). TOTAL REFEREED PUBLICATIONS=110

- Adabrah-Danquah, V., A. Durand, L. Nalley, M. Diagne, B. Frimpong, and W. Yang. 2025. Consumer Preferences and Valuation for Sustainably Produced Rice in Ghana. *Environment, Development and Sustainability*. <https://doi.org/10.1007/s10668-024-05893-8>
- Pontes Guimaraes, B., L. Nalley, and S. Lafontaine. 2025. Evaluating the Costs of Alternative Malting Grains for Market Adaptation: A Case Study on Rice Malt Production in the U.S. *npj Sustainable Agriculture*. <https://doi.org/10.1038/s44264-025-00060-6>
- Skinner, A., L. Nalley, B. McFadden, W. Yang, and R. Nayga. 2025. Required Informational Barriers to Accessing Groceries from Food Banks. *Food Security*. <https://doi.org/10.1007/s12571-024-01516-2>
- Moss L., B. McFadden, S. Adhikari, J. Wiersma-Mosley, L. Nalley, and N. Wilson. 2025. "Consumer Preferences for Value-Added Foods from Black-Owned Food Companies". *Choices*. <https://www.choicesmagazine.org/choices-magazine/theme-articles/agricultural-policy-economics-and-diverse-farms-and-farmers/consumer-preferences-for-value-added-foods-from-black-owned-food-companies>
- McFadden, B., L. Nalley, A. Durand, W. Yang and K. Loethen. 2024. Potential Response of Mexican Consumers to a Ban on Genetically Modified Maize Imports. *Food Security*. <https://doi.org/10.1007/s12571-024-01483-8>
- Smith, H., A. Ashworth, S. King, C. Kreman, D. Miller, L. Nalley, and P. Owens. 2024. Remote sensing reveals trends in vegetation recovery and land transformation post-reclamation at tar creek superfund. *Discovery Geoscience*. <https://doi.org/10.1007/s44288-024-00057-7>
- Tsvakirai, C. and L. Nalley. 2023. The coexistence of psychological drivers and deterrents of consumers' willingness to try cultured meat hamburger patties: Evidence from South Africa. *Agricultural and Food Economics*. <https://doi.org/10.1186/s40100-023-00293-4>
- Tsvakirai, C., L. Nalley, and M. Tshela. 2023. What do we know about consumers' attitudes towards cultured meat? A scoping review. *Future Foods*. <https://doi.org/10.1016/j.fufo.2023.100279>
- Phillips, J., A. Durand, L. Nalley, E. Graterol, M. Bonatti, K. Loaiza de la Pava, S. Urioste, and W. Yang. 2023. Understanding demand for broken rice and its potential food security implications in Colombia. *Journal of Agriculture and Food Research*. <https://doi.org/10.1016/j.jafr.2023.100884>
- Ahmed, Z., L. Nalley, K. Brye, S. Green, and A. Shew. 2023. Wintertime cover crop identification: A remote sensing-based methodological framework for new and rapid data generation. *International Journal of Applied Earth Observation and Geoinformation*. Vol. 125. <https://doi.org/10.1016/j.jag.2023.103564>
- Tsvakirai, C., L. Nalley, S. Rider, E. Van Loo, and T. Makgopa. 2023. The alternative livestock revolution: Prospects for consumer acceptance of plant-based and cultured meat in South Africa. *Journal of Agricultural and Applied Economics*. Vol. 55(4): 710-729. <https://doi.org/10.1017/ae.2023.36>
- Nalley, L. and A. Durand-Morat. 2023. The Impacts of Enhanced Rice Quality Genetics on Food Security and Producer Profitability Impacts of Enhanced Rice Quality Genetics. *Journal of Agricultural and Resource Economics*. Vol. 48. September, 2023. [doi: 10.22004/ag.econ.330843](https://doi.org/10.22004/ag.econ.330843)
- Smith, H., A. Ashworth, L. Nalley, A. Schmidt, M. Turmel and P. Owens. Boundary line analysis and machine learning models to identify critical soil values for major crops in Guatemala. *Agronomy Journal*. June, 2023. <https://doi.org/10.1002/agj2.21412>
- Mulimbi, W., L. Nalley, K. Brye, and D. Rutega. 2023. Conservation Agriculture Assists Smallholder Farmers and Their Agroecosystem In The Democratic Republic Of The Congo. *Agriculture, Ecosystems & Environment*. Vol 355. <https://doi.org/10.1016/j.agee.2023.108597>
- Ahmed, Z., A. Shew, L. Nalley, K. Brye, M. Popp and S. Green. 2023. An Examination of Thematic Research, Development, and Trends in Remote Sensing Applied to Conservation

- Agriculture. *Journal of International Soil and Water Conservation Research*.
<https://doi.org/10.1016/j.iswcr.2023.04.001>
- Tsvakirai, C., L. Nalley and T. Makgopa. 2023. Development and validation of a cultured meat neophobia scale: Industry implications for South Africa. *Scientific African*.
<https://doi.org/10.1016/j.sciaf.2023.e01641>.
- Mulimbi, W., L. Nalley, J. Strauss and K. Ala-Kokko. 2023. Economic and Environmental Comparison of Conventional and Conservation Agriculture in South African Wheat Production. *Agrekon*. <https://doi.org/10.1080/03031853.2023.2169481>
- Mulimbi, W., L. Nalley, R. Nayga and A. Gaduh. Are Consumers Willing to Pay for Conservation Agriculture? The Case of White Maize in the Democratic Republic of the Congo. *Natural Resources Forum*, 1– 20. 2022. <https://doi.org/10.1111/1477-8947.12268>
- Nalley, L., C. Roberts, A. Durand, T. Roberts, A. Shew and R. Parajuli. Precise Nitrogen Recommendations Improve Economic and Environmental Outcomes in Rice Production. *Environmental Challenges*. 2022. <https://doi.org/10.1016/j.envc.2022.100650>
- Ala-Kokko, K., L. Nalley, A. Durand and W. Yang. Impact of Disjunctive Marking on Consumer Preferences. *Applied Economics*. 2022. <https://doi.org/10.1080/00036846.2022.2139809>
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- M. Richardson, L. Nalley, A. Durand-Morat, P. Crandall, A. Scruggs, L. Joseph, J. Chouloute and W. Yang. A Broken Market: Can Increased Access to Broken Rice Decrease Food Insecurity in Haiti.? *Food Security*. 10.1007/s12571-022-01286-9. 2022
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- Shew, A., L. Nalley, A. Durand, K. Meredith, R. Parajuli, G. Thoma and C. Henry. Holistically Valuing Public Investments in Agricultural Water Conservation. *Agricultural Water Management*. 252 (2021) 106900. <https://doi.org/10.1016/j.agwat.2021.106900>
- Luckstead, J., H. Snell, L. Nalley, R. Nayga and J. Sarpaning. A Multi-Country Study on Consumers' Valuation for Child-Labor-Free Chocolate: Implications for Child Labor in Cocoa Production. *Applied Economic Perspectives and Policy* (2021):1-28. DOI: 10.1002/aapp.13165
- Shew, A., J. Tack, L. Nalley, P. Chaminuka and S. Maali. Yield Gains Larger in GM Maize for Human Consumption than Livestock feed in South Africa. *Nature Food*. February, 2021. <https://doi.org/10.1038/s43016-021-00231-x>
- Codjo, S., A. Durand, G. West, L. Nalley, R. Nayga and E. Wailes. Estimating Demand Elasticities in Benin. *Agricultural Economics*. 2021;1-19. <https://doi:10.1111/agec.12622> 2021
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Invited Presentations =59
Refereed Professional Oral Presentations =116
Refereed Professional Poster Presentations =71

CURRENT & PENDING SUPPORT

Name: Lawton Lanier Nalley

Instructions:

Who completes this template: Each project director/principal investigator (PD/PI) and other senior personnel specified in the Request for Applications (RFA). For Agriculture and Food Research Initiative (AFRI) applications, completion of this is only required for PDs/Pis and CoPDs/CoPis.

How this template is completed:

- Record information for active and pending projects, including this proposal.
- All current efforts to which PD/PI(s) and other senior personnel have committed a portion of their time must be listed, whether or not salary for the person involved is included in the budgets of the various projects. For AFRI applications, list only projects for which salary is requested.
- Provide analogous information for all proposed work which is being considered by, or which will be submitted in the near future to, other possible sponsors, including other USDA programs.
- For concurrent projects, the percent of time committed must not exceed 100%.

Note: Concurrent submission of a proposal to other organizations will not prejudice its review by NIFA.

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
Kemper, Nathan (PI), Lanier Nalley (Co-PD), Jacquelyn D. Mosley (Co-PD); Jack Myers (Co-PD), Andrew McKenzie (Co-PD), and Brandon R. McFadden (Co-PD),	Funded: USDA/NIFA	\$200,000	2025-2029	1.5%	Enhancing Leadership in Agricultural Economics: A Comprehensive Fellowship Program Integrating International Experience and Industry Mentorship
Dickson, Ryan (PI), Lanier Nalley (Co-PD), Margaret Worthington (Co-PD), Amanda McWhirt (Co-PD), Gina Fernandez (Co-PD), Lizzy Herrera (Co-PD), Keilah Barney (Co-PD), Melinda Knuth (Co-PD)	Funded: USDA NIFA	\$749,001	2024-2028	2.5%	Soilless Long-cane Production of Blackberry
Durand-Morat, McFadden, Atungulu, Nalley	USDA NIFA AFRI	\$648,769	08/2026 – 07/2029	10%	The Impact of Quality on the Competitiveness of U.S. Long-Grain Rice
Durand-Morat, McFadden, Nalley	USDA NIFA AFRI	\$299,382	08/2026 – 07/2029	10%	Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice

This file MUST be converted to PDF prior to attachment in the electronic application package.

Attachment 2

OMB Number: 4040-0001
Expiration Date: 11/30/2025

APPLICATION FOR FEDERAL ASSISTANCE SF 424 (R&R)

1. TYPE OF SUBMISSION <input type="checkbox"/> Pre-application <input checked="" type="checkbox"/> Application <input type="checkbox"/> Changed/Corrected Application		3. DATE RECEIVED BY STATE []	State Application Identifier []
2. DATE SUBMITTED []	Applicant Identifier []	4. a. Federal Identifier []	b. Agency Routing Identifier []
5. APPLICANT INFORMATION		UEI: WJNTJ7LBL823	
Legal Name: Division of Agriculture of the University of Arkansas System			
Department: []			
Division: []			
Street1: 1371 W. Altheimer Dr.			
Street2: []			
City: Fayetteville		County / Parish: []	
State: AR: Arkansas		Province: []	
Country: USA: UNITED STATES		ZIP / Postal Code: 72704-6898	
Person to be contacted on matters involving this application			
Prefix: Mr.	First Name: Joshua	Middle Name: []	
Last Name: Boice	Suffix: []		
Position/Title: Grants Officer			
Street1: 1371 W. Altheimer Dr.			
Street2: []			
City: Fayetteville		County / Parish: []	
State: AR: Arkansas		Province: []	
Country: USA: UNITED STATES		ZIP / Postal Code: 72704-6898	
Phone Number: 4795029827	Fax Number: []		
Email: jboice@uada.edu			
6. EMPLOYER IDENTIFICATION (EIN) or (TIN):		62-1712458	
7. TYPE OF APPLICANT: H: Public/State Controlled Institution of Higher Education			
Other (Specify): []			
Small Business Organization Type <input type="checkbox"/> Women Owned <input type="checkbox"/> Socially and Economically Disadvantaged			
8. TYPE OF APPLICATION: <input checked="" type="checkbox"/> New <input type="checkbox"/> Resubmission <input type="checkbox"/> Renewal <input type="checkbox"/> Continuation <input type="checkbox"/> Revision		If Revision, mark appropriate box(es). <input type="checkbox"/> A. Increase Award <input type="checkbox"/> B. Decrease Award <input type="checkbox"/> C. Increase Duration <input type="checkbox"/> D. Decrease Duration <input type="checkbox"/> E. Other (specify): []	
Is this application being submitted to other agencies? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> What other Agencies? []			
9. NAME OF FEDERAL AGENCY: National Institute of Food and Agriculture		10. ASSISTANCE LISTING NUMBER: 10.310 ASSISTANCE LISTING TITLE: Agriculture and Food Research Initiative (AFRI)	
11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT: Low-glycemic index (GI) rice from Arkansas: Screening cultivars and optimizing processing parameters to reduce GI			
12. PROPOSED PROJECT: Start Date: 08/01/2026 Ending Date: 07/31/2029		13. CONGRESSIONAL DISTRICT OF APPLICANT: AR-003	

14. PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR CONTACT INFORMATION

Prefix: First Name: Middle Name:

Last Name: Suffix:

Position/Title:

Organization Name:

Department:

Division:

Street1: Street2:

City: County / Parish:

State: Province:

Country: ZIP / Postal Code:

Phone Number: Fax Number:

Email:

15. ESTIMATED PROJECT FUNDING

a. Total Federal Funds Requested	<input type="text" value="300,000.00"/>
b. Total Non-Federal Funds	<input type="text" value="0.00"/>
c. Total Federal & Non-Federal Funds	<input type="text" value="300,000.00"/>
d. Estimated Program Income	<input type="text" value="0.00"/>

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?

a. YES THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:
DATE:

b. NO PROGRAM IS NOT COVERED BY E.O. 12372; OR
 PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. By signing this application, I certify (1) to the statements contained in the list of certifications* and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances* and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 18, Section 1001)

I agree

*The list of certifications and assurances, or an Internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

18. SFLLL (Disclosure of Lobbying Activities) or other Explanatory Documentation

19. Authorized Representative

Prefix: First Name: Middle Name:

Last Name: Suffix:

Position/Title:

Organization:

Department:

Division:

Street1: Street2:

City: County / Parish:

State: Province:

Country: ZIP / Postal Code:

Phone Number: Fax Number:

Email:

Signature of Authorized Representative	Date Signed
<input type="text" value="Completed on submission to Grants.gov"/>	<input type="text" value="Completed on submission to Grants.gov"/>

20. Pre-application

21. Cover Letter Attachment

AFRI PROJECT TYPE

Instructions:

Who completes this form: Each project director (PD) applying to the Agriculture and Food Research Initiative (AFRI) Request for Applications (RFA).

How this template is completed:

- Select the appropriate Project Type box and Grant Type box(es) (For FASE Grants, select an appropriate sub-category).

Project Type

Research
 Education
 Extension
 Integrated

Grant Type

Standard
 Coordinated Agricultural Project (CAP)
 Planning / Coordination
 Conference
 Food and Agriculture Science Enhancement (FASE)
 Predoctoral Fellowship
 Postdoctoral Fellowship
 New Investigator Seed
 New Investigator Standard
 Strengthening, if selected choose from the following:
 Sabbatical
 Equipment
 New Investigator Strengthening Seed
 New Investigator Strengthening Standard
 Strengthening Seed
 Strengthening Standard
 Strengthening CAP
 Strengthening Conference

Other:

Supplemental Information Form

OMB Number: 0524-0039
Expiration Date: 08/31/2025

Please complete this form in conjunction with the SF-424 Application for Federal Financial Assistance.

1. Funding Opportunity

Funding Opportunity Name

Agriculture and Food Research Initiative Competitive Grants Program Foundational and Applied Science Program

Funding Opportunity Number

USDA-NIFA-AFRI-011134

2. Program to which you are applying

Program Code Name

AFRI Commodity Board Co-funding Topics

Program Code

A1811

3. Type of Applicant

H: Public/State Controlled Institution of Higher Education

4. Additional Applicant Types

1862 Land-Grant University

5. Supplemental Applicant Types (Check all that apply)

- Alaska Native-Serving Institution
- Cooperative Extension Service
- Hispanic-Serving Institution
- Historically Black College or University (other than 1890)
- Minority-Serving Institution
- Native Hawaiian-Serving Institution
- Public Nonprofit Junior or Community College
- Public Secondary School
- School of Forestry
- State Agricultural Experiment Station
- Tribal College (other than 1994)
- Veterinary School or College

6. ASAP Recipient Information

Does the legal applicant have an active Automated Standard Application for Payments (ASAP) Recipient Identification Number for NIFA awards?

Yes No

What is the ASAP Recipient ID (which corresponds with this applications's DUNS and EIN) to be used in the event of an award?

1137468

7. Key Words

Rice, Low glycemic index, healthy foods

8. Conflict of Interest List

Conflict of Interest.pdf

Add Attachment

Delete Attachment

View Attachment

CONFLICT OF INTEREST LIST

Name: Mahfuzur Rahman

Instructions:

- Who completes this template: Each project director/principal investigator (PD/PI) or other person that the Request for Applications (RFA) specifies
- How this template is completed:
 - List alphabetically – with last name first -- the full names of the following individuals:
 - All co-authors on publications within the past three years, including pending publications and submissions
 - All collaborators on projects within the past three years, including current and planned collaborations
 - All thesis or postdoctoral *advisees/advisors*
 - All persons in your field with whom you have had a consulting/financial arrangement/other conflict-of-interest in the past three years
- Indicate the person's relationship to you (Co-Author, Collaborator, etc) with an "x".

Additional pages may be used as necessary.

Note: Other individuals working in the applicant's specific area are not in conflict of interest with the applicant unless those individuals fall within one of the listed categories.

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Buddhi Lamsal	Yes		Yes	
David Grewell	Yes		Yes	
Senay Simsek	Yes		Yes	
Benjamin Runkle		Yes		
Bibek Byanju	Yes			
Cengiz Koparan		Yes		
Dongyi Wang		Yes		
Girish Ganjyal		Yes		
Griffiths Atungulu		Yes		
Haitao Liao		Yes		
Jae-Bom Ohm	Yes			
Jeyam Subbaiah		Yes		
Keisha B Walters		Yes		
Milagros Hojilla-Evangelista		Yes		
Rupesh Kariyat		Yes		
Scott Lafontaine		Yes		
Sungil Ferreira		Yes		
Sun-ok Lee		Yes		
Shahidul Islam		Yes		
Ajay Saha		Yes		
Jasim Ahmed				Editor-in-chief
Kaustav Majumder				Co-editors

This file MUST be converted to PDF prior to attachment in the electronic application package.

CONFLICT OF INTEREST LIST

Name: Griffiths G. Atungulu

Instructions:

- Who completes this template: Each project director/principal investigator (PD/PI) or other person that the Request for Applications (RFA) specifies
- How this template is completed:
 - List alphabetically – with last name first – the full names of the following individuals:
 - All co-authors on publications within the past three years, including pending publications and submissions
 - All collaborators on projects within the past three years, including current and planned collaborations
 - All thesis or postdoctoral *advisees/advisors*
 - All persons in your field with whom you have had a consulting/financial arrangement/other conflict-of-interest in the past three years
 - Indicate the person’s relationship to you (Co-Author, Collaborator, etc) with an “x”.

Additional pages may be used as necessary.

Note: Other individuals working in the applicant's specific area are not in conflict of interest with the applicant unless those individuals fall within one of the listed categories.

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Bodie Aaron R	x			
Bowie Rebecca L	x		x	
Burton Bluhm		x		
Bruce Rebecca Mawusi	x		x	
Carbonero Franck	x			
Devlieghere Frank	x			
Ghavami Mehrdad	x			
Hettiarachchy Navam S	x			
Horax Ronny	x			
Jiang Hongrui	x			
Ju Xingrong	x			
Lee Jung A	x			
Luthra Kaushik	x			
Mauromoustakos Andy	x			
Micciche Andrew C	x			
Mohammadi-Shad Zainab	x		x	
Mosman Dana		x		
Oduola Abass A	x		x	
Okeyo Anne			x	
Olatunde Gbenga A		x		
Ricke Steven C	x			
Rogers Stephen	x			
Rothrock Jr Michael J	x			
Sadaka Sammy	x			

Conflict of Interest

Scheurs Timothy		x		
Shafiekhani Soraya	x		x	
Smith Deandrae L	x		x	
Steen Emiel	x		x	
Stephens Brandon	x			
Thote Supriya		x		
Velvick Ryan		x		
Venkitasamy Chandrasekar		x		
Wang Lifeng	x			
Wang Zhigao	x			
Wilson Shantae A	x		x	
Xu Feiran	x			
Yao Yijun	x			
Young Zachary		x		
Zhang Jing	x			
Zhong HouMin		x		
Zhou Zonghui	x		x	

This file MUST be converted to PDF prior to attachment in the electronic application package.

Project/Performance Site Location(s)

Project/Performance Site Primary Location

I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name:

UEI:

* Street1:

Street2:

* City: County:

* State:

Province:

* Country:

* ZIP / Postal Code:

* Project/ Performance Site Congressional District:

Project/Performance Site Location 1

I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name:

UEI:

* Street1:

Street2:

* City: County:

* State:

Province:

* Country:

* ZIP / Postal Code:

* Project/ Performance Site Congressional District:

Additional Location(s)

RESEARCH & RELATED BUDGET - Budget Period 1

OMB Number: 4040-0001
Expiration Date: 11/30/2025

UEI:

Enter name of Organization:

Budget Type: Project Subaward/Consortium

Budget Period: 1 Start Date: End Date:

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary (\$)	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
						Cal.	Acad.	Sum.			
Dr.	Mahfuzur		Rahman						0.00	0.00	0.00

Project Role:

Additional Senior Key Persons: Total Funds requested for all Senior Key Persons in the attached file
Total Senior/Key Person

B. Other Personnel

Number of Personnel	Project Role	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
		Cal.	Acad.	Sum.			
<input type="text"/>	Post Doctoral Associates	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Graduate Students	12.00	<input type="text"/>	<input type="text"/>	44,000.00	2,816.00	46,816.00
<input type="text"/>	Undergraduate Students	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	Secretarial/Clerical	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Hourly	12.00	<input type="text"/>	<input type="text"/>	2,000.00	136.00	2,136.00
<input type="text" value="2"/>	Total Number Other Personnel					Total Other Personnel	48,952.00
						Total Salary, Wages and Fringe Benefits (A+B)	48,952.00

C. Equipment Description

List items and dollar amount for each item exceeding \$5,000

Equipment Item	Funds Requested (\$)
<input type="text"/>	<input type="text"/>

Additional Equipment:

Total funds requested for all equipment listed in the attached file
Total Equipment

D. Travel**Funds Requested (\$)**

1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	3,000.00
2. Foreign Travel Costs	
Total Travel Cost	3,000.00

E. Participant/Trainee Support Costs**Funds Requested (\$)**

1. Tuition/Fees/Health Insurance	
2. Stipends	
3. Travel	
4. Subsistence	
5. Other <input type="text"/>	
<input type="text"/> Number of Participants/Trainees	Total Participant/Trainee Support Costs

F. Other Direct Costs

	Funds Requested (\$)
1. Materials and Supplies	12,458.00
2. Publication Costs	3,000.00
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8. GA Tuition	13,590.00
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
Total Other Direct Costs	29,048.00

G. Direct Costs

Total Direct Costs (A thru F) Funds Requested (\$)
81,000.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)
Negotiated rate: 47% MTDC	47.00	67,410.00	31,821.00
Total Indirect Costs			31,821.00

Cognizant Federal Agency

(Agency Name, POC Name, and POC Phone Number) DHHS Denise Shirlee 214-767-3261

I. Total Direct and Indirect Costs

Total Direct and Indirect Institutional Costs (G + H) Funds Requested (\$)
112,821.00

J. Fee

Funds Requested (\$)

K. Total Costs and Fee

Total Costs and Fee (I + J) Funds Requested (\$)
112,821.00

L. Budget Justification

(Only attach one file.)

