

# Wheat Grower Payments for Varietal Use: Comparison between Japan, Germany, and Australia

Hisako Sekine<sup>1</sup>

New variety development requires funding, and there is restricted opportunity for wheat breeders to collect research funds if wheat growers use their products as seed. This is a serious issue for wheat variety developers, especially for private companies. This study attempts to clarify the monetary burden placed on growers in Japan, Germany, and Australia for wheat varietal use. Using data published by public organizations, such as the United Nations' Food and Agriculture Organization and government ministries, and collected through interviews, the author compares the costs to growers in each country. The analysis yields two main conclusions: First, production in Germany is minimally related to price, and in Australia, it is weakly related to price. This means growers cannot earn enough from sales if their yields are low. The Australian system reduces the cost of varietal use for farmers, especially when yields are low. Second, German and Australian growers pay 1.2% of their output for varietal use when yields are average. In Japan, growers pay only 0.1% of their output for varietal use, and breeding programs are publicly supported. Though the Japanese government aims to introduce private sector crop-breeding industries, it could be difficult for private companies to acquire enough funds for breeding under the current system.

*Key words:* grower payments, output, production and distribution cost, varietal use fee, wheat

## 1. Introduction

### 1) Background of this study

In Japan, the varieties of major agricultural products such as rice and wheat have been developed by public institutions using public funding. However, in 2017, the Act on the Support for Strengthening Agricultural Competitiveness was enacted. As such, the national government now promotes private companies' participation in the breeding industry, including in that of rice and wheat (Ministry of Justice, 2017). New variety development requires funding (Brennan and Martin, 2005); however, there is no discussion in current literature on how to secure a budget for breeding in the private sector yet. Variety developers of self-pollinated and non-genetically modified crops such as rice and wheat have been restricted opportunities to secure research funding, particularly for crop growers that use their products as seeds. This is a serious issue for variety developers, especially for private companies.

Table 1 shows the situation of wheat breeders and breed funding in countries that are traditional wheat

exporters—and whose industries are highly competitive—and Japan. Wheat varieties in Japan, Canada, and the US are mainly developed by public organizations. In Japan and the US, growers pay a varietal use fee for their certified seed (CS) use. In Canada, a royalty fee is included in the contract between the breeders and the seed company that makes a successful bid for their varietal use. In all three countries, there is a varietal use fee for CS; however, there is not a fee for farm-saved seed (FSS). The royalty collections are limited. Thus, the breeding funding is covered by public budgets in the case of Japan and Canada, or the check-off levy in the US.

On the other hand, in France, Germany, and Australia, private companies are developing wheat varieties and using varietal use fees not only for CS, but also for FSS. The collection system for varietal use fees for FSS in France is called CVO (Cotisation Volontaire Obligatoire). CVO is charged when growers sell their products. If growers bought and used CS with a varietal use fee, CVO is refunded. The price of CVO is unified for each crop, such as wheat and barley, and is decided during discussions among a group of wheat

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<sup>1</sup> Central Region Agricultural Research Center, NARO  
shisako@affrc.go.jp

**Table 1. Breeder and breeding funding in traditional wheat exporters and Japan**

	Japan	Canada	The US	France	Germany	Australia
Main breeder	Public	Public	Public	Private	Private	Private
Main source of breeding funding	Public budget	Public budget	Check-off	Royalty	Royalty	Royalty
Varietal use fee for CS	Yes	Yes	Yes	Yes	Yes	Yes
Collection system	Seed R	Contract to seed companies	Seed R	Seed R	Seed R	EPR
Varietal use fee for FSS	No	No	No	Yes	Yes	Yes
Collection system	-	-	-	CVO	Seed R	EPR

Source: Curtis and Nilsson (2012) and Gray *et al.* (2017), and the author's survey.

Note: Seed R means the varietal use fee is charged when the seed is used.

producers, dealers, and processors every three years (Curtis and Nilsson, 2012; Gray *et al.*, 2017; Intercértales, 2020).

In Germany, FSS users pay a varietal use fee when they use the seeds, referred to here as Seed R. In Australia, wheat growers are charged a varietal use fee when they sell their products. It is called End Point Royalty (EPR), and it is used not only for FSS, but also for CS. Though these collection systems are different between Germany and Australia, they share a commonality. In both countries, each variety has its price decided by the variety owner, usually the breeding company (Sekine, 2020). This means that while the other wheat growers, for instance, those in France, have the opportunity to discuss the price of the varietal use fee, those in Germany and Australia do not.

## 2) Position of this study

There are some discussions about funding for wheat breeding, especially concerning countries that are changing their breeding or royalty collection systems. For example, in Australia, where the first wheat variety with an EPR system was released in 1996 and a private breeding company was established in 2002 amid public organizations that were developing major varieties (Sekine, 2020), Kingwell (2001) explored the charging systems for plant varieties usage.

In Canada, which is one of the countries whose breeding is done by public organizations, there is an issue about how to increase the wheat breeding budget, and thus the Plant Breeders' Right Act was reformed in 2015 to collect varietal use fees from FSS users. In this movement, Gray *et al.* (2017) characterize the United Kingdom, French, and Australian systems of charging for varietal use, and they estimate the amount of fees that could be collected in Canada if it were to adopt one of those systems. Gray *et al.* (2017) concludes

that Canada would collect the most fees if it used the Australian system.

In Japan, as mentioned at the beginning of this paper, the government encourages private companies to participate in the breeding of crops. Sekine (2020) discusses how fees are collected for wheat varietal use in Japan, Germany, and Australia; Sekine (2020) emphasizes that private companies in Germany and Australia develop new wheat varieties with funds collected from growers.

All articles focus on how to collect varietal use fees to ensure stable variety development. However, charging for varietal use forces farmers to pay additional costs. Considering the years-long effort it takes to develop new wheat varieties, farmers must pay varietal use fees continuously, even wheat yield changes every year.

This study focuses on growers' payments for wheat varietal use. Building on the work of Sekine (2020), the author tries to clarify the financial burden of these payments on wheat farmers by estimating the percentage of the fee in farmers' production and distribution costs, and in output, at wheat farms in Japan, Germany, and Australia. In this study, Japan is representative of public breeding countries, while Germany and Australia represent private breeding countries whose breeders have the opportunity to make variety use fee decisions.

