

# Determinants of VUB Innovation Adoption in Rice Productivity Improvement Program

Valeriana Darwis<sup>1\*</sup>, Lira Mailena<sup>2</sup>, Chairul Muslim<sup>1</sup>, Muhammad Syakir<sup>3</sup>, Sutardi<sup>4</sup>

<sup>1</sup> Indonesia Center for Agricultural Socio Economic and Policy Studies, Jl. Tentara Pelajar No. 3B Cimanggu Bogor West Java, Indonesia 16161

<sup>2</sup> Indonesian Center for Agricultural Technology Assessment and Development, Jl. Tentara Pelajar No. 10, Bogor, West Java, Indonesia

<sup>3</sup> Plantation Research and Development Center. Jl. Tentara Pelajar No. 1, Kampus Penelitian Pertanian, Cimanggu, Bogor, Indonesia 16111

<sup>4</sup> Yogyakarta Assessment Institute for Agricultural Technology. Maguworharjo 22nd, Karang Sari, Wedomartani, Ngemplak, Sleman, 55584 Yogyakarta, Indonesia

**Abstract.** New Superior Varieties (VUB) is a cultivation technology innovation that is continuously being developed by Balitbangtan. The average production addition of inbred rice seed is about 1.5% per year. Inbred rice varieties include Inpari 62 varieties, Inpago 18 varieties, and Inpara 11 varieties. Currently, farmers have used 25 varieties of Inpari, and 5 varieties of Inpago. This means that the use of VUB at the farm level is not optimal yet. Therefore, the aim of this paper is to determine the determinants of VUB adoption in the rice productivity improvement program. Data were collected using a questionnaire filled out via google form from 30 BPTP. Respondents consisted of 180 researchers and 113 extension workers. Data were analyzed using Analytical Hierarchy Process. The results of the analysis showed that the success of VUB adoption is influenced by determinants such as: (i) the nature of VUB innovation according to farmers' preferences, (ii) easy seed distribution and (iii) dissemination by improving technical guidance. The use of VUB can be increased by taking into account: (i) user preferences and according to the location of planting, and (ii) involving local breeders in overcoming availability and serving as a pilot location.

## 1 Introduction

Technological innovation is the most important source of agribusiness growth. Technological innovation has a very strategic role in supporting the development of a dynamic, efficient, and highly competitive agribusiness business system. Technological innovations continue to be developed and implemented in an effort to increase productivity, as mandated in Permentan No.03/Kpts/HK.060/I/2005.

Balitbangtan as the source of technological innovation applies it through three stages of activities, namely: (1) research activities that produce technology components, (2) assessment activities by utilizing agricultural technology components resulting from

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\* Corresponding author: [valicfurca@gmail.com](mailto:valicfurca@gmail.com)

research activities, and (3) dissemination activities that produce recommendations of location-specific technology packages.

One of technological innovations included in the agricultural development program handled by Balitbangtan is the New Superior Varieties (VUB). Some usage programs of VUB that have been implemented by Balitbangtan include: Special Efforts to Increase Rice, Corn and Soybean Production, Serasi Program with the target of empowering swamp land covering 1,600 hectares in the provinces of West Kalimantan and South Sumatra, as well as the Sustainable Food Torch Strengthening Program (OPAL).

The use of New Superior Varieties can improve the quality and quantity of crops and thereby can improve the welfare of farmers as well [1]. Although the government has carried out activities to increase the use of VUB, in the field this activity has not been maximally successful. This was due to several new high yielding varieties released each had certain characteristics that were different from the previously released VUB rice [2]. The yield potential of a variety can only be achieved if it is grown under suitable growing conditions for the variety [3].