BudgetJustification.pdf

Add Attachment

Delete Attachment

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RESEARCH & RELATED BUDGET - Budget Period 2

OMB Number: 4040-0001
Expiration Date: 11/30/2025

UEI:

Enter name of Organization:

Budget Type: Project Subaward/Consortium

Budget Period: 2 Start Date: End Date:

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary (\$)	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
						Cal.	Acad.	Sum.			
Dr.	Mahfuzur		Rahman						0.00	0.00	0.00

Project Role:

Additional Senior Key Persons: Total Funds requested for all Senior Key Persons in the attached file
Total Senior/Key Person

B. Other Personnel

Number of Personnel	Project Role	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
		Cal.	Acad.	Sum.			
<input type="text"/>	Post Doctoral Associates	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Graduate Students	12.00	<input type="text"/>	<input type="text"/>	44,000.00	2,816.00	46,816.00
<input type="text"/>	Undergraduate Students	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	Secretarial/Clerical	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Hourly	12.00	<input type="text"/>	<input type="text"/>	2,000.00	136.00	2,136.00
<input type="text" value="2"/>	Total Number Other Personnel				Total Other Personnel		48,952.00
						Total Salary, Wages and Fringe Benefits (A+B)	48,952.00

C. Equipment Description

List items and dollar amount for each item exceeding \$5,000

Equipment item	Funds Requested (\$)
<input type="text"/>	<input type="text"/>

Additional Equipment:

Total funds requested for all equipment listed in the attached file
Total Equipment

D. Travel

Funds Requested (\$)

1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	3,000.00
2. Foreign Travel Costs	
Total Travel Cost	3,000.00

E. Participant/Trainee Support Costs

Funds Requested (\$)

1. Tuition/Fees/Health Insurance	
2. Stipends	
3. Travel	
4. Subsistence	
5. Other <input type="text"/>	
<input type="text"/> Number of Participants/Trainees	Total Participant/Trainee Support Costs

F. Other Direct Costs

		Funds Requested (\$)
1.	Materials and Supplies	12,000.00
2.	Publication Costs	3,000.00
3.	Consultant Services	
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	GA Tuition	14,270.00
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
Total Other Direct Costs		29,270.00

G. Direct Costs**Total Direct Costs (A thru F)**

Funds Requested (\$)
81,222.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)
Negotiated rate: 47% MTDC	47.00	66,952.00	31,908.00
Total Indirect Costs			31,908.00

Cognizant Federal Agency

(Agency Name, POC Name, and POC Phone Number) DHHS Denise Shirlee 214-767-3261

I. Total Direct and Indirect Costs**Total Direct and Indirect Institutional Costs (G + H)**

Funds Requested (\$)
113,130.00

J. Fee

Funds Requested (\$)

K. Total Costs and Fee**Total Costs and Fee (I + J)**

Funds Requested (\$)
113,130.00

L. Budget Justification

(Only attach one file.)

BudgetJustification.pdf

Add Attachment

Delete Attachment

View Attachment

RESEARCH & RELATED BUDGET - Budget Period 3

OMB Number: 4040-0001
Expiration Date: 11/30/2025

UEI:

Enter name of Organization:

Budget Type: Project Subaward/Consortium

Budget Period: 3 Start Date: End Date:

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary (\$)	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
						Cal.	Acad.	Sum.			
Dr.	Maufuzur		Rahman						0.00	0.00	0.00

Project Role:

Additional Senior Key Persons: Total Funds requested for all Senior Key Persons in the attached file
Total Senior/Key Person

B. Other Personnel

Number of Personnel	Project Role	Months			Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
		Cal.	Acad.	Sum.			
<input type="text"/>	Post Doctoral Associates	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Graduate Students	6.00	<input type="text"/>	<input type="text"/>	24,000.00	1,536.00	25,536.00
<input type="text"/>	Undergraduate Students	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	Secretarial/Clerical	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="1"/>	Hourly	12.00	<input type="text"/>	<input type="text"/>	2,000.00	136.00	2,136.00
<input type="text" value="2"/>	Total Number Other Personnel						
						Total Other Personnel	<input type="text" value="27,672.00"/>
						Total Salary, Wages and Fringe Benefits (A+B)	<input type="text" value="27,672.00"/>

C. Equipment Description

List items and dollar amount for each item exceeding \$5,000

Equipment item	Funds Requested (\$)
<input type="text"/>	<input type="text"/>

Additional Equipment:

Total funds requested for all equipment listed in the attached file
Total Equipment

D. Travel**Funds Requested (\$)**

1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	3,000.00
2. Foreign Travel Costs	
Total Travel Cost	3,000.00

E. Participant/Trainee Support Costs**Funds Requested (\$)**

1. Tuition/Fees/Health Insurance	
2. Stipends	
3. Travel	
4. Subsistence	
5. Other <input type="text"/>	
<input type="text"/> Number of Participants/Trainees	Total Participant/Trainee Support Costs

F. Other Direct Costs

		Funds Requested (\$)
1.	Materials and Supplies	12,000.00
2.	Publication Costs	3,000.00
3.	Consultant Services	
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	GA Tuition	7,491.00
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
Total Other Direct Costs		22,491.00

G. Direct Costs

Total Direct Costs (A thru F) Funds Requested (\$)
53,163.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)
Negotiated rate: 47% MTDC	47.00	45,672.00	20,886.00
Total Indirect Costs			20,886.00

Cognizant Federal Agency

(Agency Name, POC Name, and POC Phone Number) DHHS Denise Shirlee 214-767-3261

I. Total Direct and Indirect Costs

Total Direct and Indirect Institutional Costs (G + H) Funds Requested (\$)
74,049.00

J. Fee

Funds Requested (\$)

K. Total Costs and Fee

Total Costs and Fee (I + J) Funds Requested (\$)
74,049.00

L. Budget Justification

(Only attach one file.) BudgetJustification.pdf Add Attachment Delete Attachment View Attachment

RESEARCH & RELATED BUDGET - Cumulative Budget

Totals (\$)

Section A, Senior/Key Person		0.00
Section B, Other Personnel		125,576.00
Total Number Other Personnel	6	
Total Salary, Wages and Fringe Benefits (A+B)		125,576.00
Section C, Equipment		
Section D, Travel		9,000.00
1. Domestic	9,000.00	
2. Foreign		
Section E, Participant/Trainee Support Costs		
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other		
6. Number of Participants/Trainees		
Section F, Other Direct Costs		80,809.00
1. Materials and Supplies	36,458.00	
2. Publication Costs	9,000.00	
3. Consultant Services		
4. ADP/Computer Services		
5. Subawards/Consortium/Contractual Costs		
6. Equipment or Facility Rental/User Fees		
7. Alterations and Renovations		
8. Other 1	35,351.00	
9. Other 2		
10. Other 3		
11. Other 4		
12. Other 5		
13. Other 6		
14. Other 7		
15. Other 8		
16. Other 9		
17. Other 10		

Section G, Direct Costs (A thru F)

215,385.00

Section H, Indirect Costs

84,615.00

Section I, Total Direct and Indirect Costs (G + H)

300,000.00

Section J, Fee

--

Section K, Total Costs and Fee (I + J)

300,000.00

Budget Justification for Total Budget:

PERSONNEL (Salary + Fringe benefits) \$125,576

SALARY \$ 118,000

Graduate research assistant

Stipend support for one PhD graduate research assistant (GRA) is requested at @ 24,000 per year for three years, and one MS student at \$20,000 per year for two years. The graduate research assistant will be responsible for model building, formal analysis, experimentation, and data analysis. The student will also work closely with the research associated with glycemic index, rice processing parameters, and optimization studies.

Fringe benefits \$ 7,576
 Graduate student fringe benefits– \$ 7,168
 Hourly Student -\$4,08

Tuition \$35,351
 Tuition for one PhD student is \$6,795/year for three years, and for one MS student is \$6,795/year for two years. Tuition is calculated based on 15 credit hours at \$453/credit hour.

Other Direct Costs

Materials and Supplies - \$ 36,458
 Funds are requested for the purchase of research and laboratory supplies, including raw materials, samples, general chemicals and reagents, functionality testing chemicals, and standards. The costs will include the glucose and total starch test kits from Megazyme, as well as chemicals and standards required in the laboratory, laboratory consumables, and other necessary protective gear. Furthermore, the maintenance of analytical equipment, such as FTIR spectroscopy, will also be included. The SEC column for HPLC, standards, buffers, and other reagents will be purchased as needed.
 The costs for purchasing and subscribing to modeling software and data analysis packages necessary for developing MANOVA models are included.

Publication \$9,000
 Funds are requested for journal publication costs for publishing the research data in high-impact journals by the PI and other personnel.

Travel (Domestic) - \$9,000
 Funds are requested to cover the expenses of the PI to travel for national conferences such as the ACS Annual session and the Cereals and Grains conference. The PI will present the research findings and build research collaborations each year.

Travel expenses to the meeting are estimated at \$ 3,000/year

Registration	\$ 1000
Airfare	\$ 400

Budget Justification UADA

Lodging	\$ 600
Ground transportation	\$ 200
Meal allowance	\$ 400
Other costs	\$ 400

TOTAL DIRECT COSTS REQUESTED	\$ 215,385
Institutional costs @ 47%	\$ 84,615
TOTAL PROJECT COSTS	\$ 300,000

RESEARCH & RELATED PERSONAL DATA

Project Director/Principal Investigator and Co-Project Director(s)/Co-Principal Investigator(s)

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on sex, race, ethnicity, or disability of its proposed PDs/Pis and co-PDs/Pis. To gather information needed for this important task, the applicant should submit the requested information for each identified PD/PI and co-PDs/Pis with each proposal. Submission of the requested information is voluntary and is not a precondition of award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information received from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. Upon receipt of the application, this form will be separated from the application. This form will not be duplicated, and it will not be a part of the review process. Data will be confidential.

Project Director/Principal Investigator

Prefix:	* First Name:	Middle Name:
Dr.	Mahfuzur	
* Last Name:		Suffix:
Rahman		
Sex:		
Race (check all that apply):		
<input type="checkbox"/> American Indian or Alaska Native	Ethnicity:	Disability Status (check all that apply):
<input checked="" type="checkbox"/> Asian	Non-Hispanic or Latino	<input type="checkbox"/> Hearing
<input type="checkbox"/> Black or African American		<input type="checkbox"/> Visual
<input type="checkbox"/> Native Hawaiian or Other Pacific Islander		<input type="checkbox"/> Mobility/Orthopedic Impairment
<input type="checkbox"/> White		<input type="checkbox"/> Other
<input type="checkbox"/> Do Not Wish to Provide		<input checked="" type="checkbox"/> None
Citizenship:		
Permanent Resident		

Co-Project Director/Co-Principal Investigator 1

Prefix:	* First Name:	Middle Name:
Dr.	Griffiths	
* Last Name:		Suffix:
Atungulu		
Sex:		
Race (check all that apply):		
<input type="checkbox"/> American Indian or Alaska Native	Ethnicity:	Disability Status (check all that apply):
<input type="checkbox"/> Asian	Non-Hispanic or Latino	<input type="checkbox"/> Hearing
<input checked="" type="checkbox"/> Black or African American		<input type="checkbox"/> Visual
<input type="checkbox"/> Native Hawaiian or Other Pacific Islander		<input type="checkbox"/> Mobility/Orthopedic Impairment
<input type="checkbox"/> White		<input type="checkbox"/> Other
<input type="checkbox"/> Do Not Wish to Provide		<input checked="" type="checkbox"/> None
Citizenship:		
US Citizen		

RESEARCH & RELATED Other Project Information

OMB Number: 4040-0001
Expiration Date: 11/30/2025

1. Are Human Subjects Involved? Yes No

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? Yes No

If yes, check appropriate exemption number. 1 2 3 4 5 6 7 8

If no, is the IRB review Pending? Yes No

IRB Approval Date:

Human Subject Assurance Number:

2. Are Vertebrate Animals Used? Yes No

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? Yes No

IACUC Approval Date:

Animal Welfare Assurance Number:

3. Is proprietary/privileged information included in the application? Yes No

4.a. Does this Project Have an Actual or Potential Impact - positive or negative - on the environment? Yes No

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an environmental assessment (EA) or environmental impact statement (EIS) been performed? Yes No

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place? Yes No

5.a. If yes, please explain:

6. Does this project involve activities outside of the United States or partnerships with international collaborators? Yes No

6.a. If yes, identify countries:

6.b. Optional Explanation:

7. Project Summary/Abstract

8. Project Narrative

9. Bibliography & References Cited

10. Facilities & Other Resources

11. Equipment

12. Other Attachments

PROJECT SUMMARY

Instructions:

The summary is limited to 250 words. The names and affiliated organizations of all Project Directors/Principal Investigators (PD/PI) should be listed in addition to the title of the project. The summary should be a self-contained, specific description of the activity to be undertaken and should focus on: overall project goal(s) and supporting objectives; plans to accomplish project goal(s); and relevance of the project to the goals of the program. The importance of a concise, informative Project Summary cannot be overemphasized.

Title: Low-Glycemic Index (GI) Rice From Arkansas: Screening Cultivars And Optimizing Processing Parameters To Reduce GI

PD: Rahman, Mahfuzur

Institution: University Of Arkansas

CO-PD: Atungulu, Griffiths

Institution: University Of Arkansas

CO-PD:

Institution:

CO-PD:

Institution:

CO-PD:

Institution:

CO-PD:

Institution:

CO-PD:

Institution:

With the increasing consumer health consciousness and the growing importance of dietary management for chronic lifestyle diseases such as diabetes and obesity, foods with a low glycemic index (GI) have gained considerable attention. Currently, most rice varieties consumed are categorized as high GI, which causes rapid increases in blood glucose levels upon consumption and contributes to several adverse metabolic outcomes. The overall goal of this project is to identify rice cultivars and their processing parameters that yield the lowest glycemic index. Specific objectives and associated activities of this project are as follows:

Objective 1. Characterize Arkansas rice cultivars based on their starch, protein, lipid, and phenolic composition, and correlate with glycemic responses

Objective 2. Optimize the processing parameters, such as parboiling, degree of milling, and cooking characteristics, to reduce the GI of selected cultivars

Objective 3. Optimization of commingling ratios of selected rice cultivars and processing conditions that yield the lowest possible glycemic index

Developing low-GI rice from Arkansas cultivars will create a niche market for the Arkansas rice industry and provide consumers with healthful options. In addition, this project will deliver holistic quality characterization, which will be valuable to breeders for the further development of low-glycemic index (low-GI) cultivars.

This project also aligns with the Make America Healthy Again initiative's goal by advancing nutrition security through the development of healthier, low-GI rice that promotes wholesome eating, reduces calorie intake, and supports better long-term health outcomes.

This proposal addresses USDA-AFRI Program Area Priority A1811: AFRI Commodity Board Co-funding topics. The commodity board is the Arkansas Rice Research and Promotion Board, and the priority is 1. Determine consumer preferences for southern rice quality characteristics.

This file MUST be converted to PDF prior to attachment in the electronic application package.

Low-glycemic index (GI) rice from Arkansas: Screening cultivars and optimizing processing parameters to reduce GI

1. Introduction

1.1 Overview

With the increasing consumer health consciousness and the growing importance of dietary management for chronic lifestyle diseases such as diabetes and obesity, foods with a low glycemic index (GI) have gained considerable attention. Currently, most rice varieties consumed are categorized as high GI, which causes rapid increases in blood glucose levels upon consumption and contributes to several adverse metabolic outcomes [1]. In contrast, low-GI rice is digested and absorbed slowly, resulting in more stable blood glucose levels. While breeding is a promising approach to increase protein content and reduce GI of rice, the price of bred low GI rice is approximately 5 times higher than that of other rice. Therefore, it is critical to deliver affordable rice with lower glycemic responses that meet the rising demand among health-conscious and at-risk consumers, such as those with diabetes or prediabetes.

A single rice grain consists primarily of starch, with smaller proportions of protein and fiber, while the bran fraction is enriched in fat, protein, and fiber. Consequently, the degree of milling markedly influences the fat and protein composition of milled rice. Furthermore, the post-harvest processing, such as parboiling and cooking, alters starch structure and increases amylose content, which can lower the GI [2]. Thus, post-harvest processing, particularly the degree of milling, parboiling, and cooking, represents a viable alternative to breeding approaches for reducing the GI of rice.

The primary objective of this project is to comprehensively evaluate the composition of Arkansas-grown rice cultivars for their nutritional properties, including starch quality, protein, lipids, fiber, and polyphenols, which collectively determine their glycemic response. The project will utilize the chemical and in vitro starch digestibility assays to screen the cultivars, considering intrinsic factors such as the amylose-to-amylopectin ratio, resistant starch content, and protein-polyphenol interactions. These compositions collectively control the GI of rice. Beyond the cultivar specification, the project will also systematically optimize processing factors, such as parboiling, degree of milling, and cooking parameters, to further reduce GI while maintaining or enhancing the desired textural and sensory attributes. Another novel component of the research is to develop a commingling strategy for different rice cultivars to further lower GI beyond the single cultivars.

Globally, the low-GI rice market is estimated to be approximately \$4 billion in 2024, with a projected annual growth rate of 5%. As the leading U.S. rice producer, Arkansas can gain a significant economic advantage by innovating its rice and rice products, targeting both premium niche markets and expanding export opportunities [3]. Thus, this project is well-positioned to strengthen Arkansas's \$1.7 billion rice industry, contribute to national nutrition goals, and target food and health sectors [4].

The project is directly aligned with USDA priorities for supporting U.S. commodity innovation, value addition, and improved nutritional outcomes for consumers. This project also aligns with *Make America Healthy Again* initiative's goal by advancing nutrition security through the development of healthier, low-GI rice that promotes wholesome eating, reduces calorie intake, and supports better long-term health outcomes.

1.1 Goals and Objectives:

The overall goal of this project is to identify rice cultivars and their processing parameters that yield the lowest glycemic index. Developing low-GI rice from Arkansas cultivars will create a niche market for the Arkansas rice industry and provide consumers with healthful options. In addition, this project will deliver holistic quality characterization of all Arkansas ground rice cultivars, which will be valuable to farmers and breeders for the further development of low-glycemic index (low-GI) cultivars.

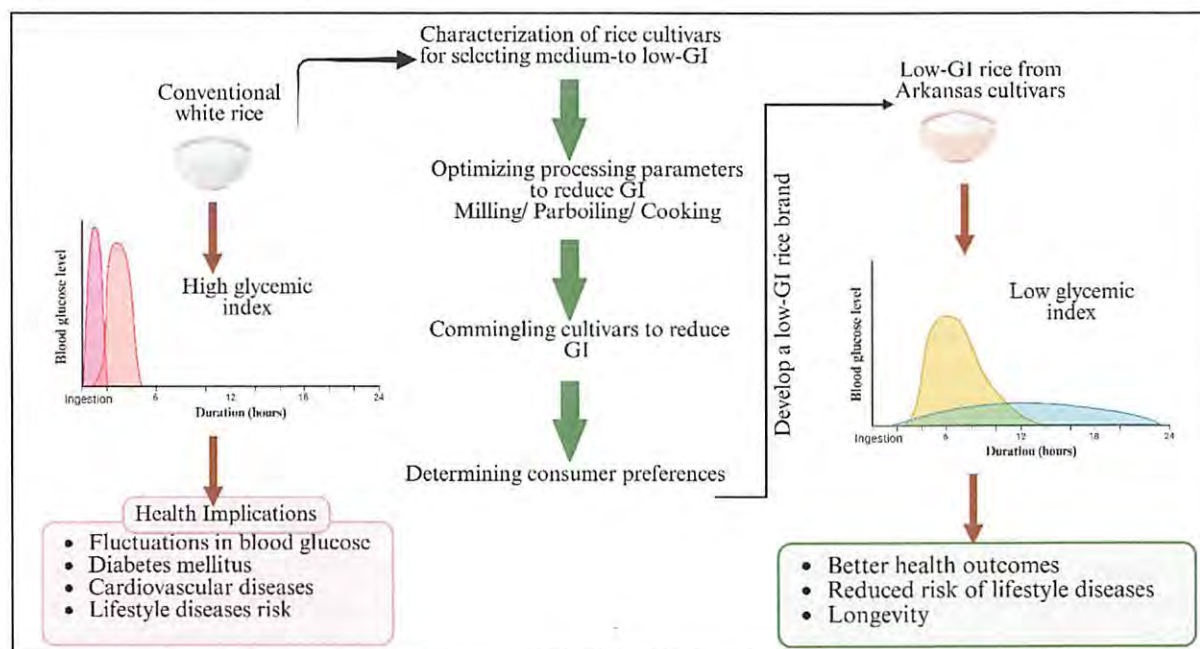


Figure 1: Graphical abstract of objectives and long-term implications of the proposed project

Specific objectives and associated activities of this project are as follows:

Objective 1. Characterize Arkansas rice cultivars based on their starch, protein, lipid, and phenolic composition, and correlate with glycemic responses

Task 1.1: Characterize the rice cultivars by proximate composition, such as starch quality, protein, lipid, and phenolic compounds

Task 1.2: In-vitro screening of the rice cultivars for their glycemic responses and correlation with their chemical composition

Objective 2. Optimize the processing parameters, such as parboiling, degree of milling, and cooking characteristics, to reduce the GI of selected cultivars

Task 2.1: Optimize the parboiling, degree of milling, and cooking methods to identify processing conditions that exhibit the least GI

Task 2.2: Characterization of the impact of processing on chemical, textural, and sensory properties of rice

Objective 3. Optimization of commingling ratios of selected rice cultivars and processing conditions that yield the lowest possible glycemic index

Task 3.1: Develop a strategy of combining or blending that yields the least GI

Task 3.2: Evaluate the chemical, texture, and sensory quality of comingled rice to ensure its consumer acceptability

1.2 Team members

The team is well-positioned to lead this project and requires expertise in multiple areas, including (1) Food Engineer and Processing specialist, and (2) Grain Processing and Post-Harvest System Engineer.

PI Mahfuzur Rahman is a food engineer and processing specialist who has been working with grains, especially rice. He shares an appointment with the University of Arkansas Rice Processing Program. He is particularly interested in applying his expertise to process rice and other grain-based proteins and polysaccharides. Dr. Rahman is the recipient of the Andersons Early-in-Career Award of Excellence - 2025 from the U.S. Quality Grains Research Consortium. His interdisciplinary approach and proficiency in rice quality evaluation make him a vital contributor to advancing the project's scientific and translational aims.

Co-PI Dr. Griffiths G. Atungulu is the director of the University of Arkansas Rice Processing Program and an expert in rice postharvest engineering, grain processing, and quality assessment, with extensive research on optimizing rice milling and parboiling techniques. He has led multiple projects focused on enhancing rice storage, improving processing efficiency, and improving nutritional quality. Dr. Atungulu is the recipient of the Andersons Award of Excellence - 2024 from the U.S. Quality Grains Research Consortium. Dr. Atungulu's in-depth understanding of post-harvest rice processing enables him to evaluate and innovate low-GI rice cultivation and processing methods.

The proposed research will provide consumers and producers with access to an affordable, healthier low-GI rice brand, supporting better community nutrition and overall health outcomes. It aligns with USDA priorities in promoting value-added agriculture and developing innovative, health-focused crop products, all while increasing growers' economic returns. Successful outcomes will enhance Arkansas's and the broader U.S. rice industry's competitiveness and public health impact through science-driven product development.

2. Review of relevant literature:

2.1 Glycemic index and health implications

According to the "Make America Healthy Again" report, 6 in 10 Americans suffer from at least one chronic disease, 1 in 4 children are affected by allergies, and 40% of the population is either diabetic or prediabetic. These alarming statistics underscore the need to advance nutrition security through the development of healthier foods, reduced-calorie intake, and support better long-term health outcomes.