The result of this study will help countries with public breeding systems, like Japan, understand how privatization of wheat breeding would affect wheat growers' payments for varietal use. Moreover, it will give an idea of how much breeders could collect from growers under a private system. For countries in which private companies develop wheat varieties, the study will help identify stable systems for charging for varietal use under varying wheat yields. Further, the result

**Table 2. Organizations and farms visited**

Name	Outline	Visited year
<b>Japan</b>		
National Agriculture and Food Research Organization: NARO	National research organization, including plant breeding	2007–2019
Three prefectural agricultural research stations	Organization for wheat breeding and multiplication supported by local government	2019
Japan Agricultural Cooperatives in Hokkaido: JA in Hokkaido	Farmers Union in Hokkaido	2007–2019
Three farms in Hokkaido	Wheat growers	2007–2019
<b>Germany</b>		
Bundessortenamt (Federal Plant Variety Office)	National government for managing varieties list	2015
Bundesverband Deutscher Planenzüchter e.V.: BDP (Federal Association of German Plant Breeders)	Organization for basic plant breeding research supported by national government and private breeding companies	2013
Saatgut-Treuhandverwaltungs GmbH: STV (Seed Trust Management, Ltd.)	Organization for collecting varietal use fees	2013
KWS LOCHOW GmbH	Private plant breeding company	2013
Landberatung Harzvorland e.V.	Agricultural consultant in Lower Saxony	2013
Two farms in Lower Saxony and two farms in Bavaria	Wheat growers	2013–2017
<b>Australia</b>		
Grains Research and Development Corporation: GRDC	National organization to fund research	2017
Australian Export Grains Innovation Centre: AEGIC	Organization funded by Western Australian Government to promote wheat sales	2017
Australian Grain Technologies Pty., Ltd.: AGT Pty., Ltd.	Private wheat breeding company	2017
InterGrain Pty., Ltd.	Private wheat breeding company	2017
Co-operative Bulk Handling, Ltd.: CBH	Wheat dealer dominating in Western Australia	2017
Agrarian Management	Agricultural consultant in Western Australia	2017
Four farms in Western Australia	Wheat growers	2017

could be applied to other crops for which growers use FSS.

## 2. Data and Method

For this study, the author used data published by public organizations, including the FAO and other ministries, and those collected through interviews. The interviews were conducted at the various farms and organizations listed in Table 2 from 2007 to 2019. These interviews were supported by the National Agriculture and Food Research Organization (NARO) and the Thünen Institute, which are national governmental research organizations in Japan and Germany, respectively, and by the Australian Export Grain Innovation Center (AEGIC), which is funded by the Western Australian Government to promote wheat sales.

Table 3 shows the characteristics of the eleven farms visited by the author. All the selected farms were located in the largest or the second largest wheat-producing

regions in the selected countries. Through the following procedure, they were selected as typical wheat farms representing the region. The three farms in Hokkaido were selected by the Japan Agricultural Cooperatives (JA) in the main wheat producing areas of Hokkaido. The 281-ha farm in Lower Saxony and the 150-ha farm in Bavaria were selected by the Thünen Institute. The other farm (458 ha) in Lower Saxony was introduced by the owner of the 281-ha farm. The other farm (75 ha) in Bavaria was connected to NARO. Four farms in Western Australia were selected by AEGIC.

Noteworthy, all (except one farm in Japan) were larger than the average farm size for the region. To avoid a large size bias, the author also contacted appropriate agricultural consultants, such as JA in Hokkaido, Landberatung Harzvorland e.V., and Agrarian Management, to ensure that the typical dealing customs for wheat seed and products in the region were followed.

Table 3. Characteristics of the farms

Country	Region	% of wheat production in the region	Av. farm size in the country	Av. farm size in the region	The visited farm's size	Labor force at the farm	Crops grown at the farm and the ratio of each
Japan							
					25 ha	4-family 4-seasonal	Wheat: 37% Red bean: 9% Sugar beet: 25% Potato: 29% (Poultry egg)
	Hokkaido	65% (the largest in the county)	2.5 ha	25.7 ha	50 ha	2-family 3-seasonal	Wheat: 45% Red bean: 5% Sugar beet: 26% Potato: 20% Green manure: 4%
					65 ha	2-family Several part-timers	Wheat: 35% Red bean: 9% Sugar beet: 31% Seed potato: 22% Fallow: 4%
Germany							
	Lower Saxony	14% (the second largest in the county)		65 ha	281 ha	1-family 1-full time 1-seasonal	Wheat: 50% Barley: 25% Rape seed: 25%
					458 ha	1-family 2-full-time 1-seasonal	Wheat: 69% Sugar beet: 17% Rape seed: 8% Maize (biogas): 6% Other (feed): 0%
			45 ha		75 ha	3-family (1-part-time) (2-seasonal support) 1-seasonal	Wheat: 50% Sugar beet: 25% Starch potato: 25%
	Bavaria	17% (the largest in the county)		30 ha	150 ha	2-family 1-full-time	Wheat: 43% Sugar beet: 11% Rape seed: 15% Maize (biogas): 25% Triticale: 4% Fallow: 2%
Australia							
	Western Australia	34% (the largest in the county)	653 ha	1.6K ha	15.0K ha	3-family 1-full-time 4-seasonal	Wheat: 53% Barley: 33% Rape seed: 7% Lupin: 7%
					17.5K ha	3-family 3-full-time 4-seasonal	Wheat: 54% Rape seed: 40% Lupin: 6%
					Two more similar farms growing wheat		

Source: MAFF (2017–2019), MAFF (2015), ABARES (2019), ABS (2020), Statistisches Bundesamt (2019, 2020a, b), and the author's survey.

Notes: 1) The capital letter K stands for one thousand.

- 2) Japan and Germany's wheat production percentages per county and region are averages of 2017 to 2019 percentages. Australia's production percentage is the average of the 2015–16, 2016–17, and 2017–18 periods.
- 3) Average farm sizes in Japan and Hokkaido were sourced from the agricultural land data of 2015. The sizes in Germany, Lower Saxony, and Bavaria are based on the arable land data of 2020. The sizes in Australia and Western Australia are based on the cropland data of 2018–19.
- 4) "Family" on the table means family member(s), "full-time" means full-time employee(s), and "seasonal" means seasonal employee(s).

