The Journal of Agricultural Sciences - Sri Lanka
Vol. 21 No 1, January 2026. pp 111-124
https://doi.org/10.4038/jas.v21i1.11228

RESEARCH

Feasibility Analysis and Identification of the Existence of *Ponelo* Rice as a Local Variety of *Gorontalo*, Indonesia

Z Abidin[1*], IM Sudiarta[2], U Ashari [1] and Syamsir [1]

Received: 29th September 2024 / Accepted: 17th October 2025

ABSTRACT

Purpose: *Rice is the primary staple food in many Asian countries, including Indonesia. In some regions of Indonesia, local rice varieties are cultivated, including in Gorontalo Province, where a local upland rice variety called Ponelo is grown. This rice is named after one of the islands in North Gorontalo Regency. This study aims to conduct a feasibility analysis and examine its existence.*

Research Method: *This study employed a mixed-methods approach with a predominance of qualitative approaches. The research was conducted from May to December 2024 in North Gorontalo Regency, Indonesia. Data were collected through snowball sampling techniques from various key informants, including farmers, agricultural extension workers, and related officials. Data analysis was carried out using the Miles and Huberman models, while agricultural feasibility was analyzed quantitatively using the agricultural income formula and benefit-cost (B/C) ratio.*

Findings and Values: *The results indicate that Ponelo rice farming is economically feasible based on agricultural income analysis, with the B/C ratio of 1.69, confirming its feasibility for cultivation. This type of subsistence agriculture slows the spread of Ponelo rice cultivation. However, the continued existence of Ponelo rice is sustained by farmers' cultural values, as they perceive its cultivation not merely as a means of fulfilling household needs but also as a cultural heritage to be preserved. When supported by appropriate agricultural development policies, this perspective can be a driver of regional food security in Gorontalo Province and, more broadly, in Indonesia.*

Keywords: *Local variety, Ponelo variety, Upland rice.*

INTRODUCTION

Indonesia possesses a rich diversity of rice, consisting of about 17,000 germplasm accessions, including some wild varieties (Maulana *et al.* 2014). As one of the centers of rice origin, Indonesia encompasses numerous regions with substansial potential for local seed sources (Susiyanti *et al.* 2020). Upland rice is a type of rice grown on dry land and represents a promising alternative for meeting food needs (Kadir *et al.* 2023). An expansion of rice field has not kept pace with increasing foof demand; therefore, one strategy to meet food needs is to develop local upland varieties (Rasyid *et al.* 2021).

Gorontalo Province has the potential to develop upland rice cultivation, covering an area of 274,595 ha (Rouf *et al.* 2023). However, only 0.8% of this potential land or only 2,201 ha of land is used for upland rice cultivation (*Gorontalo* Province Central Statistics Agency 2023).

[1]Department of Agribusiness, Faculty of Agriculture, Universitas Ichsan Gorontalo Ahmad Nadjamuddin Street No.17 Gorontalo City, Gorontalo, Indonesia, Postal Code: 96115 .

[2]Department of Agrotechnology, Faculty of Agriculture, Universitas Ichsan Gorontalo Utara Moluo, Kwandang, North Gorontalo Regency, Gorontalo, Indonesia, Postal Code: 96524.

*zainalabidin.unisan@gmail.com

These conditions indicate that opportunities for upland rice development in *Gorontalo* are substantial and require strategic efforts to expand effectively (Hipi *et al.* 2020). Data presented the *Gorontalo* Province Central Statistics Agency (2023) showed that the area of rice fields in *Gorontalo* Province is only 2.69% while non-rice fields are 78.84%, suggesting that sufficient land is available to support the expansion of upland rice farming in the province. According to (Wireko-Manu and Amamoo 2017), rice produced from widely distributed varieties is often perceived by farmers as superior to local varieties.

However, local varieties offer advantages, especially in terms of environmental adaptation and taste, and should thus be promoted to be more competitive. Meanwhile the modern rice varieties outperform local varieties in yield (Roy *et al.* 2014). However, local rice varieties demonstrate superior resilience to diverse weather stress conditions, greater durability, and favorable quality characteristics.

Local varieties are crucial in increasing food security (Sulandjari *et al.* 2023, Abidin & Syamsir 2024). Some regions in Indonesia have more than one local rice variety (Dwiningsih 2022). The upland rice of the *Ponelo* variety is a local variety of *Gorontalo* (Saleh *et al.* 2020). *Ponelo* itself is taken from the name of an island in *Gorontalo* Province (*Ponelo* Island) which is located in North *Gorontalo* Regency. In the context of local culture, *Ponelo* rice is part of the Pale tradition (local naming for rice) in *Gorontalo*. Its defining characteristic is the distinctive fragrant aroma, which allows it to be easily recognized by smell. The exploration of natural resources and the environment, including local commodities, is one of the efforts of the sustainable development strategy (Guampe *et al.* 2022). Thus, it is relevant to develop the *Ponelo* variety, a priority programs of the North *Gorontalo* Agriculture Office (Paputungan 2021).

In economic terms, local rice has a competitive advantage; its price is relatively higher than others due to the aroma and taste. In addition, in the socio-cultural context, local rice is not only a cultivated crop, but also an important part of people's lives, and even a cultural identity that plays an important role in the rituals of farming communities in rural areas.

