Strategies to increase soybean production by increasing the distribution of new superior varieties

R D Yofa, R P Perdana*, R Aldillah, C Muslim, Sunarsih, A Agustian

Indonesian Center for Agricultural Socio-Economic and Policy Studies, Jl. Tentara Pelajar 3B, Bogor, Indonesia

*restypuspa09@gmail.com

Abstract. Soybean production in Indonesia shows a downward trend over time, causing an increase in dependence on imports because the demand for soybeans is much greater. Therefore, efforts are needed to increase production by increasing productivity by using new soybean varieties, which are still very limited in distribution. This paper aims to identify the distribution of new soybean varieties, analyze the problems and factors affecting the distribution of new soybean varieties, and formulate strategies to increase the distribution of new soybean varieties. The study was conducted in the West Java and Central Java Provinces. The analysis method used in the study was qualitative descriptive. The analysis results show that in 2015-2019, soybean production in Indonesia, including in West Java and Central Java, shows a downward trend. Of the total distribution area of soybean varieties, the dominant varieties cultivated are Anjasmoro (61.48%), Wilis (10.66%), Grobogan (9.81%), Argomulyo (6.65%), and Baluran (4.01%). Meanwhile, the distribution of new soybean varieties is still very low, including Dena 1 variety (4.01%) and other new soybean varieties with a distribution area of less than 0.1% of the total distribution area. To increase the distribution of new soybean varieties, one of them can be done by developing seed breeders at the farmer level. Thus, the availability of the seeds of new soybean varieties can increase and farmers will find it easier to obtain these seeds.

1. Introduction

Soybean is one of the food commodities needed by the community as a source of protein. In addition, according to [1], soybean is one of the strategic commodities to support national food security. The population continues to increase and the soybean-based food industry continues to grow, pushing the demand for soybeans to increase over time. However, the increase in soybean demand over the last few decades has not been matched by an increase in its production. Soybean harvested area reached its peak in 1992 of 1.67 million ha with a production level of 1.87 million tons. After 1992, the harvested area continued to decline until it reached only 0.49 million ha with a production of 0.65 million tons in 2018.

The soybean production is determined by two main sources of growth, namely the planted/harvested area and productivity. The planted area may reflect farmers’ interest in soybean farming which is closely related to the community’s food needs and socio-cultural conditions. The productivity describes the level of application of production technology by farmers. The level of productivity is determined by the suitability of land and climate and the type and level of application of production technology, including the application of superior varieties [2].

There are at least five important strategies that can be taken to ensure the success of increasing soybean production, namely: (1) improving selling prices, (2) utilizing potential land, (3) crop intensification, (4) improving production processes, and (5) program consistency and the seriousness of
So far, efforts to increase soybean production have been carried out by the government through various efforts, including the creation of new superior varieties. Increasing soybean production can be pursued, among others, through the use of quality seeds from new superior varieties. New superior varieties are technological components that play an important role in increasing crop production, controlling plant pests and diseases, and minimizing the adverse effects of growing environmental conditions. Compared to other production technologies, superior varieties are accepted by farmers more quickly because they are easier to implement and relatively less expensive. The use of new superior varieties is one of the efforts to increase soybean production so that it is expected to reduce imports. It is undeniable that at present it is still difficult for Indonesia to achieve self-sufficiency in soybeans. This is partly due to the low interest in soybean farming because the profits obtained are smaller than other agricultural crops.

The Ministry of Agriculture through the Indonesian Legumes and Tuber Crops Research Institute (ILETRI) has produced various superior soybean varieties to increase productivity so that it is expected to increase yields at the farmer level. Thus, the national soybean production can also increase. However, the new soybean varieties that have been released have not been adopted by many farmers. This is partly due to the weakness of the seed system, which causes seeds not yet available in sufficient quantity and quality when needed and the socialization of new soybean varieties has not been optimal.

Based on the description above, this paper aims to identify the distribution of new soybean varieties and analyze the problems and factors affecting the distribution of new soybean varieties. The study results are useful to formulate strategies to increase the distribution of new soybean varieties.