**Table 4. Positioning of the organizations visited**

Role of the Organization	- The largest (or second largest) wheat breeder in the country	- Collection of varietal use fee in the visited region	- Agricultural consultant in the visited region	- Seed supply - Varieties registration - Support for breeding budget
Main interview item	- Breeding budget	- Collection methods - Varietal use fees from farmers	- Typical dealing customs related to seeds and products in the region	- Others
The organizations visited				
Japan	- NARO - A prefectural agricultural research station	- JA in Hokkaido	- JA in Hokkaido	- Two prefectural agricultural research stations
Germany	- KWS LOCHOW GmbH	- STV	- Landberatung Harzvorland e.V.	- Bundessortenamt - BDP
Australia	- AGT Pty., Ltd. - InterGrain Pty., Ltd.	- CBH	- Agrarian Management	- GRDC - AEGIC

**Table 5. Wheat production and destination**

	Japan		Germany		Australia	
Harvested area	211K ha		3,190K ha		12,718K ha	
Production	798K tons		24,273K tons		24,750K tons	
Destination of domestic wheat	Domestic use	100%	Domestic use	76%	Domestic use	28%
	including: Food	97%	including: Food	24%	including: Food	7%
	Seed	3%	Feed	34%	Feed	14%
	Other negligible		Seed	2%	Seed	3%
			Other	16%	Other	4%
			Export	24%	Export	72%

Source: FAO 'FAOSTAT', Ministry of Agriculture, Forestry and Fisheries (MAFF) 'Syokuryo jikyu hyo (食料自給表)' <https://www.maff.go.jp/j/zyukyu/fbs/> (accessed on March 16, 2020), Bundesministerium für Ernährung und Landwirtschaft 'Versorgung mit Weichweizen' <https://www.bmel-statistik.de/ernaehrung-fischerei/versorgungsbilanzen/getreide/> (accessed on March 13, 2020), and ABARES (2019).

Notes: 1) The capital letter K stands for one thousand.

2) Data for area of harvested wheat, wheat production, and percentage of Japanese domestic use are 10-year average from 2009 to 2018.

3) Percent of German domestic use is average from 2012/13 to 2018/19, including imported amount.

4) Percent of Australian domestic use is average from 2014 to 2017, including imported amount.

Additionally, in this paper, when calculating growers' payments for wheat varietal use, wheat production and distribution costs, and output, the author used the statistics or average data of each region or country.

Table 4 shows the organizations visited by the author and explains their positions in this study. The organizations are the largest or the second largest wheat breeders in each country, others that collect varietal use fees from farmers, and those that consult with farmers in the largest or the second largest wheat-producing regions. The author mainly asked the wheat breeding organizations about the wheat breeding budget; furthermore, JA in Hokkaido, Saatgut-Treuhandverwaltungs GmbH (STV), and Co-operative Bulk Handling Ltd. (CBH) were asked about the varietal use fee collection methods. The agricultural consul-

tants were asked about the typical dealing customs for wheat seed and product in the region, as mentioned in the explanation of Table 3.

The collected data are analyzed through a comparison between each country.

### **3. Characteristics of Wheat Production in Japan, Germany, and Australia**

#### **1) Wheat production and destination**

Table 5 shows domestic wheat production and its destination in the three targeted countries. The land available for wheat cultivation in Japan is limited, so much less is produced there than in Germany and Australia. Ninety-seven percent of the domestic product is used for food in Japan; domestic wheat is rarely used for feed. In Germany, 24% of the domestic product is

**Table 6. Number of listed wheat varieties and PBR holders**

	Japan		Germany		Australia	
Number of listed varieties (a)	59		330		155	
Number of PBR holders (b)	9		27		22	
Harvested area / (a)	3.6K ha		9.7K ha		82.1K ha	
(a) / (b)	6.6		12.2		7.0	
Top 2 PBR holders and number of its listed varieties	NARO	41	KWS LOCHOW GmbH	53	AGT Pty., Ltd.	50
	Nagano Prefecture	4	Limagrain GmbH	42	InterGrain Pty., Ltd.	28

Source: Plant Variety (Database) [http://www.hinshu2.maff.go.jp/en/en\\_top.html](http://www.hinshu2.maff.go.jp/en/en_top.html) (accessed on March 9, 2020), STV (2019: pp.27–36),

Variety Central (2019), Table 5, and the author's calculation.

Note: The capital letter K stands for one thousand.

exported, and the rest is consumed mainly for food and feed. Seventy-two percent of Australian wheat is exported: 7% is used for food and 14% is for feed.

Harvested wheat in Japan is sold only at food markets in the nation, while German and Australian wheat is traded not only at domestic food and feed markets but also at international markets.

## 2) Wheat breeding in each country

Each country has a registration system for plant varieties. Usually, after development, a new variety is tested for qualities such as distinctness, uniformity, and stability by the government. If these tests are passed, the variety is listed as a registered variety, and the variety holder is listed as the Plant Breeder's Right (PBR) holder. Table 6 shows the number of listed varieties and the number of PBR holders. The largest and second largest PBR holder in each country is also shown.

In Japan, the Support for Strengthening Agricultural Competitiveness Act was enacted in 2017. As such, the national government now promotes participation by private companies in the breeding industry for cereals such as rice and wheat. However, public organizations still play a central role in wheat breeding. There are 59 listed wheat varieties in Japan, which is about one-sixth those of Germany and about one-third those of Australia. However, the ratio of wheat production land to number of listed varieties is 3.6 thousand ha, which is smaller than for Germany (9.7 thousand ha) or Australia (82.1 thousand ha). Thus, the number of listed varieties is not small considering the wheat harvest area. There are nine PBR holders in Japan, and the number of registered breeds per PBR holder is 6.6. The largest PBR holder is a national research institution named the National Agriculture and Food Research Organization (NARO), which has 41 PBRs—70% of the total PBRs in the nation. The second largest PBR holder is Nagano Prefecture, which is a local government; it holds four PBRs.

In Germany, commercial wheat breeding has been

conducted by the private sector since the nineteenth century (Wieland, 2006). Germany has 330 listed varieties, which is the largest number of the three countries, and 27 PBR holders, which is also the largest number. The number of listed varieties per holder is 12.2. The largest PBR holder is KWS LOCHOW GmbH, and the second largest holder is Limagrain GmbH. Both holders are multinational companies that develop varieties of cereals such as wheat and barley and other crops such as vegetables and sugar beets.

