 https://doi.org/10.1051/bioconf/20238007007

Using Superior Variety and Application of CI200 to Support Food Security in South Sumatra Swamp Land

Waluyo[1], *Agus* Suprihatin[2*], *Suparwoto*[1] and *Jumakir*[1]

[1]Research Center for Food Crops, National Research and Innovation Agency (BRIN), CWS CWS Palembang, Kancil Putih street, Rusa alley, Palembang city, South Sumatra 30137
[2]Research Center for Food Crops, National Research and Innovation Agency (BRIN), CWS KSE Achmad Baiquni, Babarsari Street, Tambak Bayan, Caturtunggal, Depok district, Sleman regency, DI Yogyakarta. 55281

Abstract. Swamp paddy fields with their various problems have enormous potential to support the achievement of national food security. Using superior varieties and determining the exact planting season in the swamp rice cultivation is expected to increase rice productivity and farmers' income per unit area. The research aims to increase rice production and assess the feasibility of CI200 in swamps. The study used an oversite design with 5 replications in a farmer's swamp land with an area of 1 ha, in the Gelebek Dalam village, Rambutan District, Banyuasin Regency, South Sumatra Province. Factors tested: 1) superior varieties, there are 4 varieties namely Inpari 32, Inpara 2, Mekongga, and Ciherang, 2) seasons, application of CI200 so that planting is carried out throughout the year, namely the DS (April-August 2021) and RS (October 2021-February 2022). Inpari 32 has the highest productivity compared to other varieties, reaching 6.98 t HDG ha^{-1}. The value of the B/C ratio reached 1.51-2.44 in DS and 1.09-1.98 in RS. Therefore, the application of the CI200 cropping pattern by using NSV which has been adapted can be widely developed to support food security in swamps land.

1 Introduction

Rice is the main food crop as a staple food in various parts of Indonesia. Rice farming in Indonesia is still the backbone of the rural economy. The availability of domestic rice stocks is very important in the framework of the sustainability of national food security, which is expected to be self-sufficient in food (rice) can be achieved [1]. The Ministry of Agriculture has targeted that Indonesia will be able to be self-sufficient in sustainable food since 2010. Increased production and productivity of food crops is one of the performance parameters of the Ministry of Agriculture.

In general, swamp land has not been exploited optimally for agricultural business, even though with the application of land management and management technology and the application of integrated agricultural commodities, swamp land can become one of the mainstay sources of agribusiness growth and national food security [2]. Swamps in South Sumatra Province have two types of swamps that have been used for rice, namely swamp lands covering an area of 285,941 ha and tidal lands covering an area of 273,919 ha. Banyuasin Regency is one of the regencies that have the widest swamp after Ogan Komering Ilir Regency and Ogan Ilir Regency [3].

The demonstration was an extension method that directly contacted primary and business farmers. Demonstration farming was a technique used to share research outcomes and practices to hasten the adoption of technology among users. It involved organizing various displays to showcase effective methods for promoting agricultural development. Demfarm could accelerate the adoption of agriculturally beneficial technology constructed by end-users according to the potential of the commodity This method was utilized to speed up adoption [4].

One of the main technological components that has been proven to increase rice production is the use of new superior varieties (NSV). The use of superior varieties has a very important role in efforts to increase rice productivity [5]. The use of NSV can increase farmers' productivity and income [6]. The varieties used must be certified superior varieties and follow the land to be used [7].

Superior rice cultivars are crucial to enhancing productivity, managing pests and diseases, improving fertilization efficiency, and adapting to adverse environmental conditions. Compared to other production technologies, superior varieties are accepted by farmers more quickly because they are more effective and efficient [8]. High-yielding varieties accounted for 56% of the production components, with the main focus being on increasing yield through the development and enhancement of new high-yielding varieties [9].

Inundation and drought that cannot be predicted with accuracy are the main obstacles to the development of lowland swamps which depend on hydrographic conditions, rainfall, and river water levels [10]. In general, rice productivity in lowland swamps is

* Corresponding author: at33ns@gmail.com

relatively low. The opportunity to increase production is quite large considering the area is quite large, the technology for its utilization is already available, and the agricultural cultivation applied by farmers is generally not as recommended.

Efforts to increase the productivity of food crops in swamp lands can be carried out by utilizing the land by intensifying the application of technology and expanding the planting area by increasing the cropping index (CI) [2]. The farmers' existing rice cultivation in swampy lands still implements CI100, a condition caused by high water stagnation during the rainy season and drought during the dry season [11].

