



## North Australian native rice: Market evaluation of a potential new wild food enterprise

by Dr Penny Wurm and Dr Sean Bellairs  
September 2018



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# Foreword

Australian native rices (*Oryza rufipogon* and *O. meridionalis*) are an abundant and widespread resource on floodplains across monsoonal northern Australia, where rural and remote communities are keen to expand economic opportunities. Native Australian rice has been harvested and consumed by Aboriginal people until historical times (Ashwin 1930; Fukiwarra 1985). Studies of other enterprises (Gorman and Whitehead 2005) indicate that wild rice may have the potential to support new, small-scale, wild-harvest enterprises. Previous RIRDC-funded work on wild rice grain properties has indicated that the nutritional and cooking qualities of native rice collected from the wild are suitable as a food product (Wurm et al. 2012).

This Northern Territory (NT) study aims to build on the previous investigation of the food qualities of native rices, by undertaking a preliminary assessment of the market for a wild rice food product. In order to do this the project brings together traditional owners and enterprise developers, researchers and potential product buyers.

Partnerships and resources for the development of a culturally identified wild food enterprise required traditional owners and Aboriginal communities with:

- access to abundant resources of wild rice,
- established human resources for enterprise development,
- ready access to a market,
- access to infrastructure such as areas for trials of wild harvest, growing, processing and packaging, and
- relationships with research, enterprise support and human resources development partners.

This project brings together these partners, in a pilot feasibility study, and demonstrates enterprise potential.

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Managing Director  
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Aboriginal Bush Traders (ABT) ([www.aboriginalbushtraders.com/](http://www.aboriginalbushtraders.com/)) was represented by Honorlea Massarella and Lorraine Williams. ABT facilitated, with Kristen Johnson from Chiggy's Place Graphic Design, work with representatives of the Adelaide River Traditional Owners to develop labels and packaging.

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Steve Sunk, Jason Wilkes and TY Lee, VET School of Business and Service Industries, Charles Darwin University, kindly investigated menu options for wild rice, and photographed them.

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The rice was collected at Fogg Dam Conservation Reserve under NT Parks and Wildlife research collecting permit No. 40649.

# Abbreviations

ABT	Aboriginal Bush Traders
CDU	Charles Darwin University
NLC	Northern land Council
NT	Northern Territory

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# Executive Summary

## What the report is about

This Northern Territory (NT) study aims to build on a previous study of the food qualities of native rices, by undertaking a preliminary assessment of the market for wild rice food products and an estimation the costs involved in a small scale pilot harvest. In order to do this, the project brings together Traditional Owners and enterprise developers, researchers and potential product buyers.

Australian native rices (*Oryza rufipogon* and *O. meridionalis*) are an abundant and widespread resource on floodplains across monsoonal Australia, where remote and rural communities are keen to expand economic opportunities. Native Australian rice has been harvested and consumed by Indigenous people until historical times (Ashwin 1930; Fukiwarra 1985). Previous RIRDC-funded work on the grain properties of Australian native rices indicates that native rice collected from the wild is nutritious and has suitable cooking qualities as a food product (Wurm et al. 2012). Wild rice is a likely candidate for a investigation of product and market development, in line with a growing number of native species that are finding niche markets (Gorman and Whitehead 2005).

## Who is the report targeted at?

This report is targeting Traditional Owners and Aboriginal communities and their affiliates, who have access to native rice and who are interested in developing an enterprise based on wild harvest of native rice.

## Where are the relevant industries located in Australia?

Abundant native rice populations occur on nature conservation reserves, Pastoral Leasehold, Aboriginal Freehold and private land in northern WA, NT and QLD. This region is characterised by limited opportunities for economic development. In the NT, National Parks and Conservation Reserves are managed under Joint Agreements between NT Parks and Wildlife Service and Traditional Owners.

Traditional Owners and other Aboriginal people living in these areas are interested in, and have capacity for, the development of small enterprises based on the wild harvest of native plants. Native rice is likely to be suitable for inclusion in a portfolio of potential wild-harvest products.

In Queensland, the Innovative Food Solutions & Technologies, QLD Department of Agriculture, Fisheries and Forestry, are briefed with investigating and developing opportunities for enterprise and new food product developments in this region and have already expressed interest in this RIRDC funded pilot project. Queensland institutions such as Queensland Alliance for Agriculture and Food Industries (QAAFI), located at the University of Queensland, and the Centre for Tropical Crops and Bio-commodities (CTCB), located at the Queensland University of Technology are also interested in native Australian rices as wild relatives of cultivated rice and a potential source of genetic resources and information. In the NT, Charles Darwin University has expertise in community enterprise development based on wild harvest and natural resources. In the NT, Joint Management Agreements for conservation reserves include the development of livelihoods and enterprises for Traditional



Owners and other Aboriginal people living in them, based on natural resources management, eco-tourism and, potentially, sustainable wild harvest. Aboriginal Bush Traders is a not-for-profit-organisation, funded by Darwin Regional Indigenous Advancement & CDEP Inc, with a brief to supporting the development of enterprises based on native species and wild harvest. Organisations such as these are able to support enterprise development across the north. Pudukul Aboriginal Cultural Tours is an example of a highly successful Aboriginal enterprise that is well positioned to access, collect, process, market and sell wild harvest native rice products. In more remote areas across northern Australia, Indigenous corporations are exploring a number of wild harvest products.