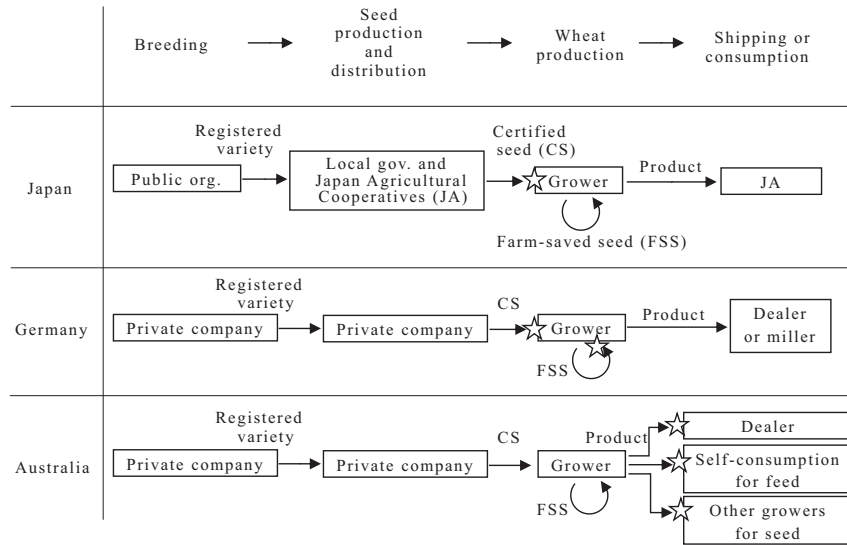
In Australia, public organizations developed wheat varieties before intellectual property rights (IPRs) were strengthened in 1994. Thereafter, some private breeding companies were established, and now, wheat breeding is conducted by these private companies (Brennan and Martin, 2005: p.2; Alston and Gray, 2013). In Australia, 155 varieties are listed, and the number of PBR holders is 22. Each company has, on average, seven PBRs. The largest PBR holder is AGT Pty., Ltd., and the second largest is InterGrain Pty., Ltd. Both companies operate mainly on the national level, which is different from the large German PBR holders. AGT Pty., Ltd. also has PBRs for lupin, triticale, and durum, and InterGrain Pty., Ltd. has PBRs for barley and oats. Both companies, however, primarily develop wheat varieties.

## 3) Wheat varietal use fees

Wheat growers in all three countries pay a varietal use fee. Figure 1 shows the points at which wheat growers are charged for varietal use.

In Japan, the varietal use fee is included in the seed price as a royalty, so farmers pay it automatically when they buy certified seed (CS). If growers use farm-saved seed (FSS), they do not need to pay. In Japan, most wheat varieties have been developed by public organizations using public budgets, so collection of varietal use fees has not become a serious issue thus far.

In Germany, growers pay a varietal use fee, called the Z-License fee (Z-Lizenzgebühr), when buying CS.



**Figure 1. Points at which varietal use fees are charged**

Source: Sekine (2020: p.493).

Note: ☆ denotes the points at which varietal use fees are charged.

The Z-License fee is included in the seed price, just as with the royalty in Japan. However, if German farmers use FSS, they must pay a Replica fee (Nachbauggebühr) for varietal use. Farmers submit a declaration form that specifies the name and amount of varieties they used to Saatgut-Treuhandverwaltungs GmbH (STV), which was established by plant breeding companies to collect Replica fees instead of breeders.

The Japanese and German systems are largely the same, except for the payment for FSS use. However, the Australian EPR system is completely different. Australian wheat growers are not charged for varietal use when they buy CS or use FSS. Rather, they must pay a royalty for varietal use when they sell or consume their harvested product.

#### 4. Analysis and Results

##### 1) Relationship between production and grower price

In economic theory, a low of supply of a product increases its price. Figure 2 shows the relationship between wheat production and grower price in the three countries.

The amount of product in Japan is related to the grower price, just as predicted by economic theory; the correlation coefficient is  $-0.50$ . On the other hand, production in Germany is only minimally related to prices, and Australian production is weakly related to prices. The correlation coefficients are  $-0.13$  and  $-0.34$

for Germany and Australia, respectively. The reason for this may be apparent from Table 5; that is, German and Australian wheat is traded not only in domestic markets but also international ones. The relationship between production and grower price is a key for the following analysis of grower payments for varietal use.

##### 2) Varietal use fee in wheat production and distribution cost as well as wheat output

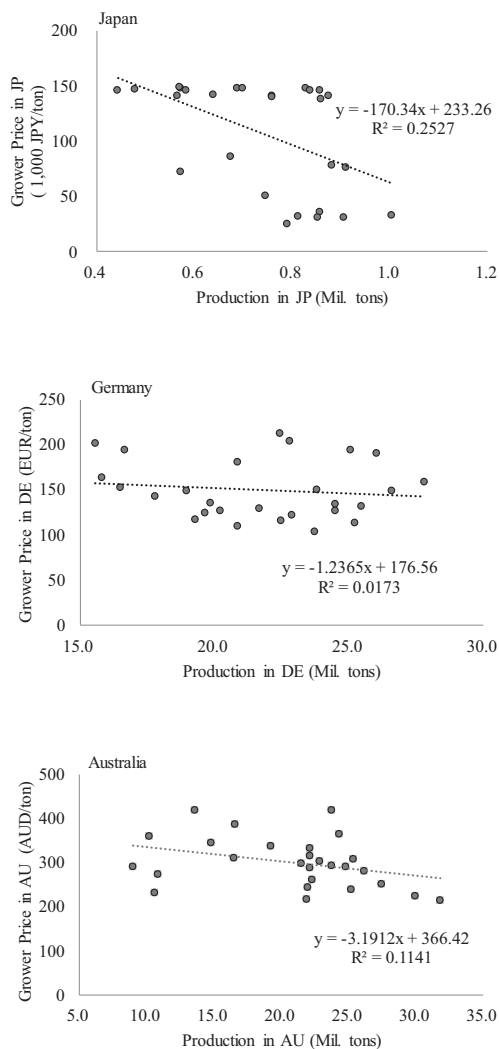
###### (1) Grower payments for wheat production and distribution

Wheat farms in the three countries are at different scales, but they use a similar growing method, rain-fed farming. Growers buy seed, fertilizer, and material for crop protection; they also use energy for machinery and outsource some work. However, wheat distribution processes are different in each country. Figure 3 shows how harvested wheat is distributed and the cost paid by growers in the three countries.

In Japan, once wheat is harvested from fields, growers ship it to an elevator owned by a local branch of the Japan Agricultural Cooperatives (JA). The wheat harvesting season in Japan is humid, so the wheat must be dried there. The cost for drying depends on the year, but the Hokkaido government, which is the largest wheat production prefecture in Japan, says that it is 26,667 JPY per ton (Hokkaido Government, 2013).