Local farmers in swamp areas in Indonesia tend to avoid new superior varieties despite the fact that local rice varieties have lower productivity and longer lifespans [12]. The yield of rice in a swamp paddy field was below 3 t ha^{-1} during the second planting season. The rice sector's productivity may increase by increasing inputs or implementing innovative technology [13].

Three superior varieties were planted in Sungai Dua Village, Rambutan District, Banyuasin Regency have smaller B/C ratio values, namely IPB 3S (0.80), Inpari 32 (0.79), and Ciherang (0.74), were obtained [14]. Therefore, this study aims to increase rice production by implementing superior varieties that implement CI200 and to assess the feasibility of CI200 rice farming in swamp lands.

2 Method

The research was conducted in a 1-hectare shallow swamp farmer's paddy field, in Gelebek Dalam Village (-3.0633° S, 104.8522° E) Rambutan District, Banyuasin Regency, South Sumatra Province (Figure 1). Geographically, Banyuasin Regency is located at 02°43'48" - 03°09'00" South Latitude, and 104°10'48" - 105°07'12" East Longitude.

Fig. 1. Research location of swamp paddy field, Gelebak Dalam Village, Rambutan District, Banyuasin Regency, South Sumatra Province.

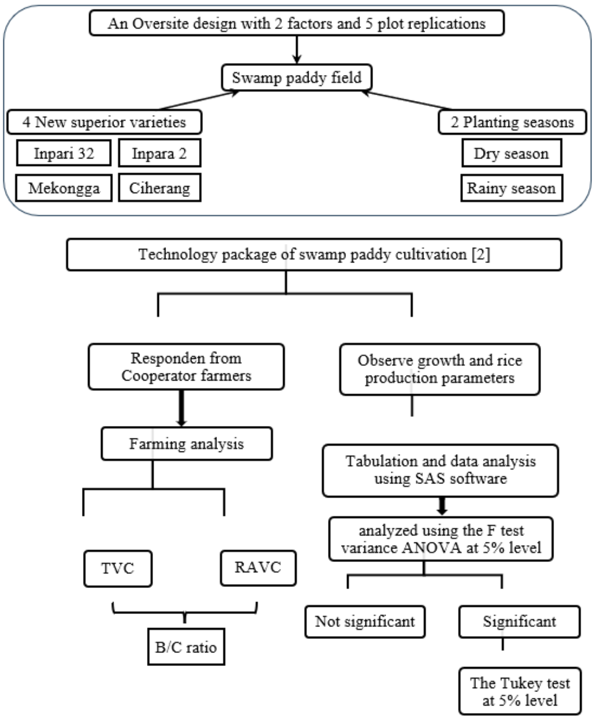

Fig. 2. Research location of swamp paddy field, Gelebak Dalam Village, Rambutan District, Banyuasin Regency, South Sumatra Province.

This study used an oversite design with 5 replications. There are 2 factors tested, namely 1) Varieties, there are 4 superior varieties, namely Inpari 32, Inpara 2, Mekongga, and Ciherang. 2) planting season, there are 2 planting times, namely dry season (April-August 2021) and rainy season (October 2021-February 2022). The technology package utilized for cultivating swamp rice is available for reference in Table 1.

Table 1. Components of shallow swamp rice cultivation technology [15]

Technology component	Research Activities	
Planting Season	April-August (DS)	October-February (RS)
Seedling Age (DAP)	25-30	25-30
Number of seeds per clump	2-3	2-3
Seed needs (kg ha^{-1})	25-30	25-30
Planting distance (cm)	25 x 25	25 x 25
How to plant	transplanting	transplanting
Variety	superior variety	superior variety
Water management	naturally	naturally
Fertilization (kg ha^{-1})	*PUTR*, LCC	*PUTR*, LCC
Manure	1 t ha^{-1}	1 t ha^{-1}

Soil processing	tillage	tillage
Pests and diseases	integrated	integrated
Harvest	90 % flowering	90 % flowering

DS: dry season; RS: rainy season; DAP: day after planting; PUTR: swamp soil test device; LCC: leaf color chart.