Some other things that should be considered in improving rice productivity besides the use of seed are: the problem of decreasing high salt content in some places [4] and fertilization use in rainfed lowland areas must be adjusted to the status of the soil and the needs of the plants [5]. From the above problem, the purpose of this paper wants to know the problem of VUB adoption in the program that has been implemented by Balitbangtan

## **2 Methodology**

The research was conducted in 2020 using secondary and primary data. Secondary data was obtained from the relevant agencies and primary data was obtained from researchers and extension workers from 30 BPTP as an executor of the rice productivity improvement program.. Collection of primary data used questionnaires that contains a comparison question of pairs of determining factors on: (i) the nature of VUB innovation, (ii) the distribution of VUB seeds and (iii) the dissemination of VUB seed innovation. The three determining factors are used to suggest alternatives to improve the application of rice VUB innovation in the future.

The selection of respondents in each BPTP is submitted to the person in charge of the activity. Questionnaire collection was conducted for 4 months and questionnaires collected as many as 293 pieces. The questionnaire was filled by 180 researcher respondents and 113 extension respondents. The primary data that has been collected is analyzed using Analytical Hierarchy Process (AHP).

## **3 Results And Discussion**

### **3.1 New Superior Varieties**

Rice crop is a very strategic crop from the perspective of: (i) economy since it is widely cultivated by farmers and farmworkers and livelihood for RMU and traders as well, (ii) social, because it is a staple food of Indonesian society and (iii) politics, because it relates to the issue of staple food, the price stability and availability becomes one of the government's priorities.

National rice production in 2019 based on Indonesian statistics decreased by 4,596,501 tons compared to rice production in 2018. The decrease in rice production is due to several factors, including: (1) irrigation networks in many rice fields that are not maintained or damaged so that efforts to increase the intensity of rice harvest is increasingly difficult to

realize, (2) the conversion of rice fields to non-agricultural use so that the area of rice fields is getting narrower, (3) new rice field printers are increasingly difficult to realize due to limited land resources that can be used as rice fields and government budget limitations and (4) efforts to increase rice production are increasingly difficult to realize due to the phenomenon of land exhaustion rice productivity response to the use of inputs is getting smaller.

There have been many government programs issued to meet basic food needs and increase rice productivity,. These policies or programs include Bimas, Inmas, Insus, Supra Insus, Sutpa, Inbis, P2BN and UPSUS rice, corn and soybeans. In each program is usually introduced New Superior Varieties (VUB) to be planted. VUB the most common type or variety issued by the government is Inbrida and annually experiences an increase of 1.51% (Table 1). But when viewed annually, the development of seeds spread is experiencing fluctuating developments. In 2015 the total production of inbrida rice seed amounted to 83,585 tons, then rose to 99,173 tons in 2016. In 2017 it dropped to 79,199 tons and in 2018 again rose to 83,916 tons.

**Table 1.** Development of Rice Seed Production Inbrida Class Seed Spread (Ton)

Island	Years				
	2015	2016	2017	2018	Average increase per year (%)
Sumatera	25,651	32,751	22,731	15,923	-10.9
Jawa	36,771	33,571	22,515	38,970	10.5
Bali, West Nusa Tenggara (WNT), East Nusa Tenggara (ENT)	6,602	9,089	8,919	7,846	7.9
Kalimantan	3,294	7,712	8,466	8,688	48.8
Sulawesi	10,121	15,607	16,730	11,478	10.0
Maluku	871	751	298	507	-1.3
Irian Jaya	227	627	454	454	49.5
Indonesia	83,585	99,173	79,199	83,916	1.51

Source : [6]

The spread of rice varieties in 2019 covers an area of 12,843,096 ha that consist of variety of Ciherang, Mekongga, Situbagendit, Cigeulis, Ciliwung, Cilamaya Muncul, Inpari 30 Ciherang Sub1 and Inpari 32. The data shows that the spread of rice varieties is still dominated by the old varieties, while the new superior varieties have not widely used by farmers. While in the website of the Center for Research of Rice Plants Balitbangtan Ministry of Agriculture, several types of rice VUB that have been released until 2020 include: (i) Hybrid Rice (Hipa) as many as 19 varieties, (ii) Inbrida Padi Sawah (Inpari) as many as 62 varieties, (iii) Inbrida Padi Gogo (Inpago) as many as 18 varieties and Inbrida Padi Rawa (Inpara) as many as 12 varieties. The reason is that many farmers still use old varieties such as Ciherang, Mekongga and IR64, due to the lack of communication between groups of institutions with one another and the relationship between institutions is still transactional [7].