2. Materials and methods

2.1 Study area and respondents

This study was conducted in 2020, which is located in West Java (Cianjur District) and Central Java (Batang District). The primary data was obtained by interviewing 30 respondent farmers in each location. Meanwhile, the secondary data were obtained from various sources or related agencies such as the Directorate General of Food Crops, Indonesian Legumes and Tuber Crops Research Institute (ILETRI), Department of Food Crops and Horticulture (West Java and Central Java Province) and the Seed Supervision and Certification Center.

2.2 Methods

The data collection used survey methods and focus group discussions with several parties/officials in relevant agencies such as the Directorate General of Food Crops, Indonesian Legumes and Tuber Crops Research Institute (ILETRI), Department of Food Crops and Horticulture (West Java and Central Java Province) and the Seed Supervision and Certification Center. The analysis method used in the study was qualitative descriptive, presented in table and pictures with a simple analysis. The recommendation for strategies to increase the distribution of new soybean varieties to increase soybean production was obtained from the synthesis of the result and discussion.

3. Results and discussion

3.1 Development of harvested area, production, and productivity of soybean, 2015-2019

During 2015-2019 the soybean harvested area in Indonesia decreased by -15.93%/year, from 614.10 thousand ha in 2015 to 285.27 thousand ha in 2019. Along with the decline in harvested area, production of soybeans also decreased by -18.21%/year, from 963.18 thousand tons in 2015 to 424.19 thousand tons in 2019. Likewise, soybean productivity decreased by -2.28%/year, from 1.57 tons/ha in 2015 to 1.49 tons/ha in 2019 (Table 1).
### Table 1. Development of harvested area, production, and productivity of soybean in Indonesia, 2015-2019

| Year | Indonesia | | | West Java | | | Central Java | | |
|------|-----------|-------------|-------------|-----------|-------------|-------------|-----------|-------------|-------------|
|      | HA (000 ha) | Prod (000 ton) | Pdv (ton/ha) | HA (000 ha) | Prod (000 ton) | Pdv (ton/ha) | HA (000 ha) | Prod (000 ton) | Pdv (ton/ha) |
| 2015 | 614.10 | 963.18 | 1.57 | 60.17 | 98.94 | 1.64 | 70.63 | 129.79 | 1.84 |
| 2016 | 576.99 | 859.65 | 1.49 | 55.02 | 92.08 | 1.67 | 60.54 | 112.16 | 1.85 |
| 2017 | 355.80 | 538.73 | 1.51 | 28.02 | 49.26 | 1.76 | 60.13 | 105.55 | 1.76 |
| 2018 | 493.55 | 650.00 | 1.32 | 76.36 | 102.06 | 1.34 | 71.53 | 113.67 | 1.59 |
| 2019 | 285.27 | 424.19 | 1.49 | 37.39 | 67.97 | 1.82 | 39.25 | 69.27 | 1.76 |
| r(%/year) | -15.93 | -18.21 | -2.28 | -6.27 | -6.33 | 0.06 | -8.57 | -10.89 | -2.32 |

Description: HA= Harvested Area; prod= production; pdv=productivity [5]

The decline in soybean production also occurred in the research locations of West Java and Central Java Provinces. Based on the data above, this is caused by a decrease in harvested area and soybean productivity. The soybean production target in 2019 was 2.8 million tons, but only 0.42 million tons were achieved. The failure to accomplish the soybean production target was caused by (1) low productivity, (2) the shelf life of soybean seeds from government assistance was relatively short so that when the seeds were available but had not entered the planting period, the seeds were not utilized by farmers, (3) soybean farmers do not want to take the risk of doing soybean farming with inadequate quality seed assistance, (4) farmers are still lacking interest in cultivating soybeans because the selling price of products cannot compete with competing commodities and imported soybeans are still dominant, and (5) specifically for soybean development from the government assistance program, is constrained by the availability of certified soybean seeds according to farmers' planting schedule [5].