Parameters observed included: 1) characteristics of the study area, 2) growth parameters (plant height and number of productive tillers), and crop production (number of filled grains, number of empty grains, thousand grains weight, and harvest dry grains (HDG), and 3) farm analysis (costs, revenues, profits, and the value of the B/C ratio). Plant samples were taken randomly, each parameter consisting of 10 plants. Grain production data was taken with 5m x 5m tiles 3 times. The rice growth and production parameters' data were analyzed using SAS software through an Oversite design. Meanwhile, Analysis of the financial feasibility of rice farming includes net income and the value of the B/C ratio using the input-output analysis method [16].

$$B/C\ ratio = \frac{(RAVC)}{TVC} \quad (1)$$

Description:
B/C ratio = Revenue to cost ratio
P = Rice selling price (IDR kg^{-1})
TVC = Total cost (IDR ha^{-1} $season^{-1}$)

$$RAVC = (Q \times P) - TVC \quad (2)$$

Q = Total rice production (kg ha^{-1} $season^{-1}$)
Meaning:
B/C ratio > 1, farming is feasible
B/C ratio = 1, The farm is at the break-even point
B/C ratio < 1, farming is not feasible

3 Result and discussion

3.1 The research site characteristics

The area of swamps in Rambutan District reaches 28,158 ha, 46.70% of the total area of the sub-district, consisting of 12,134 ha (20.12%) of shallow swamp lands, 7,504 ha (12.44%) of middle swamps and 7,504 ha (12.44%) of deep swamps 8,520 ha (14.13%). Shallow swamp land has the potential to be developed into lowland rice fields [3]. Gelebak Dalam village has a land area of 3.77% (16,98 km^2) of the Rambutan District, Banyuasin Regency [18].

The development of swamp land for agricultural activities, especially rice plants, has various obstacles, both physical and socio-economic constraints. To increase rice production in lowland swamps, it is necessary to adapt water management technology for the cultivation of food crops as a result of the effects of climate change by controlling the height of groundwater and rivers to reduce flooding or inundation of lowland swamps [18].

The land at the study site has a flat to undulating relief so that the higher parts of the swamp land are planted with rice first, followed by the lower parts of the swamp. The condition of the research land has a low fertility rate with an acid soil pH (4.2 – 5.4) so the application of fertilizer and liming will be very beneficial. Irrigation systems in swamps are almost completely natural, flooded during the rainy season and dry during the dry season. The main obstacle faced in increasing production is inundation or drought which cannot be predicted precisely.

The average yield of swamp rice in Gelebak Village, Rambutan District during the first planting season amounted to 4.11 t ha^{-1}. In contrast, the productivity of swamp rice during the second planting season was recorded at 2.64 t ha^{-1}. Rice plants contain aerenchymal tissues that permit air passage to organs (roots) that are buried in wet soil, so rice plants can adapt to paddy fields that are always or occasionally flooded with water [19]. Sustainable land management in sub-optimal wetlands can be implemented through three approaches, namely water, soil, and plant management [20].

Applied CI200 cropping pattern on swamp land of Ogan Ilir Regency, South Sumatra namely rice planting in the dry season is carried out in February-May, the age of the seedlings is 30-40 DAP, while during the rainy season it is carried out in October-February, seedling age 25-30 DAP. The number of seeds is 2-3 per hole and the number of seeds is 40 kg ha^{-1} [21].

Several factors that need to be considered in developing CI200 cropping patterns are a) sufficient water availability including time and duration of availability, b) soil conditions including physical, chemical, and soil surface characteristics, c) altitude above sea level, especially its relation to air temperature, soil, and water, d) existence of chronic and potential plant pests and diseases, e) availability and accessibility of rice types and varieties, f) accessibility and smoothness of production results with infrastructure support, g) capital capacity of farmers to develop these cropping patterns, and h) socio-cultural characteristics of farmers related to technology adoption and development [21].

3.2 Growth and productivity of rice in swamp land

Growth parameters such as plant height and number of productive tillers were not significantly different between superior varieties planted both in the rainy and dry seasons. Meanwhile, the production parameters such as the number of empty and filled grains and HDG productivity were significantly different between superior varieties and planting seasons. Planting superior varieties of rice during the rainy and dry seasons provides a significant interaction on the thousand grains weight (Table 2).

The height of the superior varieties of rice tested has moderate postures, with a plant height of 90-125 cm [22]. The Inpara 2 variety has a lower posture compared to the other varieties tested, while Ciherang has a taller plant posture (Table 3). The shorter rice posture is generally liked by farmers because the plants will fall

Table 2. Anova table for plant height, number of productive tillers, number of empty grains, number of filled grains, thousand grains weight, and harvest dry grains as influenced by superior varieties and planting season