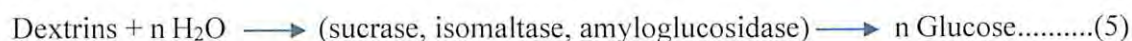
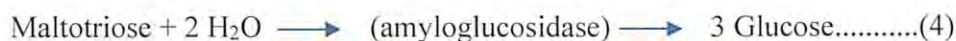
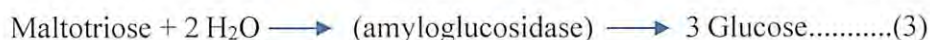
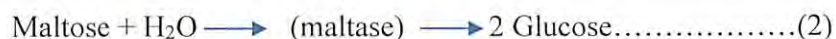
Rice is a staple cereal grain worldwide and is generally considered non-allergenic, making it an important food source for diverse populations. However, due to its high starch content, rice raises concerns related to its glycemic index (GI) and potential impact on blood sugar levels. The GI is a systematic ranking system that measures the time it takes for carbohydrate-containing foods to raise blood glucose levels after consumption. It generally scales from 0 to 100, with respect to a reference food, based on how fast the blood glucose levels rise after eating any starchy food [5]. High-GI foods (with a glycemic index >70) are rapidly digested and absorbed, leading to a rapid increase in blood glucose levels, whereas low-GI foods are broken down more slowly, resulting in a gradual rise [6]. The high-GI diets increase the risks for obesity, insulin resistance, and thereby increase the risk for chronic diseases, especially in populations vulnerable to metabolic disturbances, such as those with prediabetes or existing diabetes [6]. It has been proven that consuming high-GI diets can alleviate the risk of several metabolic and lifestyle diseases, such as cardiovascular disease and type 2 diabetes [6].

In contrast, low-GI rice (GI <50) digests more slowly, which helps stabilize glucose levels and makes rice a healthier alternative for blood sugar management. Clinically, low-GI diets are recognized for improving metabolic outcomes and are increasingly included in tailored nutrition plans for patients with chronic illnesses and those at risk of blood sugar spikes [7]. In hospital settings, incorporating low-GI rice into patient menus delivers more effective dietary management for those with diabetes, obesity, cardiovascular issues, or other metabolic disorders [8]. The benefits extend to children; offering low-GI rice in school meals and household diets ensures healthier carbohydrate intake without glucose spikes (Figure 1). It also helps counteract the growth of childhood obesity and indirectly reduces risk factors for early-onset diabetes [9].

2.2 Starch digestion and glycemic responses

Starch digestion is a complex, stepwise process from the buccal cavity to the small intestine. The starch digestion process yields glucose, which enters the bloodstream and influences the glycemic index (GI) and glycemic load (GL) [10]. The process of digestion begins with oral mastication, which breaks down food into smaller pieces for subsequent enzymatic activities throughout the gut. The salivary α -amylase initiates the hydrolysis of starch granules in the oral cavity, resulting in the formation of oligosaccharides (Eq. (1)), such as maltose [11].

Once swallowed, the masticated food passes into the stomach cavity, which contains acidic digestive fluid at a pH of 1.5-2.0. Starch digestion does not progress further in the stomach as it passes into the duodenum [12]. In the duodenum, pancreatic amylase restarts the hydrolysis of (1,4) glycosidic bonds in the amylose and amylopectin subunits of starch. This step produces metabolites such as maltose, maltotriose, and branched dextrins (Eq. (2, 3, and 4)).



The mixture then progresses into the ileum where enzymes such as maltase, sucrase, and isomaltase hydrolyze disaccharides and oligosaccharides into several monosaccharide units,

including glucose (Eq. (5)). This glucose is subsequently absorbed into the bloodstream and distributed to different tissues for energy. The efficiency and speed of this entire process, from

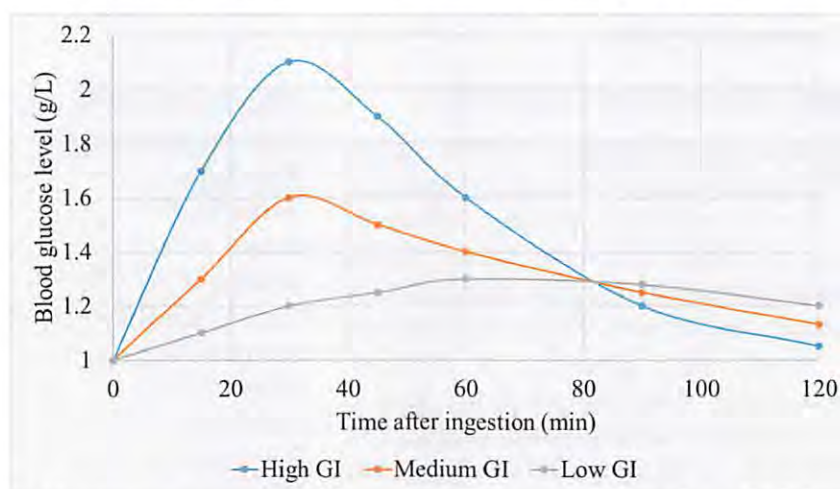


Figure 2: Glycemic responses with respect to time after ingestion of different foods

glucose utilization in tissues, affects the post-meal rise, or post-prandial blood glucose [11].

The rate and extent of starch digestion have a substantial influence on the glycemic responses of any food material (Figure 2). Rapidly digestible starches (RDS) result in a swift rise in blood glucose concentrations as they are easily hydrolyzed, which is reflected as a high GI. In contrast, slowly digestible starches (SDS) and resistant starches (RS) can only be broken down more gradually or may escape digestion altogether in the gut, which causes a flatter post-prandial glucose spike in the blood [1]. Several previous studies show a positive correlation between the quantity of RDS and the magnitude of both glycemic responses. Altogether, understanding the detailed mechanism of starch digestion provides much-needed insight into the effect of starch on blood glucose responses [1].

2.3 Rice chemical composition vs. glycemic index

2.3.1 Glycemic index of rice

The rice's chemical composition critically influences the GI of rice, such as protein and the ratio of amylose to amylopectin in the starch content. These fundamental differences result in significant variability in GI values across rice cultivars and types. For instance, varieties high in amylose and protein content tend to have lower GI, while those high in amylopectin usually show higher GI values. Processing techniques, including milling, parboiling, and cooking, further influence the starch structure and gelatinization, thereby modifying the glycemic response [5,13]. For instance, prolonged boiling increases starch gelatinization, thereby enhancing enzymatic access and glucose release, which in turn raises the GI. Conversely, moderate cooking times and methods, such as parboiling or combining rice with protein or fat, can reduce GI by limiting starch digestibility. Therefore, both intrinsic starch properties and external processing parameters must be optimized to manage the glycemic index of rice [14]. Traditional white rice typically exhibits high GI values (>70), resulting in rapid postprandial glucose spikes that contribute to carbohydrate overload and

increased risks of chronic diseases, such as cardiovascular diseases. In contrast, rice types such as brown rice, Basmati, and pigmented varieties like red and black rice generally have lower GI values due to higher amylose, fiber, and bioactive compound contents, offering healthier alternatives to consumers [15–17].

(A) Starch: amylose and amylopectin fractions

Rice kernels contain approximately 70–80% starch, which is composed mainly of amylose and amylopectin. The ratio of these two components strongly influences the glycemic response after consuming starchy foods. Amylose is a linear polysaccharide that digests slowly and resists enzymatic breakdowns, thereby delaying the hydrolysis of starch into glucose. In contrast, amylopectin is a highly branched molecule that is rapidly digested, leading to faster glucose release [19]. Amylose-rich foods, due to their resistance to enzymatic hydrolysis and lower digestibility, show lower glycemic values. Consequently, foods rich in amylopectin, such

as short- and medium-grain rice, generally show higher glycemic index (GI) values, while foods higher in amylose, such as many long-grain rice varieties, produce lower GI values [20]. The slower digestion of amylose is attributed to its compact structure, which inhibits gelatinization and reduces enzyme activity during digestion, resulting in a more gradual release of glucose.

Long-grain rice typically contains 20–30% amylose and correspondingly lower amylopectin, which contributes to its firmer, less sticky texture and high GI values. Medium-grain rice has intermediate amylose levels, ranging from 12% to 20%, which yield a tender and moderately sticky texture, making it a versatile option for table rice. Short-grain rice, with only 10–20% amylose and high amylopectin content, yields rice with lower GI [21]. Pigmented rice types, including black and red rice, show variable amylose-to-amylopectin ratios; some resemble non-pigmented varieties, while others contain slightly lower amylose (Table 1). Their unique amylopectin structures may also influence both digestibility and cooking [22].

Furthermore, the amylose content in rice ranges from 0% in waxy (glutinous) rice to approximately 30% in high-amylose cultivars, corresponding to GI values of approximately 98 down to 42, respectively [1]. For instance, a study of 25 Japonica rice cultivars with 5–25% amylose found that those above 20% typically had medium to low GI values (50–65), whereas low-amylose rice displayed high GI values (>80) [23]. Moreover, amylopectin chain length also impacts glycemic response: cultivars with shorter branches were associated with GI reductions of 5–7 points compared to those with longer branches [24]. Pigmented rice, rich in dietary fiber and polyphenols, generally falls within a GI range of 42–65 [22]. Conversely, glutinous rice, which contains almost no amylose (0–5%), consistently shows very high GI values, ranging near 85 [25]. These patterns are observed across diverse regions, although environmental conditions and processing methods can further modulate GI within these ranges.

(B) Interactions with major food molecules affect the GI

While starch digestion is directly correlated with glycemic index, other constituents, such as protein, fiber, lipid, minerals, and their interactions with starch, affect the glycemic response in a

Table 1: Glycemic index values of different types of rice

Rice Type	GI Value
White Rice	70-90
Instant Rice	85-90
Jasmine Rice	60-70
Long Grain Rice	60-65
Basmati Rice	50-58
Brown Rice	50-55
Red Rice	50-60
Black Rice	42-55
Wild Rice	45-50

Adapted from [14,18]

complex and multifaceted manner. Each plays a unique modulatory role in addition to the starch structure and its amylose-amylopectin ratio. Starch interacts with other food constituents, protein, lipids, dietary fiber, and polyphenols, significantly influencing rice's digestibility and GI manifestation [18].

Protein forms protective networks with and around starch granules through hydrogen bonding and hydrophobic interactions. This substantially restricts water mobility and limits enzyme access during digestion, effectively lowering GI. The addition of whey or soy protein isolate to waxy rice decreased RDS and increased RS, thereby dropping GI values by ~15–20 units. Furthermore, enzyme inhibition by peptides and certain amino acids reduced starch digestibility, with digestion rate constants decreasing from 2.34×10^{-2} to $2.16 \times 10^{-2} \text{ min}^{-1}$, confirming the consistent GI-lowering effect resulting from protein-starch interactions [26]. This can be reiterated by breeding high-protein cultivars (protein content approximately 11-12%), which show significantly lower GI responses (GI 41), such as Frontière rice from Louisiana.

Lipids, including triglycerides and oils, also interact with starch during cooking or other processing to form amylose-lipid complexes, which increase RS formation and reduce RDS. Clinical and in vitro studies demonstrate that adding clarified butter or soybean oil to cooked rice significantly lowers the GI by 3.8 units [17]. These effects are particularly pronounced in high-lipid rice cultivars, where the GI decreases by up to 10 points compared to standard controls. This shows a substantial positive correlation between lipid or protein content and RS, and a negative correlation with GI. This phenomenon also supports increasing the glucose levels of cooked rice with an increasing degree of milling [27]. As the surface lipid content is inversely proportional to the milling degree, it follows the same pattern as the glycemic index.

Dietary fiber and polyphenols also play vital roles in modulating rice starch's glycemic potential. Pigmented and non-pigmented rice varieties with higher fiber content show a 23% lower GI compared to conventional white rice, due to slower enzymatic hydrolysis and enhanced RS formation. The addition of oligosaccharides or inulin also increases the RS content from 3.4% to 5.2%, with an observed reduction in GI from 80 to 71. Polyphenols, such as catechin, quercetin, and curcumin, bind to starch molecules and inhibit amylase, thereby reducing the GI by up to 30 units [28]. These interactions also enhance antioxidant activity and can be utilized to modify rice-based foods with both lower GI and improved functional health properties.

Therefore, the chemical composition of rice, including starch, protein, lipid, fiber, and polyphenol content, significantly controls its glycemic index by altering starch digestibility and the formation of resistant starch.

2.4 Effect of genetic makeup on the glycemic response

The genetic factors of rice varieties significantly impact their glycemic responses, primarily due to differences in starch composition and type. Additionally, this genetic composition also determines the biochemical pathways for the release of glucose from the starches during digestion. The International Rice Research Institute (IRRI) has recently identified the genes controlling the glycemic responses of rice. They identified that ultra-low GI as ≤ 45 and low GI as 46 – 55 [29]. Crossbreeding of Samba Mahsuri and IR36 amylose cultivars yielded rice with an ultra-low GI of 42 and a protein content of $\geq 14\%$. This notable decrease in GI was due to almost doubled amylose

content and 6% increase in resistant starch [29]. These findings establish a basis for the selective breeding of rice with a low glycemic index, utilizing the genetic characteristics of the cultivars. Furthermore, the genetic variation in cultivars also affects the amylose-to-amylopectin ratio. The cultivars with elevated amylose content exhibited an elevation in resistant starch and a subsequent decrease in GI from 80 to approximately 60 [30].

Apart from starch composition, other factors, such as protein content, are also affected by the genetic composition of the cultivars. The International Rice Research Institute and the Max Planck Institute in Germany collaborated to develop a high-amylose, high-protein rice cultivar, which showed a reduction in GI from 59 to 50 and an increase in amylose content from 1.06% to 4.32%. These rice lines contain protein content of ~16%, significantly higher than the typical 2–8% in rice [31]. The elevated protein content, combined with higher amylose and resistant starch, contributes synergistically to a lower GI by slowing glucose uptake. Similarly, when compared between *japonica* and *indica* varieties, the *japonica* variety showed 21% lower glucose production and 36% higher digestion time, thereby indicating a very low GI than the *indica* variety [32].

These results support that the genetic makeup of different rice cultivars not only affects the starch structure but also the broader grain biochemical composition, thereby influencing postprandial glycemic responses.

2.5 Processing methods

Rice processing, including milling, parboiling, cooking, or instantization, significantly alters the chemical composition of both starch and other macromolecules, thereby affecting the starch digestibility and glycemic manifestation.

(a) Milling

Rice bran is the outer layer of the rice kernel, rich in nutrients including 34–52% carbohydrates (mostly starch, hemicellulose, and cellulose), 18–23% lipids, 14–16% protein, and significant dietary fiber, mainly insoluble fiber [33]. This nutrient-dense composition includes bioactive compounds such as γ -oryzanol, phytosterols, and tocopherols, which contribute to its health benefits. The chemical composition of rice

bran, particularly its high fiber content, plays a vital role in modulating the glucose response. Dietary fiber in rice bran slows starch digestion and glucose absorption, leading to a more gradual rise in blood sugar levels, thereby reducing the postprandial glycemic response. Additionally, the presence of lipids and proteins further influences digestion rates and glycemic impacts [2,27].

Milling is one of the most fundamental steps in rice processing, where the bran and germ layers are removed, thereby altering the protein, fiber, micronutrient, and starch content. It has a significant influence on GI due to changes in the physical and chemical grain composition. Brown rice typically shows a much lower GI than its extensively milled counterpart due to these compositional changes. For example, brown rice had a GI of 54.4 compared to 75.9 in fully milled white rice with 12% milling, a difference of over 21 GI units attributable to retained fibers and

Table 2: Effect of different degrees of milling (DOM) on amylose content and resistant starch for predicting glycemic responses

DOMs (%)	Amylose (%)	RS (%)	Predicted GI
0	16.20	6.35	77.98
2	15.15	5.89	81.03
4	17.35	5.40	82.49
6	18.35	5.12	83.67
8	18.75	4.64	83.25
10	18.80	4.28	84.32
12	18.65	4.30	85.55

Adapted from Wang et al. (2021)

slower starch digestibility [2]. Similarly, another research showed that brown rice had a GI of 57.6, while undermilled rice had a GI of 73.0, and white rice had a GI of 79.6 [27]. This directly correlates with the degree of milling and glycemic response of the rice cultivars (Table 2).

The increase in GI from extensive milling can be due to the increased availability of RDS and the loss of some nutrients, such as protein and dietary fiber. These secondary nutrients help to naturally slow carbohydrate breakdown and thereby lower the glycemic response of the starchy rice [2]. These findings support recommendations to favor less-milled rice grains for healthier glycemic management, especially in populations at risk for metabolic diseases.

(b) Commingling of rice cultivars

Rice commingling is a common practice in which different rice cultivars are blended during harvest, drying, or any of the storage operations. Blending different rice cultivars can significantly impact their milling quality, chemical composition, and other functional properties, such as cooking time. Commingled rice cultivars showed better peak viscosities and hardness than the single cultivars [34]. Furthermore, the starch quality, along with amylose: amylopectin ratios, has also shown significant differences in blended cultivars (27.70% RT7321, 26.10% XP753, 22.90% RT7521, 10% Diamond, 7.20% CLL16, and 6.10% RT7301) compared to single cultivars. However, the gelatinization temperature of blended cultivars did not show any discernible differences when compared with the single cultivars [35]. To summarize, commingling enables the leveraging of distinct physicochemical and nutritional traits of diverse rice cultivars, thereby providing a strategic and tailored approach to optimize milling performance, chemical composition, and functional quality.

(c) Parboiling

Parboiling is a hydrothermal process that involves soaking, steaming, and drying rice in the hull before milling. This process alters the starch structure and composition of amylose: amylopectin by partial gelatinization during steaming and retrogradation during drying. It also supports the formation of amylose-lipid complexes. All these chemical changes contribute to reducing starch digestibility and glycemic impact [36]. Numerous comparative studies have consistently shown that parboiled rice has a lower GI than non-parboiled rice. Severe parboiling of short-grain Ponni rice resulted in a significant reduction in GI, from 77 to 75, while the RS content increased from 15% to 22%. Similarly, a medium-grain cultivar showed that severe parboiling improved RS by 6% and lowered GI by 4 units, while partial parboiling caused a 7% increment in RS and a 3-point reduction in GI [16]. Furthermore, high-amylose cultivars exhibit a significantly greater GI-lowering effect upon parboiling. Another study on the parboiling of brown rice and germinated brown rice found a drop in GI below that of brown rice itself, while milling significantly increased the GI of all three categories [37].

(c) Cooking Methods

The cooking process parameters, particularly time, temperature, and water-to-rice ratio, have a predominant effect on the GI of rice cultivars. Cooking transforms starch molecules through gelatinization. This process makes it more accessible to digestive enzymes, thereby increasing the postprandial glycemic response. Increasing the cooking time by 10 minutes resulted in a 15.8% rise in GI for white medium-grain rice and a 25.4% rise for whole-grain long-grain rice. Another

key finding is that while high-amylopectin white rice generally shows a higher GI of up to 80, longer cooking times further increase GI values to as low as 90. On the other hand, whole-grain high-amylose rice maintains a lower GI even after cooking only up to 70, due to slower starch gelatinization and fiber interference [38].

Cooling cooked rice increases the formation of resistant starch through the process of retrogradation, making it less digestible and lowering the glycemic index. A clinical study in individuals with type 1 diabetes showed that consuming rice cooled for 12 hours at 25°C resulted in a glycemic response of 9.9 mmol/L compared to 11 mmol/L for freshly cooked rice [39]. Reheating cooled rice preserves some of the resistant starch and glycemic benefits, although the effect is less pronounced than with cold, retrograded rice consumed directly. This approach highlights a simple household method to lower the glycemic load of standard rice meals, with the ability to reduce GI by 10–15 points compared to freshly cooked rice, especially for high-amylopectin varieties [29].

Therefore, it can be concluded that glycemic index can be reduced through the composition and optimization of rice processing, such as milling, parboiling, and cooking.

2.6 Existing low-GI rice brands and the need for new

Low-GI rice has been produced in the United States by increasing its protein content (~12%) through breeding. Louisiana, through the LSU AgCenter, introduced “Frontière,” a rice variety with 53% higher protein and a glycemic index of 41, approximately 14 points lower than that of conventional white rice. In Illinois, university-led breeding programs enabled commercial branding efforts such as “Cahokia Rice,” which also has a GI of 41. The main challenge associated with this rice is its price; white Parish rice costs approximately \$4 /lb, while Cahokia rice costs approximately \$7 /lb in the market [40], compared to approximately \$1 /lb for regular white rice. One of the primary reasons for the high price of these specialty rice brands is the limited acreage available for production.

It is often found in the market, especially in online marketplaces such as Amazon, where low glycemic index rice, also labeled as diabetic rice, is sold (Figure 1); however, these products are not from the USA and originate from Asian countries. These rice varieties are processed through optimized parameters to reduce GI.

Arkansas is the leading rice producer in the United States, producing a variety of different cultivars. Since breeding is a long-term process with outcomes dependent on multiple factors, an alternative approach is to identify existing cultivars with favorable composition for a lower glycemic index and optimize their processing parameters. This strategy would enable the development of low-GI rice without increasing production costs, while also addressing product quality challenges associated with specialty rice.



Figure 3: Commercially available low-GI rice

2.7 Preliminary data

The rationale of the proposed project was established based on the preliminary results from predicting GI values for different rice cultivars grown in Arkansas. 12 AR-grown rice cultivars (C1 to C12) were collected from the Rice Station at Stuttgart, AR. The rice obtained from these cultivars was dried to a moisture content of ~12-14% at room temperature and then milled to remove the husk. The brown rice was then polished extensively to remove the bran, resulting in the production of white rice. The degree of milling was calculated to be 12% and the surface lipid content was 0.4%. The in-vitro starch digestion was performed on rice grains cooked in excess water using pepsin and pancreatin enzymes to remove protein influence, and an HCl buffer to mimic the acidic stomach conditions initially. This was subjected to α -amylase and amyloglucosidase enzymes for

180 minutes, and periodical samples were collected every 30 minutes. The samples were evaluated for total starch content using a monosaccharide standard. Further, the hydrolysis index was calculated using the area under the curve, and GI was calculated using the formula (Eq. (6)).

$$pGI = 39.71 + 0.54HI \dots \dots \dots (6)$$

Table 3a shows that while most of the cultivars' GI values fell between 70 and 79, two cultivars, C7 and C9, exhibited high GI values of 82 and 90, respectively. This suggests that cultivar genotype plays a significant role in the manifestation of GI, due to differences in its composition, particularly in starch, protein, and lipid content. Furthermore, it also indicated that the majority of Arkansas-grown rice cultivars fall under the medium-GI category with values ranging from 70 to 80.

Table 3a: Predicted GI of selected AR cultivars- White rice

Cultivar	predicted GI	GI category
C1	73	Medium
C2	76	Medium
C3	79	Medium
C4	79	Medium
C5	74	Medium
C6	79	Medium
C7	82	High
C8	78	Medium
C9	90	High
C10	71	Medium
C11	78	Medium
C12	78	Medium

Table 3b: Comparison of GI of milled and brown rice of Arkansas-grown cultivars

Cultivar	White rice		Brown rice	
	predicted GI	GI category	predicted GI	GI category
B1	73	Medium	70	Medium
B2	76	Medium	77	Medium
B3	79	Medium	77	Medium
B4	82	High	67	Low
B5	78	Medium	78	Medium

Following this, five selected cultivars (B1 to B5) were chosen to investigate the effect of milling on GI values. The cultivars were dehusked, and the brown rice was divided into 2 portions. One portion was brown rice, and the other portion was milled till the surface lipid content was 0.4% to obtain white rice. When the GI was compared between milled and brown rice of the same cultivars,

the cultivars showed a decrease in GI in brown rice due to its higher lipid, protein, and fiber content in the bran. Table 3b shows a comparison between white and brown rice. The cultivar B4 showed a significant reduction of 15 GI units, whereas B2 showed only a 1 GI unit decrease. Overall, the data show that brown rice has a lower GI than white rice, which implies that the degree of milling significantly affects the GI of rice.