According to [6], the increase in soybean production in West Java is more influenced by the increase in harvested area. This shows that soybean productivity is very low in its contribution to the increase in soybean production. Meanwhile, the study result [6] revealed that increasing soybean production could increase harvested area and productivity. Further, according to [7], increasing soybean productivity requires the support of soybean cultivation technology, among others, in the form of superior seeds and an appropriate agro-ecosystem environment.

#### 3.2 Development of the distribution of new soybean varieties

The Ministry of Agriculture through ILETRI has developed various new soybean varieties with their respective advantages, such as tolerance to drought, shade, acid dry land, resistance to pod breaking and others. The new soybean varieties that have been produced, include Demas 1 (2014), Dena 1 (2014), Dena 2 (2014), Devon 1 (2015), Dega 1 (2016), Deja 1 (2017), Deja 2 (2017), Devon 2 (2017), Detap 1 (2017), Detap 2 (2018), Derek 1 (2018), Demas 2 (2019), Demas 3 (2019), Dering 2 (2019), and Dering 3 (2019).

In Indonesia, the dominant soybean varieties used by farmers are Anjasmoro, Grobogan, Wilis, Argomulyo, Bungrangrang and Baluran varieties. The distribution of soybean varieties from 2017-2019 has not shown much progress because farmers still tend to plant old varieties commonly grown. This can be seen from the lack of new soybean varieties cultivated by farmers in Indonesia. Although the yield potential of the new soybean varieties is not much different from the old varieties, if farmers use varieties that are in accordance with the agro-ecosystem/regional conditions, they will provide more optimal results. In addition, the risk of using the same variety continuously will cause resistance to certain pests so that it will affect the yield [8]. Research result [9] also shows that farmers in Malawi who adopt superior soybean varieties produce 61% higher than farmers who do not adopt superior soybean varieties. Likewise, the benefits obtained are also more significant (53%) than farmers who do not adopt.
The total distribution area of soybean varieties in Indonesia in 2019 was 206,171 ha. The area of the soybean variety has decreased from 2018, which reached 738,462 ha (72%). In 2018, special efforts were being carried out by the Ministry of Agriculture to support the increased production of rice, corn and soybeans.

The data shows that from 2017-2019, the Anjasmoro is the variety with the largest distribution area of 126,760 ha in 2019, even in 2018, it reached 305,705 ha (Figure 1). In addition, other varieties that are widely developed in Indonesia are Argomulyo, Bungrangrang, Baluran, Grobogan and Wilis.

In 2019, only a few new soybean varieties began to develop or were adopted by farmers, such as the Dering 1 (2012), Gamasugen 1 (2013), Dena 1 (2014), Demas 1 (2014), and Devon 1 (2015). Dena 1 variety is one of the new soybean varieties that farmers quite widely used. This variety was released in 2014 but only started to develop a lot in 2019, with a distribution area of 809 ha. The areas with the largest distribution area of the Dena 1 variety are West Sulawesi with 705 ha and Banten covering 90 ha. Meanwhile, other new soybean varieties are still very limited in their distribution. However, compared to the Anjasmoro variety, the distribution of the Dena 1 variety in 2019 in Indonesia only reached 0.64% of the wide distribution of the Anjasmoro variety. This shows that the distribution rate of new soybean varieties is still very low.

In West Java Province, the wide distribution of soybean varieties reaches 30,340 ha. From the total area, the dominant soybean variety cultivated was Anjasmoro (97.68%). Meanwhile, other superior
varieties cultivated by farmers include Argomulyo, Grobogan, Dena 1, and others with a variety distribution of less than 1%. In Central Java Province, the total distribution area of soybean varieties in 2019 reached 27,535.20 ha. Of the total area, the dominant varieties planted were Anjasmoro (47.16%) and Grobogan (47.95%). In addition, there are also several varieties used by farmers, such as Argomulyo (2.13%), Baluran (2.00%), and Wilis (0.76%).

