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Mapping the terrain: Baseline profiling of adlay (*Coix lacyma-jobi* L.) production in Bohol, Philippines

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Abstract

In the Philippines, adlay (*Coix lacryma-jobi* L.) is an underutilized cereal with many nutritional benefits compared to corn and rice. While some adlay cultivars have been produced on the island of Bohol, there is a need for more comprehensive information about adlay production in the province. The study employed chain referral sampling to identify adlay producers. This resulted in 41 confirmed producers being interviewed to assess the adlay production in Bohol. The findings revealed that Bohol has 88 adlay cultivars, with 15 from Batuan, 18 from Carmen, 47 from Catigbian, and eight from Sagbayan. Producers typically plant adlay seeds directly with a spacing of 0.06 x 0.06 meters. The study also noted that adlay production in Bohol is relatively unknown, and its utilization is limited, primarily for crafting accessories and decorations. Consequently, the results suggest further research to characterize differences in these adlay cultivars and assess their field performance.

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Introduction

The Philippines boasts a rich reservoir of diverse crop species, offering various possibilities for food, fiber, animal fodder, oil, and medicine. Despite this abundance, certain crops remain underutilized. Adlay (*Coix lacryma-jobi* L.) is a promising yet underexplored tropical grain. Recognized as an underutilized crop in the country, adlay possesses unique attributes that make it a potential game-changer in addressing food security and promoting agricultural sustainability (Wagan *et al.*, 2009).

Adlay, a tall grain-bearing tropical plant from Graminae or Poaceae, shares botanical similarities with staples like rice, corn, and wheat. Its status as a staple food crop is attributed to its exceptional eating quality, allowing it to be seamlessly incorporated into various culinary applications, including soups and broths (Simeon, 2016). Remarkably, Adlay outshines white rice by providing three times more energy while offering a rich source of healthy carbohydrates and essential nutrients (Cardona, 2021). Moreover, adlay grain is gluten-free with high carbohydrates and high-protein content but with a low glycemic index compared to rice. Based on studies conducted by the Department of Science and Technology - Food and Nutrition Research Institute (DOST-FNRI), a 100g serving of adlay is rich in carbohydrates (73.9g), protein (12.8g), and fat (1.0g). It also contains essential minerals like calcium (25mg), phosphorus (43.5mg), iron (5mg), and notable levels of niacin (4.3mg), thiamine (0.28mg), and riboflavin (0.19mg) higher than those brown rice (Jover *et al.*, 2020). Recent studies have demonstrated that adlay extracts exhibit anti-cancer, anti-inflammatory, anti-obesity, anti-hyperlipidemia, anti-tumor, anti-allergic, and anti-microbial activities (Das *et al.,* 2017; Taquiqui *et al.*, 2021; Ferrer *et al.*, 2021; Zhang *et al.*, 2019; Manosroi *et al.*, 2014; Chen *et al.*, 2011; Yuan *et al.*, 2019; Lee *et al.*, 2008; Chen *et al.*, 2016). Women in Japan have traditionally used adlay to improve skin and for its anti-aging effects (Chen *et al.*, 2020).

Adlay has garnered attention in the Philippines as an incredibly versatile and powerful grain. The Department of Agriculture recognizes its potential as a key rice alternative, attributing its health benefits and resilience. Its cost-effectiveness in grain production positions adlay as an economically viable choice for farmers, particularly when compared to rice and corn. Unlike these traditional crops, adlay exhibits independence from inputs such as fertilizers and pesticides and requires minimal irrigation (Aradilla, 2018; Mendoza *et al.*, 2015). Its adaptability to marginal lands with adverse environmental conditions and resistance to pests and diseases further reinforces its appeal in agricultural landscapes (Aradilla, 2016; Gloria *et al.*, 2015). Certified as an organic crop, Adlay holds promise as a valuable source of food and feed and an economic driver. In Northern Mindanao, specific varieties such as Ginampay, Gulian, Kiboa, Tapol (glutinous), and dwarf have gained recognition as alternative staple foods, offering a diversified dietary selection. Additionally, efforts to establish seed production areas in various municipalities across Bukidnon, Lanao del Norte, Misamis Occidental, and Misamis Oriental have been initiated (Rivera, 2023).

Addressing the overarching goal of achieving food self-sufficiency in the Philippines, Adlay emerges as a plausible solution to the complex issue of food security (Aradilla, 2018; Simeon, 2016). Acknowledging its strategic importance, the Philippine government, through the Department of Agriculture, has conducted various assessments and information drives focusing on adlay, primarily in selected provinces. However, despite these initiatives, information on Adlay cultivars originating in Bohol remains undocumented, prompting the need for a comprehensive study. This research aims to assess the demographic and farm profiles of Adlay producers, unravel the production and post-production practices applied, understand the purposes driving adlay production, and identify the challenges encountered in its cultivation. Through this study, we aim to contribute valuable insights that will inform policies and practices surrounding adlay cultivation in Bohol, thus unlocking its full potential within the agricultural landscape of the Philippines.