Rice productivity improvement programs that implemented at the location of respondents include: Upsus Pajale, Serasi, Agricultural Area Development, Food Barns, Seed Independent Village and IP Improvement. While the types of VUB in the program and used by farmers include: (i) Inpari, IR 64, Cigeulis, Ciherang and Mekongga on irrigated rice fields; (ii) Inpara, Banyuasin, Cisantana, Margasari and Martapura on swamp rice paddy fields and (iii) Inpago, Situ Patenggang, Situ Bagendit, Batu Tegi, Sigambiri, Unsoed, Luhur and Rindang on gogo rice paddy fields (Table 2)

**Table 2.** Productivity Improvement Program and VUB Usage at Farmer Level

Program	New Superior Varieties		
	Rice Paddy Irrigation	Swamp Rice	Padi Gogo
<ul style="list-style-type: none"> <li>- UPSUS Pajale</li> <li>- Serasi</li> <li>- Pengembangan Kawasan Pertanian</li> <li>- Lumbung Pangan</li> <li>- Desa Mandiri Benih</li> <li>- Peningkatan IP</li> </ul>	Inpari 6, Inpari 9, Inpari 10, Inpari,11, Inpari 16, Inpari 22, Inpari 24, Inpari 26, Inpari 27, Inpari 28, Inpari 29, Inpari 30, Inpari, 32, Inpari 33, Inpari 34, Inpari 35, Inpari 36, Inpari 38, Inpari 39, Inpari 40, Inpari 41, Inpaari 42, Inpari 44, Inpaari 47, IR 64, Cigeulis, Ciherang, Mekongga	Inpara 1, Inpara 2, Inpara 3, Inpara 4, Inpara 5, Inpara 6, Inpara 7, Inpara 8, Inpara 9, Inpara 10, Inpara 11, Inpara 12, IR 42, Banyuasin, Cisantana, Margasari, Martapura	Inpago 8, Inpago 9, Inpago 10, Inpago 11, Inpago 12, Situ Patenggang, Situ Bagendit, Batu Tegi, Sigambiri Putih, Sigambiri Merah, Unsoed 1, Unsoed 2, Towuti, Rindang 1, Rindang 2, Luhur 1, Luhur 2