## **Background**

A previous study by Charles Darwin University, The University of Sydney and SeaSpec Pty Ltd has found grains of *Oryza meridionalis* and *O. rufipogon* to be nutritious, and with suitable cooking qualities.

That and the current project were based in the Fogg Dam Conservation Reserve approximately 50 km east of Darwin, on the Adelaide River floodplain. This site was chosen for the following reasons.

1. The Reserve is jointly managed by the NT Parks Service and Daminmin Joint Management Committee representing Traditional Owners. The objectives of the Joint Management of reserves includes sustainable and appropriate enterprise development for the traditional owners of the land.
2. Fogg Dam supports abundant populations of *O. meridionalis* and *O. rufipogon*, the seeds of which are accessible for harvesting by airboat in the late wet season/ early dry season each year.
3. Adjacent to the Reserve are NT Government horticultural and agricultural research stations, with infrastructure such as workshops and equipment.
4. Traditional owners of Fogg Dam have established tourism enterprises, and therefore have demonstrated skills and interest in enterprise development. These enterprises themselves also represent a potential market and mechanism for the sale of wild rice products.
5. Aboriginal Bush Traders enterprise facilitators and CDU researchers have established relationships with the NT Park Service and Northern Land Council, who represent traditional owners and facilitate Joint Management of Fogg Dam.

For these reasons, Fogg Dam Conservation Reserve is a site that brings together the underpinning physical and organisational infrastructure required for a project investigating this potential enterprise development.

## **Aims/objectives**

This project draws upon partnerships among Traditional Owners, enterprise developers and facilitators and researchers to undertake a pilot feasibility study of the market for a wild rice food product, based on wild harvest.

This was achieved by:

- Documenting the logistics associated with field collection and milling native rices
- Developing culturally appropriate packaging and labelling to use in trial marketing
- Estimating the cost of wild harvested native rice by determining the time and resources required:

- to collecting native rice from the wild
- to prepare, clean and mill collected seeds, using research scale equipment
- Obtaining feedback from potential buyers - namely restaurants cooks, tour operators and their customers - about the trial product, its cost and its market potential
- Developing recommendations about the potential market for wild harvest native rice enterprise and future research

## Methods used

The steps in project implementation were as follows:

1. Establishment of project partnerships and confirmation of study site.
2. Field collection of wild rice seeds.
3. Preparation, cleaning and milling of wild rice grains to produce samples of grain.
4. Development of culturally appropriate packaging and labelling by Aboriginal partners in the project.
5. Distribution of native rice products to potential market outlets such as tourism enterprises and restaurants to assess market interest, using unstructured discussion about the product.

## Results/key findings

1. The timing of seed production of the two wild rice species, perennial *O. rufipogon* and annual *O. meridionalis*, is staggered by one month, thus reducing the risk of not being able to collect seeds in a given year.
2. However risk of not being able to collect at a particular site in a given year occurs due to variable rainfall and flood plain inundation.
3. Collection times for sufficient quantity of seeds are acceptable, although an airboat is required.
4. Seed processing is labour intensive and requires innovation in cleaning and milling technologies to reduce the costs of production.
5. Native rice is an iconic species for people familiar with the monsoonal floodplains and there is considerable interest in longer term involvement in a culturally identified wild harvest enterprise.
6. The grain has potential as an attractive and palatable gourmet food, suitable for restaurant menus.
7. There is interest from restaurants in increasing the number of native ingredients in menus.

## Implications for relevant stakeholders

These iconic native plants produce a visually appealing, nutritious and palatable food crop for which there is likely to be a market in restaurants, and possibly as a novelty product in tourism enterprises.

With support from appropriate partnerships, Traditional Owners and Aboriginal land managers may consider further investigating a culturally identified, wild harvest, native rice enterprise.

## **Recommendations**

Based on the findings of this study that native rice does have potential as a wild harvest product, we recommend an expanded and larger project to build on this pilot study.