Materials and methods

A modified structured questionnaire served as the primary tool for data collection, administered through personal interviews. Given the need for comprehensive data on adlay producers from official sources such as the Office of the Provincial Agriculturist (OPA) and the Agricultural Promotion Center (APC), we employed a chain referral sampling technique for efficient data collection in our research. This method allowed for identifying adlay producers through referrals from existing contacts within the community.

The sampling process commenced with identifying initial adlay producers known to the researchers, who subsequently referred additional producers within their network. This iterative process continued until a satisfactory sample size encompassing representatives from various towns across Bohol was attained, and upon completing the chain referral sampling survey, Batuan, Carmen, Catigbian, and Sagbayan towns emerged as focal points for adlay production (Fig. 1). This sampling strategy facilitated the comprehensive identification of adlay producers, providing a robust foundation for subsequent data collection and analysis.

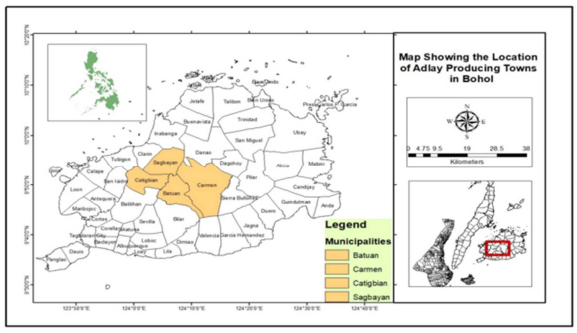

Fig. 1. Map showing the adlay-producing towns in Bohol, Philippines

Results and discussion

As presented in Table 1, the demographic profile of adlay producers indicates notable trends within the area. Analysis reveals that most (59%) of the producers are female, married individuals aged between 45 and 50, with less than five years of experience in adlay production. These findings suggest a recent onset of adlay production in the province, with a notable inclination towards female participation in production activities.

Table 1. Demographic profile of Adlay producers in Bohol, Philippines

Demographic profile	Frequency (N=41)	Percentage (%)
Sex		
Male	17	41
Female	24	59
Age		
20-25	2	5
26-30	0	0
35-40	3	7
45-50	17	41
55-60	9	22
65-70	8	20
75-80	2	5
Civil Status		
Single	5	12
Married	34	83
Widow/Widower	2	5
Number of years in Adlay production		
0-5	29	71
6-10	9	22
11-15	1	2
16-20	1	2
21-25	1	2

Table 2. Farm profile of adlay production in Bohol, Philippines

Demographic profile	Frequency (N=41)	Percentage (%)
Area (m^2)		
1	29	71
2	1	2
3	2	5
10	1	2
20	1	2
30	1	2
50	2	5
100	3	7
250	1	2
Ownership status		
Owned	17	41
Tenanted	10	24
Rented	0	0
Leased	14	34
Source of seeds		
Carmen	11	27
Batuan	3	7
Catigbian	21	51
Danao	1	2
Sagbayan	2	5
Bilar	1	2
Balilihan	1	2
Cebu	1	2
Quantity of harvest (Kg)		
1	19	46
2	9	22

3	2	5
5	5	12
10	1	2
15	1	2
25	1	2
50	1	2
75	1	2
100	1	2

In addition, Table 2 outlines the farm profile of adlay producers. Generally, the area allocated for adlay cultivation is limited to one square meter, aligning with the observation that adlay production in Bohol is a recent development. Most cultivated lands are owned individually, and farmers commonly obtain seeds from the Local Government Unit (LGU). The study identified 88 adlay cultivars in the province, with Catigbian's LGU contributing 47 cultivars. Moreover, most producers typically harvest an average of one kilogram per cropping, primarily utilized in crafting decorations and accessories. However, producers can generate quantities exceeding one kilogram in response to specific demands for adlay seeds.

Table 3. Production practices adopted by Adlay producers

Practices	Frequency (N=41)	Percentage (%)
Seed Preparation		
Soaking	16	39
Pre-germination	0	0
Direct Sowing	23	56
Transplanting	2	5
Planting Distance (m)		
0.06 x 0.06	22	54
0.025 x 0.025	15	37
0.03 x 0.03	0	0
1.0 x 1.0	4	10
Cropping System		
Monocrop	33	80
Intercrop	0	0
Mixed	8	20
Land Preparation		
Plowing		
Manual	4	10
Mechanical	0	0
None	37	90
Harrowing		
Manual	4	10
Mechanical	0	0
None	37	90
Planting		
Manual	41	100
Mechanical	0	0
Water Management		
Rainfed	41	100
Mechanical	0	0
Weed Management		
Manual	41	100
Mechanical	0	0