### 3.2 Determinants of VUB Innovation Implementation

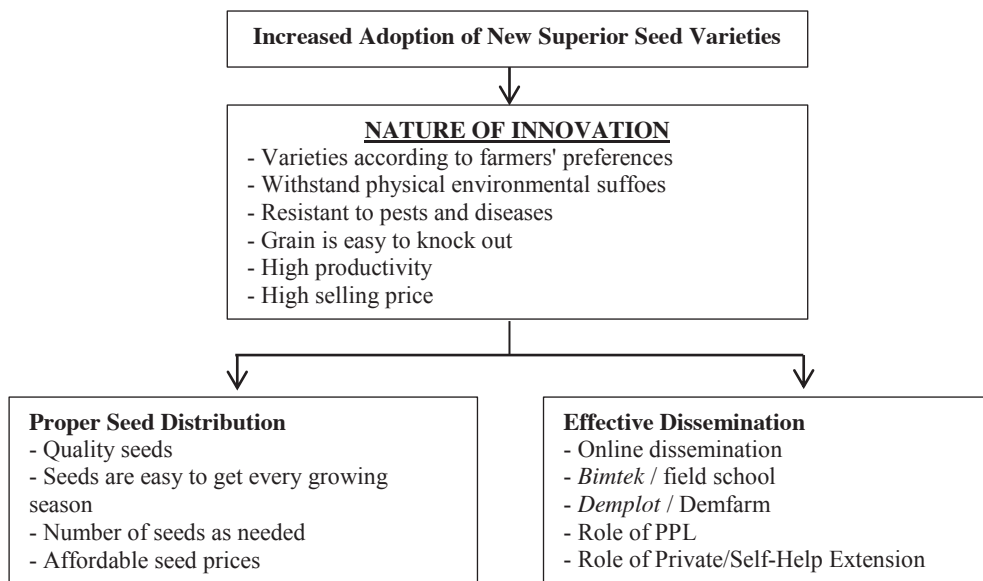
In strengthening the development of the seed sector, there are several determining factors that must be considered namely farmers' preferences [8], farmer perception [9], the performance of VUB itself [10] and the use of certified seeds [11]. The use of certified rice seeds will have good growth power, varietal purity and a known lifetime, with good quality, rice plants will grow more uniformly, thereby maximizing yields when harvested. Preference is influenced by three factors, namely: (i) seed algae (long slim grain shape, clean yellow grain color, heat, >90% growth, and simultaneously rejuvenated growth); (ii) crop (disease resistant, sturdy/rebah-resistant stems, plant height 90-105 cm, productive number of sapleds 25, upright flag leaf position and low loss rate); and (iii) post-harvest (market guarantee, higher price, easy to sell, >60% yield, and pulen rice flavor) [12].

Especially in West Java [13], factors that affect the spread of rice VUB which is subsequently adopted by farmers are: (i) Rice yield (rice ratio: dry grain harvest) : 60-70 percent, (ii) - Productivity (yield) : 7-9 t/ha GKP, (iii) - Biotic intolerant (low temperature tolerant, High Al, High Fe, Salinity) and Abiotic (WBC, HDB, Tungro, Blast), (iv) Characteristics of grain (slim / long shape, straw yellow grain color / herang) – Medium-Premium White Rice, (v) Characteristics of rice (slim shape, clear white color without lime grains, slightly pulen-pulen texture, good rice taste) – Medium-Premium White Rice, and (vi) Availability of seeds (BS, FS/BD/White Label, SS/BP/Purple Label) and ScatterEd Seeds (ES/BR/Blue Label).

Technological innovations in this study focus also on farmers perception of the performance of VUB which is devoted to (i) technological excellence seen from the durability of varieties to physical environmental stranglehold, pests and diseases, (ii) grain that is easily knocked out, and (iv) technological advantages that seen from productivity and high selling prices. Delivery of VUB is divided into two main factors, namely seed dissemination and distribution system. The dissemination of innovation is described again as the method used and implementing the innovation. Furthermore, the proper distribution of seeds is spelled out on the quality of the seeds distributed, the ease of obtaining seeds in each growing season, the number of seeds available and the price of seeds (Figure 1).

Determining factors of the profit of the nature of innovation VUB rice obtained through a comparison of pairs by giving importance weight to six predetermined factors. Furthermore, the results of the analysis are used as the determining factor for each element that becomes the focus of evaluation of the application of technology. From the results of

weighting is seen to be the most important determining factor in the feedback on the application of technology is the suitability of rice varieties with the preferences of farmers, with a weight of interest of 0.24995 (Table 3). Ranked second and third as the determining factors in the adoption of innovation VUB rice is: high productivity (0.22055) and pest-resistant diseases (0.19121).



**Fig. 1.** Determinants of VUB Innovation Implementation

The results of the three most important determining factors reflect the rationality of the answers from respondents who describe rice farming is intended for the achievement of high production, with low pest attacks. In addition, rice production is produced according to the tastes or desires of farmers.