1. Evaluate sustainability of wild harvest of native rice by documenting environmental impacts on the floodplains.
2. Determine factors determining flowering and seed production in order to predict yield.
3. Improve cleaning and milling technologies to increase milling efficiencies and reduce costs.
4. Investigate options for managed plantings of wild rice to supplement wild harvest in order to reduce costs.
5. Research traditional cooking and preparation methods, in order to enrich cultural identification and increase product options.
6. Identify additional communities interested in culturally identified, wild harvest, native rice enterprise, in order to increase and stabilise supply.
7. Network nationally with native food product manufacturers, buyers and chefs to understand and develop wider markets.
8. Formally evaluate product quality according to food regulatory requirements.
9. Review appropriate options for enterprise models in the northern Australian context and for Australian native rice specifically

# Introduction

Native rices are important components of our ecological, biodiversity and cultural heritage. Native rices (*Oryza rufipogon* and *O. meridionalis*) comprise an abundant and widespread resource in floodplains across monsoonal Australia, and have been harvested and consumed by Indigenous people for generations and until recent times (Ashwin 1930; Fujiwarra 1985). In terms of ecology and biodiversity, they also underpin the vertebrate food chain on the monsoonal floodplains (Madsen and Shine 1996; Wurm 1998). These native rices are also an internationally significant genetic resource, and have the potential to contribute to a world-wide need for agricultural rice development in the Asia-Pacific region, having remained largely isolated from cultivated rice (*O. sativa*) (Henry et al. 2010. Hoang et al. 2016 ).

Native rice may have the potential to underpin a wild harvest bush tucker enterprise, and may also provide an opportunity for a new food industry. Native bush foods have potential for commercial development through the sustainable harvesting of natural resources to underpin small enterprises in rural and remote communities, as a “bush tucker”, “novelty” or gourmet product (either as grains or flour) for the tourism and niche gourmet markets (Gorman & Whitehead 2005, Whitehead et al. 2006). A previous RIRDC funded project which specifically investigated the grain qualities of native rices, and found the pasting qualities and nutritional value of wild rices were comparable to those of cultivated rice (Wurm et al. 2012).

Abundant native rice populations occur on nature conservation reserves, Pastoral Leasehold, Aboriginal Freehold or private land in northern WA, NT and QLD. This region is characterised by limited opportunities for economic development. In the NT, National Parks and Conservation Reserves are managed under Joint Management Agreements between NT Parks and Wildlife Service and Traditional Owners. A wild rice enterprise could supplement existing economic and cultural activities on these lands, and may be integrated into other activities associated with using and managing floodplains.

This current pilot project specifically investigates the feasibility of an enterprise based on native Australian rice grain, by developing samples of products made from wild harvested native rice, and by surveying potential markets for interest in these products as bush tucker, gourmet or novelty items.

This and the previous RIRDC-funded pilot study foreshadow a future larger project, namely a full scale enterprise development and feasibility study, which stands upon existing partnerships among Indigenous land owners and managers, collaborators with expertise in wetland plant ecology, agronomy and grain science, cookery and small enterprise development.

In collaboration with Indigenous project partners, this larger project would include assessment of the cultural considerations of offering native rice as a product for tourism, an evaluation of the ecological feasibility of and impact of native rice wild-harvest in the field, studies of wild rice agronomy under trial conditions, and an assessment of the effort, cost and barriers associated with all aspects of an enterprise development.

# Objectives

This study is focussed on the NT and specifically on a site not far from the city of Darwin, but has application to sites elsewhere in monsoonal northern Australia.

Specifically, the aims of this pilot project are to:

- Document partnerships underpinning a wild harvest enterprise development project
- Document the steps involved in wild harvesting of native rice
- Trial research-scale grain processing methods for wild-harvested native rice seeds
- Estimate indicative costs of obtaining grains
- Design, develop and trial appropriate presentation options for wild rice as a culturally identified native food product
- Use trial products to investigate local market interest in native rice (including restaurants and tourism enterprises)
- Make recommendations regarding further investment in enterprise development based on wild harvest of native rice

# Methodology

## Permissions for collection

Samples were collected at Fogg Dam under Permit to Take Protected Wildlife No. 40649, issued by the NT Parks and Wildlife Service. The authority issuing permits is required to consult, on the behalf of the applicant, with biophysical scientists, land owners and others with an interest in the land.

The Northern Land Council facilitated initial discussion with Adelaide River Traditional Owners, specifically Limilngan-Wulna elders, who gave their permission for the project to proceed.

The Kenyon family, operators of the Pudukul Aboriginal Cultural Tours (<http://www.pudukul.com.au/>), then stepped forward as project participants.

## Grain collection

Grain samples were collected within the Fogg Dam Conservation Reserve (12° 33' S, 131° 19' E) in the Adelaide River catchment, Northern Territory. Collecting was done in April 2012, at the end of the wet season, when sufficient grain was held in the inflorescence to make collecting most efficacious. Due to the hydrological conditions in that particular wet season resulting in an early reduction in water levels, only access to *O. meridionalis* populations was possible (Figure 1), although abundant populations of the later flowering *O. rufipogon* populations were present.