Dependent variables	plant height		number of productive tillers		number of empty grains		number of filled grains		thousand grains weight		Harvest Dry Grains	
	MS	F value	MS	F value	MS	F value	MS	F value	MS	F value	MS	F value
Varieties (V)	315.67	1.77ns	154.67	0.58ns	12.09	2.35ns	6747.29	316.03**	0.09	43.00**	4.44	29.09**
Season (S)	422.50	2.36ns	102.40	0.38ns	24.03	4.68*	172.23	8.07*	0.04	18.00**	1.40	9.19*
V x S	196.97	1.1ns	238.67	0.89ns	1.76	0.34ns	10.56	0.49ns	0.01	3.67*	0.02	0.11ns

*,** Significant difference at 0.05 and 0.01 probability levels, respectively; ns: nonsignificant.

due to the wind blowing, but at the time of the research, none of the varieties collapsed. The difference in plant height of the four varieties tested was due to genetic factors and environmental influences, such as soil fertility, spacing, water conditions, and temperature [23]. Plant height is one of the selection criteria for rice plants, but high posture does not guarantee high production [24] and productivity [25].

Table 3. Rice growth and productivity parameters of several superior varieties were planted during the dry and rainy seasons.

Factor	Parameter			
	plant height (cm)	**number of productive tillers**	**number of empty grains**	**number of filled grains**
Varieties:				
Inpari 32	99.6 a	16.8 a	13.8 a	192.7 a
Inpara 2	95.5 a	16.4 a	12.8 a	151.1 b
Mekongga	103.4 a	14.0 a	12.1 a	141.3 c
Ciherang	108.7 a	23.2 a	11.2 a	135.0 c
Season:				
Dry	98.55 a	16.0 a	11.7 b	157.1 a
Rainy	105.05 a	19.2 a	13.25 a	152.95 b

Different letters in the same column indicate significant differences according to the F test (P ≤ 0.05).

The Ciherang variety has a higher number of productive tillers per clump compared to other varieties, while the Mekongga has the lowest number of productive tillers (Table 3). According to Ramadhani et al [26] research, the Ciherang varieties display more productive tillers per clump and demonstrate resistance to pests and adaptability. The difference in the number of productive tillers is caused not only by the type of variety but also by environmental factors. As stated by Waluyo and Suparwoto [25] which stated that the height of waterlogging in swamps greatly affects the number of tillers. Factors that influence tiller formation are spacing, fertilizer, varieties, and planting season [27]. Genetic and environmental factors determine the growth and development of plants. The number of productive tillers is a factor that greatly influences rice productivity [28].

The number of filled grains of the superior varieties tested was independently influenced by genetic (variety) and environmental (season) factors, while the number of empty grains was strongly influenced by the environment (Table 2). Lack of water at the flower formation stage will cause a decrease in the number of grains per panicle, but if it occurs at the pollination/fertilization stage it will cause an increase in the number of empty grains per panicle [29]. The percentage of the number of empty grains to the number of filled grains of the superior varieties tested has a value of less than 10%. The Inpara 32 variety had the highest number of filled grains compared to other varieties, and the highest number of empty grains occurred during the rainy season (Table 3). The high or low percentage of filled grains per panicle is caused by differences in response and resistance of each variety to unfavorable environmental conditions, especially during the reproductive phase.

Table 4. The thousand grains weight (g) of several superior varieties planted during the dry and rainy seasons

Season	Varieties			
	Inpari 32	**Inpara 2**	**Mekongga**	**Ciherang**
Dry	27.2 ab	27.0 c	27.28 ab	27.2 ab
Rainy	27.24 ab	27.14 bc	27.3 a	27.24 ab

Different letters in the same column indicate significant differences according to the F test (P ≤ 0.05).

The use of high-yielding rice varieties and the determination of the planting season provide a very real interaction with the parameter weight of a thousand grains. The highest of a thousand grains weight was achieved by the Mekongga variety which was planted in the rainy season. Meanwhile, the Inpara 2 variety planted during the dry season had the lowest thousand grains weight (Table 4). The high and low rice grains per panicle are caused by differences in response and resistance of each rice variety to unfavorable environmental conditions, especially during the reproductive and ripening phases. The higher the percentage of rice grains, the lower the percentage of empty grains.

The Inpari 32 variety had the highest productivity of 6.98 t HDG ha^{-1}, and the Ciherang variety had the lowest productivity of 5.03 t HDG ha^{-1} (Table 5). Paddy cultivation in swamps during the rainy season can produce 5.0-6.0 t HDG ha^{-1} [12]. Ciherang planted during the rainy season in swamp rice fields in Kotadaro II Village, Rantau Panjang Regency, Ogan Ilir District, South Sumatra also produced a productivity of 5 t ha^{-1} [30]. Inpari is more suitable in swampy rice fields which are inundated most of the year [12]. Swamp rice cultivation by using new superior varieties can reach productivity up to 5.0-7.0 t HDG ha^{-1} [31] and 10 t ha^{-1} [32]. The capacity of plants to relocate assimilates during seed filling and accumulate dry matter before heading affects the variation in rice yield [33].