Table 2. The wide distribution of soybean varieties in West Java and Central Java, 2019

| No. | Soybean varieties | West Java | Central Java |
|-----|-------------------|-----------|--------------|
|     | Area (ha)         | %         | Area (ha)    | %             |
| 1   | Anjasmoro         | 29,637.00 | 97.68        | 12,986.50     | 47.16         |
| 2   | Argomulyo         | 469.00    | 1.55         | 586.00        | 2.12          |
| 3   | Baluran           | -         | -            | 550.00        | 1.99          |
| 4   | Dena 1            | 3,00      | 0.01         | -             | -             |
| 5   | Dega 1            | -         | -            | 45.00         | 0.16          |
| 6   | Grobogan          | 210.00    | 0.69         | 13,202.70     | 47.94         |
| 7   | Wilis             | -         | -            | 210.00        | 0.76          |
| 8   | Varietas lokal    | 18.00     | 0.06         | -             | -             |
| 9   | Lainnya           | 3.00      | 0.01         | -             | -             |
|     | amount            | 30,340.00 | 100.00       | 27,535.20     | 100.00        |

Source: Direktorat Jenderal Tanaman Pangan 2020 [10]

The yield potential of several new soybean varieties is higher than the old varieties. The Dega 1 variety (2016) has a potential yield of 3.82 tons/ha and an average yield of 2.78 tons/ha. Soybean productivity of the Dega 1 variety was almost the same as the Grobogan variety, but much higher than the Anjasmoro varieties (2.03-2.25 tons/ha) and Argomulyo (1.5-2 tons/ha). This Dega variety is favoured by farmers in Central Java. This is shown from the research results of [11], which conducted a preference test on soybean varieties in Central Java. The results show that the farmers’ preference scores for the Dega 1 variety are almost the same as the Grobogan variety, both in terms of varietal characteristics, selling prices, and market convenience. However, what makes the difference is the score for the seed access. The Dega 1 variety scores lower than Grobogan due to the low availability of seeds for the Dega 1 variety, making it difficult for farmers to obtain seeds. This causes the distribution of the Dega 1 variety is still low even though it is interested by farmers.

Meanwhile, in West Java, new soybean varieties that are widely used include the Dena 1 variety. The potential yield of the Dena 1 variety is 2.89 tons/ha, while the average yield is 1.69 tons/ha. The potential and average yield of the Dena 1 variety was lower than that of the Grobogan variety. However, farmers in West Java quite like this variety because it has the advantage of being shade-tolerant to be planted intercropping with other commodities. The distribution of the Dena 1 variety is still very limited because farmers only cultivate it as an intercrop in their farming business to earn additional income.

3.3 Problems and factors affecting the distribution of new soybean varieties

Dominant factors that encourage farmers to adopt a technology include the benefits of previous farming businesses and increased productivity [12]. In general, the varieties selected by farmers have a high level of productivity due to obtaining high farming profits. Therefore, the main factor that farmers consider in the application of technological innovation components is that the application of technological innovation can increase productivity. According to Sembiring [13], superior varieties are one of the innovative technologies that are reliable to increase productivity, either through increasing the potential or yield of plants and their tolerance and/ or resistance to biotic and abiotic stresses.

Technological characteristics are one of the factors that influence the technology adoption of superior soybean varieties. Research results Putra et al. Putra et al. [14] shows that the variety’s technological characteristics significantly influence the adoption of the Grobogan variety. In addition, according to Purba and Rozi [15], the factors that affect the distribution of superior soybean varieties are (a) the
presence/number of seed breeders, (b) farmers’ concern for the use of quality seeds from new superior varieties, (c) farmers’ confidence in the benefits of using quality seeds and their accessibility to obtain superior new varieties, (d) availability of quality seeds from new superior varieties, (e) farmers’ purchasing power for quality seeds, and (f) local government support in providing easy access to obtain quality seeds of new superior varieties.

Results research based on interviews with respondent farmers in West Java and Central Java showed that in addition to the characteristics inherent in soybean varietal technology, the availability of superior varieties in the market is also one factor determining the distribution of superior soybean varieties. Often, new soybean varieties are in accordance with farmers’ preferences, but the seeds are difficult to obtain in the market or where the sale of seeds is far away. This cause farmers to return to using varieties that are easily available in the market. This is in line with the research results [16], which revealed that access to seeds is one factor that determines farmers’ adoption decisions. One of the reasons for the low availability of seeds is that the breeding of new soybean varieties is still limited at the management unit of seed source (UPBS) level. Meanwhile, private seed producers are still less interested in producing new soybean varieties because they are not commercialized.