**Figure 1. Populations of *O. meridionalis* at seed shed, April 2012, Fogg Dam, NT. Seeds collected at this site and date were used for product development in this study. Photo: Penny Wurm**





**Figure 2. Populations of *O. rufipogon* at seed shed in May 2011, Fogg Dam, NT. Seeds from this population were not accessible during 2012, due to the rapid rate at which water receded during the early 2012 dry season. Photo: Penny Wurm**

Grain was collected by passing through stands of rice in an airboat while suspending collection containers over the edge of the boat, at the level of the inflorescences (Figure 3). Samples were then labelled and placed in loosely tied clean plastic bags (Figure 4). Because of the high numbers of insects collected along with the seed, plastic bags of grain were left outdoors and open for 24-48 hours to allow the insects to evacuate the bags, and then allowed to sun dry for several days (Figure 5). Seeds were then separated from remaining detritus and transferred to paper bags and stored at room temperature at constant humidity in the air-conditioned laboratory in Darwin.



**Figure 3. Lorraine Williams (ABT) emptying a freshly collected container of *O. rufipogon* from the airboat, May 2011. Seeds were collected by holding the bins over the edge of a moving airboat, and were then gathered from the bins as well as from the airboat deck. Photo: Penny Wurm**



**Figure 4. Securing collected *O. rufipogon* seed in the field May 2011. Note these seeds were not used in the study due to fungal smut infection that became apparent after storage. Photo: Penny Wurm**



**Figure 5. *O. meridionalis* seeds collected April 2012, air-drying before cleaning and milling. Note long awns. Photo: Penny Wurm**

Seed was collected in April 2011, however it could not be used, due to a fungal infection which became apparent after storage. Samples submitted to Dr Jose Liberato, Plant Pathologist, NT Department of Primary Industries, were made available to Dr Roger Shivas, Biosecurity Queensland, who identified the fungus as the smut *Tilletia australiensis*, known only from NT (DAFF, n.d.).



## Seed cleaning

The long awns present on native rice prevented it from being placed directly into a mill. Due to the scope of the study, we resorted to hand cleaning the awns from seed, prior to milling. This involved hand circulating handfuls of seeds through a series of domestic kitchen sieves (Figure 6). Other methods using vacuum airflow were trialled but proved unsuccessful.



**Figure 6. Project team members (L-R: from CDU, NT DPIR and Pudukul Aboriginal Cultural Tours) hand cleaning native rice seeds to remove awns, Middle Point Horticulture Research Station, NT, at a project workshop. Photo: Penny Wurm**

## Seed milling

Several methods were tested to de-husk cleaned seeds, including rubbing seeds between ribbed rubber sheeting secured to boards. However, a research scale Satake de-husker rice mill proved the most efficacious (Figure 7).

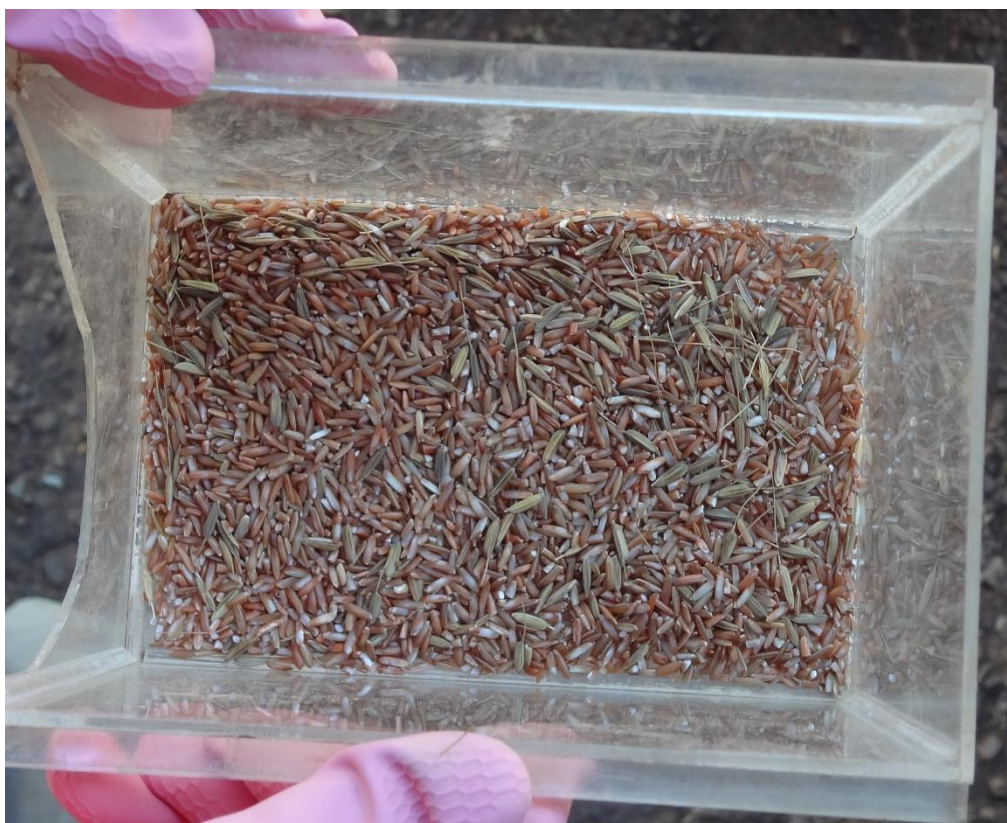
A significant proportion of seeds remained with husk after milling which made them inedible (Figure 8). For this reason, seeds were run through the mill three times, after which no further husks were removed, and the proportion of cracked seeds increased. Various methods were trialled for separation de-husked seeds from other materials, including airflow and tumbling over rough fabric surfaces. However, none of these were successful, and due to the scale of the project we resorted to hand removing the small proportion of unhusked seeds.