Table 5. The harvest of dry grains from several superior varieties planted during the dry and rainy seasons

Season	Varieties				mean
	Inpari 32	Inpara 2	Mekongga	Ciherang	
Dry	7.27	5.90	5.50	5.30	5.99 a
Rainy	6.70	5.40	5.17	4.77	5.51 b
mean	6.98 a	5.65 b	5.33 b	5.03 b	(-)

Different letters in the same column indicate significant differences according to the F test ($P \leq 0.05$).

Table 5. showed that planting superior varieties of rice in swamps can be carried out throughout the year because they are not affected by the choice of planting season, whether the dry or rainy season. This is as conveyed by Waluyo and Suparwoto [34] and Paiman *et al.* [12] stated that one of the efforts to improve and maintain national food security is through the use of suitable and adaptive varieties, both location and season-specific.

Superior rice varieties reliably boost output because they yield more, are more resistant to disease attacks and pests, have shorter lives [12,35,36], and have fluffier tastes [35]. Rice varieties with high yields must have a yield index of 0.45–0.50, medium plant age (100–120 days), and a yield potential of 10 t ha^{-1} in the dry season and 7–8 t h^{-1} in the rainy season [37]. The yield potential of a rice variety is determined by four components, namely panicle length, number of grains per panicle, percentage of filled grains, empty grains, and thousand grains weight [38].

Based on the results of the correlation analysis, show that the plant height parameter has a positive correlation with a thousand grains weight, with a correlation coefficient of 0.72. The parameter of the number of filled grains is very significantly positively correlated with harvested dry grains, with a correlation coefficient value of 0.97 (Table 6). This shows that a higher number of filled grains will further increase the productivity of harvested dry grains per unit area. Therefore, efforts to increase rice productivity in lowland swamps can be made by increasing the number of filled grains per panicle, not per plant cluster. This can be seen in Table 6. that the number of productive tillers per clump is not significantly correlated with rice productivity, namely the number of filled grains and harvested dry grains.

Table 6. Correlation analysis between parameters observed in swamp rice cultivation using CI200

Parameter	NPT	TGW	HDG
PH	0.46999	0.72079*	-0.50352
NG	-0.21435	0.63453	0.97453**

*,** Significant difference at 0.05 and 0.01 probability levels, respectively; NPT: number of productive tillers; TGW: thousand grains weight; HDG: harvest dray grains, PH: plant height; NFG: number of filled grains.

The Ciherang variety with a higher number of productive tillers and a taller plant posture, but with the lowest number of filled grains, and lowest productivity compared to other superior varieties. Therefore, the selection of rice varieties greatly determines the productivity of rice in swamps. Compared to higher posture plants, the moderate posture is typically more resilient to falling over brought on by the wind or other cultivation variables [39].

The introduction of NSV is expected to be able to increase rice yield compared to varieties that have been commonly planted in previous seasons. The results of the study by Sirappa et al. [40] showed that the introduction of new superior varieties of rice supported by appropriate cultivation technology could increase yields by 21-54%. Therefore, the achievement of a variety must be supported by technology and an optimal growing environment. Lowland rice farming on shallow land has been found to significantly improve production. The rice production in microclimates within the South Sumatra Province contributes to national rice production.

3.3 Feasibility of CI200 Rice Farming in Swamp land

The results of the analysis of the feasibility of rice farming from the four varieties tested and planted at the time DS and RS provided quite diverse income, net revenue, and B/C ratio values. Rice farming of the Inpari 32 variety that is planted during the dry and rainy seasons provides the highest profit value in terms of cash and total costs compared to other superior varieties. Meanwhile, the Menkongga variety planted during the dry and rainy seasons provides the lowest profit value in terms of cash or total costs. Therefore, the value of the B/C ratio of rice farming that planted the Inpari 32 variety throughout the year had the highest values, namely 2.45 (Table 7) and 1.98 respectively (Table 8). This shows that the CI200 cropping pattern in swamp paddy fields using superior varieties is very feasible to develop on a large scale.