In addition, according to respondent farmers, the price of seeds also determines their decision to adopt new soybean varieties. The price of seeds for new soybean varieties is often relatively higher than the seeds of old varieties. This cause farmers to persist in using the old varieties. As stated by Krisdiana [17], the external socio-economic factor that affects the rate of adoption of soybean varieties is the price of seeds.

Research results Purba and Rozi [15] also showed almost the same condition, which is soybean farmers in Banten Province had difficulty getting superior seeds. The seeds planted came from the market or random seeds with low growth power. The procurement of soybean seeds is mostly done through the Jabalsim system (seed flow between fields and between seasons) without being coordinated. This makes it difficult to develop the quality of the seeds produced, so that it contributes to the slow adoption of new superior varieties. Until now, the distribution of new soybean varieties is still experiencing problems due to the irregularity of the seed system in Indonesia. The lack of development of soybean seeds is partly due to farmers’ lack of interest to become soybean seed breeders because the profits obtained are not as much as rice seeds. Likewise, according to Ruskandar et al. [18], one of the obstacles in increasing rice production in South Sumatra is the low use of new superior varieties. The adoption of superior varieties was hampered due to several factors, including unavailability of seeds, lack of availability of labor for rice farming due to competition from other businesses, and the availability of fertilizers was not guaranteed.

3.4 Efforts to increase the distribution of new soybean varieties
The main problem in the distribution of new soybean varieties is the low availability of seeds. Therefore, to accelerate the distribution of new soybean varieties, it is necessary to increase the availability of seeds. According to Suharyon et al. [19], it can be done, among others, through the development of soybean seed breeders at the farmer level. Thus, it is hoped that farmers will find it easier to obtain seeds of new soybean varieties. For this reason, the Assessment Institutes for Agricultural Technology in collaboration with the Agricultural Extension Center can involve seed breeders in the vicinity of the dissemination site for new soybean varieties so that they are interested in producing extension seeds (ES) of these varieties.

According to Mejaya and Hakim [20], breeders are part of the dissemination process to accelerate the adoption of new superior varieties. If seeds are available, then farmers around the dissemination location will be interested in cultivating these varieties in the following season. Availability of dispersed seeds at the location of the dissemination site is very important to increase the adoption of these new superior varieties to increase productivity in the area around the development site. If the farmers in the dissemination location have received the new soybean variety, it is hoped that this information will spread to surrounding farmers and develop outside the dissemination location area. The adoption of superior varieties is also positively and significantly influenced by access to irrigation, access to credit,
and membership of farmer groups [21]. Therefore, to increase farmers’ interest in breeding seeds of new soybean varieties, government support is needed in easy access to credit for business capital. In addition, the government is also expected to provide market guarantees for soybean seed breeders so that seed breeding at the farmer level can be sustainable.

4. Conclusions

Soybean production has decreased over time, so it is necessary to increase soybean production to reduce imports. One of the efforts to increase soybean production is through increasing the use of new soybean varieties. There have been enough new soybean varieties that have been released, but until now, the level of distribution is still very low. One of the reasons is the low availability of new soybean varieties. Therefore, to increase the availability of new soybean varieties, it can be done by developing soybean seed breeders at the farmer level. To support these efforts, socialization of new soybean varieties also needs to be improved. In addition, government support in credit facilities for seed breeders will encourage the development of the seed breeding of new soybean varieties at the farmer level. The government, through the Ministry of Agriculture is expected to establish partnerships with private seed producers so as to increase their interest in producing seeds of new soybean varieties. In addition, the Ministry of Agriculture is expected to encourage UPBS to focus more on producing seeds of new soybean varieties, especially those that are location-specific, have high productivity and are in accordance with the farmers’ preferences. The dissemination of new soybean varieties must also be carried out so that farmers recognize and are interested in adopting.