Ultimately processing revealed a beautiful and attractively variable rich brown grain (Figure 9).



**Figure 7. Satake dehusser rice mill in action, at a project workshop, Middle Point Horticulture Research Station, NT. Provided by NT DPIR. Photo: Penny Wurm**





**Figure 8. Native rice after one run through the Satake rice mill. Note that not all husks are removed and some seeds are cracked. Photo: Penny Wurm**



**Figure 9. Milled and hand sorted *O. meridionalis* grain (foreground) with cleaned but un-milled seeds (background), styled for marketing purposes. Note that a proportion of milled seeds are broken but edible. Photo: Jason Wilkes**

# Results

## Grain collection and availability

Fogg Dam, on the Adelaide River floodplain, NT, is a highly suitable site for this pilot study and subsequent enterprise development, due to abundant populations of both *O. meridionalis* and *O. rufipogon*.

The window of opportunity for collecting wild rice is relatively short, several weeks at the end of the dry season, and is determined by:

- Abundance of ripe seeds at a particular time in each year (possibly determined by day length and/or length of growing season preceding flowering), and
- Adequate water to allow access to the rice via airboat, at the particular time when seeds are available (varies each year).

We observed that the timing of flowering and shed of *O. meridionalis* precedes *O. rufipogon* by approximately one month. This spread in seeding time between the two species reduces the risk of not being able to collect seeds due to unsuitable water levels.

For example, in 2011 we collected mainly *O. rufipogon* in mid-May (RIRDC project approval and collecting permits were not secured until early May), when seed shed of *O. meridionalis* had already occurred.

However, in 2012 water levels receded much earlier, such that the floodplain was not accessible (by airboat) after mid-April. However, at this time *O. meridionalis* seeds were abundant, while *O. rufipogon* inflorescences were just emerging and seeds were not present.

In 2011, we were able to collect approximately 5 kg of unprocessed seeds of *O. rufipogon* in 1.5 hours of airboat time (late in the seed shedding season for that species), and in 2012 we collected approximately 40 kg of *O. meridionalis* seeds in 2 hours of airboat time (at the peak of seed production and availability).

Samples of *O. rufipogon* collected in 2011 could not be used in this study due to a fungal outbreak identified in the stored seed shortly after collection. This was an unprecedented occurrence, in that the CDU team has for many years collected seed for research purposes, stored in a similar manner to that collected for this project, and over longer periods of time, without a fungal out-break of this nature ever occurring. Dr José Liberato (Principal Plant Pathologist, NT DPI) identified the fungus as the smut *Tilletia australiensis*, which has previously been collected four times from Fogg Dam described originally in 2008 by Dr Roger Shivas, and only known from Fogg Dam.

## Seed preparation and milling

The native rice seeds are characterised by long persistent awns, which have to be removed prior to milling. It was possible to remove these by hand, although the time involved adds to the cost of production - but is not necessarily a barrier. Gently twisting the seeds against a mesh was effective for removing the awns.

Varying sizes and other features among individual seeds, meant milling was not completely successful, with some 25% of seeds remaining with husks after one pass through the mill. Re-milling reduced the retention of husks but increased the proportion of cracked seeds (although cracked seeds were not seen as a problem in all cooking trials – see following).



The labour involved in re-milling and removing unpalatable seed due to husk retention contributes additional costs to production. The solution used in this research-scale project was hand sorting – a possibly prohibitively expensive option for production scale projects. Improved or customised milling technology for native rice seeds is required.

## **Packaging and product development**

Three products were developed from the milled rice:

- Loose unpackaged grain for use in cooking trials and restaurant market evaluation,
- Small, culturally identified packets of rice for sale as a novelty product in shops or associated with cultural tours, and
- Body products with wild rice ingredients.

## **Cooking trials and perceptions**

The project team also cooked, shared and ate rice on several occasions with guests from various interests groups and its nutty aroma and flavour along with its purple-brown colour when cooked was always positively commented upon.

Commercial Cookery and Bakery staff in the CDU VET Business and Services Industry School, trialled samples of native rice. The chefs responded enthusiastically to the product, and specifically noted its desirable colour, aroma and flavour. The CDU Chefs described it as describing it as mixing well in dishes and successfully tried it in in range of gourmet dishes (Figure 10) including bread, pilaf, rice pudding dessert, in pancakes and as a side dish with meat or fish.