These preliminary results suggest that cultivar and processing can have a significant impact on the glycemic response of rice grains. These data sets, along with the extensive review from published research literature, suggest that selecting a suitable cultivar and optimizing the process parameters can favorably lower the GI of the rice grains. Therefore, it is imperative to screen all Arkansas varieties to characterize their composition and optimize processing conditions for reducing the glycemic index (GI).

3. Rationale and Significance

Rice with a low glycemic index (GI) has gained significant importance in the consumer market, offering a healthier alternative to conventional rice. This trend caters to health-conscious individuals, especially those managing blood sugar and metabolic conditions such as diabetes and cardiovascular issues. Low-GI rice is a nutritionally effective solution with significant implications for both metabolic and cardiovascular health, as well as hormonal and overall well-being.

Currently, while several low-GI rice cultivars are available globally, including some developed in Louisiana with higher protein content, these have not successfully penetrated the market due to higher pricing. On the other hand, Arkansas rice, with its moderate protein levels and diverse composition, holds untapped potential for developing affordable, low-glycemic-index (low-GI) rice varieties by leveraging factors such as amylose-to-amylopectin ratios and other chemical constituents.

The *significance* of this research extends beyond health benefits to economic impacts, as the global market for low-glycemic index (low-GI) rice is rapidly expanding. While Asian-grown rice is capturing the low-GI rice market, developing a low-GI rice brand in Arkansas will empower local growers to capture value-added market segments, increase export potential, and differentiate Arkansas rice within the competitive landscape. In addition, this project will deliver holistic quality characterization of all Arkansas ground rice cultivars, which will be valuable to farmers and breeders for the further development of low-glycemic index (low-GI) cultivars. Nonetheless, the U.S. low-GI rice market is valued at \$2.1 billion in 2024, growing at an annual rate of over 6%, indicating gradual progress and potential for greater success.

This proposal addresses USDA-AFRI Program Area Priority 1811: AFRI Commodity Board Co-funding topics, with the commodity board being the Arkansas Rice Research and Promotion Board. The project aligns with key USDA priorities, focusing on supporting small family farms, value chain innovation, and enhancing nutritional outcomes, in line with the **Make America Healthy Again** initiative. Successful completion will position Arkansas as a frontrunner in health-oriented rice production, contributing to public health improvements and strengthening regional agricultural economies. It can further be expanded to other major rice and staple crop-growing states to establish them as market leaders in the production of niche specialty crops.

4. Approach:

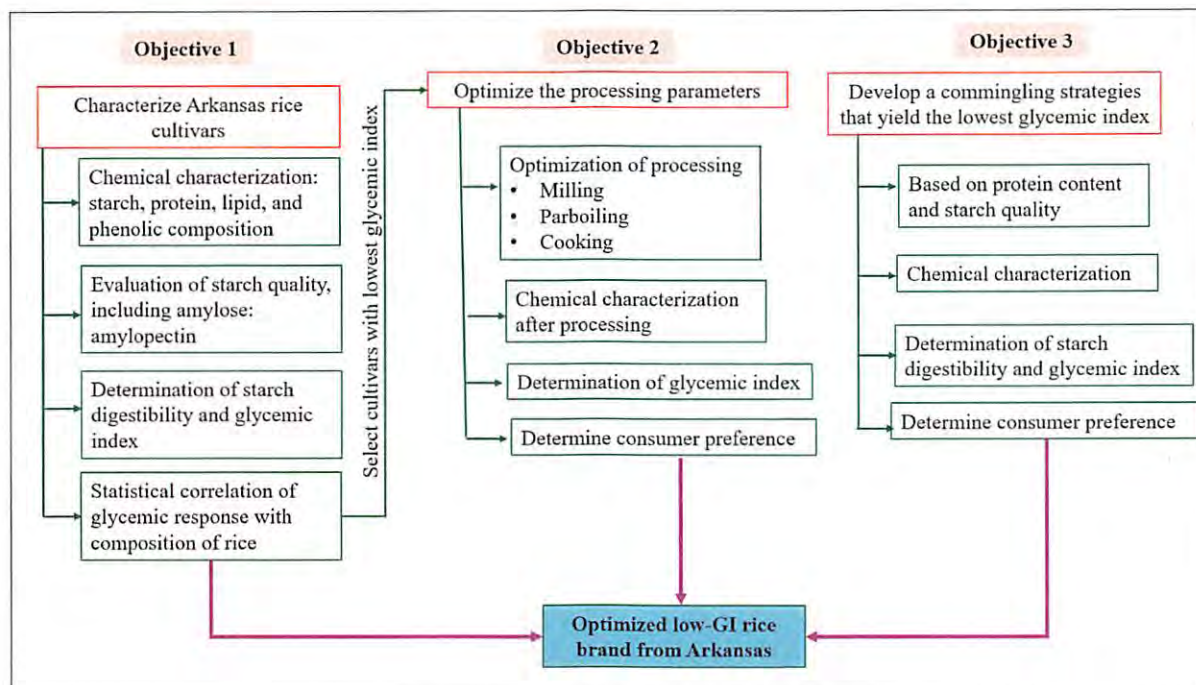


Figure 4: Workflow design of the proposed project

4.1 Objective 1. Characterize Arkansas rice cultivars based on their starch, protein, lipid, and phenolic composition, and correlate with glycemic responses

4.1.1 Introduction:

Different AR-grown rice cultivars display substantial variability in their physicochemical and nutritional properties. The *working hypothesis* is that these compositional variations will influence the GI of rice, a critical factor determining its impact on human health and dietary management. Establishing correlations between the glycemic response and the proximate composition of Arkansas-grown rice cultivars will provide valuable insights for selecting nutritionally superior and low-glycemic index (GI) varieties (Figure 3).

4.1.2 Workplan:

Task 1.1: Characterize the rice cultivars by proximate composition, such as starch quality, protein, lipid, and phenolic compounds

Samples: All Arkansas-grown rice cultivars, such as Aroma22, Diamond, Jewel, Titan, Lynx, and RT7301, as well as pigmented cultivars, will be collected during their harvest season (Table 4). The cultivars will be categorized into long-grain, medium-grain, and short-grain to facilitate easier comparison among them.

Proximate composition: The protein, lipid, moisture, and ash contents will be evaluated using the nitrogen combustion method, the Soxhlet method, the gravimetric method, and the combustion

method, respectively. The acid and neutral-digested fiber contents will be estimated based on the enzymatic extraction-combustion method [42].

Further, the mineral (macro; Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg), and micro; Iron (Fe), Zinc (Zn), Manganese (Mn), and Copper (Cu) composition will be evaluated using Inductively Coupled Plasma Optical Emission Spectroscopy. For pigmented rice cultivars, the phenol and flavonoid compounds will be determined AOAC methods [43].

Starch quality: The starch indices, such as total starch (TS), digestible carbohydrates (DC), and Resistant starch (RS), will be determined using the commercially available enzyme kits (Megazyme) [44]. The amylose content will be evaluated using the Iodide colorimetric method, and the amylopectin will be calculated as the difference between total starch and amylose contents. The starch regions of amylose (AM1 and AM2), amylopectin (MCAP and SCAP), will be characterized using the Size-exclusion chromatography method [34], and the molecular size distributions will be established. The starch gelatinization and crystallization will be estimated using X-ray diffraction and Differential Scanning Calorimetry methods established by UARPP. The characterization will be performed every 3 months to a year to understand the effects of ageing on the composition.

Task 1.2: In-vitro screening of the rice cultivars for their glycemic responses and correlation with their chemical composition

Glycemic index evaluation: The selected cultivars will be tested for their glycemic response using the method given by Pautong et al.[44]. The analysis will be performed by initially hydrolyzing the protein constituents using pepsin and an HCl-KCl buffer to remove any interference. Then the starch will be hydrolyzed using α -amylase and amyloglucosidase, and the glucose will be quantified using glucose oxidase peroxidase (GOPOD) enzyme at different time intervals (30-, 60-, 90-, 120-, 150-, and 180-minute intervals) [45]. The predicted Glycemic index (pGI) will be calculated (Eq. (7))as follows:

$$\text{Starch hydrolysis (\%)} \text{ at time } t = \frac{\text{Weight of released glucose} \times 0.9}{\text{Total starch weight}} \times 100 \dots \dots \dots (7)$$

The hydrolysis index (HI) will be calculated as the area under the curve of the starch hydrolysis (%) Vs time graph and divided by the area under the curve for the reference standard (white bread). The predicted glycemic index (pGI) was calculated using the modified first-order equation (Eq. (8)) given by Goni et al. [46] to extrapolate the equation below:

Cultivar	Group	Cultivar	Group
Diamond	Long	Aroma22	Long
Ozark	Long	RT7421FP	Long
ProGold L4	Long	RT7521FP	Long
DG283L	Long	RT7302	Long
RTv7303	Long	Titan	Medium
CLL16	Long	Taurus	Medium
CLL18	Long	DG353M	Medium
CLL19	Long	ProGold M3	Medium
CLHA03	Long	Rt3202	Medium
PVL03	Long	CLM04	Medium
PVL04	Long	CLM05	Medium
DG563PVL	Long	Lynx	Short
RTv7231MA	Long	RU9601099	Short
RT7331MA	Long	CH202	Short
RT7401	Long	Scarlett	Pigmented
RTXP753	Long	Tiara	Pigmented
DG3H2007	Long	Data obtained from [41]	

$$pGI = 39.71 + 0.54HI \dots\dots\dots(8)$$

The glycemic response will be tested for each 3 months for one year to understand the effect of aging on the glycemic activity of rice cultivars. These responses will be correlated with chemical compositions using suitable correlation matrices. Based on these matrices, cultivars with a medium to low glycemic response will be selected for the remainder of the project.

Statistical correlation: The proximate and starch compositions will be correlated with the glycemic responses using multivariate statistical analyses [13,15]. Pearson's correlation coefficients will be derived for the interrelationships between the nutritional components of rice varieties and the corresponding glycemic indices, as well as loads, using a two-sided test of significance at 0.01 and 0.05 levels. Stepwise multiple regression analyses will also be performed with independent (moisture, protein, fat, ash, insoluble dietary fiber (IDF), soluble dietary fiber (SDF), carbohydrates, phytate, amylose, macro minerals, micro minerals, and resistant starch (content and type) and dependent (glycemic index) variables at probability level of 0.05 ($p \leq 0.05$) to determine the significant effect and percent contribution of the factor(s) in GI variability.

4.1.3 Expected results:

Upon successful completion of Objective 1, we will have a comprehensive dataset of compositions for different rice cultivars and establish correlations with their glycemic responses. A holistic characterization of the Arkansas rice cultivars (including long, medium, short, hybrid, pigmented, and breeding-line cultivars) with starch (amylose: amylopectin), protein, fiber, lipid, polyphenols, and micronutrient compositions, which will be helpful for farmers to understand the quality of the rice they grow and for genotypic breeding.

4.1.4 Anticipated pitfalls and alternative strategies:

Variability in rice composition and aging effects may impact the accuracy of correlating the glycemic index with proximate composition. Alternative strategies for addressing this pitfall may include standardizing process conditions, incorporating specific pretreatments, and utilizing advanced statistical methods to control variability as deemed necessary.

4.2 Objective 2. Optimize the processing parameters, such as parboiling, degree of milling, and cooking characteristics, to reduce the GI of selected cultivars

4.2.1 Introduction

Processing techniques such as parboiling, milling, and cooking play an essential role in modifying the rice starch. These alterations can significantly influence starch digestibility and, consequently, GI. By optimizing such parameters, it is possible to develop rice and its products with reduced glycemic responses while maintaining desirable quality parameters. The *working hypothesis* is that optimizing processing parameters, including parboiling, degree of milling, and cooking methods, will significantly reduce the glycemic index of selected rice cultivars.

4.3.2 Workplan:

Task 2.1: Optimize the parboiling, degree of milling, and cooking methods to identify processing conditions that exhibit the least GI

Milling parameters: To optimize the milling parameters, the paddy will be milled using the Satake dehusking machine until different degrees of milling (DOM) are achieved, such as 5%, 7%, or 9%.

Polishing time will be taken as 25–30 s, 50–60 s, and 100–120 s to obtain different levels of milling % for the selected rice samples [2]. The DOM will be calculated as:

$$DOM = \left(1 - \frac{\text{Weight of milled rice}}{\text{Weight of brown rice}}\right) \times 100 \dots \dots \dots (9)$$

The surface lipid content of the milled rice at different degrees will be evaluated using the NIR-vis spectrometry method, and the protein content will be measured using the nitrogen combustion method [34].

Parboiling parameters: The parboiling parameters will be optimized by soaking 200g of rice in 1000 mL of DI water at different temperatures, including 30 °C, 40°C, 50°C, 60°C, and 70°C, for varying time intervals of 90, 120, 150, and 180 minutes [36]. The samples will then be steamed and dried to a final moisture content of 12-13%.

Cooking process: The cooking parameters will be evaluated by pre-soaking and cooking 50g of rice grains in excess water. The pre-soaking time and temperature, as well as cooking temperatures and times, will be varied to optimize the process [47].

Glycemic responses: For all the rice products obtained, the glycemic responses will be evaluated as mentioned in Objective 1. The parameters of yielding rice with lower GI will be selected.

Task 2.2: Characterization of the impact of processing on chemical, textural, and sensory properties of rice

Starch quality and chemical composition: All rice products obtained from processing using different parameters will be evaluated for their proximate and chemical composition, as described in Objective 1. The physical properties, such as color difference, hue angle, moisture content, and 1000-kernel weight, will be determined. The proximate composition will be analyzed by established standard protocols developed by UARPP [16]. The crystallization and gelatinization properties will be evaluated using X-ray diffraction and differential scanning calorimetry [17]. Furthermore, the pasting properties were measured using a Rapid Visco Analyzer.

Cooking properties: Established protocols by UARPP will be used to quantify cooking properties, including cooking time, texture, and keeping quality [18]. The rice grains will be cooked in excess water to determine the optimal cooking time, water absorption, starch release, and texture of cooked rice.

Texture analysis: Texture Profile Analysis to quantify key parameters such as hardness, stickiness, cohesiveness, and chewiness of selected rice samples. The test will be performed by the double compression method using a 1.0 kg standard weight. The values for the mentioned textural attributes will be calculated and presented.

Sensory acceptance: The developed low-GI rice will be evaluated by trained sensory panels to evaluate aroma, flavor, appearance, and palatability systematically. The tests will be performed using a hedonic scale of 1-9, with 1 being the least favorable and 9 being the most favorable. The results of the tests will be presented in the spider plot, and a comprehensive statistical analysis will be performed based on the obtained data.

Statistical correlation: Multivariate statistical analyses, such as cluster analysis and MANOVA, will be performed to understand the interplay between processing parameters, chemical composition, and low-glycemic index (low-GI).

4.2.3 Expected results:

The completion of Objective 2 will result in optimized process parameters for reducing the GI of selected rice cultivars.

4.2.4 Anticipated pitfalls and alternative strategies:

Over-processing may reduce rice quality, and complex parameter interactions (either physical or compositional) may interfere with optimization and statistical interpretations. In the event of the above pitfalls, complex factorial designs such as response surface methodology will be adapted to minimize interference. Furthermore, the process parameters will be reassessed as necessary to maintain the quality of the selected rice cultivars.

4.3 Objective 3. Optimization and holistic characterization of comingling ratios of selected rice cultivars and processing conditions that yield the lowest possible glycemic index

4.3.1. Introduction

Developing low-GI rice through optimized cultivar selection and processing is a promising strategy for meeting consumer demand for healthier rice. However, single cultivars or processing methods alone may not achieve the lowest possible glycemic response. Comingling is a common practice in the rice milling industry, and Comingling selected long- and medium-grain cultivars with specific processing parameters offers a synergistic approach to reduce GI. The *working hypothesis* is that blending selected cultivars and processing with an optimized method will yield a synergistic reduction in glycemic index compared to individual cultivars processed alone.

4.3.2 Work plan

Task 3.1: Develop a strategy of combining or blending different cultivars that yields the least GI

Optimization of comingling ratios: Based on the data obtained from objectives 1 and 2, the low-GI cultivars will be identified using statistical tools. The selected cultivars will be comingled in different ratios to yield the lowest GI rice. The comingling will be performed within the sub-categories: long-grain, medium-grain, short-grain, and pigmented rice, as well as among the categories required to achieve low-GI rice [34]. The comingling process will be performed in various ratios, including 10:90, 25:75, 50:50, 75:25, and 90:10 [48,49].

Identification of optimized rice: GI will be determined for all the comingled ratios to understand the intricacies of combining different cultivars. Additionally, the optimized process parameters will be evaluated for the low-GI comingled rice to determine if the GI can be further lowered. After determining the optimal comingling ratio of the selected cultivars to achieve a lower GI, the optimized low-GI rice will be developed.

Task 3.2: Evaluate the chemical, textural, and sensory quality of comingled rice to ensure its consumer acceptability

Characterization: The developed optimal blends will be evaluated for their physical (color), chemical (proximate composition and starch quality), thermal (XRD, DSC, and RVA), cooking, textural, and sensory characteristics using the methods described in Tasks 4.2.2 and developed by UARPP.

Statistical correlation: Multivariate statistical analyses, such as cluster analysis and MANOVA, will be performed to understand the interplay between comingling parameters, chemical composition, and low-glycemic index (low-GI). Activities 1 and 2 of Objective 2 will be performed

in parallel to simultaneously obtain the glycemic responses of each processing method and parameter.

4.4.3 Expected results:

The completion of Objective 3 will establish and characterize the optimal comingling ratios of selected rice cultivars and processing methods that produce the lowest glycemic index rice. This will provide a scientifically validated rice product with enhanced health benefits and market potential for low-glycemic index (low-GI) branding.

4.3.4 Anticipated pitfalls and alternative strategies:

The experimental complexity and mixture of interactions resulting from the increased number of input variables will be quite challenging to handle and draw deducible conclusions from the obtained data. In such cases, we will narrow down the cultivar combinations in each set of experiments and apply an elimination method across different sets to arrive at a low-GI conclusion.

4.4 Plans to communicate results

The research outcomes will be shared through peer-reviewed journal articles (~2) and scientific conference presentations at the Arkansas Rice board meeting, University of Arkansas Industry Alliance meeting, Cereals and Grains Association, and Institute of Food Technologists (IFT) conferences (~4). Additionally, we will collaborate with industry stakeholders to determine the most effective ways to communicate with the industry. The proximate and chemical composition data sets will also be shared with the rice breeders for future breeding purposes.

4.5 Statistical Analyses

All experiments will be done in triplicate, and the analysis of variance will be calculated. Means will be compared using the least significant difference (LSD) or t-test procedure using SAS software at a 95% significance level. Further, the multivariate statistics will be performed using MANOVA or correlation tests.

4.6 Timeline:

		Year 1		Year 2		Year 3	
Objective 1							
Task 1	Characterize the rice cultivars by proximate composition	>	>	>	>		
Task 2	In-vitro screening of the rice cultivars for their glycemic responses	>	>	>	>		
Objective 2							
Task 1	Optimize processing				>	>	>
Task 2	Characterization of the impact of processing on quality				>	>	>
Objective 3							
Task 1	Develop a strategy of combining					>	>
Task 2	Evaluate consumer acceptability					>	>
Publications and Report-making			>	>	>	>	>

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Facilities and Other Resources

Statewide Mass Spectrometry Facility

The facility provides mass spectrometry resources and services to the University of Arkansas as well as other university, industrial, and government researchers. Their array of mass spectrometers includes a Bruker Ultraflex II MALDI-TOF, a Bruker Amazon Ion Trap Capillary LC/MS/MS, a Shimadzu 8040 UPLC/MS/MS, a Shimadzu 8060 UPLC/MS/MS, a Shimadzu LCMS-IT-TOF, and a Shimadzu 8040 GC/MS/MS.

Nuclear-Magnetic Resonance Laboratory

The Nuclear-magnetic resonance facility located in the Center for Protein Structure and Function in the Chemistry and Biochemistry department has several NMR instruments including Bruker 700 MHz NMR with a cryoprobe, Bruker 500 MHz NMR with a cryoprobe, a Bruker Wide-Bore 300 MHz solid-state NMR, and a Bruker 300 MHz AMX/ASX NMR.

Polymer and Nano Engineering Laboratory, the Bell Engineering Center at the University of Arkansas.

The lab is well equipped with UV-Visible spectrophotometer (Shimadzu BioSpec-1601), Thermogravimetric Analyzer (TA Instruments TGA5500) with mass spectrometry for evolved gas analysis, Quartz Crystal microbalance (Q-Sense by Biolin Scientific) equipped with an Ismatec high precision multichannel dispenser pump, two dedicated potentiostats (BioLogic SP-300 and BioLogic Sp-200), and 2 potentiostat/galvanostats (WaveNowXV and WaveNow), and a micro GC (Agilent Technologies 490 micro GC). Thermofisher Nicolet is50 Fourier transform infrared (FTIR) bench and Continuum microscope system, Anton Paar Litesizer 500 Dynamic light scattering (DLS) and Zeta potential (ZP) system, and Agilent Technologies 1200 series 1200 High-performance liquid chromatography (HPLC) system for Gel permeation chromatography (GPC). The equipment in Walters's lab that are in the process of purchasing are: Drop Shape Analyzer (Krüss DSA25E) for contact angle (CA) and surface tension measurements.

Nano and Biomaterials Characterization Facility at the Institute of Nanoscience and Engineering.

The Arkansas Nano and Bio Materials Characterization user facility located in the Nanoscience and Engineering Institute has a variety of instruments for chemical and structural characterization. The facility provides access and training to the following equipment: 2 scanning electron microscopy systems (FEI Nova Nanolab 200 Dual-Beam SEM and focused-ion beam with EDX capabilities and a Philips XL30 environmental SEM), 3 transmission electron microscopy systems (Titan 80-3000, Tacnai TF20, and JEOL 1011), Raman microscope, X-ray photoelectron spectroscopy (PHI Versaprobe 5000), and two X-ray diffractometers (Panalytical X'Pert MRD and Philips PW1830 Double System Diffractometer). The facility also provides access to sample preparatory equipment such as a spin coater (CEE-100), thermal processor system (AG Associates Heatpulse 610 rapid thermal processor), photolithographic mask aligner (Karl Suss MJB 3 Mask aligner), profiler (Dektak-3), plasma cleaner (PE-50 plasma cleaner), metals supper coater (Edwards 306 e-beam evaporator), and wet bench space.

Equipment

MAJOR EQUIPMENT

PI Rahman's Novel Ingredient Processing and Utilization Lab, Department of Food Science, University of Arkansas, is equipped with a Plasma generator (Leap 100), ultrasonic processors (Branson Sonifier 450), a rotary evaporator (Buchi R-100), a water bath, several pH meters, a benchtop, and a floor centrifuge machine. In addition, the lab has an HPLC, a UV-Vis spectrophotometer, an FTIR, and fluorescence spectroscopy.