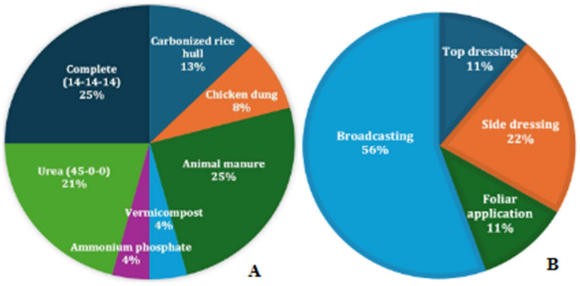

Fig. 2. Application of different types of fertilizers (A) and modes of application (B) observed among adlay producers

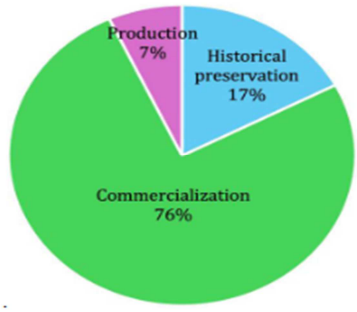

Fig. 3. Purpose of farmers in adlay production in Bohol, Philippines

Table 3 illustrates the production practices adopted by adlay producers. Data analysis indicates that the predominant practice among producers is direct sowing, with a planting distance of 0.06m x 0.06m. This finding suggests a deviation from the recommended planting distance of adlay, which is indicated at 1.0m x 1.0m (Aradilla, 2016; Aradilla, 2018), as observed in Bohol. Furthermore, most producers engage in monocropping due to the constraints of limited land allocated for adlay production. Due to the limited area, manual watering of adlay plants is the prevailing practice among producers. Similarly, manual weeding is extensively employed for weed management to mitigate weed incidence. Furthermore, producers commonly apply complete fertilizers and animal manure at one kilogram per square meter throughout the cropping season (Fig. 2A). The application methods predominantly involve broadcasting application (Fig. 2B).

Table 4 provides insights into the post-production practices adopted by adlay producers after harvesting.

The data indicates that most producers store adlay grains temporarily in unsealed jute sacks before processing them into accessories and decorations, as they believe this practice helps minimize grain deterioration.

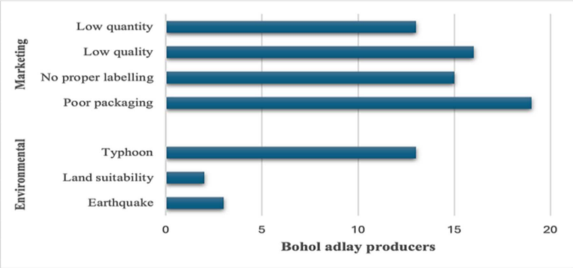

Fig. 4. Marketing and environmental constraints encountered by adlay producers

Table 4. Post-production practices of adlay producers in Bohol, Philippines

Post-production practices	Frequency (N=41)	Percentage (%)
Harvesting Schedule		
Weekly	17	41
Quarterly	2	5
If needed	22	54
Harvesting Methods		
Manual	41	100
Mechanical	0	0
Methods of storage		
Unsealed	27	66
Sealed	14	34
Duration of storage		
One day	9	22
Two days	4	10
Three days	5	12
Weeks	8	20
Months	15	37
Storage material		
Sack	25	61
Cellophane	16	39

As depicted in Fig. 3, most producers cultivate adlay for commercial reasons. Conversely, some prioritize preserving its historical importance, notably in Catigbian, Bohol. Nevertheless, in terms of consumption, there is a lack of enthusiasm among producers, indicating that adlay isn't widely embraced as a food source in the province. Many producers are unaware of adlay's edibility and nutritional value, leading to its limited utilization. This emphasizes the need to explore the potential of adlay cultivars in Bohol as a potential staple crop, warranting further research.

Moreover, adlay producers encounter obstacles related to environmental factors and marketing limitations (Fig. 4). Data collected indicates that typhoons significantly disrupt production in the province. Furthermore, concerns about the quality and quantity of yields and issues surrounding packaging and labeling require clarification within the marketing sphere. These findings highlight the early stages of adlay cultivation in Bohol and stress the need for comprehensive measures to raise awareness, enhance quality, and stimulate local demand. Likewise, continuous research engagements such as characterizing adlay cultivars and assessing their field performance to provide management practices for the producers are necessary to boost and sustain the adlay industry of the province.

Conclusion

Adlay production in Bohol has recently commenced, with a prevalent practice among Boholanos of cultivating adlay in limited spaces due to its current lack of popularity and low demand. To improve the industry's prospects, it is clear that an extensive information campaign is necessary. Despite some producers entering commercialization, challenges persist, particularly concerning low-quality and limited-quantity harvests, insufficient labeling, and inadequate packaging. As of May 2023, Bohol province has identified 88 adlay cultivars, with 15 originating from Batuan, 18 from Carmen, 47 from Catigbian, and 8 from Sagbayan. These findings highlight the region's early stages of adlay cultivation and stress the urgent need for comprehensive measures to raise awareness, enhance quality, and stimulate local demand. Likewise, continuous research engagements are necessary to explore its potential, disseminate information about its benefits, and provide management practices to boost and sustain the adlay industry within the region.

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