Chefs from restaurants in Darwin were also interested in the product and samples were able to be provided to two restaurants. Its best features were considered to be that it was nutritious, a local product and an attractive colour.

Regarding the percentage of cracked VS whole grains, the chefs found anything up to 50% cracked grains was presentable and suitable for use in risotto, fritters or bread, although would not fetch premium price. Darwin chef David Griffin preferred a maximum of 10% cracked grains.

Price was a major factor, while there was interest even at \$100 per kg, it was felt that reducing the price to \$50 per kg would be important as “restaurants have hard profit margins”.



**Figure 10 (a).** Recipes developed by CDU Cookery staff Steve Sunk, Jason Wilkes and TY Lee. Top to Bottom: in whole grain bread; incorporated into batter for fritters; augmented with cultivated rice in seafood pilaf. Photos: Jason Wilkes



**Figure 10 (b). Recipes developed by CDU Cookery staff Steve Sunk, Jason Wilkes and TY Lee (cont.). Top to Bottom: side dish with fish; augmented with cultivated white rice in risotto and served with fish; as a side dish with kangaroo paella. Photo: Jason Wilkes**

## Culturally identified novelty products

Floodplains and Aboriginal culture and land management practices both feature heavily in the interests of tourists visiting the Top End (Director of Parks, 2001). So novelty products including floodplain items are likely to have a market among tourists who have visited floodplain areas. Small packets of uncooked wild rice presented in a simple but attractive culturally identified packaging were developed by the participating Traditional Owners and Pudukul Cultural Tours proprietors (Figure 11).

Although not the focus of this project, there is also potential for body products to be developed that incorporate wild rice ingredients. For example, rice grains were incorporated into small hand soaps as a demonstration activity at one of the project workshops (Figure 12). Another example of value-adding to the wild harvest, is to use by-products of grain processing in non-food items, such as using silica washed from husks, and feature the wild rice ingredient in the product promotion.



**Figure 11. Sample of packaging and culturally identified labelling for novelty tourist products. Lying flat are labels formatted to be wrapped around soap bars. Standing is a packet for a 50g sample of wild rice, which is stapled to the package in a vacuum sealed plastic bag. Photo: Lorraine Williams**





**Figure 12. Hand soaps incorporating rice grains as an example of “value adding” that can be achieved using small amounts, or by products. Note that the orang soaps include brown cultivated rice for comparison. Photo: Penny Wurm**

## Estimations of cost of production

In this research scale study we calculate the cost of wild harvested native rice to be approximately \$110.00 kg<sup>-1</sup> (Table 1). We estimate we could reduce this cost to less than \$70 kg<sup>-1</sup> with improved and customised milling technology, and increased economy of scale.

The most expensive production stages are (Table 1):

- Removing husks, prior to milling – done by hand in this study
- Removing seed that has retained husk after milling – done by hand in this study

In terms of the harvest weight vs product yield, we found that for every 1 kg of ready-to-eat native rice grain approximately 2.2 kg of unprocessed grain was required. In other words, some 54% of harvest weight is lost in awns, husks and seeds that retain the husk after milling.

Feed-back from participating chefs indicates that a price of \$120.00 kg<sup>-1</sup> is high for a local market, but that southern markets may find this price achievable (not investigated in this study). Cracked grains would not be accepted at this premium price.

Feed-back from tourism enterprises indicates that attractively labelled and culturally identified small sample packets of 50 g may be sold at \$10.00 (i.e. \$200 kg).

**Table 1. Justification of the calculation of cost of production of wild harvest native rice this study.**

<b>PREDICTED COSTS IF 160 kg COLLECTED</b>					
<b>Item</b>	<b>Description</b>	<b>Time</b>	<b>Expenses</b>	<b>Cost</b>	<b>Product</b>
Pre collecting logistics	Packing vehicle, equipment prep	3 person hours	\$ 25.00 per hour	\$ 75.00	
Transport	Vehicle hire (running costs)	4 hours; 40km	\$0.50/km	\$ 20.00	
	Fuel (diesel)	1.15 per litre	\$0.50/km	\$ 20.00	
Airboat	Checking seed readiness	1.5 hour			
	Collecting (4 hours)	8 hour	\$25.00 per hour	\$ 200.00	
	Pilot salary	8 hours for checking and collecting	\$50 per hour	\$ 400.00	
	Fuel (unleaded)	8 hours for checking and collecting	\$50 per hour	\$ 400.00	
	Drying logistics	2 hour	\$25.00 per hour	\$ 50.00	160 kg unprocessed uncleaned grain
Sorting time	Storage logistics	2 person hour	\$25.00 per hour	\$ 50.00	160 kg unprocessed uncleaned grain
	Cleaning (by hand)	160 person hours (1 hour /kg)	\$25.00 per hour	\$ 4,000.00	120 kg unprocessed cleaned grain
	Milling logistics	2 hours logistics	2 hours	\$ 50.00	
	Milling	2.5 hour per 40 kg	1.5	\$ 75.00	60 kg milled seed
	Removing seed with husks	2.0 hour per 1 kg	120 hours	\$ 3,000.00	48 kg ready to eat grain
Total cost				\$ 5,340.00	
Cost per kg				\$ 111.25	