In Australia, more than 70% of wheat is exported. Harvested wheat is usually carried to a receival point near the fields. There, wheat is adjusted to fit market





**Figure 2. Relationship between production and grower price in Japan (JP), Germany (DE), and Australia (AU)**

Source: FAO 'FAOSTAT'.

Note: Data from 1991 to 2017. Grower price is deflated by Implicit Price Index, 2010 = 100.

standards. After adjustment, wheat is carried to a terminal elevator on a port by rail. Growers' burden for distribution depend on the farm location. In Western Australia, which is the main wheat exporting state, CBH dominates wheat transactions. There, wheat growers pay, on average, 10.0 AUD per ton for transportation to a receiving point, and they pay 10.8 AUD per ton for adjustment once there. Growers also must

pay for destination freight to a port. The cost for freight is around 15.0 AUD to 25.0 AUD per ton, so this paper uses 20.0 AUD per ton to estimate the wheat distribution cost.

Almost all wheat growers in Japan sell their products to JA, and most growers in Western Australia sell to CBH. This means that the prices are the same for products that are of the same quality and are grown at the same time, though growers in Australia have the opportunity to choose when to sell. On the other hand, growers in Germany watch prices and decide when and to whom they will sell their crop by themselves. Growers temporarily store wheat at their farms after harvest. The harvesting season has low humidity, so growers do not need to dry harvested wheat at farms unless it is kept for several months. In Germany, there are many millers spread across the country (BMEL, 2019: p. 10); for example, the interviewed farmer in Bavaria can access four millers within 30 km. One typical way to sell wheat is that dealers come to farms to pick up wheat; another way is growers carry wheat to a miller themselves. Farmers choose dealers or millers based on the trade price, including shipping cost, which depends on the distance from farms to buyers.

## (2) Grower payments for wheat varietal use

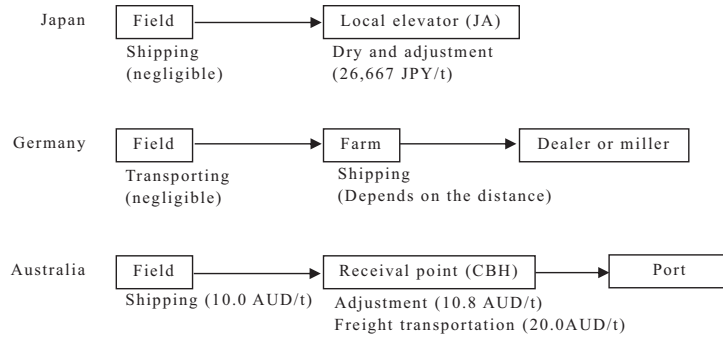
As discussed in section 2, wheat growers pay varietal use fees in all three countries. Table 7 shows the seed use rate and varietal use fee in the three countries.

In Japan, 92% of wheat seed is CS, and only 8% is FSS. The CS variety use fee depends on the PBR holder, but it is about 0.6% of the CS price on average. The fee goes to breeding organizations when growers buy CS from JA, which is the monopoly distributor for wheat seed. Under this system, a 100% collection rate for varietal use fees for CS can be achieved. On the other side, growers in Japan are not charged varietal use fees for FSS.

In Germany, 45% of wheat seed is CS and 55% is FSS. The varietal use fee for CS depends on the variety, but it is 114.9 EUR per ton, on average. The fee is collected when growers buy CS, which is the same as in Japan. Therefore, PBR holders can collect 100% of CS varietal use fees. The varietal use fee for FSS also depends on the variety, but it is 57.5 EUR per ton, on average, which is half the Z-License fee. STV checks the payment from FSS users based on their declaration, but it is too difficult for STV to check all growers' FSS. As a result, PBR holders collect only 30% of FSS varietal use fees, including the small farmers' payment exemption (Curtis and Nilsson, 2012: p.227).

In Australia, only 5% of wheat seed is CS, while 95% is FSS. It is difficult for PBR holders to monitor FSS use by growers, so varietal use fees are collected





**Figure 3. Grower payments for wheat distribution**

Source: Hokkaido Government (2013) and the author's survey.

**Table 7. Seed use rate and varietal use fee**

		Japan	Germany	Australia
CS	Use rate	92%	45%	5%
	Avg. price of royalty	Seed price $\times$ 0.6%	114.9 EUR/ton (seed)	3.4 AUD/ton (product)
	Collection rate	100%	100%	80%
	Collector	JA	Seed distributor	Wheat dealer
FSS	Use rate	8%	55%	95%
	Avg. price of royalty	-	57.5 EUR/ton (seed)	3.4 AUD/ton (product)
	Collection rate	-	30%	80%
	Collector	-	STV	Wheat dealer

Source: Zenkoku Beibaku Kairyo Kyokai (全国米麦改良協会) [https://www.zenkokubeibaku.or.jp/mugi\\_s.html](https://www.zenkokubeibaku.or.jp/mugi_s.html) (accessed on March 6, 2020), Curtis and Nilsson (2012: pp.14-15, pp.20-21), STV (2019: pp.27-36), Variety Central (2019), and the author's survey.

under the EPR system. The varietal use fee depends on the variety, but it averages 3.4 AUD per ton. PBR holders collect 80% of the varietal use fee, but they fail to collect the other 20% because it is difficult to collect when growers consume their products on their farm as feed or food.

### (3) Proportion of varietal use fee to cost and output

Wheat production and distribution costs as well as output are estimated in Table 8, based on the data in Figure 3 and Table 7. Table 8 also shows varietal use fees and their percentage of cost and output.

In Japan, the cost is over the output, and that gap is covered by direct payments from the national government. The varietal use fee is 0.0% of the cost and 0.1% of the output. Both proportions are low because breeding in Japan is mainly publicly funded.

In Germany, the Z-License fee is 3.3% of the cost and the Replica fee is 1.6%. The percentage for varietal use is 1.2% of the output when a grower uses 45% CS and 55% FSS.

In Australia, the varietal use fee is 2.0% of the cost

and 1.2% of the output. 1.2% of the output is, coincidentally, the same proportion as in Germany.

Table 8 is estimated based on average yields, but wheat yield changes every year. Table 9 shows the estimation under a plus or minus 20% yield from the average using the same price as Table 8.