**Table 3.** Matrix Comparison Pairing Factors Determining the Advantages of Innovation Properties VUB Padi

Element Factors Advantage Nature of Innovation	Conformity with farmers' preferences	Withstand physical environmental suffoes	Resistant to pests and diseases	Easy Grain To Knock Out	High Productivity	High Selling Price	Weights	Ranking
Conformity with farmers' preferences	1	2.8788	2.3034	3.7381	2.0064	1.144	<b>0.24995</b>	<b>1</b>
Withstand physical environmental suffoes		1	1.292	4.1792	1.0135	1.5018	<b>0.17146</b>	<b>4</b>
Resistant to pests and diseases			1	4.4472	1.5777	1.9873	<b>0.19121</b>	<b>3</b>
Easy Grain To Knock Out				1	3.7628	1.8070	<b>0.05018</b>	<b>6</b>
High Productivity					1	1.8788	<b>0.22055</b>	<b>2</b>
High Selling Price						1	<b>0.11665</b>	<b>5</b>
<b>CI = 0.07375</b>								

Quality seed is the most important determining factor in the distribution of VUB rice seeds. This is represented by the weighted results of 0.37067 (Table 4) In addition to

quality seeds, there are two other determining factors with the order of second and third interests after quality seeds. The second most important determining factor is the seed that is easily obtained every growing season with a weight of 0.36972. Furthermore, the third most important determining factor is the affordable seed price with a weight of 0.12984. From the results of this analysis can be concluded that to succeed the distribution of VUB seeds into the hands of farmers, then all that is needed is: the seeds distributed are quality seeds, the seeds are easy to obtain, especially when they want to be planted, the price of seeds is affordable and the number of seeds available as needed.

**Table 4.** Comparison Matrix Pairs Determining Factors VUB Rice Seed Distribution

Elements of Rice VUB Seed Distribution	Quality seeds	Seeds are easy to obtain every growing season	Number of seeds as needed	Affordable seed prices	Weights	Ranking	
Quality seeds	1	3.6649	4.9900	3.22483	<b>0.37067</b>	<b>1</b>	
Seeds are easy to obtain every growing season		1	3.8582	2.16617	<b>0.36972</b>	<b>2</b>	
			Number of seeds as needed	1	3.64473	<b>0.12977</b>	<b>4</b>
				Affordable seed prices	1	<b>0.12984</b>	<b>3</b>
<b>CI = 0.01932</b>							

Methods of online dissemination, technical guidance/field school, demplot/demfarm, the role of service extension / civil servants and private extension are determining factors that are believed to affect the effectiveness of innovation dissemination VUB Padi. Based on the paired comparison matrix in the AHP which results in weighting and ranking it is known that technical guidance and field schools remain the first priority determining factors in the dissemination system (Table 5).

**Table 5.** Comparison Matrix Paired Determining Factors Of Dissemination of Innovation of VUB Rice Seeds

Elements of Innovation Dissemination VUB Padi	Online dissemination	Technical guidance/Field School	Demplot / Demfarm	Role of Extension Service / Civil Servants	The Role of Self-Help Extension / Private	Weights	Ranking	
Online dissemination	1	0.72994	0.47038	0.5803	0.59536	0.09133	5	
Technical guidance/Field School		1	1.6045	2.1988	2.6183	0.34540	1	
			Demplot/Demfarm	1	2.6949	3.0019	0.29264	2
				Role of Extension Service / Civil Servants	1	3.0149	0.16788	3
					The Role of Self-Help Extension / Private	1	0.10274	4
<b>CI = 0.04306</b>								

Technical guidance is equipped with demplot and demfarm to be the user's choice as shown in Table 5 where the demplot becomes the second priority rank with a weight of 0.29264. This result is very reasonable because through technical guidance farmers can improve knowledge and understanding of rice VUB followed by a plot to provide evidence to farmers so that farmers are confident of adopting VUB rice. Technical guidance will

increase: (i) farmers' skills to work effectively and efficiently [14] and (ii) increase farmers' awareness to explore and receive information on technological innovations [15]. The role of service extension and civil servants becomes the third determining factor in the running of effective dissemination as an information provider, facilitator and farmer partner in the application of rice VUB.