Field rice can be one of the options to increase food security, supporting by the availability of dry land. Adequate references for the *Ponelo* variety in *Gorontalo* are limited, especially clear information about its existence, and an analysis of its income and feasibility. Thus, this study provides an overview of both of these issues. This research has two objectives. First, it aims to comprehensively describe the analysis of *Ponelo* rice farming business by conducting an economic analysis and the feasibility of *Ponelo* rice for cultivation. Second, it seeks to qualitatively search of the existence of *Ponelo* rice in *Gorontalo*, focusing on how the farmers' lives are related to *Ponelo* rice as a local variety, which continues to be cultivated to this day. This qualitative objective contextually identifies factors hindering its wider adoption, and the reasons why farmers choose to continue planting *Ponelo* rice.

This study employed a mixed-methods approach (Qualitative and Quantitative). with the type of field survey and exploratory research (Bungin 2007, Rahman *et al.* 2022). This method provides a complete picture of the distribution of the development of *Ponelo* rice varieties in *Gorontalo*. Highland rice is grown on dry land without being flooded. The potential for upland rice development in Indonesia is significant due to the extensive availability of dry land across the country (Yunus *et al.* 2018, Wijayanto *et al.* 2021). In several provinces on the island of Sulawesi, upland rice plays an important role in meeting the food needs of the community, especially in areas that do not have rice fields (Kikuta *et al.* 2020).

This study is a follow-up to previous research that revealed *Ponelo* variety as a local variety of *Gorontalo* with several advantages and high production potential (Megasari *et al.* 2020, Megasari *et al.* 2021). This present study examines the *Ponelo* variety from a socio-

economic perspective (existence and agricultural analysis).

MATERIAL AND METHODS

Study area

The research was conducted from May to December 2024. The initial location of the study was conducted on *Ponelo* Island, Poleno Islands District, North *Gorontalo* Regency, Indonesia (Fig. 1). The research location was selected based on the early history of Poleno rice originating from *Ponelo* Island which was then traced to its spread. This initial process includes an initial interview and preparation of the research flow, research questions, and research focus (Khoa *et al.* 2023).

Research informants

The research informants were determined by a purposive sampling method. Purposive sampling is a non-probability sampling technique, selected based on the knowledge or certain characteristics of informants that are relevant to the purpose of the research, such as in the case of selecting farmers who cultivate *Ponelo* rice varieties or agricultural officials who have relevant information (Ames *et al.* 2019).

The informants were divided into two categories. First, they were all farmers who cultivated *Ponelo* rice varieties as primary data needs in terms of analysis of *Ponelo* upland rice farming. The number of farmers interviewed was adjusted to the results of field findings regarding the actual number of farmers who planted *Ponelo* rice. Second, related government agencies, including agricultural extension workers, village governments, and agricultural office employees, were selected for primary and secondary data purposes regarding the distribution of *Ponelo* rice planting.

Data collection

Data were collected using the snowball sampling method with the initial informant being agricultural extension workers. Exploration was carried out in each area growing upland rice of the *Ponelo* variety in Gorontalo to obtain data on distribution of varieties. The data collection also combined several methods: observation, survey, and in-depth interviews. Qualitative research aims to interpret the meaning embedded within collected data and the insights obtained from field observations. According to Mohajan (2018), in-depth interviews are conducted with research informants using predetermined questions organized in a questionnaire format.

The interview used open-ended questions, enabling comprehensive exploration of information through an interactive interview process. This method provided researchers with richer and more nuanced insights into the phenomena under investigation. The interviews were recorded using a voice recorder and then transcribed. Consent was sought from the informants prior to the data collection.

Data analysis

This qualitative data was analyzed using the Miles and Huberman method (Data reduction, data view, conclusion) (Miles *et al.* 2013). This method was chosen because it aligns with the qualitative approach used in this study, particularly for processing descriptive data from in-depth interviews and field observations. This process allows researchers to systematically identify patterns, themes, and relationships between data. The final stage of this method was data triangulation to reduce the potential for data errors and validate the data (Shea 2022). Meanwhile, quantitative analysis on the economic feasibility was carried out by calculating production, costs, and income using the following formula.

$$GI = P \times H$$

GI = Gross income
P = Production
H = Rice price per Kg (USD/KG)

The Benefit - Cost ratio (BCR) was generated using the following calculation.

$$BCR = \frac{GI}{TC}$$

BCR = Benefit-Cost ratio

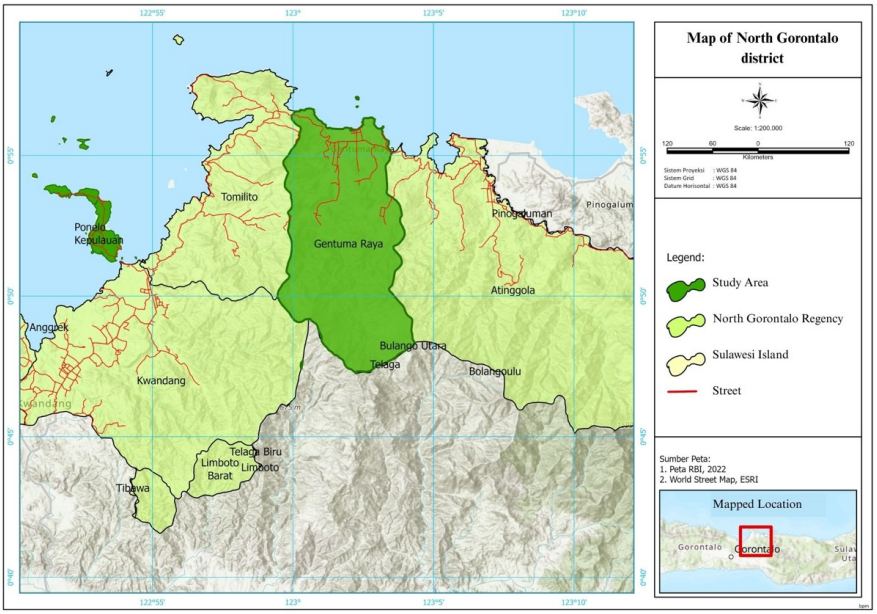

Figure 1. The Research Location, Gentuma Raya District, North *Gorontalo* Regency, *Gorontalo* Province, Indonesia. This image is a map of the northern island of Sulawesi, in the administrative area of *Gorontalo* Province, Indonesia.