If the yield increases 20% in Japan, the varietal use fee is 0.0% of the cost, and 0.1% of the output; these proportions match those for average yields. If the yield decreases 20%, the varietal use fee is 0.1% of the cost and 0.1% of the output. The proportions are hardly changed because the varietal use fee is too small to impact the cost or output in Japan. In addition, the growers' burden for varietal use in the output is eased by higher prices in low-yield years, as shown in Figure 2.

If the wheat yield increases 20% in Germany, the Z-License and Replica fees remain 3.3 and 1.6%, respectively, of the cost for production and distribution. However, the varietal use fee proportion of the output is reduced to 1.0%. If the yield decreases 20%, the proportion of varietal use fee to cost does not change,

**Table 8. Wheat production and distribution cost, output, and varietal use fee under average yield**

	Japan <sup>2)</sup>			Germany <sup>2)</sup>			Australia		
Total Agricultural area	23.2	ha		131.8	ha		4,437.3	ha <sup>3)</sup>	
Total labor input <sup>1)</sup>	1.8	person		1.4	person		2.3	person <sup>3)</sup>	
Wheat area	7.3	ha		64.3	ha		2,448.3	ha <sup>3)</sup>	
Yield	4.6	t/ha		8.2	t/ha		2.1	t/ha <sup>4)</sup>	
Price	42,171	JPY/t		158.2	EUR/t		279.3	AUD/t <sup>4)</sup>	
Output	193,987	JPY/ha		1,297.2	EUR/ha		586.5	AUD/ha	
	(% of variable cost)			(% of variable cost)			(% of variable cost)		
Seed	28,260	JPY/ha	(8.1%)	76.0	EUR/ha	(11.5%)	27.0	AUD/ha <sup>5)</sup>	(7.7%)
Fertilizer	98,520	JPY/ha	(28.2%)	195.1	EUR/ha	(29.4%)	90.0	AUD/ha <sup>5)</sup>	(25.6%)
Crop protection	46,884	JPY/ha	(13.4%)	168.0	EUR/ha	(25.3%)	110.0	AUD/ha <sup>5)</sup>	(31.3%)
Other specific costs	4,830	JPY/ha	(1.4%)	20.3	EUR/ha	(3.1%)	-		
Energy	20,706	JPY/ha	(5.9%)	116.3	EUR/ha	(17.5%)	15.0	AUD/ha <sup>5)</sup>	(4.3%)
Contract work	27,536	JPY/ha	(7.9%)	87.8	EUR/ha	(13.2%)	11.0	AUD/ha <sup>5)</sup>	(3.1%)
<b>Production cost/ha</b>	<b>226,736</b>	<b>JPY/ha</b>	<b>(64.9%)</b>	<b>663.5</b>	<b>EUR/ha</b>	<b>(100.0%)</b>	<b>253.0</b>	<b>AUD/ha</b>	<b>(72.0%)</b>
Production cost/ton	49,290	JPY/t	-	80.9	EUR/t	-	120.5	AUD/t	-
Shipping and transportation	negligible			Included in other specific costs <sup>7)</sup>			63.0	AUD/ha <sup>6)</sup>	(17.9%)
Drying and adjustment	122,668	JPY/ha <sup>6)</sup>	(35.1%)	-			22.7	AUD/ha <sup>6)</sup>	(6.4%)
Levy	-			-			6.0	AUD/ha <sup>8)</sup>	(1.7%)
End Point Royalty	-			-			7.1	AUD/ha	(2.0%)
<b>Distribution cost/ha</b>	<b>122,668</b>	<b>JPY/ha</b>	<b>(35.1%)</b>	-			<b>98.8</b>	<b>AUD/ha</b>	<b>(28.0%)</b>
Distribution cost/ton	26,667	JPY/t	-	-			47.0	AUD/t	-
<b>Total cost/ha</b>	<b>349,404</b>	<b>JPY/ha</b>	<b>(100.0%)</b>	<b>663.5</b>	<b>EUR/ha</b>	<b>(100.0%)</b>	<b>351.8</b>	<b>AUD/ha</b>	<b>(100.0%)</b>
Total cost/ton	75,957	JPY/t	-	80.9	EUR/t	-	167.5	AUD/t	-
CS variety use fee	170	JPY/ha	(0.0%)	21.8	EUR/ha <sup>9)</sup>	(3.3%)	7.1	AUD/ha	(2.0%)
FSS variety use fee	-			10.9	EUR/ha <sup>9)</sup>	(1.6%)			
	(% of output)			(% of output)			(% of output)		
CS variety use fee	1,241	JPY/farm		630.8	EUR/45% of farm		17,382.9	AUD/farm	
FSS variety use fee	-			385.5	EUR/55% of farm				
Total	1,241	JPY/farm	(0.1%)	1,016.3	EUR/farm	(1.2%)	17,382.9	AUD/farm	(1.2%)

Source: MAFF (2013–2017), European Commission (2019: p.25), Bankwest (2016: p.18), Bankwest (2017: p.20), Bankwest (2018: p.20), ABARES (2019), Kingwell *et al.* (2016: p.66), Variety Central (2019), Australian Government Department of Agriculture, Water and the Environment website (<https://www.agriculture.gov.au/ag-farm-food/levies/rates#field-crops>, accessed on March 11, 2020), and interviews and calculation by the author.

Notes: 1) Total labor input includes only full-time workers; part-time workers are excluded.

2) Japan's and Germany's data are the average from 2013–2017.

3) Average from 2015–2017 referring to Bankwest (2016, 2017, 2018)

4) Average from 2014–2018 referring to Australian Government Department of Agriculture, Water and the Environment website

5) See Kingwell *et al.* (2016).

6) See Figure 2.

7) See European Commission (2019: p.8).

8) Levy is 1.02% of the sale value referring to Australian Government Department of Agriculture, Water and the Environment website.

9) Calculated on the condition of 190 kg-seed-use per hectare.