Table 7. Farming analysis of swamp rice cultivation using several superior varieties in the dry season (Maret-July)

No	Production facilities	Unit	Unit price (IDR)	Amount (IDR)
1.	Seeds (kg)	30	10,000	300,000
2.	Fertilizer			
	Urea (kg)	150	2,250	337,500
	Phonska (kg)	150	2,300	345,000
	Manure (kg)	1,000	500	500,000
3.	Pesticides			
	Reagent (250 ml)	1,500	71,500	572,000
	Antracol 70 WP (500 g)	3,500	155,000	1,085,000
	Sidamethrin 50 EC (400 ml)	3,200	42,000	336,000
	Spontam 400 SL (500 ml)	3,500	60,000	420,000
	Amount (IDR)			**3,550,500**
4.	Labor (man.days)			
	Land processing	35	50,000	1,750,000
	Nursery	5	50,000	250,000
	Planting	20	50,000	1,000,000
	Weeding	20	50,000	1,000,000
	Fertilization	5	50,000	250,000
	Spraying	5	50,000	250,000
	Harvest and post-harvest	50	50,000	2,500,000
	Amount (IDR)			7,000,000
	Total cost (IDR)			**10,550,500**
5	Income (IDR)			
	Inpari 32 (kg)	7,250	5,000	36,250,000
	Inpara 2 (kg)	5,900	5,000	29,500,000
	Mekongga (kg)	5,500	5,000	27,500,000
	Ciherang (kg)	5,300	5,000	26,500,000
6	Net Revenue (IDR)			
	Inpari 32			25,699,500
	Inpara 2			18,949,500
	Mekongga			16,949,500
	Ciherang			15,949,500
7	B/C ratio			
	Inpari 32			2.44
	Inpara 2			1.80
	Mekongga			1.61
	Ciherang			1.51

Table 8. Farming analysis of swamp rice cultivation using several superior varieties in the rainy season (October-February)

No	Production facilities	Unit	Unit price (IDR)	Amount (IDR)
1.	Seeds (kg)	30	10,000	300,000
2.	Fertilizer			
	Urea (kg)	150	2,250	337,500
	Phonska (kg)	150	2,300	345,000
	Manure (kg)	1,000	500	500,000
3.	Pesticides			
	Reagent (250 ml)	1,500	71,500	572,000
	Antracol 70 WP (500 g)	3,500	155,000	1,085,000
	Sidamethrin 50 EC (400 ml)	3,200	42,000	336,000
	Spontam 400 SL (500 ml)	3,500	60,000	420,000
	Klerat/rat poison (kg)	10	69,950	699,500
	Amount (IDR)			**4,250,000**
4.	Labor (man.days)			
	Land processing	35	50,000	1,750,000
	Nursery	5	50,000	250,000
	Planting	20	50,000	1,000,000
	Weeding	20	50,000	1,000,000

	Fertilization	5	50,000	250,000
	Spraying	5	50,000	250,000
	Harvest and post-harvest	50	50,000	2,500,000
	Amount (IDR)			7,000,000
	Total cost (IDR)			**11,250,000**
5	Income (IDR)			
	Inpari 32 (kg)	6,700	5,000	33,500,000
	Inpara 2 (kg)	5,400	5,000	27,000,000
	Mekongga (kg)	5,200	5,000	26,000,000
	Ciherang (kg)	4,700	5,000	23,500,000
6	Net Revenue (IDR)			
	Inpari 32			22,250,000
	Inpara 2			15,750,000
	Mekongga			14,750,000
	Ciherang			12,250,000
7	B/C ratio			
	Inpari 32			1.98
	Inpara 2			1.40
	Mekongga			1.31
	Ciherang			1.09

Shallow and middle swamps could apply CI100 and CI200 planting patterns throughout the year. However, the deep swamps are only implemented CI100 during the dry season [41]. Rotation of superior varieties planted is necessary to prevent the explosion of pests and diseases. However, this will cause a loss of information when the highest productivity is achieved by one superior variety in the swamp paddy field. At the beginning of the rainy season, NSV should be selected which is resistant to planthoppers and resistant to several diseases. The selection of NSV must pay attention to the existence of endemic pests and diseases. In brown planthopper endemic areas, the use of Mekongga, Ciherang, Cibogo, Inpari 2, and Inpari 3 varieties is highly recommended, while those that are endemic to tungro should be planted with Inpari 7, 8, and 9. Planthopper pest populations are more numerous during RS compared to DS, while borer attacks are not looking at the season [21].

4 CONCLUSION

The Inpari 32 variety had the highest productivity of 6.98 t HDG ha^{-1}. The value of the B/C ratio reached 1.55-2.45 in the DS and 1.13-1.98 in the RS. This shows that the application of the Rice Cultivation Technology Package in Lebak rice fields using superior rice varieties effectively supports the implementation of CI200. Therefore, the application of the CI200 planting pattern using the adapted NSV can be widely developed to support food security in swamp lands.