GI = Gross income
TC = Total Cost

RESULTS AND DISCUSSION

Local varieties are an important asset to increase food security. The name *Ponelo* itself is taken from an island in *Gorontalo* Province (*Ponelo* Island) located in North *Gorontalo* Regency. According to Megasari *et al.* (2020), *Ponelo* as a local variety of *Gorontalo*, has several advantages, such as high yield potential, short harvest period, drought resistance, mild rice flavor and high protein content. Viandari and Anshori (2021) argued that upland rice has excellent potential even though it is limited. The exploration of natural resources and the environment, including local commodities, is one of the efforts of the sustainable development strategy.

This study did not determine the number of farmers to be informants, the number was adjusted to the criteria determined for the purpose of fulfilling the research data. The study found 38 farmers growing rice fields at the research site, following the characteristics of the farmers in Table 1.

The majority of farmers' education is elementary school graduates (52.63%), with even four farmers (10.53%) have never attended formal school. In term of age, the majority of farmers farmers are between 46 – 60 years old, indicating a relatively ageing farming population. Data on the education and age show weaknesses in the agricultural sector, including limited familiarity with technology and challenges related to farmer regeneration. Similar finding were reported by Tulungen (2022), who note that 91% in Indonesia are over 40 years old, with most of them between 50 – 60 years old.

Low education and the age of farmers are very serious challenges to farmer regeneration, with only 8% of young farmers aged between 20-39 years old engaged in farming. However, the data in Table 1 shows that farmers possess substantial farming experience; 68.42% have been involved in agriculture for 31–40 years.

This long experience is closely related to the type of commodity developed, namely upland rice. Farmers perceive upland rice farming to be maintained, even if they grow small quantities on narrow plots.

Table 1. Socio-Economic Characteristics of Rice Farmers in Langke Village, North *Gorontalo* Regency, Indonesia.

Variables		Amount	%
Sex	Male	38	100
	Female	0	0
Age (year)	<30	0	0
	30–45	7	18.42
	46–60	19	50.00
	61–75	12	31.58
Education Level	No Schooling	4	10.53
	Elementary School	20	52.63
	Junior High School	0	0.00
	Senior High School	14	36.84
	University	0	0.00
Farming experience (year)	10–20	0	0.00
	21–30	9	23.68
	31–40	26	68.42
	41–50	3	7.89
Land area (Ha)	0.5–1	13	34.21
	1.1–1.5	20	52.63
	1.6–2	5	13.16

Table 2. Agricultural Business Income in *Ponelo*'s Field Rice Farm, North *Gorontalo* Regency, *Gorontalo* Province, Indonesia.

	Gross Income	
1	Rice Production	325 Kg
2	Selling Price	1.19 USD
	Income [1]×[2]	386.78 USD
	Costs	Value (USD)
1	Fixed Costs	
	Land Tax	1.74
	Grass Cutting Machine Rental	8.26
	Depreciation of Tools	4.19
	Total Cost	14.19
2	Variable Costs	
	Production facilities	26.78
	Labor	102.50
	Total Cost	129.28
	Income	
1	Gross income	386.78
2	Total Cost	143.47
	income [1]−[2]	243.31
	B/C ratio	1.69

Economic feasibility

Ponelo rice is a plant that is managed on upland originating from Ponelo Island, North *Gorontalo* Regency, and has since spread to several areas. *Ponelo* upland rice production is generally influenced by land area, production facilities, weather, pests and plant diseases. The amount of *Ponelo* rice farming income depends not only on the production volume but also on the product's selling price. This agricultural income is the value of rice that is harvested and sold in the form of rice. Agricultural analysis data were taken from farmers as research informants. The average income from *Ponelo* rice farming is shown in Table 2. Table 2 shows that the average amount of rice production per respondent is 325 Kg per planting season. It is sold at an average price of 1.19 USD,/Kg per growing season. Thus, each respondent received income of 386.78 USD, per planting season. This income analysis assumes that farmers sell their rice crops. The cost incurred in *Ponelo* rice farming includes fixed costs and variable costs. Fixed cost components include land taxes, lawn mower rentals, and equipment depreciation. The variable cost component includes input usage and labor costs. The average fixed cost of upland rice farming is 14.19 USD/planting season, comprising a land tax fee of 1.74 USD, a lawn mower rental for land clearing of 8.26 USD, and a depreciation fee of 4.19 USD, The farming equipment used includes machetes, sprayers, and hoes.

The average variable cost of rice farming is 129.28 USD per planting season. Variable costs consist of the cost of production facilities and the use of labor. Production facilities include seeds, fertilizers, pesticides, and sack purchases, with an average cost of 26.78 USD per planting season. Family labor is used in land preparation, planting, fertilization, maintenance, harvesting, and post-harvest activities at an average cost of 102.5 USD per planting season. The use of family members as labor saves production costs in rice farming.