- A plasma generator (Leap 100, PlasmaLeap Technologies, Australia) equipped with a plasma jet, dielectric barrier discharge (DBD), and water reactors. The plasma equipment can be operated at the variables: duty cycle (85 μ s -105 μ s), voltage (100V-240V), discharge frequency (1.0 kHz -2.0 kHz) by using different carrier gases (atmospheric air, argon, nitrogen, oxygen, and carbon dioxide).
- Ultrasound: Branson Sonifer Ultrasound sonicator is an advanced ultrasonic processor with replaceable horn attachments. The sonicator functions at a power of 700W and generates sound waves up to 20 kHz frequency with precision output control. Specifically designed for biological and liquid processing applications, this unit includes a 1" diameter, 5" long probe with a 100 μ m maximum amplitude.
- Ultrasound: Branson 2510 Ultrasound bath is equipped with a 220 V AC input, 2.8 L tank capacity, digital timer, and temperature monitor. The ultrasound equipment operates up to 40 kHz and can be heated to 69 °C. This equipment can generate a consistent cavitation effect throughout the tank.
- The Shimadzu I-Series HPLC integrated with LC technology is a compact and robust chromatography system with high precision and auto-validation. This equipment can be used with various columns, including Size Exclusion (SEC), Ion-exchange (IEC), and Reverse-phase (RP-HPLC), and is compatible with a wide range of detectors (UV, PDA, etc.). Our system is equipped with a PDA detector featuring a deuterium (D2) lamp and fully temperature-controlled optics, providing an exceptional level of sensitivity and baseline stability.
- The Agilent Cary 630 FTIR spectrophotometer is a benchtop FTIR module with diamond ATR that produces high-quality results for chemical characterization of samples. The equipment can operate at a scanning range of 4000–650 cm^{-1} , with a spectral resolution of 4 cm^{-1} . The ATR crystal yields accurate and high-quality results with every sampling, precisely measuring solids, liquids, and thin films to provide excellent spectral data.
- A Drop Shape Analyzer (Krüss DSA25E) for contact angle (CA) and surface tension measurements is under purchase.

- Agilent Synergy H1M reader is a modular multimode microplate reader, with monochromator-based optics and filter-based optics. It offers flexibility and sensitivity across a broad range of applications. Synergy H1 offers continuously variable bandwidth monochromators for UV absorbance or fluorescence excitation and emission. It also offers environmental control for incubation up to 75 °C, supporting 6 to 384-well plates.
- ThermoScientific Multifuge X4 centrifuge offers multi-use applications requiring more rotor choices, speeds, and programming capacity. This equipment can handle large numbers of samples and operates at a maximum speed of 16,000 rpm, with temperature adjustments ranging from 4 to 30 °C. Additionally, the Beckman Coulter J2-21M high-speed refrigerated floor model centrifuge can handle large volumes of samples and offers a variety of rotors to suit our specific experiments. It operates at 21,000 RPM (dependent upon rotor) and temperatures 0-30 °C.
- VWR® 25D Homogenizer is ideal for a wide range of lab applications, such as generating emulsions and suspensions, making homogenous solutions, cell disruption, protein extractions, and other laboratory processing. It comprises a high-watt motor that can homogenize samples ranging from 0.05 mL to 3.5 L at speeds of up to 30,000 rpm.
- The lab is an integral part of the University of Arkansas Rice processing program, which is equipped with a texture analyzer (TA), a differential scanning calorimeter (DSC), and a Thermogravimetric analyzer (TGA).
- Texture analyzer: A universal testing machine (UTM) is available in the rice processing program laboratory for the tensile strength analysis. Appropriate grips are available with the instrument with suitable load implementation for various types of specimen analysis.
- Differential scanning calorimeter (DSC): The rice processing program laboratory is equipped with a Q2000 differential scanning calorimeter (TA Instruments, USA) for analyzing the glass transition temperature. The sample can be scanned under a nitrogen flow from 100 °C to 250 °C with the desired heat flow.
- Thermogravimetric analyzer (TGA): The Q50 instrument (TA Instruments, USA) is available in the rice processing program lab for thermogravimetric analysis to see thermal stability. For sample analysis, platinum pans and aluminum oxide (Al₂O₃) pans can be equipped based on temperature ranges. The instrument is operated at various heat flow rates, and the mass changes can be measured from 25 °C to 800 °C. The temperature changes in the furnace as well as weight loss of sample continuously recorded in the instrument and nitrogen gas is used for cooling the instrument.
- Software resources and tools: For the structural modelling component of the project, open-source software such as SWISS-MODEL and AlphaFold2 will be used. For molecular

mechanics and refinement, CHARMM-GUI and GROMACS will be used, for which necessary academic licenses will be obtained as needed. For docking and interaction analysis, open-source tools such as AutoDock Vina and AutoDock Tools will be applied, along with a licensed Molecular Operating Environment (MOE) for molecular descriptor generation. PyMOL (open source) will be used for molecular visualization. Open source software such as QSARIN, TensorFlow, PyTorch, and RDkIT will be applied to develop ML-based QSAR models. The data analysis and visualization will be performed using statistical tools such as R and Python, utilizing the University's academic licenses.

University of Arkansas Rice Processing Program

The Rice Processing Program's facilities and equipment are primarily located at the University of Arkansas Food Science Department, Fayetteville, AR. The research program has the facilities and equipment for complete physico-chemical analysis, sensory evaluation and nutritional evaluation of food products. The rheology lab of the program is equipped with a miniature rice cooker, a texture analyzer, a rheometer, a differential scanning calorimeter, a thermo-mechanical analyzer, a dynamic mechanical analyzer, a rapid visco-analyzer 4 (Newport Scientific Pty. Ltd., Warriewood, NSW, Australia), and viscoamylographs. In addition, it has natural air dryers, equilibrium Moisture Content Control units, threshers, dehuskers/dehullers (Satake Rice Machine, Satake Engineering Co., Ltd., Tokyo, Japan), milling equipment (McGill #2 Rice Mill, RAPSCO, Brookshire, TX), granular material separator - a double tray sizing machine (Grainman Machinery Manufacturing Corp., Miami, FL), Near-Infrared spectrometer (NIR) equipped with a diode array analyzer (DA 7200, Perten instruments, SE-141 05 Huddinge, Sweden), cyclone mill with a 0.5 mm sieve (model 2511, Udy Corp., Fort Collins, CO), X-ray cabinet unit (UltraFocus 60, Faxitron Bioptics LLC), Temperature and relative humidity control units, soxtec fat extractor, hunter color measurement system, grinders/cyclone mills, data loggers, freezer, refrigerator, and others.

- Natural air dryers
- Equilibrium Moisture Content Control units
- Threshers
- Granular material cleaner (South Dakota Seed Blower, Seedboro, Chicago, IL)
- Dehuskers/dehullers (Satake Rice Machine, Satake Engineering Co., Ltd., Tokyo, Japan)
- Milling equipment (McGill #2 Rice Mill, RAPSCO, Brookshire, TX)
- Granular material separator - a double tray sizing machine (Grainman Machinery Manufacturing Corp., Miami, FL)
- Granular material sorter
- Near-Infrared spectrometer (NIR) equipped with a diode array analyzer (DA 7200, Perten instruments, SE-141 05 Huddinge, Sweden)
- cyclone mill with a 0.5 mm sieve (model 2511, Udy Corp., Fort Collins, CO)
- Rapid Visco Analyzer- (RVA) Super 4 (Newport Scientific Pty. Ltd., Warriewood, NSW, Australia)

Others:

- X-ray cabinet unit (UltraFocus 60, Faxitron Bioptics LLC)
- Diode array-based NIR analyzer
- Temperature and relative humidity control units (2) and auxiliary drying/conditioning chambers
- Specialized temperature and relative humidity control units for high-temperature drying
- Grading equipment for USDA rice milling quality tests and evaluations
- General grain cleaning equipment
- Equilibrium moisture content measuring system
- Boerner sample divider
- Fiber optic lamps
- Video microscopy system
- Rice panicle/small bundle thresher
- Satake image analyzer
- Winseedle image analysis system
- SeedCount image analysis system
- Fissure inspection device
- Single kernel moisture meter
- Capacitance moisture meter
- Seedburo bulk density tester
- Granular material 1,000-kernel mass measurement system
- Various temperature and RH probes/meters
- Thermogravimetric analyzer
- Thermal mechanical analyzer
- Dynamic mechanical thermal analyzer
- Rapid Visco Analyzer (RVA-4)
- Soxtec fat extractor
- Hunter color measurement system
- Kett whiteness meter
- Digital micrometer and caliper
- Grinders/cyclone mills
- Analytical balances
- Convection ovens
- Fume hoods, gas, air, and DI water
- Walk-in coolers, 4°C
- Walk-in freezers, -10°C
- Data loggers

OTHER RESOURCES

Nano and Biomaterials Characterization Facility at the Institute of Nanoscience and Engineering, at the University of Arkansas

The Arkansas Nano and Biomaterials Characterization user facility, located within the Nanoscience and Engineering Institute, features a range of instruments for chemical and structural characterization. The facility provides access and training to the following equipments: 2 scanning electron microscopy systems (FEI Nova Nanolab 200 Dual-Beam SEM and focused-ion beam with EDX capabilities and a Philips XL30 environmental SEM), 3 transmission electron microscopy systems (Titan 80-3000, Tacnai TF20, and JEOL 1011), Raman microscope, X-ray photoelectron spectroscopy (PHI Versaprobe 5000), an atomic force microscope (AFM), a x-ray photoelectron spectroscopy (XPS) and two X-ray diffractometers (Panalytical X'Pert MRD and Philips PW1830 Double System Diffractometer).

The facility also provides access to sample preparatory equipment such as a spin coater (CEE-100), thermal processor system (AG Associates Heatpulse 610 rapid thermal processor), photolithographic mask aligner (Karl Suss MJB 3 Mask aligner), profiler (Dektak-3), plasma cleaner (PE-50 plasma cleaner), metals supper coater (Edwards 306 e-beam evaporator), and wet bench space.

- The FEI Nova Nanolab 200 Dual-Beam combines high-resolution scanning electron microscopy (SEM) with focused ion beam (FIB) milling and integrated energy-dispersive X-ray spectroscopy (EDX) to enable advanced imaging, site-specific sample preparation, nanofabrication, and compositional analysis at sub-micron scales. This system supports precise cross-sectioning and elemental mapping, facilitating a range of materials and device studies.
- The Philips XL30 environmental SEM complements this capability by allowing high-magnification imaging of delicate, wet, or non-conductive samples under low vacuum or environmental conditions, enabling the examination of biological, geological, and soft materials in their native state with minimal preparation.
- The Titan 80-3000 is an advanced transmission electron microscope (TEM) featuring a field emission gun with an electron beam energy range of 80 to 300 keV. It offers both conventional TEM and high-resolution scanning TEM (STEM) capabilities, achieving atomic-scale spatial resolution (down to 0.1 nm in STEM mode), and is equipped with a CEOS spherical aberration corrector for highly precise imaging. The system also integrates analytical tools, such as electron energy-loss spectroscopy (EELS) and X-ray energy-dispersive spectroscopy (XEDS), for high-resolution chemical and elemental analysis, as well as full diffraction capabilities and 3D tomographic imaging, for comprehensive nanoscale characterization.
- The Veeco Dimension 3100 AFM is a high-resolution scanning probe microscope designed for detailed three-dimensional surface imaging at the nanometer and sub-nanometer scale. It supports both contact and tapping modes, with options for conductive AFM, STM, magnetic force microscopy, and operation in liquid environments. The system accommodates large samples—up to 150 mm in diameter and 12 mm thick—with an x-y stage movement of up to 150 mm and a maximum piezo scan range of 90 μm x 90 μm in x-y and 6 μm in z, all at 16-bit resolution for exceptional height accuracy and lateral precision.

- The PANalytical X'Pert Materials Research Diffractometer (MRD) is a high-resolution X-ray diffractometer designed for advanced materials characterization, particularly suited for thin films, wafers, and bulk materials. The system features interchangeable optics—such as hybrid and 4-crystal Ge monochromators, parabolic mirrors, and polycapillary lenses, providing angular resolution around 5 arcseconds in q and 2θ – θ scans, and optional in-situ high-temperature stages (up to 1100°C) for thermal studies. Typical applications include phase identification, thin film analysis, glancing incidence diffraction, stress and texture analysis, and micro-XRD mapping, with dedicated software for data collection and interpretation.
- X-ray photoelectron spectroscopy (XPS) at the Nano Facilities Center utilizes the VersaProbe station from Physical Electronics (PHI), which provides outstanding micro-spectroscopy analytical performance. The PHI VersaProbe is capable of performing detailed elemental and chemical analysis using X-ray Photoelectron Spectroscopy (XPS), also commonly referred to as Electron Spectroscopy for Chemical Analysis (ESCA). The instrument is considered for rapid, spatially resolved investigation of solid.

KEY PERSONNEL

Project Investigator/Director (PI/PD)

Dr. Mahfuzur Rahman, with the University of Arkansas System Division of Agriculture (UADA) will serve as the PI/PD and oversee the project. He will analyze the rice samples from proximate, glycemic response, starch quality, and other chemical characterization in his lab; will provide the necessary mentorship to graduate students and trainees to plan and execute experiments, data analysis, prepare and publish manuscripts; and will be responsible for coordinating with Co-PIs to complete the project successfully.

Co-PI

DR. Griffiths Atungulu with the University of Arkansas System Division of Agriculture (UADA) will serve as the co-PI/PD and oversee the project. He will collect rice samples, optimize processing, milling, and parboiling, and will provide the necessary mentorship to graduate students and trainees to plan and execute experiments, data analysis, prepare and publish manuscripts

Data Management Plan

Our data management plan (DMP) has been developed to include secure, cloud-based, real-time sharing of raw experimental results and other data forms. Our core principle has been to maintain all project data in a secure but collaborative system, which enhances the real-time engagement of project personnel (esp. graduate students) across different labs. Specific definitions and constructs are detailed below.

Expected Data Type

Lab supervisors will maintain comprehensive records for all laboratory experiments, including dates, personnel, observations, and interpretations. These records will be supplemented with files containing test details and summaries if tests performed are analytical in nature or if tests are performed as external samples elsewhere. PIs will oversee data logging practices. Software management and source code management, will be employed ensuring equal rigor in software documentation.

Data Format

All the research data will be stored according to the standard information (project title, PI/co-PI, objectives, details of study implementation, details of techniques and software used, all raw data or location of raw data, and resulting data analyses). Electronic data, such as worksheets, charts, and documents, will follow standardized file naming protocols and contain a standard information template with date, principal investigator, project title, etc.

Data Storage and Preservation

Various types of raw data (research and extension) and processed data with *basic statistics* and *objective-specific analysis* will be stored on an access-controlled, secure cloud-based data storage system, the BOX. The participant LABS will follow the guidelines of the University of Arkansas regarding the public dissemination of data and information via the website unless state or local regulations require more restrictive management of the data. Primary communication between participants, including external stakeholders, will take place primarily via email, which will follow the University's secure email procedures, which are accepted as general best practices.

Data Sharing, Protection, and Public Access

In some cases, it is universally accepted that the most efficient and effective method of stimulating research results is to form a public database with certain sample data. In these cases, the PI will present this option to the management team and, if approved, establish the proper venue for publishing the data to maximize impact. Research outcomes and other results will be disseminated to the scientific community through publications in peer-reviewed journals and through presentations at scientific conferences, as well as on the web pages of the involved institutions, per the IP and publication guidelines stipulated in the membership agreements.

The data will be shared through secured platforms BOX upon request. Endpoint security applications and features are installed on all computers used for data collection to reduce the risk and possibility that malicious threats will compromise the system. All internal and external electronic connectivity will use secure protocols such as but not limited to SFTP, HTTPS, SMTPv3 when transferring or moving digital content from one platform to another. BOX platform also

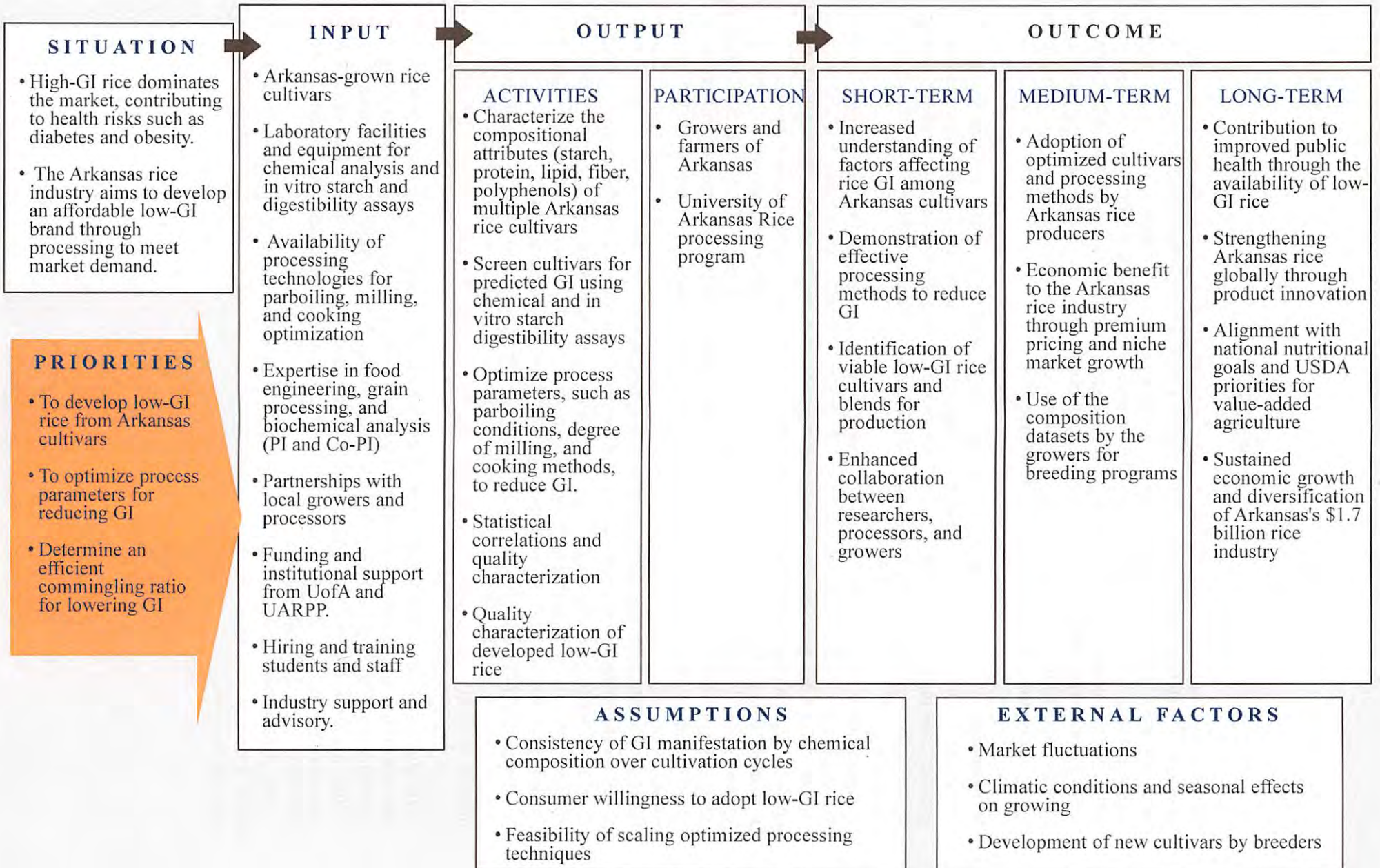
offers login options with or without passwords for different levels of internal and/or public accesses.

In cases where extremely large data sets are required, these may be saved in dedicated hard drives with redundant copies made for backup. This will alleviate the need to transfer huge amounts of data across network connections that may or may not have the bandwidth necessary to accommodate such large data transfers. In these cases, the hard drives will be kept secure through encryption, and accessible only by those researchers and students working on the projects.

Who will be responsible for data management?

The PI will be responsible for the overall DMP management, and the lead Co-PIs from each institution will be responsible for the data management of the activities happening inside the institution. The lead Co-PIs will routinely update the data management progress to the PI during the management team meetings. All participant faculties will have the DMP management access and maintenance tasks for specific research/extension goals. The IT supporting staff from each institute will provide infrastructure support for the DMP requirement. It is also expected that resources will be available on a limited basis to address initial data management needs.

LOGIC MODEL



PRIORITIES

- To develop low-GI rice from Arkansas cultivars
- To optimize process parameters for reducing GI
- Determine an efficient commingling ratio for lowering GI

Mentoring Plan

The graduate students will be recruited in the Department of Food Science at the University of Arkansas. The student will be mentored to become a potential researcher as well as an early-career faculty member at R1 institutes participating in this project. The graduate student mentoring plan will be tailored in such a way that they will be exposed to all pillars of a faculty job in the United States. More specifically, they will be trained in laboratory experiments, teaching, and mentoring skills, grant writing and project management, publication, and presentation. This project will also give an opportunity to develop strategies for long-term collaborations, leadership roles, multi-author publications/patents, and industrial relationships.

1. Orientation will include in-depth conversations between advisors and the graduate student. The topics will include: i) research community, overall interests, creativity, goals, and expectations; ii) specific goals in this proposed project; iii) the amount of independence as a graduate researcher; iv) interaction with coworkers inside and outside of the institution, and with other researchers in the future.

2. Participation in the research group meetings on research projects, in which members will be expected to present their research biweekly. The graduate students will receive machine learning, nonthermal plasma, packaging film, and characterization training. Feedback and coaching will be given to help the graduate researcher develop their communication and presentation skills.

3. Career Counseling and advising will provide the graduate researcher with the skills, knowledge, and experience needed for his/her chosen career path. Encourage attendance at relevant workshops on campus and at other venues to gain updated knowledge and explore lifetime learning opportunities in research, teaching, and entrepreneurship. Additionally, the external advisory committee will be requested to host the graduate students as interns, providing external research and industrial research experience when possible.

4. Opportunities for grant proposal preparation by direct involvement of the graduate researcher in proposal writing. The graduate student will have opportunities to learn the best practices in proposal preparation, including identifying key research questions, defining objectives, describing approaches and rationales, and constructing a work plan, timeline, and budget.

5. Strong expectations on journal publications and presentations of research results from work supported by the grant. The graduate student will receive guidance and training in preparing manuscripts and presentations. Opportunities will be available to attend national and international scientific conferences.

6. Teaching and mentoring Skills will be developed in the context of regular meetings within their research groups during which students describe their work to colleagues and assist each other with solutions to challenging research problems, often resulting in cross-fertilization of ideas.

7. Instruction in Professional Practices will be provided on a regular basis in the context of the research work and will include fundamentals of the scientific method, laboratory safety, and other standards of professional practice.

8. The progress monitoring plan of the graduate researcher will be compared to his individual development plan every six months, and appropriate changes will be made to reflect the immediate and future needs.