**Table 9. Wheat production and distribution cost, output, and varietal use fee under 20% yield increase or decrease****1) 20% yield increase**

	Japan			Germany			Australia		
Wheat area	7.3	ha		64.3	ha		2,448.3	ha	
Yield	5.5	t/ha		9.8	t/ha		2.5	t/ha	
Price	42,171	JPY/t		158.2	EUR/t		279.3	AUD/t	
Output	231,941	JPY/ha		1,550.4	EUR/ha		698.3	AUD/ha	
	(% of variable cost)			(% of variable cost)			(% of variable cost)		
Seed	28,260	JPY/ha	(7.6%)	76.0	EUR/ha	(11.5%)	27.0	AUD/ha	(7.3%)
Fertilizer	98,520	JPY/ha	(26.4%)	195.1	EUR/ha	(29.4%)	90.0	AUD/ha	(24.3%)
Crop protection	46,884	JPY/ha	(12.5%)	168.0	EUR/ha	(25.3%)	110.0	AUD/ha	(29.7%)
Other specific costs	4,830	JPY/ha	(1.3%)	20.3	EUR/ha	(3.1%)	-		
Energy	20,706	JPY/ha	(5.5%)	116.3	EUR/ha	(17.5%)	15.0	AUD/ha	(4.0%)
Contract work	27,536	JPY/ha	(7.4%)	87.8	EUR/ha	(13.2%)	11.0	AUD/ha	(3.0%)
<b>Production cost/ha</b>	<b>226,736</b>	<b>JPY/ha</b>	<b>(60.7%)</b>	<b>663.5</b>	<b>EUR/ha</b>	<b>(100.0%)</b>	<b>253.0</b>	<b>AUD/ha</b>	<b>(68.3%)</b>
Production cost/ton	41,225	JPY/t	-	67.7	EUR/t	-	101.2	AUD/t	-
Shipping and transportation	negligible			Included in other specific costs			75.0	AUD/ha	(20.2%)
Drying and adjustment	146,669	JPY/ha	(39.3%)	-			27.0	AUD/ha	(7.3%)
Levy	-			-			7.1	AUD/ha	(1.9%)
End Point Royalty	-			-			8.5	AUD/ha	(2.3%)
<b>Distribution cost/ha</b>	<b>146,669</b>	<b>JPY/ha</b>	<b>(39.3%)</b>	-			<b>117.6</b>	<b>AUD/ha</b>	<b>(31.7%)</b>
Distribution cost/ton	26,667	JPY/t	-	-			47.0	AUD/t	-
<b>Total cost/ha</b>	<b>373,405</b>	<b>JPY/ha</b>	<b>(100.0%)</b>	<b>663.5</b>	<b>EUR/ha</b>	<b>(100.0%)</b>	<b>370.6</b>	<b>AUD/ha</b>	<b>(100.0%)</b>
Total cost/ton	67,892	JPY/t		67.7	EUR/t		148.2	AUD/t	
CS variety use fee	170	JPY/ha	(0.0%)	21.8	EUR/ha	(3.3%)	8.5	AUD/ha	(2.3%)
FSS variety use fee	-			10.9	EUR/ha	(1.6%)			
	(% of output)			(% of output)			(% of output)		
CS variety use fee	1,241	JPY/farm		630.8	EUR/45% of farm		20,810.6	AUD/farm	
FSS Variety use fee	-			385.5	EUR/55% of farm				
Total	1,241	JPY/farm	(0.1%)	1,016.3	EUR/farm	(1.0%)	20,810.6	AUD/farm	(1.2%)

**2) 20% yield decrease**

	Japan			Germany			Australia		
Wheat area	7.3	ha		64.3	ha		2,448.3	ha	
Yield	3.7	t/ha		6.6	t/ha		1.7	t/ha	
Price	42,171	JPY/t		158.2	EUR/t		279.3	AUD/t	
Output	156,033	JPY/ha		1,044.1	EUR/ha		474.8	AUD/ha	
	(% of variable cost)			(% of variable cost)			(% of variable cost)		
Seed	28,260	JPY/ha	(8.7%)	76.0	EUR/ha	(11.5%)	27.0	AUD/ha	(8.2%)
Fertilizer	98,520	JPY/ha	(30.3%)	195.1	EUR/ha	(29.4%)	90.0	AUD/ha	(27.0%)
Crop protection	46,884	JPY/ha	(14.4%)	168.0	EUR/ha	(25.3%)	110.0	AUD/ha	(33.0%)
Other specific costs	4,830	JPY/ha	(1.5%)	20.3	EUR/ha	(3.1%)	-		
Energy	20,706	JPY/ha	(6.4%)	116.3	EUR/ha	(17.5%)	15.0	AUD/ha	(4.5%)
Contract work	27,536	JPY/ha	(8.4%)	87.8	EUR/ha	(13.2%)	11.0	AUD/ha	(3.3%)
<b>Production cost/ha</b>	<b>221,906</b>	<b>JPY/ha</b>	<b>(69.7%)</b>	<b>663.5</b>	<b>EUR/ha</b>	<b>(100.0%)</b>	<b>253.0</b>	<b>AUD/ha</b>	<b>(76.0%)</b>
Production cost/ton	59,975	JPY/t	-	100.5	EUR/t	-	148.8	AUD/t	-
Shipping and transportation	negligible			Included in other specific costs			51.0	AUD/ha	(15.3%)
Drying and adjustment	98,668	JPY/ha	(30.3%)	-			18.4	AUD/ha	(5.5%)
Levy	-			-			4.8	AUD/ha	(1.5%)
End Point Royalty	-			-			5.8	AUD/ha	(1.7%)
<b>Distribution cost/ha</b>	<b>98,668</b>	<b>JPY/ha</b>	<b>(30.3%)</b>	-			<b>80.0</b>	<b>AUD/ha</b>	<b>(24.0%)</b>
Distribution cost/ton	26,667	JPY/t	-	-			47.0	AUD/t	-
<b>Total cost/ha</b>	<b>320,574</b>	<b>JPY/ha</b>	<b>(100.0%)</b>	<b>663.5</b>	<b>EUR/ha</b>	<b>(100.0%)</b>	<b>333.0</b>	<b>AUD/ha</b>	<b>(100.0%)</b>
Total cost/ton	86,642	JPY/t		100.5	EUR/t		195.9	AUD/t	
CS variety use fee	170	JPY/ha	(0.1%)	21.8	EUR/ha	(3.3%)	5.8	AUD/ha	(1.7%)
FSS variety use fee	-			10.9	EUR/ha	(1.6%)			
	(% of output)			(% of output)			(% of output)		
CS variety use fee	1,241	JPY/farm		630.8	EUR/45% of farm		14,200.1	AUD/farm	
FSS Variety use fee	-			385.5	EUR/55% of farm				
Total	1,241	JPY/farm	(0.1%)	1,016.3	EUR/farm	(1.5%)	14,200.1	AUD/farm	(1.2%)

Source: See Table 8.