The income of the *Ponelo* upland rice farming business is obtained from the difference between rice sales (income) and agricultural costs incurred. Income is affected by production volume and the agricultural costs. Farming is considered profitable if the income is greater than the costs or vice versa. The average income earned from *Ponelo* upland rice farming is 386.78 USD/planting season. The total agricultural cost incurred is 143.47 USD/planting season. So, the average income obtained by the respondent farmers is 243.31 USD/planting season. The B/C ratio value obtained is 1.69, meaning that every increase in farm costs of 1 USD will result in a profit of 1.69 USD. Thus, it can be concluded that upland rice farming is profitable and feasible for farmers to cultivate. The B/C ratio value of *Ponelo* rice is high when compared to other field rice varieties, such as the research finding of Januarti *et al.* (2021), reporting that the B/C ratio of rice in Rawa Lebak fields is 1.31. Similiarty, Dedi *et al.* (2022) found that the B/C ratio of field rice is in Wonogiri Regenccy is 1.04.

The existence of Ponelo rice in Gorontalo

Ponelo rice in *Gorontalo* Province is concentrated in North *Gorontalo* Regency. This local rice has strong ties with some upland rice farmers in remote villages in North *Gorontalo*. Farmers grow local *Ponelo* rice not only to meet daily needs but also to maintain the existence of the *Ponelo* rice variety. *Ponelo* rice is planted by farmers in hilly areas in several areas in North *Gorontalo* Regency.

Several types of upland rice are cultivated by farmers in North *Gorontalo* Regency, including rice varieties provided by the Ministry of Agriculture for cultivation (the Inpago Fortiz 13), to increase the area of upland rice planting in *Gorontalo* Province. This effort is carried out in all districts in *Gorontalo* Province. The expansion of upland rice cultivation to maintain food security in Goronralo is based on the large number of vacant lands in the province.

Although there are official varieties provided by the Ministry of Agriculture, some farmers in North *Gorontalo* Regency still maintain the *Ponelo* rice variety and plant it every year. Farmers consider this variety superior to other upland rice varieties, as the rice produced has a

Table 3. Data on the area planted and harvested for upland rice in *Gorontalo* Utara Regency.

Subdistrict	Year 2019 (Ha)		Year 2020 (Ha)		Year 2021 (Ha)		Year 2022 (Ha)	
	Planting area	Harvest area	Planting area	Harvest area	Planting area	Harvest area	Planting area	Harvest area
Atinggola	454	364	277	267	220	220	220	220
Gentuma Raya	189	172	354	352	270	270	137	137
Kwandang	179	29	120	120	75	75	75	
Tomilito	504	359	84	76	155	155	79	
Ponelo Kepulauan	98	107	60	51	100	100	36	36
Anggrek	54	56	81	79	25	25		
Monano	4	4			10	10		
Sumalata	933	955	531	511	874	872	265	265
Sumalata Timur	29	29	125	125	10	10		
Tolinggula	35	35			5	5		
Biau	28	28	112	100	75	75		
Amount	2505	2138	1744	1681	1819	1892	812	658

Source: North Gorontalo Regency Agriculture Service (2024)

more fragrant taste and is more resilient to pests and diseases.

Ponelo rice developed by the farmers has thepotential to be developed or disseminated, because of the nature and environment adaptation process has been going on for a long time. Muehleisen *et al.* (2020) agree that the likelihood of adaptation of local plants is higher than that of non-local plants and the likelihood of contracting local plant diseases is smaller. Table 3 presents data on the upland rice planting and harvesting area in North *Gorontalo* Regency in 2019 - 2022. The data covers all upland rice varieties planted by farmers in North *Gorontalo* Regency. Although the number is limited, the existence of *Ponelo* rice in *Gorontalo* is maintained by the behavior and habits of farmers in mountainous areas. The results of our study show that *Ponelo* rice farming is economically profitable even though it is smaller than rice farming in rice fields.

The findings of this study contradict those reported by Tiruneh & Beshir (2021), who revealed that farmers intuitively maintain and choose the rice varieties to be planted based on the production outcomes; whereby higher-yielding varieties are more likely to be cultivated and sustained. In contrast, this study found that *Ponelo* rice farmers planted the variety not only for production reasons, but also the cultural values and long-standing traditions passing down from previous generations, reflecting a strong commitment to preserving *Ponelo* rice.

The distribution of *Ponelo* rice does not cover the entire area of *Gorontalo* Province. To date, *Ponelo* rice can only be found planted in Langke Village, North *Gorontalo* Regency. Many upland rice farmers have switched to corn due to the high price of corn commodities and declining soil fertility in several places, including on Ponelo Island. The number of farmers growing the rice is limited, the majority of farmers currently plant corn and coconut crops because they are considered more profitable. One of the officials at the Ponelo Village Office said that "in the past, many farmers on Ponelo Island planted rice in the mountains, but after the increase in corn prices, almost all of them switched to growing corn and no longer planted rice" (A Nusa, Personal Communication, July 13, 2024).

Likewise, one of the farmers who used to plant *Ponelo* rice said that "it has been a long time since I planted *Ponelo* rice, the soil structure has change. Rice plants used to be

more than 1-meter-high, after fertilization, the production was higher but the next planting was affected, resulting in infertile and dwarf crops. Additonally, the price of corn was getting higher, so they preferred to plant corn over rice" (R Djafar, Personal Communication, September 1, 2024).

For every 0.5 ha of land, approximately 4 kg of *Ponelo* rice seed is required, and fertilization is applied once per planting season, two weeks after planting. Compared with rice commonly cultivated in paddy fields, *Ponelo* rice exhibits relatively low productivity. According to *Ponelo* rice farmers and confirmed by agricultural extension officers at the North *Gorontalo* Agriculture Office, *Ponelo* upland rice production is considered high if it reaches 1.5 tons per hectare. Despite its low production, the selling price is quite high, reaching 1.19 USD/kg of rice, while the price of rice is approximately 0.74 USD/kg.