### 3.3 VUB Innovation Implementation Improvement Strategy

Strategy to improve the application of rice VUB seed innovation is obtained from previous analysis, namely from the calculation of the right seed distribution ranking and effective dissemination. Alternative improvements that need to be done, in order for the adoption of technology, namely: (a) mapping the adaptation test and needs of rice VUB, (b) improvement of seed breeding innovation, (c) development of seed breeder group, (d) development of extension capacity, (e) subsidy program and price incentive.

From the results of AHP analysis, the most important thing to improve the application of VUB innovation adoption, especially in the availability of VUB varieties are: the varieties provided should pay attention to the suitability of local land or specific locations and the guarantee of availability (Table 6). Ranked second improvement required in the spectrum of excellence nature of innovation is the improvement of seed innovation. This means that breeders or breeders are still required to produce varieties desired by farmers or rice agribusiness players. Thus, to improve the innovation research system where innovation of superior varieties is oriented to the user of the seed and not based on the preferences and preferences of researchers or breeders.

On the contrary, spectrum of distribution of innovation and dissemination of innovation is ranked as the second strategy by developing seed breeder groups. This option is very suitable in the perspective of the distribution of varieties VUB rice will be very fast if its existence is around the location of the farmer itself, because it is provided by the breeders. This process will quickly get to farmers if dissemination is carried out by breeders who are not far from the domicile of rice farmers.

The last rank in the spectrum of innovation nature is an improvement in the development of extension capacity. This is a very interesting finding, because it represents the absence of information about the cultivation is not an obstacle for farmers to cultivate. This condition reinforces policy advice for the government to increase the existing counseling capacity. This is because information from existing extension workers do not provide input for farmers.

**Table 6.** Alternative Priorities for Improving the Implementation of Innovation VUB Padi

Alternatives to Improving The Application of Rice VUB/Feedback Elements	Innovation Nature Excellence		Innovation Distribution		Innovation Dissemination	
	Weights	Ranking	Weights	Ranking	Weights	Ranking
Mapping the suitability and needs of VUB	0.27724	<b>1</b>	0.37047	<b>1</b>	0.33721	<b>1</b>
Improvement of Seed Innovation	0.26541	<b>2</b>	0.19940	<b>3</b>	0.20515	<b>3</b>
Seed Breeding Group Development	0.22925	<b>3</b>	0.21244	<b>2</b>	0.22126	<b>2</b>
Extension Capacity Building	0.11290	<b>5</b>	0.13091	<b>4</b>	0.14339	<b>4</b>
Subsidy programs and Price Incentives	0.11520	<b>4</b>	0.08679	<b>5</b>	0.09299	<b>5</b>

For the spectrum of innovation distribution and dissemination of innovation the latter rank is a program of subsidies and price incentives. This finding can be interpreted that the provision or absence of seed price subsidies will not hinder the delivery of innovation and



dissemination. This can also be interpreted as expensive price of seeds will not dampen desire of farmers to cultivate the rice. This statement can be true, because the use of rice seeds at the farmer level is not much since the average use of seeds in one hectare as much as 25 kg.

## 4 Conclusions and Suggestions

Indonesian Agency for Agricultural Research and Development (IAARD) annually issued New Superior Varieties (VUB), but the level of use has not been optimal. Respondent farmers will easily adopt VUB if the VUB is in accordance with farmers' preferences, high productivity, resistant to pest attacks, easily obtained when needed at an affordable price. In order for farmers to increase the use of VUB, it is recommended that: (i) issue VUB based on mapping the needs and suitability of location-specific land, (ii) convince farmers by conducting technical guidance while making cultivation pilots and (iii) increasing the role of extension to assist farmers in the cultivation of VUB.

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