**Table 10. Estimation of varietal use fees collected by PBR holders**

	Japan	Germany	Australia
Collected varieties use fee (a)	32.9M JPY (0.3M USD)	37.0M EUR (41.1M USD)	67.3M AUD (51.8M USD)
Number of listed varieties (b)	59	330	155
Number of PBR holders (c)	9	27	22
(a)/(b)	557.6K JPY (5.0K USD)	112.1K EUR (124.6K USD)	434.2K AUD (334.0K USD)
(a)/(c)	3.7M JPY (33.0K USD)	1.4M EUR (1.6M USD)	3.1M AUD (2.4M USD)

Source: Tables 5, 6, and 7.

Notes: 1) The capital letter M stands for one million, and K stands for one thousand.

2) Exchange rate is obtained from FAOSTAT. 112 JPY/USD, 0.9 EUR/USD, 1.3 AUD/USD, average from 2014 to 2018.

3) Japan:  $28,260 \text{ JPY/ha} \times 0.6\% \times 211\text{K ha} \times 92\% \times 100\% = 32.9\text{M JPY}$ .

4) Germany: Seed demand  $3,190\text{K ha} \times 190 \text{ kg/ha} = \sim 606\text{K ton}$

CS use  $114.9 \text{ EUR/ton} \times 606\text{K ton} \times 45\% \times 100\% = \sim 31.3\text{M EUR}$ .

FSS use  $57.5 \text{ EUR/ton} \times 606\text{K ton} \times 55\% \times 30\% = \sim 5.7 \text{ M EUR}$ .

Total  $31.3 \text{ M} + 5.7 \text{ M} = 37.0\text{M EUR}$ .

5) Australia:  $24,750\text{K ton} \times 3.4 \text{ AUD/ton} \times 80\% = \sim 67.3\text{M AUD}$ .

but the proportion of the output rises to 1.5%. According to Figure 2, low production does not increase grower prices, so growers will feel as if they are paying more for varietal use in that case.

In Australia, if the yield increases 20%, the percentage of the varietal use fee to the cost for production and distribution rises to 2.3%, and that percentage of the output remains 1.2%. If the yield is reduced by 20%, the proportion of the varietal use fee to the cost is reduced to 1.6%, and the proportion of the output remains 1.2%. Variety users must pay different fee amounts depending on the yield, but the proportion of the varietal use fee to the output is same. Therefore, growers' burden for varietal use payment would be the same, even if grower prices do not go up in the event of low yields, as shown in Figure 2.

### 3) Amount of varietal use fees collected by PBR holders

Thus far, the author has estimated the varietal use fees charged to individual growers. Here, the author focuses collectively on the amount of varietal use fees collected from growers by wheat PBR holders. Table 10 shows the estimation of the varietal use fees collect by PBR holders in the three countries. Table 10 shows that Japanese PBR holders collect 0.3 million USD, German holders gather 41.1 million USD, and Australian holders collect 51.8 million USD. To compare these figures, the collected fees are divided by the number of varieties in each country. After this calculation, 5.0 thousand USD are collected per variety in Japan, 124.6 thousand USD are collected in Germany, and 334.0 thousand USD are collected in Australia. In

addition, when the collected fees are divided by the number of PBR holders, each received 33.0 thousand USD in Japan, 1.6 million USD in Germany, and 2.4 million USD in Australia. We can see there are big differences between these countries.

### 4) Consideration

Figure 2 showed that the production in Germany has very little relation to price, while production in Australia is weakly related to price. This means growers have the ability to earn more from sales if there are high yields. In this situation, growers can afford to pay varietal use fees, even if the fees rise. On the other hand, in the case of low yields, growers cannot earn enough from sales if the grower price does not rise. When this happens, it is difficult for growers to pay the same varietal use fees as when their yield is high or average. Considering the changeable nature of wheat yields, the Australian EPR system seems to be better for wheat growers. Alston and Gray (2013: p.31) point out that the production risk can be shared by growers and breeders under the EPR system. Variety development takes years, so wheat breeders need stable funding for breeding. It could be better for wheat breeders to collect varietal use fees using the German system than the Australian system if yields fluctuate. However, in Germany, wheat growers can switch from CS to FSS to cut costs if yields decrease. Moreover, it cannot be said that the German system is always stable for breeders.

As shown in Table 10, though wheat varietal improvement is conducted by the private sector in both Germany and Australia, there are big differences in the

amount of fees collected per variety or per PBR holder. These differences may come from characteristics of the PBR holders, such as whether they are a multinational or domestic company. They may also come from the kinds of plants they develop, or the features of the varieties in each country. More investigation into private breeding programs in other countries is needed to find the reason.

According to Table 10, Japanese PBR holders collect varietal use fees that are too small to fund the development of new varieties. As previously mentioned, although the Japanese government wants private companies to enter the cereal breeding industry, it could be difficult for private companies to acquire enough breeding funds in the current system.

### 5. Conclusion

This study reaches two conclusions. First, production in Australia is only weakly related to price, while that in Germany is almost completely unrelated to price. This means that when yields are low, growers will not be able to earn enough from sales. Because of this, the Australian system can ease farmers' burdens with respect to varietal use payments, especially when yields are low.

Second, according to Table 8, German and Australian growers pay 1.2% of their output for varietal use when their yields are average. This estimation suggests that growers can afford to pay about 1.2% for wheat breeding. In Japan, growers pay only 0.1% of their output for varietal use, and breeding programs are publicly supported. Though the Japanese government aims to introduce private sector crop breeding industries, it could be difficult for private companies to acquire enough breeding funds under the current system.

This study focuses on grower payments for varietal use. However, as shown in Table 10, varietal use fees collected by breeders differ by country. Although private companies develop wheat varieties in both Germany and Australia, the value collected per variety and per company also differ between the countries. Thus, the next issue will be wheat breeding investment efficiency in wheat producing countries. How has breeding investment changed the number of new varieties, and their yields abilities, in each country? After solving this issue, the efficient private breeding system can be identified, which will be beneficial not only to wheat breeders and growers but also to wheat consumers.

Additionally, this paper reveals that Japanese varietal use fees are at a much lower rate compared to those of countries that breed through the private sector. However, even if Japanese breeders collected the 1.2%

that Germany's and Australia's do, Japanese wheat production is still limited; therefore, it is expected that grower payments would not be able to cover the breeding programs. Thus, the funding of the private sector's breeding programs is a priority issue in Japan.

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