Agricultural patterns and culture of local rice farmers Ponelo

Farmers in Langke Village, especially those ccultivating *Ponelo* rice, considers planting rice in the mountains as a culture. They believe it as a heritage that must be preserved. Farmers have a habit of preserving and maintaining the availability of upland rice seeds, namely by a portion of their harvest for use in the subsequent planting season. They also keep some for consumption, which aims to ensure that farmers never run out of seed stock.

Ponelo field rice is planted on vacant land in hilly areas, and the planting schedule is adjusted to the entry of the rainy season in October – November. The harvest-age of *Ponelo* upland rice is longer than that of paddy rice. It is harvested when it enters the age of five months after planting. The existence of *Ponelo* rice is inseparable from the culture of indigenous peoples who have an understanding that rice is a staple food crop for humans. According to their beliefs, planting rie is must be done, even if not in the rice fields.

Ponelo rice farmers independently form their groups but are not well-structured, they group together for helping each other and harvest. This practice is a feature of small-scale subsistence farming to meet the family's food needs. However, the presence of institutions, such as farmer groups, plays an important role in agriculture as a forum for information sharing. This finding agrees with Loko *et al.* (2022) who argued that farmer groups are important in terms of disseminating information and adopting modern agricultural practices. Figure 2 illustrates a planting activity carried out by field rice farmers in Langke Village in November 2024, this planting activity is usually carried out in the morning and continued in the afternoon. In *Ponelo* rice planting requires no regular spacing, such as rice planting. The seeds planted are adjusted to the condition of the land, because there are still many remnants of land clearing on the planted land.

Culture of farmers in Langke village in Ponelo rice cultivation

There are special rituals carried out by several rice farmers in *Gorontalo*. This ritual is intended to ask for blessings from ancestors and nature, with the hope that farming activities will be smooth and production is abundant. During the planting season, farmers perform the Mopo'a Huta ritual (usually interpreted as feeding the soil in the hope of being given fertility). When the harvest season arrives, the ritual of Maa Ledungga (praying together and eating together) is performed as a gratitude for the harvest season. These rituals are also currently adopted into routine activities in many areas in *Gorontalo*. In addition to these traditions, there is a belief or culture in *Gorontalo* called Panggoba (people who have knowledge of planting time prediction). It is prediction of the initial planting schedule, which is believed to be hereditary, so that the rice planted does not coincide with the dry season or certain pest attacks. However, not all farmers play the role of Panggoba. It is only practiced by those who are considered traditional elders and have knowledge of the supernatural dimension.

In the cultivation of rice in the *Ponelo* field in Langke Village, North *Gorontalo* Regency.

(1) (2)

Figure 2. (1). The Process of Planting Paddy Fields in Langke Village (2). Ponelo Paddy Seeds. The left image is the planting of Ponelo rice by farmers in Langke Village, Gorontalo, Indonesia. Planting was carried out by men in hilly areas on November 21, 2024. The right image is the Ponelo rice seeds planted by farmers, obtained from the previous year's harvest.

Farmers plant rice with the Gotong Royong (working together) system or called Huyula or Mapalus. Most farmers plant with the Huyula or Mapalus system alse apply it at harvest time. In this Mapalus system, each landowner only provides food and is mostly done by men. In addition to the Mapalus culture, *Ponelo* rice farmers also adhere to the harvest sharing system. This custom forms a community to be stronger; the laborers used at planting is re-invited when the harvest arrives with a 20% share of the harvest given to the labores. So, the same labores are hired when planting and harvesting. These workers are usually also rice farmers or from other commodity farmers, who seek to obtain a share of the *Ponelo* rice harvest.

The majority of *Ponelo* rice farmland is far from the village with no vehicular access. All land can only be accessed on foot. Most farmers have garden houses or second houses, which they set up in their respective gardens. During the growing season, this garden house becomes a temporary residence until the planting season is over. Likewise, when the harvest season starts, farmers' gardens located in hilly areas is crowded with farmers' activities, even until night.

Farmers plant *Ponelo* rice seeds using Kalele (Fig. 3), a small knife that is inserted into the ground, followed by inserting 3 – 4 seeds into the soil. Another characteristic of planting *Ponelo* rice is the absence of treatment on the seeds before planting. In other rice farming, generally, the seeds are soaked first until they germinate. In contrast, *Ponelo* rice farmers plant seeds without this treatment.

In harvesting rice, farmers harvest *Ponelo* rice using a knife called Langgapa (small knife) (Fig. 3). The rice panicles are taken one by one then tied and hung in the storage room (each farmer's house). This method is believed to extend the shelf life of *Ponelo* rice, ensuring household food stocks or seeds for the next planting season.

According to the Head of the Gentuma Raya District Agricultural Extension Center, that "*Ponelo* rice farmers use natural pesticides. For example, when there is an attack of walangsangit pests, in paddy fields farmers usually have to spray chemicals. However, for upland rice, the pests are controlled naturally using leaves that walangsangit does not like. Chemical spraying has its effects. Usually, farmers only use herbicides before planting to clear weeds from the land. After planting, they no longer use pesticides, especially once the rice plants begin to bear grain, because it would definitely affect the quality of the rice produced." (P Berce, Personal Communication, August 20, 2024). The existence of *Ponelo* rice in *Gorontalo* has its own agricultural pattern that is maintained by farmers. They refer to traditional agriculture that considers the conservation of natural resources. One of the practices is the land rotation system, farmers with 3 or 2 lands do not plant all their land. For example, in one planting season, they only plant on one land; in the next planting

Figure 3. (1). Harvesting tool *(Langgapa)* (2). Planting tool *(Kalele)*. The left image is a harvesting tool used by farmers in Langke Village, *Gorontalo, Indonesia, Langgapa* clamped on the fingers of the hand and used to cut rice panicles. The right image is a planting tool, *Kalele* used by sticking into the ground to make a planting hole then followed by inserting 3 to 4 rice seeds.