5. References

[1] Krisdiana R 2014 Penyebaran varietas unggul kedelai dan dampaknya terhadap ekonomi perdesaan J. Penelit. Pertan. Tanam. Pangan 33 61–9
[2] Subandi A H and Kuntyastuti H 2013 Areal pertanaman dan sistem produksi kedelai di Indonesia Kedelai Tek.Produksi dan Pengemb. 104–29
[3] Subandi S 2007 Teknologi produksi dan strategi pengembangan kedelai pada lahan kering masam Iptek Tanam. Pangan 2 12–25
[4] Zakaria A K 2016 Kebijakan pengembangan budi daya kedelai menuju swasembada melalui partisipasi petani Anal. Kebijak. Pertan. 8 259
[5] Direktorat Jenderal Tanaman Pangan 2020 Laporan Tahunan Direktorat Jenderal Tanaman Pangan Tahun 2019 (Jakarta: Direktorat Jenderal Tanaman Pangan)
[6] Juswadi J, Sumarna P and Mulyati N S 2021 Potensi peningkatan luas panen, produksi, dan produktivitas kedelai di Jawa Barat Paspalum J. Ilm. Pertan. 9 86–93
[7] Suhartini S H 2018 Analisis sumber-sumber pertumbuhan produksi kedelai Anal. Kebijak. Pertan. 16 89–108
[8] Effendi B S, Kartohardjono A and Munawar D 2011 Peran varietas tahan dalam menurunkan populasi coklat biotipe 4 pada tanaman padi J. Penelit. Pertan. Tanam. Pangan 30 145–53
[9] Triastono J, Jatuningtyas R K and Kurniyati E 2019 Preferensi petani terhadap varietas unggul baru Prosiding Nasional Kesiapan Sumber Daya Pertanian dan Inovasi Spesifik Lokasi Memasuki Era Industri 4.0 pp 205–13
[10] Sembiring H 2007 Kebijakan penelitian dan rangkuman hasil penelitian Balai Besar Penelitian Tanaman Padi dalam mendukung peningkatan produksi beras nasional Prosiding Seminar Apresiasi Hasil Penelitian Padi pp 39–59
[14] Putra A A, Nuswantara B and Nadapdap H J 2020 Adopsi inovasi teknologi kedelai Varietas Grobogan di Desa Bantal Kecamatan Bancak Kabupaten Semarang Paradigm Agribisnis 3 24–44

[15] Purba R and Rozi D F 2011 Kapasitas penyediaan benih kedelai oleh kelembagaan produksi benih di Provinsi Banten Prosiding Seminar Hasil Penelitian Tanaman Aneka Kacang dan Umbi pp 461–9

[16] Ghimire R, Huang W C and Shrestha R B 2015 Factors Affecting Adoption of Improved Rice Varieties among Rural Farm Households in Central Nepal Rice Sci. 22 35–43

[17] Krisdiana R 2014 Dinamika preferensi petani dan penyebaran varietas unggul kedelai di Provinsi Nusa Tenggara Barat Bul. Palawija 93–101

[18] Ruskandar A, Rustiati T and Wardana P 2005 Adopsi varietas unggul baru dan keuntungan usahatani padi di lahan rawa lebak pp 399–406

[19] Suharyon, Busyra and Minsyah N 2016 Upaya percepatan adopsi varietas unggul baru (VUB) di lahan tadah hujan : studi kasus di Kabupaten Sarolangun Jambi Prosiding Seminar Nasional Membangun Pertanian Modern dan Inovatif Berkelanjutan dalam Rangka Mendukung MEA (Bogor, ID: BB Pengkajian Teknologi Pertanian)

[20] Mejaya M J and Hakim L 2017 Upaya percepatan adopsi varietas unggul baru padi Inpari pp 1–12

[21] Abdul-Rahaman A, Issahaku G and Zereyesus Y A 2021 Improved rice variety adoption and farm production efficiency: Accounting for unobservable selection bias and technology gaps among smallholder farmers in Ghana Technol. Soc. 64