## Permissions, consultation and establishment of partnerships

NT Parks and Wildlife Service, the authority issuing permits is required to consult, on the behalf of the applicant, with biophysical scientists, land owners and others with an interest in the land. In this case this included the District and Park Rangers and Daminmin Joint Management Committee. The Senior Ranger at Fogg Dam, Greg Williams, facilitated the securing of permissions and the subsequent smooth running of the project through general and specific support as required and appropriate, in his role as Joint Management facilitator for that Reserve. Greg also facilitated a final report back on the project by Lorraine Williams (ABT) and Penny Wurm (CDU) to the Daminmin Joint Management Committee at an AGM. There was considerable interest in a future project expressed at the meeting.

The Northern Land Council facilitated initial discussion with Adelaide River Traditional Owners, specifically Limilngan-Wulna elders Mr David Kenyon and Aunty Joan Kenyon to secure approval for the project to proceed. David envisaged potential for the future development of a wild rice enterprise project to involve young people with an interest in land care and tourism, and the local Green Corp (comprising young people mainly from Traditional Owner families) could also become involved.

Graham and Lynette Kenyon stepped forward from among Adelaide River Traditional Owners as interested enterprise partners in this pilot study. Their daughters joined the project via their VET in School curriculum at Taminmin High School. The family also own and operate Pudukul Aboriginal Cultural Tours (<http://www.pudukul.com.au/>), which involves a network of family and community members, offering clients orientation to Aboriginal culture, bush tucker-based meals and wetland tours. In addition, the family operates Windows on the Wetlands Visitors Centre (<http://www.parksandwildlife.nt.gov.au/parks/windowwetlands>), under contract with the NT Government. This facility includes a shop and snack food outlet. Pudukul has been an enterprise partner in three subsequent grant applications (since the receipt of this AgriFutures grant).

Enterprise development advice was provided to the project team by Aboriginal Bush Traders (<http://www.aboriginalbushtraders.com/index.php/>) under the terms of a MoU between ABT and participating Traditional Owners. ABT in turn subcontracted graphic designers for assistance for packaging development. ABT have been a named partner in subsequent grant applications (since the receipt of this AgriFutures grant).

Expertise in milling and access to rice milling equipment and work spaces was supplied by NT Department of Primary Industry and Resources, under both a Partnership Agreement between CDU and the NT Government, and a MoU between ABT and NT DPI.

During the course of the project additional research connections were made. Sean Bellairs and Penny Wurm were invited to the Australian Wild Rice Symposium April 12-13, 2012, Brisbane, convened by Professor Robert Henry, QAAFI, and funded by RIRDC, focussing on the genetic diversity and use of wild rice. This invitation was extended on the basis of CDU's ecological knowledge of wild rices and the previous RIRDC report (Wurm et al. 2012), and the current RIRDC project. This meeting enabled discussion with Innovative Food Solutions & Technologies, QLD Department of Agriculture, Fisheries and Forestry (and a subsequent joint grant application that was not successful). ABT staff expressed interest in collaboration with Innovative Food Solutions & Technologies.

In 2016, the CDU team initiated collaboration with QUT Centre for Tropical Crops and Bio-Commodities (CTCB), for studies of wild rice. This activity has involved one visit to CDU by QUT staff, Professor Sagadevan Mundree (Director), Dr Brett Williams (Postdoctoral Fellow), Dr My Linh Hoang (postdoctoral fellow). During the visit we travelled to field sites on the Mary River floodplain to orient the visitors the habitat of wild rice, met key CDU staff in the Research Centre for Environment and Livelihoods and developed a concept for potential collaborations for research into Australian native rice. This collaboration has led to the preparation of an overarching vision document

for a suite of wild rice related projects, and a one joint publication (Hoang et al. 2016). We are seeking funding sources to progress this vision, in collaboration with additional partners including NT DPIR and University of Melbourne.

The report authors are currently collaborating with Professor Pascal Tremblay, an economist in The Northern Institute, CDU, to investigate the enterprise models unpinning the Canadian and US wild rice industries (based on *Zizania* spp.). The Canadian industry is mostly culturally identified, lower-volume high-value, and the US industry has developed along higher-volume lower-value commodity lines. We expect that there may be lessons for an Australian wild rice industry in exploring this comparison.

The NT Government's agricultural diversification program includes consideration of cultivated rice (NT Government, 2016). The CDU and NT DPIR teams are now exploring ideas that may link wild rice to the diversification program and rice research planning.