season, they plant on the second land only. They believe that this system can restore soil fertility during planting breaks. The planting time of *Ponelo* rice adjusts to the weather (Panggoba). Usually, farmers plant in October - November, the planting time is adjusted to the beginning of the rainy season, so farmers only plant *Ponelo* rice once a year. This finding aligns with Yu *et al.* (2022), his research shows that crop and land rotation will maintain soil fertility and climate change so that it can be applied to the concept of sustainable agriculture. A strong understanding of indigenous knowledge systems for natural resource management contributes to ecological sustainability and spatial cultural diversity (Wang *et al.* 2021). The strong bond between *Ponelo* rice and the unique farmers in *Ponelo* rice farming encourages sustainable and ecological farming. It should be noted that traditional farmer knowledge needs to be combined with current knowledge. Traditional farmer knowledge leads to the conservation of natural resources to maintain food security (Zapico *et al.* 2020).

With regard to the customs and culture of the farmers, the local varieties have an intense bond with the farmers, some *Ponelo* rice farmers consider growing rice to maintain the main source of life and an emotional bond with the ancestors. The economic calculation are favorable with a B/C ratio of 1.69. However, when compared to other commodities, the productivity of *Ponelo* rice fields is very low, with the average production of 325 Kg/farmer. This figure proves that farmers cultivate *Ponelo* rice not only for income considerations. When examined in terms of how farmers maintain local varieties, similar patterns emerge across regions, despite variations in rituals and practices. Novita (2025) reported that local rice farmers in Kampar Regency consider not only economic aspects, but also emotional and cultural aspects in their farming decisions.

Ponelo rice farming is a type of subsistence agriculture without market orientation, this hindering the spread of *Ponelo* rice varieties. Only who farmers associating it with customs or culture continue to grow *Ponelo* rice. Currently, limited *Ponelo* rice farmers found in *Gorontalo*. The type of subsistence farming carried out by *Ponelo* rice farmers in North *Gorontalo* Regency makes *Ponelo* rice very expensive, Most *Ponelo* rice farmers limit the amount of rice they sell; even most farmers do not sell their crops at all. Despite the high demand of *Ponelo* rice, it is difficult to find the stocks available in the market. Such agriculture is popular in rural areas in many countries. Ismael *et al.* (2021) revealed that the use of narrow land for subsistence agriculture is a widespread practice in rural areas in developing countries. Achmad *et al.* (2022) argued that subsistence farming has a strong

foundation in maintaining family food security and conservative agricultural practice.

On the island of Sulawesi, several types of local field rice are identified. Amrin *et al.* (2025), conducted a study in Buton Regency, Southeast Sulawesi to examine upland rice farming practices in the region. The study identified three types of upland rice cultivated in Winning Village: bhae pongasih (black glutinous rice), bhae lambowau (red glutinous rice), and lawoto (white glutinous rice). Similarities can be observed between upland rice farmers in Buton Regency and *Ponelo* rice farmers in *Gorontalo*, particularly in their continued practice of upland rice farming, which they regard as a cultural heritage to be preserved.

However, distinct characteristics are also evident, especially for land cultivation. *Ponelo* farmers apply a land rotation system. Farmers in Winning Village plant their land for four seasons, then they move to new land and return to the original land for a few years afterwards, or have a longer time gap. In addition, ritual practices are a notable feature of upland farming in Winning Village, including the Khabelai ritual, which involves cutting down four trees on the land to be cultivated, followed by a two-day rest period before land clearing continues.

Research by Sukmawati *et al.* (2023), which was conducted in Polewali Mandar Regency, West Sulawesi, also examined the local wisdom of farm farmers. Their findings indicated some of the same agricultural patterns as *Ponelo* rice, such as the role of customs that are maintained in each process of field rice cultivation, from planting to harvest.

Even more extreme, they believe that failure to observe customary practices in upland rice cultivation may bring misfortune to their lives and families. However, in terms of production volume, the rice field in Polewali Mandar exhibits a higher level of productivity than *Ponelo* rice, reaching 2.1 tons/ha and increasing to 3.3 tons/ha per hectare with fertilization.

CONCLUSIONS

The rice cultivation culture adopted by *Ponelo* upland rice farmers needs to be seen as an opportunity for agricultural development directed at maintaining regional food security. Analysis of *Ponelo* upland rice farming business shows that this commodity is profitable, with a B/C ratio value of 1.69. *Ponelo* rice also has a high price and is in demand by consumers, especially those who are looking for healthy food without chemical residue contamination. Therefore, more concrete supporting policies are needed, such as local seed conservation programs, providing incentives to conservation farmers, and strengthening farmer groups to strengthen market access and dissemination. In addition, sustainable upland rice management also needs to be integrated in regional agricultural development planning, so that local potential such as *Ponelo* rice can continue to be preserved and developed optimally in the future. This study has several limitations, including the lack of detailed data on the number of farmers, harvest area, and *Ponelo* rice production volume. The data in Table 3 only illustrate planting area and harvest area of all types of field rice varieties in *Gorontalo*, rather than *Ponelo* rice specifically. This limitation also highlights a broader challenge for government decision-making, as the lack of comprehensive data on local rice varieties in *Gorontalo* constrains the formulation of evidence-based policies. Future efforts should therefore focus on improving data availability through the collaboration between researchers and relevant governments. In addition, many farmers remain strongly rooted in *Gorontalo* customs and predominantly use the *Gorontalo* language in daily communication, which poses challenges for researchers in obtaining more in-depth information.