References

1. A. Suryana. Orasi Pengukuhan Profesor Riset Bidang Sosial Ekonomi Pertanian, Badan Litbang pertanian. Bogor (2007)
2. Waluyo, Fuadi Irsan, dan Yanter Hutapea, *Inovasi teknologi pengelolaan sumberdaya lahan rawa lebak di Sumatera Selatan*, dalam Buku Bunga Rampai Teknologi Unggulan Pengelolaan Lahan Sub Optimal di Sumatera Selatan, Unsri Press, Palembang (2021)
3. Badan Pusat Statistik Sumsel, *Luas lahan menurut penggunaan di Sumatera Selatan*, dalam Badan Pusat Statistik Provinsi Sumatera Selatan, Palembang (2022)
4. T. Kartinaty, R. Massinai, D. P. Widiastuti, J. TABARO, **5**(2): 20-29 (2022)
5. Kiswanto dan F. Y. Adriyani, *Uji adaptasi varietas unggul baru padi sawah di Kecamatan Pubiana Lampung Tengah*, dalam Prosiding Seminar Nasional Pengkajian dan Diseminasi Inovasi Pertanian Menduking Program Strategi Kementrian Pertanian Buku 2, Balai Besar Pengkajian dan Pengembangan Teknologi Pertanian, Cisarua 9-11 Desember 2010, Bogor (2011)
6. F. D. Arianti, R. Nurlaily, M. N. Setiapermas, *Peningkatan produktivitas padi melalui penggunaan varietas unggul baru dan pemupukan di lahan sawah tadah hujan*, dalamProsiding Seminar Nasional Teknologi Pertanian Kesiapan Sumber Daya Pertanian dan Inovasi Spesifik Lokasi Memasuki Era Industri 4.0, Balai Besar Pengkajian dan Pengembangan Teknologi Pertanian, pp 191-196, Bogor (2020)
7. I. N. Arnama, Perbal: Jurnal Pertanian Berkelanjutan **8** (2): 166-175 (2020)
8. Y. Rina and K. Koesrini, J. Researcher. Question. Plant. Food, **2**(2): 85-94 (2018) doi: 10.21082/jpptp.v2n2
9. N. Chairuman, J. Pertan. Trop., **1**(1): 47–54 (2013) doi: 10.32734/jpt.v1i1.2867
10. Helmi, Jurnal Pertanian Tropik, **2**(2):78- 92 (2015)
11. E. Saleh, C. Irsan, M. U. Harun, *Evaluasi pola tanam pada lahan rawa lebak dangkal Ogan Keramasan*, dalam Laporan Penelitian, Universitas Sriwijaya, Palembang (2013)