In summary, the project has nurtured new and existing partnerships. As a result of this, the project has concluded with a strong team of diverse individuals and groups with enthusiasm for progressing a larger project focussing on wild rice conservation, research and enterprise development.

## Implications

This pilot study indicates there is potential for native rice to be a culturally-identified, wild harvest native food or novelty tourist product, where there are appropriate partnerships, infrastructure and natural resources and access to tourist and restaurant markets. To make the enterprise sustainable and viable, improvements to cleaning and milling are required.

## Recommendations

Recommendations are targeted at Aboriginal groups interested in native food enterprises based on wild harvest of native rice from monsoonal floodplains in the NT and elsewhere in northern Australia. In addition, recommendations focus on augmented or cultivated wild rice populations.

Based on the findings of this study, we recommend an expanded and larger project to build on this pilot study.

1. Identify additional communities interested in culturally identified, wild harvest, native rice enterprise, in order to increase and stabilise supply.
2. Evaluate sustainability of wild harvest of native rice by documenting environmental impacts on the floodplains.
3. Determine factors determining flowering and seed production in order to predict yield
4. Improve cleaning and milling technologies to increase milling efficiencies and reduce costs.
5. Investigate options for managed plantings of wild rice to supplement wild harvest in order to reduce costs.
6. Research traditional cooking and preparation methods, in order to enrich cultural identification and increase product options.

7. Network nationally with native food product manufacturers, buyers and chefs to understand and develop wider markets.
8. Formally evaluate product quality according to food regulatory requirements.
9. Review appropriate options for enterprise models in the northern Australian context and for Australian native rice specifically

# References

- Ashwin A.C. (1930). From South Australia to Port Darwin with sheep and horses in 1870-71. *Proceedings of the Royal Geographical Society of Australasia* **32**: 47-93.
- DAFF (Department of Agriculture Fisheries and Forestry) (n.d.) Smut Fungi of Australia: *Tilletia australiensis*. Accessed 16 December 2016 from <http://collections.daff.qld.gov.au/web/key/smutfungi/Media/Html/tilletiaaustraliensis.html>.
- Director of National Parks (2001). *Kakadu National Park Visitor Survey Program 2000-2001*. Retrieved 16 December 2016 from <http://www.environment.gov.au/parks/publications/kakadu/survey-summary.html>
- Ferdinands K., Beggs K. and Whitehead P. (2004). Biodiversity and invasive grass species: multiple use or monoculture? *Wildlife Research* **32**: 447-457. <http://dx.doi.org/10.1071/WR04036>
- Fujiwarra H. (1985). Plant opoliths (phytoliths) in Kakadu archaeological sites: a preliminary report. In R. Jones (ed.) (1985). *Archaeological research in Kakadu National Park*, pp155-164. Special Publication No 13, Australian National Parks and Wildlife Service, Canberra.
- Gorman J. and Whitehead P. (2005). *Small-scale commercial plant harvests by indigenous communities*. RIRDC Publication No. 04/148.
- Henry R., Rice N., Waters D.L.E., Kasem S. Ishikawa R., Hao Y., Dillon S., Crayn D., Wing R. and Vaughan D. (2010) Australian *Oryza*: Utility and conservation. *Rice* **3**: 235-241. <http://dx.doi.org/10.1007/s12284-009-9034-y>.
- Hoang, T. M. L., Tran, T. N., Nguyen, T. K. T., Williams, B., Wurm, P., Bellairs, S., and Mundree, S. (2016). Improvement of Salinity Stress Tolerance in Rice: Challenges and Opportunities. *Agronomy* **6(4)**: 54. doi:[10.3390/agronomy6040054](https://doi.org/10.3390/agronomy6040054)
- Madsen T. and Shine R. (1996). Seasonal migration of predators and prey, a study of pythons and rats in northern Australia. *Ecology* **77**: 149-156.
- NT Government (2016). Diversify your land: non-pastoral lease permits. Accessed on 16 December 2016 from <https://nt.gov.au/industry/agriculture/farm-management/diversify-your-land-non-pastoral-use-permits>

Whitehead P.J., Gorman J., Griffiths A.J., Wightman G., Massarella H. and Altman J. (2006). *Feasibility of small native plant harvest by indigenous communities*. RIRDC Publication No. 04/149.

Wurm P.A.S., Campbell L., Batten G.D. and Bellairs S.M. (2012). *Australian native rice: A new sustainable wild food enterprise*. Research Project No PRJ000347/Publication No 10/175, Rural Industries Research and Development Corporation, Canberra. Report available at <https://rirdc.infoservices.com.au/items/10-175> .

Wurm P.A.S. (1998). A surplus of seeds: high rates of post-dispersal seed predation in flooded grassland in monsoonal Australia. *Australian Journal of Ecology* **23**: 385-392.



## **North Australian native rice:** Market evaluation of a potential new wild food enterprise

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