Acknowledgements

The author would like to thank the Ministry of Education and Culture of the Republic of Indonesia, as the funder of this research, with letter number 0459/E5/PG.02.00/2024.

REFERENCES

Abidin Z, Syamsir (2024) *Sosiologi Pertanian dan Pola Hidup Masyarakat Marjinal*. Mitra Ilmu, Makassar, Indonesia.

Achmad B, Sanudin, Siarudin M, Widiyanto A, Diniyati D, Sudomo A, Hani A, Fauziyah E, Suhaendah E, Widyaningsih TS, Handayani W, Maharani D, Suhartono, Palmolina M, Swestiani D, Budi Santoso Sulistiadi H, Winara A, Nur YH, Diana M, Ruswandi A (2022) Traditional Subsistence Farming of Smallholder Agroforestry Systems in Indonesia: A Review. *Sustainability* 14(14), 1–33. https://doi.org/10.3390/su14148631.

Ames H, Glenton C, Lewin S (2019) Purposive sampling in a qualitative evidence synthesis: A worked example from a synthesis on parental perceptions of vaccination communication. *BMC Medical Research Methodology* 19(1), 1–9. https://doi.org/10.1186/s12874-019-0665-4.

Amrin IA, Janu L, Rahman H (2025) Petani Ladang di Desa Winning Kecamatan Pasar Wajo Kabupaten Buton. *Kabanti: Jurnal Kerabat Antropologi* 9(1), 112–124. https://doi.org/10.33772/2s977a56.

Bungin B (2007) *Metodologi penelitian kualitatif*. Grafindo Persada, Indonesia.

Dedi D, Harinta YW, Dewati R (2022) Komparasi Tingkat Produktivitas Padi Sawah dan Padi Gogo di Kecamatan Manyaran Kabupaten Wonogiri. *Journal of Agribusiness, Social and Economic* 2(1), 37–49. https://journal.univetbantara.ac.id/index.php/jase/article/view/2541.

Dwiningsih Y (2022) Rojolele: A Premium Aromatic Rice Variety in Indonesia. *Preprints*. 1–14. https://doi.org/10.20944/preprints202210.0373.v1.

Guampe FA, Zainal A, Amane APO, Nur M, Mahardhani AJ, Habibie FH, Hartati A, Pamuttu DL, Amruddin A, Akbar M (2022) *Pembangunan Pedesaan (Prinsip, Kebijakan dan Manajemen)*. https://repository.penerbitwidina.com/publications/558537.

Gorontalo Province Central Statistics Agency (2023) *Penggunaan Lahan Provinsi Gorontalo*. https://gorontalo.bps.go.id/id/publication/2024/08/15/643d40314697b37bfd390639.

Hipi A, Sumarno J, Rouf AA, Saleh TW (2020) Performance of several varieties of maize and upland rice in intercropping system in Northern Gorontalo. *IOP Conference Series: Earth and Environmental Science* 484(1), 012049. https://doi.org/10.1088/1755-1315/484/1/012049.

Ismael F, Mbanze AA, Ndayiragije A, Fangueiro D (2021) Understanding the Dynamic of Rice Farming Systems in Southern Mozambique. *Agronomy* 11(5), 1018. https://doi.org/10.3390/agronomy11051018.

Januarti I, Junaidi Y, Mulyana E (2021) Analisis Usahatani Padi Gogo di Lahan Rawa Lebak. *Agrisaintifika* 5(1), 32–39. https://doi.org/10.32585/ags.v5i1.1109.

Kadir M, Aty R, Chadijah St (2023) Yield performance of Sulawesi upland rice varieties. *Asian Journal of Research in Crop Science* 8(4), 145–150. https://doi.org/10.9734/ajrcs/2023/v8i4195.

Khoa BT, Hung BP, Hejsalem-Brahmi M (2023) Qualitative research in social sciences. *International Journal of Public Sector Performance Management* 12(1–2), 187–209. https://doi.org/10.1504/IJPSPM.2023.132247.

Kikuta M, Makihara D, Pasolon YB, Rembon FS, Miyazaki A, Yamamoto Y (2020) Agronomic traits and grain quality of upland rice in SE Sulawesi. *International cooperation in agriculture* 18, 41–47. https://doi.org/10.50907/jicad.18.041.

Loko YLE, Gbemavo CDSJ, Djedatin G, Ewedje E-E, Orobiyi A, Toffa J, Tchakpa C, Sedah P, Sabot F (2022) Characterization of rice farming systems. *Scientific Reports* 12(1), 3959. https://doi.org/10.1038/s41598-022-07946-2.

Maulana Z, Kuswinanti T, Sennang NR, Syaiful SA (2014) Genetic diversity of local rice germplasm. *International Journal of Scientific & Technology Research* 3(4), 198–202.

Megasari R, Darmawan M, Sjahril R, Riadi M, Pertiwi ED (2020) Pengujian sistem tanam legowo terhadap hasil padi gogo. *Agrium* 23(1).

Megasari R, R Araa, Darmawan M, Sudiarta IM, Andrian D (2021) Uji sistem tanam jajar legowo padi Ponelo. *Perbal* 9(1), 1–9.

Miles MB, Huberman AM, Saldana J (2013) *Qualitative Data Analysis*. SAGE Publications.

Mohajan HK (2018) Qualitative research methodology. *Journal of Economic Development, Environment and People* 7(1), 23–48.

Muehleisen AJ, Engelbrecht BMJ, Jones FA, Manzané-Pinzón E, Comita LS (2020) Local adaptation to herbivory in tropical trees. *Ecology* 101(11), e03151. https://doi.org/10.1002/ecy.3151.