12. Paiman, Ardiyanta, M. Ansar, I. Effendy, and B. T. Sumbodo, Agricultural Science, **8**: 300–309 (2020)
13. D. Abubakar, L. Anggraeni, and A. Fariyanti, J. Ekon. And Wise Developer, **8**(2): 120–144 (2019) doi: 10.29244/jekp.8.2.2019.120-144.
14. Y. Nearti, B. Fachrudin and N. Jayanti, Sriwijaya J. of Environment, **7**(2): 118-128 (2022) http://dx.doi.org/10.22135/sje.2022.7.2.118-128
15. Waluyo, F. Irsan and Y. Hutapea. *Inovasi teknologi pengelolaan sumberdaya lahan rawa lebak di Sumatera Selatan,* dalam Bunga Rampai Teknologi Unggulan Pengelolaan Lahan Sub Optimal di Sumatera Selatan, hal: 108-127, UNSRI Press, Palembang (2021)
16. R. Hendayana, *Analisis data sosial ekonomi: Cerdas dan cermat menggunakan alat analisis data untuk karya tulis ilmiah*, IAARD PRESS, Bogor (2015)
17. BPS. *Kecamatan Rambutan dalam angka*. Penerbit: BPS Kabupaten Banyuasin, Pangkalan Balai, 137 p (2022). https://banyuasinkab.bps.go.id/publication/download.html?nrbvfeve=MjI0ZDU0NTc3YzUwY2UyZWIwYWYwOWNh&xzmn=aHR0cHM6Ly9iYW55dWFzaW5rYWIuYnBzLmdvLmlkL3B1YmxpY2F0aW9uLzIwMjIvMDkvMjYvMjI0ZDU0NTc3YzUwY2UyZWIwYWYwOWNhL2tlY2FtYXRhbi1yYW1idXRhbi1kYWxhbS1hbmdrYS0yMDIyLmh0bWw%3D&twoadfnoarfeauf=MjAyMy0wOS0yMyAyMTo0OTo1Mw%3D%3D
18. A. N. Triana, *Kajian pengelolaan tanah dan air lahan rawa lebak*, dalam Prosiding Seminar Nasional Hari Air Dunia, 21 Maret 2019, Palembang (2019)
19. R. Velásquez, F. García, D. Diamont, M. Perdomo, G. Torrealba, Agronomía Trop. **64** 39–47 (2014)
20. M. E. Armanto, R. H. Susanto, and E. Wildayana, Sriwijaya Journal of Environment. **2**(1): 1-7 (2017)
21. Balibangtan, Agroinovasi, dalam Sinar Tani, Edisi 8-14 Februari No. 3443 XLII, Jakarta (2012)
22. IRRI, Standard Evaluation System for Rice (SES), International Rice Research Institute, Philippines (2002)
23. Waluyo, Suparwoto, dan Sudaryanto, J. Hidrosfir Indonesia **3**(2): 57–66 (2008)
24. Suprapto dan A. Dradjat. Buletin Plasma Nutfah Vol. **11** No. 1 (2005)
25. Waluyo dan Suparwoto, *Pemanfaatan lahan rawa lebak dalam mendukung ketahanan pangan melalui teknologi spesifik lokasi di Sumatera Selatan*, dalam Prosiding Seminar Nasional Membangun Good Govermance Menuju Desa Mandiri Pangan dan Energi Menuju ERA MEA, FakultasPertanian Sebelas Maret, 27-28 April 2016, Surakarta (2016)
26. S. Ramadhani, N. B. Astuti, and M. Mahdi, JOSETA J. Socio-economics Trop. Agric., **1**(3): 68–77 (2019) doi: 10.25077/joseta.v1i2.147
27. H. R. Sugeng, *Bercocok Tanam Padi*, CV Aneka Ilmu, Semarang (2001)
28. O. S. Lesmana, H. M. Toha, I. Las, dan B. Suprihanto, *Varietas unggul baru padi*, Balai Penelitian Tanaman Padi, Sukamandi (2004)
29. Sujinah dan A. Jamil. Iptek Tanaman Pangan, **11**(1): 1-7 (2016)
30. Irmawati, H. Ehara, R. A. Suwignyo, and J. I. Sakagami, Trop. Agr. Develop. **59**(1): 35-39 (2015)
31. Suparwoto, Waluyo, dan Syahri, Laporan akhir: PTT lahan rawa lebak Kabupaten Ogan Ilir Sumatera Selatan. Balai Pengkajian Teknologi Pertanian Sumatera Selatan (tidak dipublikasi), Palembang (2014)
32. M. D. Hapsah, *Potensi, peluang, dan strategi pencapaian swasembada beras dan kemandirian pangan nasional*. dalam Inovasi Teknologi Padi Menuju Swasembada Beras Berkelanjutan. Buku Satu. Balitbangtan, Badan Litbang Pertanian, Hal. 55-70, Jakarta (2005)
33. A. Hambali dan I. Lubis, Bul.Agrohorti **3**(2): 137–14 (2015)
34. Waluyo dan Suparwoto. *Pengkajian beberapa varietas unggul baru (VUB) padi di lahan rawa lebak kabupaten Ogan Komering Ilir Sumatera Selatan*, dalam Prosiding Seminar Nasional Lahan Suboptimal. Universitas Sriwijaya, 08-09 Oktober Palembang (2015)
35. M. N. H. Miah, T. Yoshida, Y. Yamamoto, and Y. Nitta, J.Crop Sci. **65**: 672–685 (1996)
36. Arinta dan I. Lubis, Buletin Agrohorti, **6**(2): 270-280 (2018)
37. A. Dobermann and T. H. Fairhurst, Better Crops International Special Suplement, **16**: 7-11 (2002)
38. S. Yoshida, *Fundamentals of rice crop science*, International Rice Research Institute, Los Banos, Laguna, Philippines (1981)
39. Sobrizal and M. Ismachin, Plant Mut. Rep. **1**(1) 18–21 (2006)
40. M. P. Sirappa, A. N. Susanto, dan Y. Tolla, Jurnal Pengkajian dan Pengembangan Teknologi Pertanian, Vol. **9**(1): 18-28 (2006)
41. Y. Pujiharti, Jurnal Litbang Pertanian, **36**(1):13-2 (2017)