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator			
Prefix:	Dr.	* First Name: Mahfuzur	Middle Name: <input style="width: 80%;" type="text"/>
* Last Name:	Rahman	Suffix:	<input style="width: 80%;" type="text"/>
Position/Title:	Assistant Professor		
Department:	Food Science		
Organization Name:	Division of Agriculture of the University of Arkansas System		
Division:	<input style="width: 95%;" type="text"/>		
* Street1:	1371 W. Altheimer Dr.		
Street2:	<input style="width: 95%;" type="text"/>		
* City:	Fayetteville	County/ Parish:	<input style="width: 80%;" type="text"/>
* State:	AR: Arkansas	Province:	<input style="width: 80%;" type="text"/>
* Country:	USA: UNITED STATES	* Zip / Postal Code:	72704-6898
* Phone Number:	479-575-4737	Fax Number:	<input style="width: 80%;" type="text"/>
* E-Mail:	mahfuz@uada.edu		
Credential, e.g., agency login:	<input style="width: 95%;" type="text"/>		
* Project Role:	PD/PI	Other Project Role Category:	<input style="width: 80%;" type="text"/>
Degree Type:	<input style="width: 95%;" type="text"/>		
Degree Year:	<input style="width: 95%;" type="text"/>		
* Attach Biographical Sketch	<input type="button" value="BiographicalSketchRAHMAN.pdf"/>	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/> <input type="button" value="View Attachment"/>
Attach Current & Pending Support	<input type="button" value="CurrentPendingSupportRAHMAN.p"/>	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/> <input type="button" value="View Attachment"/>

PROFILE - Senior/Key Person 1			
Prefix:	Dr.	* First Name: Griffiths	Middle Name: <input style="width: 80%;" type="text"/>
* Last Name:	Atungulu	Suffix:	<input style="width: 80%;" type="text"/>
Position/Title:	Professor		
Department:	Food Science		
Organization Name:	Division of Agriculture of the University of Arkansas System		
Division:	<input style="width: 95%;" type="text"/>		
* Street1:	1371 W. Altheimer Dr.		
Street2:	<input style="width: 95%;" type="text"/>		
* City:	Fayetteville	County/ Parish:	<input style="width: 80%;" type="text"/>
* State:	AR: Arkansas	Province:	<input style="width: 80%;" type="text"/>
* Country:	USA: UNITED STATES	* Zip / Postal Code:	72704-6898
* Phone Number:	479-575-6843	Fax Number:	<input style="width: 80%;" type="text"/>
* E-Mail:	atungulu@uada.edu		
Credential, e.g., agency login:	<input style="width: 95%;" type="text"/>		
* Project Role:	Co-PD/PI	Other Project Role Category:	<input style="width: 80%;" type="text"/>
Degree Type:	<input style="width: 95%;" type="text"/>		
Degree Year:	<input style="width: 95%;" type="text"/>		
Attach Biographical Sketch	<input type="button" value="BiographicalSketchATUNGULU.p"/>	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/> <input type="button" value="View Attachment"/>
Attach Current & Pending Support	<input type="button" value="CurrentPendingSupportATUNGULU"/>	<input type="button" value="Add Attachment"/>	<input type="button" value="Delete Attachment"/> <input type="button" value="View Attachment"/>

BIOGRAPHICAL SKETCH

NAME: **Mahfuzur Rahman**

POSITION TITLE: Assistant Professor

Education and Training

Institution	Degree	Date	Field of study
• Iowa State University	Ph.D	12/2021	Food Science and Technology
• North Dakota State University	M.S	05/2018	Cereal Science
• Shahjalal University of Science and Technology, Bangladesh	B.Sc	10/2010	Food Engineering

Positions and employment

2023-	Assistant Professor , University of Arkansas, Fayetteville, AR, USA
2021-2023	Senior Scientist , Research & Development, The Kraft Heinz Company, Glenview, IL
2018-2021	Graduate Research Assistant , Iowa State University, Ames, IA, USA
2016-2018	Graduate Research Assistant , North Dakota State University, Fargo, ND
2011-2016	Lecturer , Shahjalal University of Science and Technology, Sylhet, Bangladesh

Honors

- **2025:** The Andersons Early-in-Career Award of Excellence - 2025 from the U.S. Quality Grains Research Consortium.
- **2024:** Winners of the 2024 Tanners for Comprehensive Reviews: The award is specifically given to the research paper with the highest number of citations within a given timeframe.
- **2021:** Research Excellence Award. This award honors students whose research accomplishments are among the top 5% at Iowa State University in overall quality.

Professional Memberships and Service

- **Professional membership:**
 - American Oil Chemists' Society -Member at large, Protein and Co-Product division
 - Institute of Food Technologists- Member at large- Nonthermal Processing Division
 - Cereals and Grains Association
- **Editorial and Review Activities**
 - Legume Science, Editorial Board member. (October 30, 2023 - Present)
 - Panel member. SBIR 8.5 Phase II Program Proposals, USDA NIFA, (December 11, 2023 - December 12, 2023)
 - AOCS Best paper review for ADM/PCP Best Paper award
 - Newsletter Editor, AOCS Protein and Co-Products Newsletter editorial team, 2020-21 and 2021-2022.
 - Reviewed articles for Journals: Sustainable food proteins, LWT- Food Science and Technology, Cereal Chemistry, Legumes, and Food and Bioprocess Technology
- **Organize and co-chair conference session:**

- Emerging Sustainable Processing of Technologies of Proteins’ at the AOCS annual meeting 2024, scheduled on April 28–May 1, 2024, in Montréal, Québec, Canada.
- ‘Sensory and Consumer Perception of Alternative Sources of Proteins’ at the 2023 AOCS Annual Meeting & Expo, April 30–May 03, 2024, Denver CO,
- ‘Application of Advanced, Novel, and Clean-Tech Processing for Preparation and Utilization of Plant Proteins for Foods’ at the 2022 AOCS Annual Meeting & Expo. Virtual.
- ‘Application of Advanced, Novel, and Clean-Tech Processing for Preparation and Utilization of Plant Proteins for Foods’ at the 2021 AOCS Annual Meeting & Expo. Virtual.

Publications (last four years)

1. Galib, R. M., & **Rahman, M. M.** (2025). Rice and Rice Milling By-products as Alternative Protein Sources: Insights into Subunit Profiles, Molecular Structures, Functional and Nutritional Properties, and Cheesemaking Performance. *Future Foods*.
2. Modupalli, N., Galib, R. M., Sen, R., Lafontaine, S., & **Rahman, M. M.** (2024). Improving yield, functional properties, and aroma profile of rice bran protein through innovative extraction and precipitation methods. *Journal of Cereal Science*, 120, 104033.
3. Kabir, M. S., Wazed, M. A., **Rahman, M. M.**, Akter, M. S., & Ahmed, M. (2024). Metabolomics of parboiled and non-parboiled rice on metabolites, antioxidant capacity, and minerals content in raw rice, cooked rice, and rice gruel. *Journal of Food Measurement and Characterization*, 18(8), 6551-6560.
4. Modupalli N, **Rahman M.** Impact of non-thermal plasma generated using air and nitrogen on functional properties of milk protein dispersions. *Journal of Food Process Engineering*. 2024 July 02; 47(7). DOI: 10.1111/jfpe.14680
5. Islam, M. N., Modupalli, N., & **Rahman, M. M.** (2025). Fabrication of Antibacterial and Functional Films from Starch-Polyvinylpyrrolidone Composite Using Plasma Treatment and Silver Nanoparticles. *ACS omega*.
6. Modupalli, N., & **Rahman, M. M.** (2025). Enhancing the Digestibility and Functional Properties of Food Proteins Using Non-Thermal Plasma. *Sustainable Food Proteins*, 3(2), e70008.
7. **Rahman, M.M.**, and Lamsal, B. 2023. Effects of atmospheric cold plasma and high-power sonication on rheological and gelling properties of mung bean protein dispersions. *Food Research International*, 63:112265.
8. **Rahman, M.M.**, Hojilla-Evangelista, P., and Lamsal, B. 2023. Impact of high-power sonication on yield, molecular structure, and functional properties of soy protein isolate. *Innovative Food Science & Emerging Technologies*, 79: 103034.
9. **Rahman, M. M.**, Byanju, B., & Lamsal, B. P. (2024). Protein, lipid, and chitin fractions from insects: Method of extraction, functional properties, and potential applications. *Critical Reviews in Food Science and Nutrition*, 64 (18), 6415-6431.
10. **Book chapter**
 - Modupalli, N., Lamsal, B., and **Rahman, M.M.**, 2024. Protein functionalization by physical modification in J. Wanasundara, J., P. Ismail and B. Lamsal (Eds) *Functionality of Plant Proteins: Properties, Assessment, Modification, and Applications*. Elsevier.

CURRENT & PENDING SUPPORT

Name: Mahfuzur Rahman

Instructions:

Who completes this template: Each project director/principal investigator (PD/PI) and other senior personnel specified in the Request for Applications (RFA). For Agriculture and Food Research Initiative (AFRI) applications, completion of this is only required for PDs/PIs and CoPDs/CoPIs.

How this template is completed:

- Record information for active and pending projects, including this proposal.
- All current efforts to which PD/PI(s) and other senior personnel have committed a portion of their time must be listed, whether or not salary for the person involved is included in the budgets of the various projects. For AFRI applications, list only projects for which salary is requested.
- Provide analogous information for all proposed work which is being considered by, or which will be submitted in the near future to, other possible sponsors, including other USDA programs.
- For concurrent projects, the percent of time committed must not exceed 100%.

Note: Concurrent submission of a proposal to other organizations will not prejudice its review by NIFA.

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PEN DING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITT ED	TITLE OF PROJECT
	<u>Active:</u>				
M. Rahman, G. Atungulu,	Rice Capital Inc.	\$15,000	05/01/2025- 12/31/2025	1%	Develop a method to extract rice bran protein
M. Rahman	Arkansas Wheat Promotion Board	\$ 17,601	07/01/2025- 06/31/2028	1%	Diversifying Arkansas Wheat Applications: Chemical- and Water-Free Electrostatic Fractionation for High-Functionality Wheat Protein
M. Rahman	Arkansas Corn Board	\$ 45,150	08/1/2025- 07/31/2026	1%	Innovative Application of Arkansas Corn: Replacement of Forever Chemicals in Food Packaging with Corn Gluten Meal
M. Rahman C. Vieira	Arkansas Soybean Promotion Board	\$50,046	08/1/2024- 07/31/2025	1%	Screening Arkansas Soybean Cultivars for Protein Quality as a Novel Food Preservative

Current and Pending Support

M. Rahman, S. Lafontaine, G. M. Ganjyal	USDA NIFA AFRI	\$299,736	08/1/2024-07/31/2026	12.5%	Ultrasound and Fermentation Assisted fractionation: A Novel Method to Isolate High-quality and Functional Plant Proteins.
M. Rahman., Acuff, J.C. and K. Walters	Arkansas Bioscience Institute	\$49,964	10/1/2024-9/31/2025	1%	Development of anti-microbial films from agricultural byproducts for medical applications
R. Kariyat and M. Rahman	Arkansas Bioscience Institute	\$49,800	10/1/2024-9/31/2025	1%	Exploring the potential of cold plasma for pesticide degradation in rice grains
	<u>Pending:</u>				
M. Rahman	USDA NIFA AFRI	300,000	08/1/2026-07/31/2029	2%	This Proposal: Low-glycemic index (GI) rice from Arkansas: Screening cultivars and optimizing processing parameters to reduce GI
M. Rahman	USDA NIFA AFRI	300,000	08/1/2026-07/31/2029	2%	Develop a Prototype of All-Pecan-based Intelligent Films: Turning Pecan Waste into High-value Food Packaging Solutions
M. Rahman	The Andersons Research Grant Program	\$ 50,000	01/01/2026-12/31/2027	2%	Plant-Based Egg Analog from Rice Bran: Valorization of Rice Milling By-Products into Functional Egg Replacers
M. Rahman	NSF CAREER	\$ 429,689	06/01/2026-05/31/2030	5%	Data-Driven Protein Modification Using Cold Plasma for Tailored Film Fabrication

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CV: Griffiths G. Atungulu, University of Arkansas Division of Agriculture
Director University of Arkansas Rice Processing Program
Rice/Grain Processing & Post-Harvest System Engineering Program
Food Science Department, 2620 N Young Avenue, Fayetteville Arkansas, 72704
Tel.: +14795756843; Email: atungulu@uark.edu

Education

Ph.D.: Iwate University Japan (Agricultural Engineering – 2004)

M.S.: Iwate University Japan (Agricultural Engineering – 2001)

B.S.: Jomo Kenyatta University of Agriculture & Technology, Kenya (Agri. Engineering – 1996)

Employment and Professional History

- **2020-Present:** Director, University of Arkansas Rice Processing Program
- **2025-Present:** Professor, University of Arkansas Division of Agriculture
- **2019- 2025:** Associate Professor, University of Arkansas Division of Agriculture
- **2013-2019:** Assistant Professor, University of Arkansas Division of Agriculture
- **2012-2013:** Associate Project Engineer, University of California Davis, CA
- **2008-2011:** Post-doctoral Researcher, University of California Davis, CA
- **2006-2008:** Research Scientist/Engineer (JSPS), Kyushu University Japan
- **2004-2005:** Research Scientist, Iwate University Japan
- **1998-2010:** Lecture, Jomo Kenyatta University, Kenya

Awards, Honors, and Professional Memberships (since 2015)

- Anderson's Cereal and Oilseed Award of Excellence, 2024
- Board of Trustees Member, American Society of Agricultural & Biological Engineers (ASABE)
- Chair of the Publication Council of the ASABE
- Associate Editor American Society of Biological Engineers
- Associate Editor, Cereal Chemistry Journal of the Cereal & Grains Associations
- Chair/Vice Chair/Secretary, U.S. Quality Grain Consortium, NC 213
- Chair/Treasurer, American Society of Agric. & Biological Engineers- Arkansas Chapter
- Panel Manager, USDA NIFA SBIR (2023& 2024)
- Member of the American Association of Cereal Chemists International (AACCI)
- Member of the Institute of Food Technologists (IFT)
- Organizing Committee Member: International Conference on Food Security and Sustainability

Research areas

The Director of The University of Arkansas Rice Processing Program. Has worked on various aspects of biological and agricultural engineering, especially as related to food processing and post-harvest systems engineering. At present, directs a research, teaching and outreach program that is focused on engineering and optimization of classical and innovative processing technologies to secure grain processing-efficiency, automated quality monitoring and processing control, improved quality and shelf-life, and mitigation of mycotoxin formation. Rice research spans the

areas of drying, chilling, aeration, milling, storage and value-added processing. Research conducted utilizes lab-and field-based experiments, computerized mathematical modeling, and simulations tools to generate results and conclusions that advance science and positively impact the food, feed and pet-food industries.

Selected Refereed Journal Publications in the Past 4 Years: [* indicates corresponding author; underline indicates student advisee]

1. Okeyo, A., Luthra, K., Siebenmorgen, J., Vazquez, A. R., **Atungulu, G.** * (2024). Impact of degree of milling on cooking duration and textural attributes of long-grain hybrid rice for instant rice processing. *Cereal Chemistry*. doi.org/10.1002/cche.10788 (in press)
2. Olaoni, S., Luthra, K., **Atungulu, G.*** (2024). Impact of Kernel Thickness on Germination and Vigor of Seed Rice. *Applied Engineering in Agriculture*. 40(1): 135-141. (doi: 10.13031/aea.15757) @2024
3. Luthra, K., Oduola, A., Vazquez, A. R., **Atungulu, G.*** (2024). Impacts of Rice Drying Techniques on Inter-Kernel Moisture Variability and Quality. *Journal of the ASABE*. (doi: 10.13031/ja.15803) @2024. (in press)
4. Owusu, E., Luthra, K., **Atungulu, G.*** (2024). Material state diagrams for informed decision-making during drying of contemporary rice cultivars. *Drying Technology*, 42(5), 917-925. doi.org/10.1080/07373937.2024.2322110
5. Ouma, F., Luthra, K., Oduola, A., **Atungulu, G.*** (2024). Investigating safe storage conditions to mitigate aflatoxin contamination in rice. *Food Control*, 163, 110529. doi.org/10.1016/j.foodcont.2024.110529
6. Olaoni, S., Luthra, K., Bautista, R. C., **Atungulu, G.*** (2024). Impact of Fissure Location on the Germination and Vigor of Seed Rice. *Journal of the ASABE*. 67(3): 533-541. (doi: 10.13031/ja.15758) @2024
7. Owusu, E., Scott, S., Luthra, K., Graham-Acquah, S., January, R., Annor, G. A., **Atungulu, G.*** (2024). Rice gelatinization temperature prediction using the rapid visco analyzer vis-à-vis the traditional DSC method. *Cereal Chemistry*, 101(3), 622-629. <https://doi.org/10.1002/cche.10764>
8. Oduola AA, Bruce RM, Shafiekhani S, **Atungulu GG***. 2023. Impacts of industrial microwave and infrared drying approaches on hemp (*Cannabis sativa* L.) quality and chemical components. *Food and Bioproducts Processing*. 137, 20-27, <https://doi.org/10.1016/j.fbp.2022.10.010>
9. Okeyo A, Luthra K, **Atungulu GG***. 2023. Impact of degree of milling on cooking duration and textural attributes of long-grain hybrid rice for instant rice processing. *Cereal Chemistry*, 100(4), 830-840
10. Ding C*, Chang L, Luo Y, Tao T, **Atungulu GG**, Ding H, Huang L, Simelane MBC, Zhao S, Liu Q. 2023. Influence of cooking and texture attributes of far infrared radiated Japonica rice during storage. *Journal of Cereal Science*, 112, 103710.
11. Panigrahi S, Luthra K, Singh C*, **Atungulu G**, Corscadden K. 2023. On-farm grain drying system sustainability: current energy and carbon footprint assessment with potential reform measures. *Sustainable Energy Technologies and Assessments*, 60, <https://doi.org/10.1016/j.seta.2023.103430>
12. Guimaraes, B. P., Schrickel, F., Rettberg, N., Pinson, S. R., McClung, A. M., Luthra, K., **Atungulu, G.**... & Lafontaine, S.* (2024). Investigating the Malting Suitability and Brewing Quality of Different Rice Cultivars. *Beverages*, 10(1), 16. doi.org/10.3390/beverages10010016

CURRENT & PENDING SUPPORT

Name: Griffiths G. Atungulu

Instructions:

Who completes this template: All individuals contributing to this research.

How this template is completed:

- Record information for active and pending projects, including this proposal.
- All current efforts to which individuals contributing to the research have committed a portion of their time must be listed, whether or not salary for the person involved is included in the budgets of the various projects.
- Provide analogous information for all proposed work which is being considered by, or which will be submitted in the near future to, other possible sponsors, including other programs.
- For concurrent projects, the percent of time committed must not exceed 100%.

NAME (bold signifies PI)	SUPPORTING AGENCY/ SPONSOR AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
<u>CURRENT:</u>					
Griffiths Atungulu	Arkansas Rice Research and Promotion Board	\$81,686	4/1/25 – 3/31/26	10%	Impact of specific agronomic and post-harvest practices on rice quality and milling yields
Griffiths Atungulu, Yulin Jia, etc	Arkansas Rice Research and Promotion Board	\$102,020	4/1/25 – 3/31/26	10%	Determining the role of fissure resistance and chalkiness in governing head rice yield
Griffiths Atungulu	NC-213 The U.S. Quality Grains Research Consortium, The Ande	\$50,000	1/1/24-12/31/25	5%	Innovative Technology Solutions for Ensuring Safety in Packaged Pre-Cooked Rice

Current and Pending Support

Nilda Burgos & Griffiths Atungulu	U.S. Department of Agriculture	\$300,000	7/1/24-6/30/26	5%	Integrated Weed Management: Developing New Tools to Complement the Old
Griffiths Atungulu	Industry (LFF)	\$93,000	2024-2026	2%	Engineering Process to Eliminate Rice Cake Cracking Post-processing.
Griffiths Atungulu	Arkansas Dryer & Warehouseman Assn, Inc.	\$2,500	4/1/25-3/31/26	2%	Rice Processing Education Program
Griffiths Atungulu	Supreme Rice Mill, Incorporated	\$15,000	4/1/25-3/31/26	2%	Rice parboiling process optimization
Griffiths Atungulu	RiceTec	\$15,000	4/1/25-3/31/26	2%	Seed rice drying optimization
Griffiths Atungulu	Kellogg's	\$15,000	4/1/25-3/31/26	2%	Rice processing
Griffiths Atungulu	Riceland Foods, Inc.	\$15,000	4/1/25-3/31/26	2%	Rice drying and milling process efficiency improvement
Griffiths Atungulu	Anheuser Busch (AB)	\$15,000	4/1/25-3/31/26	2%	Cultivar analysis
Griffiths Atungulu	Producers Rice Mill, Inc.	\$10,000	4/1/25-3/31/26	2%	Rice drying and milling optimization
Griffiths Atungulu	Riviana Foods Inc.	\$15,000	4/1/25-3/31/26	2%	Instant rice processing method development
Mahfuzur Rahman, Griffiths Atungulu	Rice Capital	\$15,000	4/1/25-3/31/26	2%	Rice bran & insect protein research
Griffiths Atungulu & Mahfuzur Rahman	Arkansas Economic Development Council	\$7,500	4/1/23-3/31/26	2%	Dehydrated milk processing with innovative heating technology
Klein Iteleji, R. P. Kingsly Ambrose, Gretchen A. Mosher, Dirk E. Maier, Griffiths G. Atungulu, Sam G. McNeill	USDA-HEC 2022	\$750,000	1/8/23 -7/31/26	10%	Training the Next Generation of Leaders for a Transforming Grain Industry
Gibson KE, Acuff JC, Baum JI, Rucker, KJ, [collaborating mentor: Griffiths G. Atungulu]	USDA AFRI (A7401)	\$730,000	10/1/2021 – 9/30/2025	2%	F ² OCUS (Future of Food: Opportunities and Careers for Undergraduate Students) Fellowship Program

Current and Pending Support

Griffiths Atungulu	Women's Giving Circle	\$17,309	1/1/2025-12/31/2025	2%	Breast Milk Dehydration Project
Griffiths Atungulu	Industry, Mars Foods	\$400,000	4/1/25-3/30/27	2%	UARRP Initiative to help improve Mars-Specific Cultivars' performance
<u>PENDING:</u>					
Sungil Ferreira, Griffiths Atungulu, etc	FFAR	\$449,989.14	1/1/26-12/31/29	2%	Value-added Upcycling of Rice Agricultural Byproducts: Enhancing Sustainable Food Systems Through Mycoproteins
Alvaro Durand, Griffiths Atungulu, etc	USDA-NIFA	\$154,780	7/1/26-6/30/28	2%	The Impact of Quality on the Competitiveness of U.S. Long-Grain Rice
Mahfuzur Rahman, Griffiths Atungulu, etc	USDA NIFA	\$300,000	7/1/26-6/30/29	2%	This Proposal: Low-glycemic index (GI) rice from Arkansas: Screening cultivars and optimizing processing parameters to reduce GI



Kevin McGilton
President & CEO

September 25, 2025

To Whom It May Concern,

Riceland Foods, Inc., is a farmer-owned cooperative founded in 1921 and is the largest marketer and miller of rice in the United States. Riceland is active supplying customers in all segments of the U.S. rice market.

The U.S. domestic market is critical demand for U.S. rice farmers and millers. Export markets can be very unreliable due to many factors that are typically out of the industry's control. The domestic market has traditionally been a reliable and stable market for the industry.

Unfortunately, over the last 15 years there has been a major influx of foreign rice into the United States. And in the last 10 years to quantity of imported rice has doubled to 1.4 million metric tons which equals 30% of U.S. domestic rice consumption. Aromatic Jasmine rice from Thailand and Basmati rice from India are the greatest contributors to the rapid increase.

These large quantities of foreign rice coming into the U.S. have driven down demand for U.S. rice which in turn has driven down prices to levels that are not sustainable for the industry.

Riceland supports Dr. Lanier Nalley's efforts to identify and quantify the contributing factors associated with the rapid increases of imported rice into the United States and determining action items the U.S. industry should take to compete in the domestic market.

Sincerely,

A handwritten signature in black ink, appearing to read "K. McGilton".

Kevin McGilton
President & CEO



Keith Glover
President & CEO

September 29, 2025

USDA NIFA Review Committee
National Institute of Food and Agriculture
U.S. Department of Agriculture

On behalf of Producers Rice Mill, Inc., I am writing to express our enthusiastic support for a funding grant for the proposal titled "**Import Substitution and Competitiveness in the U.S. Rice Market**" led by Dr. Lawton Lanier Nalley and Dr. Alvaro Durand from the University of Arkansas System.

The United States (U.S.) domestic rice industry produces approximately 3 million acres of rice each year. Over half of the U.S. grown rice is sold and consumed in the U.S., while about 45% of the total U.S. rice production is exported to other countries.