Novita UD (2025) Mempertahankan varietas padi lokal. *Shar-E* 11(2), 100–111. https://doi.org/10.37567/shar-e.v11i2.4236.

Paputungan J (2021) Varietas Padi Ponelo Segera Dikembangkan. *Gorontalopost.id*. https://gorontalopost.id/2021/04/06/varietas-padi-ponelo-segera-dikembangkan/.

Rahman A, Sari NMW, Fitriani F, Sugiarto M, Sattar S, Abidin Z, Irwanto I, Nugroho AP, Indriana I, Ladjin N (2022) *Metode Penelitian Ilmu Sosial*. Widina, Makassar, Indonesia.

Rasyid A, Darmawan M, Sudiarta IM, Megasari R (2021) Pertumbuhan tanaman padi Ponelo pada pupuk nitrogen. *Perbal* 9(1), 10–17. https://doi.org/10.30605/perbal.v9i1.1559.

Rouf AA, Munawaroh S, Moko HD (2023) Pendapatan usahatani padi gogo varietas unggul baru. *Seminar Nasional Lahan Suboptimal* 10(1), 947p.

Roy S, Ali M, Jahan M, Saha U, Ahmad Hamdani MS, Hasan M, Alam MdA (2014) Evaluation of indigenous Boro rice varieties. *Life Science Journal* 11, 122–126.

Saleh TW, Sumarno J, Rouf AA (2020) Optimalisasi Lahan Budidaya Tumpangsari Padi dan Jagung: Pengaruh Kombinasi Varietas terhadap Produktivitas. *Jurnal Penelitian Pertanian Tanaman Pangan* 4(2), 105–111. https://doi.org/10.21082/jpptp.v4n2.2020.p105-111.

Shea T (2022) The potential for qualitative triangulation to mitigate investigative negligence. *Police Practice and Research* 23(2), 195–211. https://doi.org/10.1080/15614263.2021.1915786.

Sukmawati S, Kusmiah N, Kandatong H (2023) Kajian Kearifan Lokal Petani Padi Ladang Di Desa Ratte Kecamatan Tubbi Taramanu Kabupaten Polewali Mandar. *Jurnal Agroterpadu* 2(1), 120–129. https://doi.org/10.35329/ja.v2i1.3575.

Sulandjari K, Abidin Z, Lubis MM, Hastuti DRD (2023) Effect of Community Participation, Knowledge Transfer, Technology Adoption on Community Food Security and Agricultural Sustainability: A study on farmer entrepreneurs in Indonesia. *West Science Interdisciplinary Studies* 1(10), 1080–1091. https://doi.org/10.58812/wsis.v1i10.310.

Susiyanti S, Rusmana R, Maryani Y, Sjaifuddin S, Krisdianto N, Syabana MA (2020) The Physicochemical Properties of Several Indonesian Rice Varieties. *Biotropia* 27(1), 41–50. https://doi.org/10.11598/btb.2020.27.1.1030.

Tiruneh A, Beshir A (2021) Participatory Variety Selection in Upland Rice (Oryza sativa L.) at Guraferda District, South West Ethiopia. *Rice Research* 9(10). From: https://www.researchgate.net/publication/356749793.

Tulungen FR (2022) Strategic Programs to Release the Vision of Agriculture 5.0 in North Sulawesi, Indonesia to get much Income. *Budapest International Research and Critics Institute-Journal (BIRCI-Journal)* 5(4), 30247–30258. https://doi.org/10.33258/birci.v5i4.7183.

Viandari NA, Anshori A (2021) Rice cultivation on dry land during dry season supported by deep well irrigation and soil amelioration. *IOP Conference Series: Earth and Environmental Science* 672(1). 7–8 November 2020, Jember, Indonesia. https://doi.org/10.1088/1755-1315/672/1/012019.

Wang N, Fang M, Beauchamp M, Jia Z, Zhou Z (2021) An indigenous knowledge-based sustainable landscape for mountain villages: The Jiabang rice terraces of Guizhou, China. *Habitat International* 111, 102360. https://doi.org/10.1016/j.habitatint.2021.102360.

Wireko-Manu FD, Amamoo C (2017) Comparative Studies on Proximate and Some Mineral Composition of Selected Local Rice Varieties and Imported Rice Brands in Ghana. *Agriculture and Food Sciences Research* 4(1), 1–7. https://doi.org/10.20448/journal.512.2017.41.1.7.

Wijayanto T, Ramdayani, Arditya, Asniah, Suliartini NWS, Rahni NM, Afa LO (2021) Growth performance of several promising local upland rice (Oryza sativa L.) genotypes of Southeast Sulawesi. *IOP Conference Series: Earth and Environmental Science* 807(4), 042080. https://doi.org/10.1088/1755-1315/807/4/042080.

Yu T, Mahe L, Li Y, Wei X, Deng X, Zhang D (2022) Benefits of Crop Rotation on Climate Resilience and Its Prospects in China. *Agronomy* 12(2), 436. https://doi.org/10.3390/agronomy12020436.

Yunus F, Abidin Z, Xyzquolyna D (2018) Analisis Pendapatan Usahatani Jagung (Zea mays L.) pada Lahan Kering Desa Bakti Kecamatan Pulubala Kabupaten Gorontalo. *Agropolitan* 5(1), 28–37. From: https://www.neliti.com/publications/259198.

Zapico FL, Dizon JT, Fernando ES, Borromeo TH, McNally KL, Hernandez JE (2020) Upland Rice: Cultural Keystone Species in a Philippine Traditional Agroecosystem. *Asian Journal of Agriculture and Development* 17(2), 93–104. https://doi.org/10.37801/ajad2020.17.2.6.