In 2025, the U.S. is projected to import approximately 1.5 million metric tons of foreign grown milled rice. Imported rice into the U.S. has doubled over the past 10 years. Roughly eighty percent (80%) of these imports are aromatic rice, of which jasmine makes up the vast majority. The U.S. grows a domestically grown jasmine rice. Unfortunately, the U.S. grown jasmine doesn't seem to be substituted for the foreign grown jasmine.

We believe a study is desperately needed to determine why U.S. grown aromatic is not being accepted and where it may be lacking to foreign grown aromatic rice.

The research objectives outlined in this proposal are both timely and essential to the advancement of the U.S. rice industry. Specifically, the project aims to:

1. Identify U.S.-grown rice varieties with the potential to compete more effectively against imported aromatic rice through collaboration with researchers and industry leaders.
2. Assess the socioeconomic and rice-consumption characteristics of U.S. rice consumers through a nationally representative consumer survey.
3. Estimate both the economic value (willingness to pay) and market shares for imported aromatic rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, and U.S.-grown jasmine-type rice, using experimental auctions.
4. Analyze the impact of labeling on consumers' willingness to purchase U.S. long-grain rice versus imported aromatic rice.
5. Disseminate project findings to U.S. rice stakeholders—including researchers, millers, and traders—through active participation in industry and professional conferences, rice field days, and other outreach events, as well as by producing accessible printed and digital resources tailored for diverse media platforms.

Producers Rice Mill, Inc. supports initiatives that advance innovation, productivity and sustainability in the rice industry. We are confident that this project will yield practical strategies and insights, helping U.S. rice compete more effectively in domestic and global markets. We fully endorse this project and respectfully urge USDA to give this proposal full consideration for funding.

Sincerely,

Keith Glover
President & CEO
kglover@producersrice.com

P.O. Box 1248 Stuttgart, Arkansas 72160 USA (870) 673-4444 E-mail: kglover@producersrice.com



September 24, 2025

Alvaro Durand-Morat
Associate Professor and L.C. Carter Endowed Chair
Dept. of Agricultural Economics and Agribusiness
AGRI 213, University of Arkansas
Fayetteville, AR, 72701

Dear Dr. Durand-Morat:

On behalf of the US Rice Producers Association, I am writing in support of your research proposal, "Import Substitution and Competitiveness in the U.S. Rice Market," submitted to the AFRI Commodity Board Co-funding Topics.

Representing rice producers in Arkansas, California, Louisiana, Mississippi, Missouri, and Texas, US Rice Producers Association (USRPA) is the only national rice producers' organization comprised by producers, elected by producers, and representing producers in all six rice-producing states. As such, USRPA knows well both the challenges and opportunities facing our industry. Rice is an important commodity and is the economic backbone of many rural communities in the south-central United States.

With rice imports to the U.S. at an all-time high, it is crucial that we find ways to make U.S. rice more competitive domestically. Identifying and promoting a U.S.-grown long-grain rice with comparable appearance and cooking characteristics to imported aromatic varieties could strengthen domestic competitiveness and help reclaim market share.

USRPA strongly supports your research team's proposal, which is critical to U.S. rice's marketability and competitiveness. Please do not hesitate to contact me if you have questions regarding our support.

Sincerely,

A handwritten signature in black ink that reads "Mollie Buckler". The signature is written in a cursive, flowing style.

Mollie Buckler
President & CEO
US Rice Producers Association

25722 Kingsland Dr., Ste. 102, Katy, Texas 77494 • Phone: 713-974-7423 • usriceproducers.com

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September 24, 2025

Re: AFRI Commodity Board Co-funding Topics

To Whom it May Concern,

USA Rice is the global advocate for U.S. rice farmers, millers, merchants, and allied businesses. We strive toward effective policy and program development to support the growth and profitability of the entire U.S. rice industry, part of which requires strategic investment in research and development opportunities that help the industry address challenges.

A key to the U.S. rice sector's success over the last century has been the ability to competitively export a substantial portion of the crop, but to also maintain a significant domestic market share.

Unfortunately, over the last two decades, a substantial shift has occurred as American consumers have increased imports of fragrant rice varieties to the detriment of U.S. fragrant rice and traditional long grain rice. Quality is evaluated differently according to the specific preferences of each individual market segment, which means that there's not a silver bullet in terms of one variety that could address all of our needs. Some consumers draw lines in the sand for chalk, others for grain length, cooking time, stickiness, aroma, milling yields, etc.

USA Rice believes that it is going to be imperative to the future of our industry if we're going to retain the U.S. domestic market that we evaluate market characteristics and help better inform the U.S. rice growing, milling, and merchandising industries which varieties of domestic rice could potentially be used in lieu of imported specialty varieties. The University of Arkansas proposal "**Import Substitution and Competitiveness in the U.S. Rice Market**" is the perfect project to address these concerns and would have a lasting, significant economic impact on the entire Gulf and Mid-South rice growing regions.

USA Rice supports the important work Dr. Durand-Morat is doing to strategically advance production capabilities for the U.S. rice industry and we encourage you to fund "Import Substitution and Competitiveness in the U.S. Rice Market" to help maintain the long-term economic viability of the U.S. rice industry. We are looking forward to continuing to support this project in an advisory capacity.

Sincerely,

Peter Bachmann
President & CEO

Arkansas Rice Research and Promotion Board
1 Natural Resources Drive
Little Rock, AR 72205

November 21, 2025

Subject: Request for Support for NIFA Proposal – Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice

Dear Members of the Arkansas Rice Research and Promotion Board,

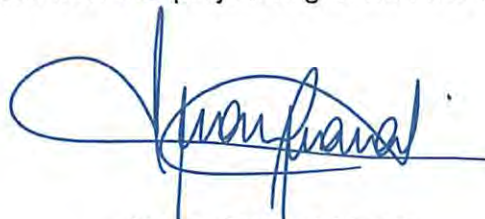
We are writing to request your **support for co-funding** our research proposal submitted to the USDA National Institute of Food and Agriculture (NIFA) under the Commodity Board Co-Funding topic, *“Determine consumer preferences for southern rice quality characteristics.”*

Our research project, titled **“Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice,”** aims to strengthen the competitiveness of U.S. long-grain rice by identifying opportunities to replace imported rice with domestically produced varieties, expanding domestic market channels, and enhancing consumer awareness of U.S.-grown rice. Through this work, we hope to generate actionable insights that benefit rice producers, processors, and marketers—particularly those in Arkansas, the nation’s leading rice-producing state.

We believe the Board’s support would underscore the importance of this effort to the Arkansas rice industry and help ensure the research’s impact across the value chain.

Thank you for considering our request. We would welcome the opportunity to provide additional details or discuss how this project aligns with the Board’s priorities.

Sincerely,



Alvaro Durand-Morat
Associate Professor and LC Carter Endowed Chair for Rice and Soybeans
Department of Agricultural Economics and Agribusiness
University of Arkansas
213 AGRI, Fayetteville, AR. 72701
adurand@uark.edu
479-575-2377

PROJECT SUMMARY

Instructions:

The summary is limited to 250 words. The names and affiliated organizations of all Project Directors/Principal Investigators (PD/PI) should be listed in addition to the title of the project. The summary should be a self-contained, specific description of the activity to be undertaken and should focus on: overall project goal(s) and supporting objectives; plans to accomplish project goal(s); and relevance of the project to the goals of the program. The importance of a concise, informative Project Summary cannot be overemphasized.

Title: Addressing Import Substitution Through Domestic Market Expansion For U.S. Long-Grain Rice

PD: Durand-Morat, Alvaro

Institution: University Of Arkansas

CO-PD: MCFadden, Brandon

Institution: Unviersity Of Arkansas

CO-PD: Nalley, Lawton Lanier

Institution: University Of Arkansas

CO-PD: PD/PI 4 Name (Last, First, MI)

Institution:

CO-PD: PD/PI 5 Name (Last, First, MI)

Institution:

CO-PD: PD/PI 6 Name (Last, First, MI)

Institution:

CO-PD: PD/PI 7 Name (Last, First, MI)

Institution:

The U.S. long-grain rice sector faces growing competition from rising imports of high-quality aromatic rice, particularly Thai jasmine, which threatens its position in the domestic market. Because the domestic market is the largest and most critical outlet for U.S. rice, enhancing competitiveness at home is essential. A central challenge lies in grain quality: while U.S. jasmine-type varieties exist, they lack the marketing standards, certification systems, and strong brand recognition that have made Thai Hom Mali rice successful. Further, the widespread practice of commingling long-grain varieties at mills reduces quality consistency and weakens consumer confidence.

To address these challenges, this project will examine whether identity-preserved U.S. long-grain and jasmine-type rice can serve as closer substitutes for imports. Specifically, it will (1) identify domestic varieties with strong competitive potential, (2) assess consumer preferences and openness to quality labeling, (3) estimate the economic value and market shares of domestic versus imported rice, and (4) share findings with stakeholders through outreach and industry engagement.

With annual contributions exceeding \$34 billion to the U.S. economy and support for more than 125,000 jobs, rice is a cornerstone of rural economies, particularly in states like Arkansas and Louisiana. Therefore, strengthening the competitiveness of U.S. long-grain and jasmine-type rice is an economic priority vital to sustaining communities across the southern United States.

This proposal addresses the following priority scope listed for program area priority 7f. AFRI Commodity Board Co-funding Topics, in the RFA 2025: Determine consumer preferences for southern rice quality characteristics

This file MUST be converted to PDF prior to attachment in the electronic application package.

Executive Summary Project Title: Addressing Import Substitution through Domestic Market Expansion for U.S. Long-Grain Rice

Project Type: Research project

Grant Type: Standard

Program Area Priority Scope Addressed: This proposal addresses the following priority scope listed for program area priority 7f. AFRI Commodity Board Co-funding Topics, in the RFA 2025:

- Program Area Priority 1: Determine consumer preferences for southern rice quality characteristics.

Distribution of Effort: 100 percent research.

Program Staff and Their Role

Program Director (PD): Alvaro Durand-Morat

Associate Professor and LC Carter Endowed Chair for Rice and Soybeans.

Department of Agricultural Economics and Agribusiness. University of Arkansas.

AGRI 217. University of Arkansas. Fayetteville, AR, 72701.

Co-PD: Brandon McFadden.

Professor and Tyson Endowed Chair in Food Policy Economics.

Department of Agricultural Economics and Agribusiness. University of Arkansas.

AGRI 217. University of Arkansas. Fayetteville, AR, 72701.

Co-PD: Lawton Lanier Nalley.

Professor and Department Head.

Department of Agricultural Economics and Agribusiness. University of Arkansas.

AGRI 217. University of Arkansas. Fayetteville, AR, 72701.

Critical Stakeholder Needs: The U.S. long-grain rice sector faces growing challenges from rising imports of high-quality aromatic rice, particularly jasmine, which directly competes with domestically produced long-grain rice. Although exports remain vital, the domestic market is the largest and most critical outlet for U.S. rice, making competitiveness at home essential for the industry's long-term viability.

Strengthening domestic performance requires a deeper understanding of how grain quality shapes consumer preferences. Given that the majority of the rice produced in the Southern U.S. is long-grain rice, the industry needs to find a way to make domestically produced long-grain rice more competitive against rising imports. Identity-preserved U.S. jasmine-type and other high-quality long-grain varieties could serve as closer substitutes for imports than the domestically commingled rice currently marketed. Promoting these varieties based on their quality traits offers a strategic opportunity to enhance competitiveness against imports and secure a stronger position for U.S. rice in its most important market.

Louisiana and Arkansas currently cultivate several jasmine-type rice varieties that have the potential to serve as viable substitutes for the growing demand for imported jasmine rice. However, the absence of an established marketing standard or certification system limits consumer recognition of the quality attributes of domestically produced jasmine-type rice. Unlike Thai Hom Mali rice, which benefits from well-defined quality certifications and strong brand recognition in global markets, U.S.-grown jasmine-type rice lacks comparable mechanisms to signal its sensory and quality characteristics to consumers. Compounding the quality issue of US rice in the domestic market is the common practice of comingling varieties at the mill, which can result in heterogeneous quality attributes. If a high-quality variety currently produced in the U.S. (either aromatic or non-aromatic) could be identified as being similar in quality attributes to imported rice, there is a potential to curb the current import substitution through its identity preservation and marketing.

Despite these challenges, rice remains economically important for the United States. The industry contributes more than \$34 billion annually to the U.S. economy and supports over 125,000 American jobs. In states like Arkansas and Louisiana, rice is not only a top-five agricultural sector but also a cornerstone of rural economies across the American South. Strengthening the competitiveness of U.S. long-grain rice is therefore more than a trade issue—it is essential to sustaining jobs, communities, and economic growth across the southern United States.

Outreach Plan: Through the project initiatives, we will engage multiple stakeholders. Our outreach plan includes participation in rice field days (e.g., Arkansas Rice Expo, LSU Rice Field Day) and industry forums such as the Rice Technical Working Group and the Rice Marketing and Technology Convention. We will also utilize print, digital, and social media to disseminate information and gather feedback from a wide range of stakeholders, including farmers, processors, rice breeders, and retailers.

Potential Economic and Social Benefits: The results of this project will equip U.S. long-grain rice supply chain stakeholders—breeders, millers, retailers, and traders—with the insights needed to make strategic decisions that enhance the sector's growth and help restore U.S. rice's

competitiveness. By aligning U.S.-grown varieties with domestic consumer preferences and directing research investments toward the quality traits most valued domestically, the industry can maintain and even strengthen domestic market share, capture new opportunities, and secure a more resilient future for U.S. rice.

Stakeholder Engagement: Several stakeholders from the U.S. rice industry, including the Arkansas Rice Research and Promotion Board, the U.S. Rice Federation, the U.S. Rice Producers Association, and Riceland Foods, have provided significant input to the proposal. The research team will invite the Arkansas Rice Research and Promotion Board to serve as the Advisory Board for this project, which will provide feedback and guidance to the research team to ensure the project's goals are met.

Introduction

Statement of the long-term goal

The U.S. long-grain rice sector is increasingly under pressure from growing import competition and declining export performance. While approximately half of U.S. long-grain rice is exported annually, the domestic market remains the single most important market for U.S. long-grain rice. Imported rice into the U.S. has surged, particularly of high-quality aromatic varieties (jasmine), which are widely regarded as close substitutes for domestically produced long-grain and aromatic rice. This rapid growth of imports is reshaping the domestic market and poses a direct threat to the long-term viability of the U.S. rice industry.

The long-term objective of this project is to strengthen the growth and competitiveness of the U.S. rice sector by deepening understanding of how grain quality influences domestic market performance. Specifically, the study will test the hypothesis that identity-preserved long-grain rice varieties—such as U.S. jasmine-type cultivars (e.g., Aroma 22) or other high-quality non-aromatic varieties with attributes comparable to Thai Hom Mali, the leading aromatic rice imported into the United States—are closer substitutes for imported aromatic rice than the commingled long-grain rice currently sold domestically. If supported, this hypothesis would imply that marketing identity-preserved U.S. long-grain rice with superior quality traits could enhance its competitiveness relative to imports and thereby improve the overall position of U.S. rice in the domestic market.

Our specific objectives are to:

1. Through quality analysis, identify the potential of specific U.S.-grown rice varieties to compete more effectively against imported aromatic rice among U.S. consumers through collaboration with agricultural researchers and rice industry leaders.
2. Evaluate the socioeconomic and rice consumption characteristics of U.S. consumers, particularly individuals who have recently incorporated imported aromatic rice into their diets, and assess willingness to accept alternative labeling schemes for high-quality U.S. long-grain and jasmine-type rice, as measured through a nationally representative consumer survey.
3. Estimate both the economic value (willingness to pay) and market shares for imported aromatic rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, and U.S. jasmine-type rice, and “certified U.S. jasmine-type” rice using experimental auctions.
4. Disseminate project findings to U.S. rice stakeholders—including researchers, agricultural scientists, millers, and traders—through active participation in industry and professional conferences, rice field days, and other outreach events, as well as by producing accessible printed and digital resources tailored for diverse media platforms.

To achieve our objectives, we propose to use a multi-method approach to elicit the economic value of different rice quality attributes and measure the market opportunities for high-quality U.S. long-grain rice (including jasmine-type rice) to better compete with imported aromatic rice. We will employ consumer surveys and experimental auction methodologies to investigate the rice consumption patterns of U.S. households, with particular attention to consumers who currently purchase imported aromatic rice. These approaches will further

enable us to estimate the relative competitiveness and market potential of high-quality U.S. long-grain rice within the domestic market.

Findings from these objectives will be integrated to deliver actionable insights, including:

- Assessing the U.S. market potential of identity-preserved high-quality U.S. long-grain and jasmine-type rice.
- Identify priority areas (such as specific quality traits) for domestic rice breeding programs aimed at developing varieties that can compete more effectively with imported aromatic rice; and
- Determine the characteristics of current and potential consumers to develop marketing strategies to enhance the competitiveness of U.S. rice within the domestic market, including exploring the impacts of the certification logo for U.S. jasmine-type rice.

Our project is innovative because it shifts the discussion of competitiveness from the historical metric of price to the emerging metric of quality. Currently, U.S. long-grain rice is more price-competitive than imported aromatic rice in the domestic market, so cost is not a driving factor behind increased imports. Instead, we propose that aromatic rice and long-grain rice function as close substitutes, with aroma being just one of several quality traits that influence consumer preferences and demand. This study will assess the extent to which aroma, alongside other intrinsic quality attributes, influences consumer purchasing behavior, both in terms of rice type selection and willingness to pay.

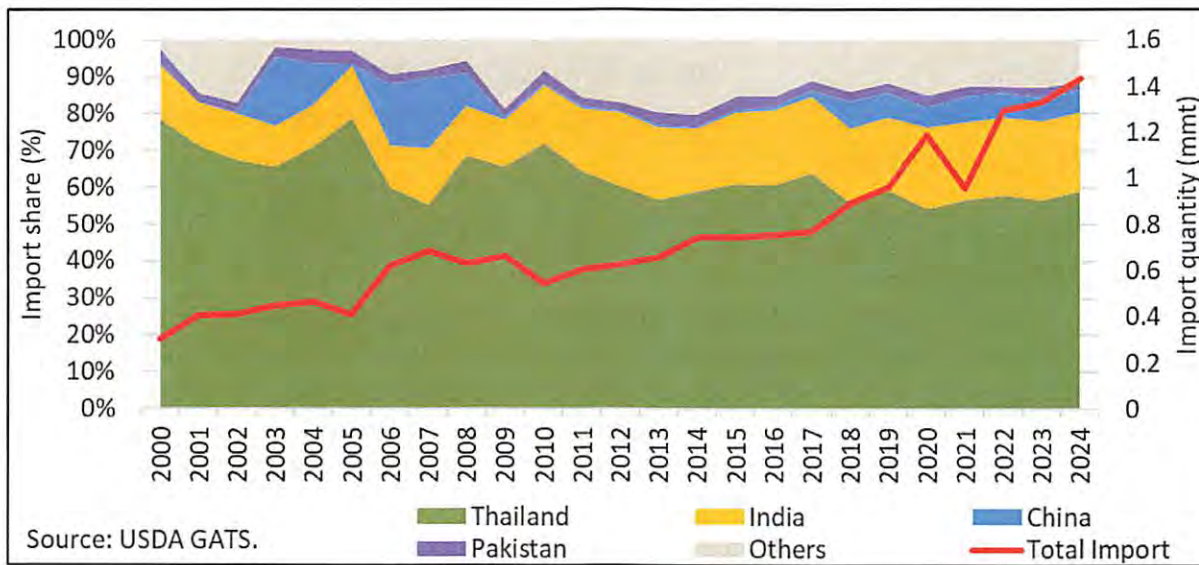
Our team brings unparalleled expertise and networks. The PI has experience analyzing the global rice market and conducting specific market assessments in the U.S and abroad. Dr. McFadden has a strong background in quantitative methods applied to marketing agricultural products and experience conducting consumer research nationally and internationally. Dr. Nalley has over 100 peer-reviewed publications, many of which focus on rice economics, and extensive experience conducting research overseas. Collectively, our team combines scientific expertise, economic insight, and trusted industry relationships to deliver actionable results for the U.S. rice sector.

Background information

While the United States consistently ranked among the world's top five rice exporters, rice imports grew rapidly from 300 TMT in 2000 to 1.43 MMT (milled basis) in 2024 (see Figure 1). To put these numbers in perspective, rice imports in 2024 amounted to roughly the combined production of Louisiana (899 TMT on a milled basis) and Missouri (564 TMT on a milled basis), or 44% of Arkansas' rice production.

The bulk of the rice imported is aromatic rice, primarily jasmine rice from Thailand, as well as basmati rice from India and Pakistan. Imports of non-aromatic long-grain and medium-grain rice have grown slightly in the last 20 years (primarily to serve the Puerto Rican market). Hence, for U.S. long-grain rice to compete with imports, the industry must identify and market U.S. varieties that share similar characteristics of the rice being imported.

Figure 1. Evolution of U.S. rice imports and import market share by source.



Aromatic rice can be classified into two general types: basmati and jasmine. Basmati rice is characterized by translucent, extra-long, and slender kernels, with a length-to-width ratio of between 3.5-4.5 or more, that elongate up to two times when cooked. Basmati rice is non-sticky when cooked due to its intermediate to high amylose content. Aside from the aroma differences, basmati rice is much more slender than the long-grain rice varieties grown in the U.S., including jasmine-type rice, which makes U.S. long-grain rice a less likely substitute for imported basmati rice.

Jasmine rice is the main type of rice imported into the U.S., most of which is a variety known as Thai Hom Mali (Thai official variety name: Khao Dawk Mali 105, or KDML105). Table 1 below shows the main quality characteristics of Thai Hom Mali rice. Jasmine's physical characteristics are closer to domestically produced long-grain rice, both in its raw and cooked form, than basmati rice. Moreover, many long-grain varieties used in the U.S. fall within the same ranges of physical (e.g., length, length-to-width ratio) and chemical or cooking (e.g., amylose content, gelatinization temperature) characteristics of jasmine rice. Thus, a high-quality long-grain rice variety that shares most of the quality attributes with jasmine rice should be a closer substitute compared to long-grain rice currently offered in the market, which is mostly a mix of many domestic varieties, including rice hybrids.

Table 1. Quality profile of Thai Hom Mali rice (Khao Dawk Mali 105, or KDML105)

Attribute	Value/Characteristics
Grain length	Approx. 7.5 mm
Length/Width ratio	Approx. 3.4:1 (slender long grain)
Appearance polished grain	translucent, pearly, glossy exterior
Amylose content	14-18% (low to intermediate)
Gelatinization temperature	6-7 alkali spreading value (medium)

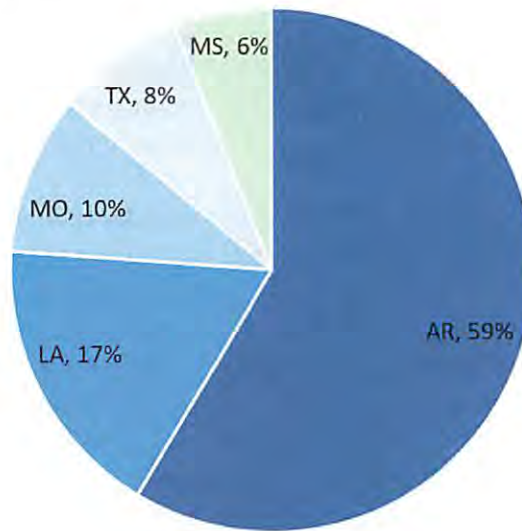
Texture	Soft, tender. Less firm than high amylose long-grain rice
Genetic purity	Approx. 92% required under Thai standards
Aroma	2-acetyl-1-pyrroline (2AP) of approx. 0.81 ppm

Source: Vanavichit et al., 2018.

Rationale and Significance

The U.S. is the largest rice producer outside of Asia, averaging 9.25 MMT in 2020-2024, of which 6.99 MMT (75.6%) was long-grain rice. Almost all long-grain rice is produced in the southern U.S. (see Figure 2), of which approximately half is consumed domestically, and the other half is exported, primarily across the Western hemisphere. The U.S. rice industry contributes more than \$34 billion to the U.S. economy annually, providing jobs for more than 125,000 people in the U.S. Rice is a top-five agricultural sector in Arkansas and Louisiana, and the driving economic force across many communities in the southern U.S.

Figure 2. Share of U.S. long-grain rice production by state, 2020-2024.



Source: USDA, 2024.

The heavy reliance of U.S. long-grain rice in the domestic market underscores the need to ensure its competitiveness by better understanding consumer demand, particularly when it comes to the factors driving consumers to choose imported aromatic rice over domestically produced long-grain rice.

Once regarded as the global benchmark for quality, U.S. long-grain rice has seen its reputation erode in many of its key export markets, potentially including the domestic market. Restoring consumer trust begins with a clear understanding of their quality preferences and the ability to deliver products that meet those expectations.

This project represents the first systematic effort to economically assess U.S. consumer

preferences for imported aromatic rice and U.S. long-grain rice, including domestically produced jasmine-type rice. The project entails evaluating the quality profiles of leading (in terms of currently produced acreage) U.S. long-grain rice varieties (including currently produced domestic jasmine-type varieties) to identify those that more closely resemble the characteristics of imported aromatic rice and estimate their market value and potential as a substitute for imported aromatic rice. Moreover, this project proposes to analyze the socioeconomic characteristics of U.S. rice consumers with special emphasis on those consuming imported aromatic rice to identify patterns that could be used for developing marketing campaigns aimed at better promoting high-quality U.S. long-grain rice. The project also proposes assessing the impact of different labelling options for the U.S. high-quality long grain rice developed as a close substitute for imported aromatic rice. Currently, there is no domestic certification or standard to label a product as jasmine-type rice, which may leave consumers confused, given the various names currently given to domestically produced jasmine-type rice. This study will explore whether a certification would increase market share for domestically produced jasmine-type rice. Consumer choices are influenced by several variables aside from the intrinsic quality of the rice. Packaging and labelling options will be developed by the research team in consultation with industry leaders and evaluated to ascertain consumers' attitudes and the market potential of alternative labelling.

The findings will provide valuable insights, informing both research (e.g., setting new breeding objectives, optimizing milling processes) and marketing strategies (e.g., identity preservation, pricing schemes, labeling options tied to varietal marketability). Together, these efforts aim to strengthen the competitiveness of U.S. long-grain rice and support sustainable growth across the sector.

Our project directly addresses FY 2025 7f: AFRI Commodity Board Co-funding Topics, Program Priority area 1: Determine consumer preferences for southern rice quality characteristics, by investigating how U.S. long-grain rice quality affects its competitiveness in the domestic market vis-à-vis imports. In doing so, the project aims to enhance the competitiveness of U.S. rice and expand its domestic market share.

Approach

Key Personnel and Roles

The research team consists of agricultural economists with expertise in rice economics (production, demand, trade) and consumer behavior. The research team's combined expertise will effectively address the project objectives:

Objective 1: To analyze the quality characteristics of the main long-grain rice varieties grown and consumed in the U.S., as well as the main imported jasmine varieties (e.g., Thai Hom Mali rice).

Dr. Durand-Morat will lead Objective 1 with the assistance of Dr. Nalley. Dr. Durand-Morat has vast experience in rice production and trade research. In these areas, he has published research on rice consumption patterns by demographics (Mulimbi et al., 2024), the assessment of consumer preferences for different aspects of rice quality, including fortification (Durand-Morat et al., 2024), physical quality attributes (Phillips et

al., 2024; Peterson-Wilhelm et al., 2023; Saha et al., 2021) and credence attributes (Okpiaifo et al., 2020), and the trade impact of rice technology such as different irrigation systems (Nalley et al., 2022), herbicide technology (Durand-Morat et al., 2018), and rice breeding (Shew et al., 2018).

Dr. Nalley has vast experience in rice economic research, in which he has published in areas such as the impacts of rice quality genetics on food security (Nalley and Durand-Morat, 2023), the impact of broken rice percentage on international rice trade (Richardson et al., 2022), quality determinants of rice purchasing (Peterson-Wilhelm et al. 2021), economic impacts of sustainable rice production (Shew et al., 2021; Shew et al., 2019), and the economic impact of enhanced rice breeding (Nalley et al., 2016; Nalley et al., 2017).

Objective 2: Estimate the potential of high-quality long-grain rice grown in the U.S., including jasmine-type rice such as Aroma 22, to compete with imported jasmine rice in the domestic rice market.

Dr. McFadden and Dr. Durand-Morat will lead Objective 2 with the assistance of Dr. Nalley. Dr. McFadden has vast experience in consumer preference research. In this area, he has published research using online choice experiments (McFadden et al., 2023; McFadden et al., 2021), lab experiments (Neuhofer et al., 2023; Neuhofer et al., 2020), field experiments (Langer et al., 2022; Pakseresht et al., 2017), sensory experiments (Flowers et al., 2019), and auctions (McFadden et al., 2022).

While all personnel are committed to assisting with all study objectives and research needs, Table 2 presents their specific roles and time contributions.

Table 2. Key personnel involved and their roles.

Key personnel	Affiliation	FTE	Roles and responsibilities
1. Alvaro Durand-Morat (Lead) Associate Professor and LC Carter Chair for Rice and Soybeans	University of Arkansas (UofA), Fayetteville	0.10 (Research: 80%, Extension: 20%)	- Develop and implement the strategy to conduct the proposed research. - Assist in the evaluation of rice varieties, developing and conducting surveys, stakeholder interviews, and outreach strategy.
2. Brandon R. McFadden (Co-PI) Professor and Tyson Chair in Food Policy Economics	UofA, Fayetteville	0.05 (Research: 90%, Extension: 10%)	- Lead the consumer preference assessment, using state-of-the-art preference valuation methods. Assist with outreach strategy.
3. Lawton Lanier Nalley (Co-PI) Professor and Department Head	UofA, Fayetteville	0.05 (Research: 90%, Extension: 10%)	- Assist in conducting consumer preference assessments, using state-of-the-art preference valuation methods. - Assist with outreach strategy.

Research Objectives and Methods

Table 3 lays out the key objectives and the activities proposed to achieve them.

Table 3. Competitiveness pathway of the U.S. long-grain rice sector

Key objectives	Activities
1. Identify U.S.-grown rice varieties with the potential to compete more effectively with imported aromatic rice.	1.1. Identify the quality profile of U.S. long-grain varieties through a literature review and interview with industry experts
	1.2. Cluster and principal component analysis to identify distinct varietal groups
	1.3. Conduct quality analysis of the prospective rice varieties to ascertain their quality and create a long-grain rice with the same quality attributes as Thai Hom Mali rice, except for aroma.
2. Assess the socioeconomic and rice-consumption characteristics of current and potential U.S. rice consumers, consumer preferences for rice attributes, and the impact of alternative labelling for high-quality U.S. long-grain and jasmine-type rice.	Conduct a nationally representative online survey including a hypothetical choice experiment. Estimate hypothetical willingness to pay (WTP) and market shares for rice attributes, estimate the effect of labelling, and define consumer segments based on preferences.
3. Estimate the economic value (willingness to pay) and market shares for imported aromatic rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, and U.S. grown jasmine-type rice.	Conduct experimental auctions using imported jasmine rice and U.S. grown long-grain varieties, including jasmine-type rice. Estimate non-hypothetical willingness to pay (WTP), labelling effects, and implied demand curves for each product to determine market sizes at varying prices.

The following section discusses the details of these specific objectives and outcomes.

Objective 1: *Identify U.S.-grown rice varieties with the potential to compete more effectively against imported aromatic rice.*

Sub-Objective 1.1: *Identify the quality profile of U.S. long-grain varieties through a literature review and interview with industry experts.*

Many long-grain rice varieties have been commercially released and produced in the U.S. in the last several decades. For example, the University of Arkansas’s rice breeding program has released 29 varieties since funding through the Rice Research and Promotion Board began in 1980, LSU has released more than 30 varieties since 2000, and Ricetec® has released more than 10 hybrid rice varieties since the release of the first hybrid rice in 2000. In such a large sample of varieties, there is likely variability in quality profiles, with some varieties potentially fitting the quality profile of jasmine Thai Hom Mali rice better than others.

This part of the research will survey and document the milling and cooking profiles of the long-grain rice varieties released and produced in the U.S. in the last 30 years. The main source of information includes published data from rice breeding programs and seed dealers,

including patent application information, and information from industry experts (e.g., rice breeders, producers, and millers). The primary output of this research activity will be a compendium of long-grain rice varieties, along with their respective quality profiles. The compendium would serve as a valuable resource for both researchers and the rice industry to ascertain the competitiveness potential of existing rice varieties, and the potential paths for breeding long-grain varieties with jasmine-like quality profiles.

We expect to generate extension material to highlight the varietal composition in the selected rice markets.

Sub-Objective 1.2: Cluster and principal component analysis to identify distinct varietal groups

The information collected in sub-objective 1.1 (the rice compendium) will be evaluated for the selected quality attributes using principal component analysis (PCA) and cluster analysis to determine the pattern of variation and relationships among varieties and their quality characteristics. PCA originated with the work of Pearson (1901) and Hotelling (1933) and is a statistical technique for data reduction. It helps reduce the number of variables in an analysis by describing a series of uncorrelated linear combinations of the variables that contain most of the variance. Within the context of this project, PCA will be used to understand the main sources of quality variation among the varieties selected. Cluster analysis attempts to determine natural groupings (or clusters) of observations (Kaufman and Rousseeuw, 1990). While there are various clustering methods, we propose using both partition and hierarchical clustering. Partition methods break the observations into distinct non-overlapping groups, whereas hierarchical clustering creates hierarchically related sets of clusters. The goal of clustering is to find distinctive groups of rice varieties for each quality attribute selected. This allows us to find varieties that have a similar quality for the attribute of interest, which will be an important aid for the U.S. rice industry to identify the market potential of existing U.S. long-grain rice varieties and/or future areas of research to develop rice varieties with the desired quality traits to better compete with imported Thai Hom Mali rice.

We will produce extension materials and scientific publications to present the quality assessment results of all collected rice varieties, including outcomes from the PCA and clustering analyses.

Sub-Objective 1.3: Conduct quality analysis of the prospective rice varieties.

The information generated from sub-objectives 1.1. and 1.2 will be used to identify a set of prospective varieties that more closely resemble the quality profile of Thai Hom Mali jasmine rice, the main rice imported into the U.S. Rice quality attributes can be classified in several diverse ways. For example, attributes can be classified as intrinsic (e.g., shape, chalkiness, aroma) or extrinsic (such as packaging, labeling, or brand). Rice quality attributes can also be classified as search, experience, and credence attributes. Search attributes allow for an evaluation before purchasing and include attributes such as shape, color, price, brand, and packaging. Experience attributes such as texture, stickiness, and aroma can be assessed only after trying the product. Lastly, consumers cannot assess credence attributes directly; instead, they rely on institutions to guarantee their presence, such as organic, regenerative, or fair-trade

labels (Cuevas et al., 2016).

This project will focus on the following search and experience attributes: size (length), shape (length-to-width ratio), color, percentage of broken rice, percentage of chalk rice, apparent amylose content (AC), gel consistency (GC), and gelatinization temperature (GT).

The length, length-to-width ratio, color, percentage of broken rice, and percentage of chalk rice will be determined using a Vibe QM3 Rice Analyzer. The broken percentage represents the amount of broken rice in the sample by weight and is measured as:

$$Broken_i = \frac{WB_i}{\text{weight of working sample } i} * 100$$

where WB_i is the weight of broken rice in sample i (Saha et al., 2021). USDA (2020) defines kernels' chalkiness as whole or broken kernels of rice that are one-half or chalkier relative to the weight of the sample. Therefore, the chalk percentage is measured as:

$$Chalk_i = \frac{WC_i}{\text{weight of working sample } i} * 100$$

where WC_i is the weight of chalk rice in sample i (Saha et al., 2021). The length and width of the rice are measured in millimeters. The length of the kernel in sample i is the average length across the whole sample n . Similarly, the width of the kernel in sample i is the average width across the entire sample n .

$$AvgLength_i = \sum_{j=1}^n \frac{length_{ji}}{n}$$

$$AvgWidth_i = \sum_{j=1}^n \frac{width_{ji}}{n}$$

Color is measured in the CIELAB color space. CIELAB comprises three channels: L^* represents the lightness value of the color; a^* represents green or red respectively; and b^* measures blue as negative and yellow as positive value. *Color* is estimated as:

$$Color_i = \sqrt{L_i^2 + a_i^2 + b_i^2}$$

The higher the value of color, the whiter the rice sample.

Amylose, one of the two starch polymers found in rice, is widely regarded as a key determinant of rice texture (Morrison and Azudin, 1987; Cuevas et al., 2016). Its content is typically measured using iodine colorimetry as described by Juliano (1971). Based on amylose levels, rice is commonly classified into five categories: waxy (0–2%), very low (3–9%), low (10–19%), intermediate (20–25%), and high (>25%) (Kumar and Khush, 1987). Another important trait is the gelatinization temperature (GT), traditionally defined as the point at which most starch granules lose their birefringence—the optical property related to light refraction and polarization (Bhattacharya, 1979). GT is usually determined through differential scanning calorimetry (DSC), which tracks changes in thermal properties to identify the temperature range where starch granules irreversibly melt in the presence of water, acting as a plasticizer. Rice with higher GT requires more water and longer cooking times compared to lower GT

varieties (Juliano, 1971). GT values generally range from low (<70°C) to high (>74°C) (Bhattacharya, 1979).

Objective 2: Assess the socioeconomic and rice-consumption characteristics of U.S. rice consumers, including willingness to accept alternative labelling for high-quality U.S. long-grain and jasmine-type rice.

An online survey of U.S. consumers will be conducted to gather information about rice consumption habits, including perceptions about rice quality, socioeconomic and demographic characteristics, and consumers' willingness to accept alternative labelling options for high-quality U.S. long-grain rice, such as "certified U.S. jasmine-type rice". The survey will be designed in Qualtrics® and administered via Prolific to collect responses from a representative sample of U.S. consumers (i.e., gender, race, income, and education levels from the U.S. Census Bureau (2023)). The target sample size is 2,000 respondents, which provides a margin of error of about ± 2.5%.

A choice experiment (CE) will be used to assess consumer preferences for selected rice labelling alternatives. CEs follow the Random Utility Theory (McFadden, 1973), which states that, given a set of alternatives, individuals choose the alternative that generates the highest level of utility. The conceptual foundation for choice experiments is found in hedonic methods, where demand for goods arises from the demand for attributes (Holmes et al., 2017). Choice experiments have been widely employed in several fields, such as transportation, market research, health, and environmental economics. Utility for participant i can be represented by $U_i = V_i + \varepsilon_i$; where V_i is the observable portion of utility derived from a choice option, and ε_i is the unobserved portion of utility. For example, the observable utility for choice option j can be represented by:

$$V_{ij} = \alpha + \beta_1 Att_j + \gamma_1 Price_j,$$

where Att_j denotes some attribute associated with choice option j , $Price_j$ is the price associated with choice option j , and α , β_1 , and γ_1 are coefficients to be estimated. Assuming the error term ε_i is distributed iid extreme value, a logit model can be estimated and the probability of individual i choosing option j is:

$$\text{Prob(option } j \text{ is chosen)} = \frac{e^{V_{ij}}}{\sum_{k=1}^J e^{V_{ik}}}.$$

Thus, relative choice probabilities are explained by differences in utility. This framework allows us to determine the attributes and attribute levels associated with consumer preferences for rice (i.e., size, shape, color, percentage of broken rice, percentage of chalk rice, apparent amylose content, gel consistency, and gelatinization temperature). All experiments will be created following a D_b-efficient design to extract a D-error representing the efficiency with which the experimental design extracts information from the respondent (Szinay et al., 2021). All econometric modeling (e.g., estimation of multinomial and random parameter logit models) will be conducted in Stata®. Further, this framework allows us to determine the effects of labelling on WTP and market shares, as well as defining consumer segments using latent class analysis.

Objective 3: Estimate the economic value (willingness to pay) and market shares for imported Thai Hom Mali rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, U.S.-grown jasmine-type rice, and rice labeled as certified U.S. grown jasmine-type rice.

The evaluation of the competitiveness of U.S. long-grain rice relative to Thai Hom Mali jasmine rice will be assessed using experimental auctions (EA). EAs attempt to simulate a real market situation in which consumers decide to buy and make the purchase, thus offering participants real products and allowing for the exchange of real money. In this way, the participant may incur actual costs if a bid deviates from their true willingness to pay (WTP), thereby incentivizing them to reveal their true WTP (Lusk and Hudson 2004). Auctions use a set of rules to determine, according to the bids presented by the participating bidders, who the winner of the auctioned good is and the price to be paid (McAfee and McMillan 1987). All econometric modeling will be conducted in Stata®.

We will survey consumers face-to-face and have rice-tasting exercises (sensory analysis) to support the valuation of rice quality. To the extent possible, we will use non-hypothetical valuation approaches. However, in situations where non-hypothetical approaches are unsuitable (e.g., too many attributes identified as relevant, which poses logistical challenges, such as sourcing large quantities of all possible rice products), we propose using cheap talk scripts to address hypothetical bias.

The target sample size is 400 participants. The goal is to develop a sample that is representative of the U.S. rice consumer population. The demographic profile of rice consumers from objective 2 will be used as a sampling frame. We propose to conduct EAs in multiple locations across the U.S. Preliminary locations for consideration include Kansas City, KS (low density of immigrants), Seattle, WA, Portland, OR, or San Francisco, CA (large Asian population), Atlanta, GA (multicultural), and Houston, TX (large Hispanic population).

The Becker–DeGroot–Marschak (BDM) elicitation format will be used. BDM is an incentive-compatible method used in economics and experimental research to elicit a person's true willingness to pay (WTP) for a good or service. BDM is a popular elicitation method because it can capture individual valuations without requiring a group setting. This makes it especially suitable for use outside the laboratory, where gathering participants at the same time is often more difficult (Canavari et al., 2019).

Each EA will consist of two rounds; thus, each participant will offer two bids for each product. In Round 1 (No information), participants will evaluate the unlabeled cooked and raw rice options, taste the cooked rice to assess the quality, and then record their WTP. In Round 2 (labelled), rice samples will be labeled as imported Thai Hom Mali rice, high-quality long-grain rice, standard long-grain rice, and jasmine-type long-grain rice, and participants will record again their WTP for each product. The differences in WTP values from Round 1 to Round 2 estimate the effects associated with labelling; that is, the marginal difference in WTP from knowing what the different rice options are and where they are produced. Additionally, this approach allows us to estimate the implied demand curves for each product to simulate how pricing affects market sizes.

Outreach

Although this is a research-only project with no extension component, working together with the Arkansas Rice Research and Promotion Board, we will create a strategic approach to disseminate the findings of this project to the target audience, that is, members of the U.S. long-grain rice supply chain, from breeders to input suppliers, retailers and exporters, and policymakers. The outreach activities we envision include:

1. Dissemination of findings in rice field days organized by the extension services in the leading rice-producing states, including Arkansas, Louisiana, and Mississippi. Rice field days are excellent venues to promote our project and disseminate the results among farmers, processors, and members of the local communities. We will develop printed material to highlight the findings of our project and provide information on how to access the information online.
2. Organization of a rice quality symposium at the 2027 Rice Technical Working Group (RTWG) Meeting. RTWG meets biennially to provide for continuous exchange of information, cooperative planning, and periodic review of all rice research and extension activities being conducted by the states, federal government, and cooperating agencies. It is an ideal venue to disseminate our project findings among researchers, extension agents, and representatives of the U.S. rice industry.
3. Participation in industry and professional conferences and meetings. We propose organizing a rice quality discussion panel at the 2027 or 2028 Rice Outlook Conference and Rice Market and Technology Convention. These two venues are ideal because they bring together rice industry leaders from the U.S. and Latin America. We also envision presenting the findings of this project in professional meetings such as the Agricultural and Applied Economics Association Meeting.

Project Timeline

Table 3. Timeline of expected project outcomes.

Project Objective	Year 1				Year 2				Year 3			
	Quarter				Quarter				Quarter			
	1	2	3	4	1	2	3	4	1	2	3	4
1.1. Identify the quality profile of U.S. long-grain varieties through a literature review and interview with industry experts (Durand-Morat and Nalley)												
Data collection	■	■										
Interview with industry leaders	■	■										
Development of rice compendium		■	■	■								
Objective 1.2: Cluster and principal component analysis to identify distinct varietal groups (Durand-Morat, McFadden, Nalley)												
Data analysis				■	■	■						
Publication of results					■	■						
Objective 1.3: Conduct quality analysis of the prospective rice varieties (Durand-Morat, Nalley)												
Data analysis						■	■					
Publication of results						■	■					

Objective 2: Assess the socioeconomic and rice-consumption characteristics of U.S. rice consumers, including willingness to accept alternative labelling for high-quality U.S. long-grain and jasmine-type rice (McFadden, Durand-Morat, Nalley)												
Development of research protocols												
Survey implementation												
Data analysis												
Dissemination of results												
Objective 3: Estimate the economic value (willingness to pay) and market shares for imported Thai Hom Mali rice, high-quality U.S. long-grain rice, standard-quality U.S. long-grain rice, U.S.-grown jasmine-type rice, and rice labeled as certified U.S. grown jasmine-type rice (McFadden, Durand-Morat, Nalley)												
Development of research protocols												
Survey implementation												
Data analysis												
Dissemination of results												

Potential pitfalls that may be encountered

Managing a project demands effective coordination and execution of activities by all the members involved. Also, respecting the timing of the project outcomes is vital due to the linkages between the different objectives. Any delay in completing the proposed activities will affect the timing of subsequent research activities and the overall project. We will implement a schedule of PI meetings to update each member regularly about the progress on every aspect of the project. The assistance of graduate students assigned to this project will be crucial to defining the content of each meeting. We will also rely on the feedback from our Advisory Board to guide the scheduled meetings.

Another possible pitfall is the possibility that the current domestically produced jasmine-type rice varieties are so heterogeneous in quality that clustering them into one “jasmine-type” group may not be feasible. It may be that only one or several of the currently produced jasmine-type varieties are suitable substitutes. As with any survey, obtaining a representative sample of rice consumers could be an issue. This will try to be mitigated through screening questions, but the risk still exists.

Finally, we need to obtain approval from the Institutional Review Boards (IRB) of the research institutions involved in conducting activities involving human subjects. Our experience conducting similar activities suggests that IRB approval should not be an issue of concern. Still, there is always a chance that research protocols must be changed to obtain such approval.

Support Letters

The following stakeholders from the U.S. rice industry provided strong letters of support for this project:

Peter Bachmann. President and CEO, U.S. Rice Federation. U.S. Rice Federation is an advocate for all segments of the U.S. rice industry.

Mollie Buckler. President and CEO, U.S. Rice Producers Association (USRPA). USRPA represents rice producers from all six rice-producing states.

Kevin McGilton. President and CEO, Riceland Foods, Inc. Riceland Foods is a farmer-owned cooperative and the largest marketer and miller of rice in the U.S.

Keith Glover. President and CEO, Producers Rice Mill, Inc. Producers Rice Mill is a farmer-owned cooperative and one of the largest marketers and millers of rice in the U.S.

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