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Determinants of farmland prices and their local variation

Changro Lee

Kangwon National University, Department of Real Estate, Chuncheon, Republic of Korea, e-mail: spatialstat@naver.com, ORCID https://orcid.org/0000-0002-7727-3168

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Abstract. The setting of farmland prices in the market not only reflects existing agricultural activities but also expected potential for development. This study decomposes farmland prices into values representative of current agricultural production and the prospective development potential at the county level in South Korea. The income value of farmland is derived by analysing agricultural revenue and production cost, and the sale value of farmland is estimated by reviewing transaction prices filed with the administrative authority. The difference between income value and sale value is adopted as the development value in this study. The results of the estimation show that the proportion of development value in the price of farmland is remarkably high, with a median proportion of 0.78, indicating that the threat of converting land to non-agricultural use is non-trivial because it remains a financially attractive alternative. In addition, the magnitude of the portion of the development value in the price of farmland varies considerably across counties depending on the distance to nearby metropolitan cities. This implies that agricultural policy should be designed in a locally optimised manner to effectively restrain the conversion of farmland for urban use.

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1. Introduction

Land prices reflect not only the current uses of land, but also its potential uses. In the literature, the price of farmland is typically decomposed into a discounted stream of expected revenue generated by agricultural production plus a discounted stream to reflect the value of future development (Plantinga & Miller, 2001). This approach to structuring agricultural land prices has an important implication for policymakers as well as scholars, because an estimated price with a high proportion of development value would be a strong motivation for converting the land to non-agricultural use, and thus can be understood as a potential threat to agriculture. The continual loss of agricultural land to urbanisation is a well-known issue in the agricultural industry (Fazal, 2000; Kurowska et al., 2020; Umanailo, 2021). In South Korea, land used for agricultural purposes was reduced by 16% from 1,873,000 hectares in 2009 to 1,581,000 hectares in 2019 (KOSIS, 2020). The loss of agricultural land implies a loss of environmental amenities and domestic food production capacity. Particularly, if the proportion of development value in the price of farmland were to increase considerably in a particular region, it may signal policymakers to design relevant policies to deter environmentally undesirable land conversion in the area.

This study decomposes farmland prices in South Korea into separate components based on the value of agricultural production and the potential for land development. For this decomposition, the income-based farmland value is estimated using agricultural revenue and production cost data. The market-based farmland value is then calculated by analysing the transaction prices filed with the relevant administrative authority. Finally, the difference between the income value and sale value – that is, the development value of farmland – is estimated. This study aims to determine the level of development value of farmland in South Korea and provide implications for policy design.

Farmland conversion is characterised by the conversion of individual parcels of land, and thus it is desirable to identify the conversion pattern of farmlands at a smaller spatial scale. In this study, the crop production and future development components of farmland prices are identified at the county level. Prior studies on agricultural policy have been conducted largely at the national or provincial scale and provided insights relevant to this scale. In contrast, this study presents the results of the decomposition of the value of farmland at the county level, enabling appropriate policy to be designed at the local level. This approach can provide useful insights for local governments, including county governments.

Value is a measure of worth based on the future benefits anticipated to accrue because of ownership of a property, whereas price is determined with reference to factual market data such as consummated sales (Appraisal Standard Board, 2020). Unlike value, which is a matter of opinion, price is a fact. Following this definition, the current study attempted to distinguish value from price where possible.

The remainder of this paper is organised as follows. Section 2 presents background information on farmland valuation. Section 3 describes the processes used to derive the income-based value and market-based value. The income-based and market-based values are compared and their implications discussed in Section 4. Finally, a summary of the study and conclusions are presented in Section 5.

2. Literature review

2.1 Approaches to farmland valuation

Three approaches are commonly employed in the valuation literature: income capitalisation, sales comparison and cost. The income capitalisation approach is used to estimate the value of real estate that is used to generate income. In this approach, the expected benefits – that is, future financial returns from holding real estate – are estimated first. Income expectancy is capitalised at the market-derived rate of capitalisation. The income capitalisation approach is the preferred method for intangible asset valuation and income-generating property valuation (Casey, 2001; Matsuura, 2004; Verginis & Taylor, 2004).

The sales comparison approach is the most frequently used procedure for determining the value of real estate. In this approach, the real estate being appraised is compared to recently traded properties with characteristics similar to those of the subject. The comparison process entails adjusting the price of the subject by considering the difference in, for example, the age, size and maintenance level of the property. This approach is preferable if a sufficient number of comparable sales have been concluded in the market and is widely used for valuations ranging from vacant lots to improved properties (Lisi, 2019; Farkas & Porumb, 2020; Yousfi et al., 2020).

The cost approach estimates the value of a property by determining the replacement or reproduction cost that would be required to construct a property similar to that being appraised, then subtracting the accrued depreciation from the estimated replacement or reproduction cost. This approach is useful for the valuation of specialised properties such as government assets and corporate machinery (Alves & Lopes, 2005; van Vuuren, 2016; Copiello et al., 2017) because it is extremely difficult to find appropriate comparable sales in the market.

From a theoretical perspective, only the income capitalisation and sales comparison approaches can be utilised to estimate the value of farmland. The cost approach is not applicable, because farmland cannot be reproduced.

2.2 Determinants of farmland prices

Although farmland markets are shaped by various complex factors, including historical cultivation culture (Marks-Bielska, 2017), farmland prices are generally understood to be composed of two components: the value derived from income associated with agricultural production and the value based on expected development prospects. Prior studies can also be classified into two categories in this context: the first focused on rent generated from agricultural income; the second concentrated on non-agricultural factors, such as distance to an urban centre. Therefore, income from agriculture is considered the major land price determinant in the former approach, whereas the sale value in the open market is recognised as the primary price determinant in the latter.

The first category of studies utilised farm income from the sale of agricultural products or crop yield to estimate farmland prices (Djanibekov & Finger, 2018; Takáč et al., 2020). Although these studies proposed that domestic sales revenue played a key role in estimating prices, Kirschke et al. (2021) stressed that international agricultural prices became a key determinant of farmland prices in Germany. Other studies in this category focused on the impact of government subsidies on farmers' income and, ultimately, farmland prices (Weersink et al., 1999; Kirwan, 2009).

The second type of study employed variables other than farm income to estimate the sale value of farmlands: the characteristics of buyers and sellers (Stewart & Libby, 1998), the influence of urbanisation, such as the effect of sprawl or distance to urban centres (Shi et al., 1997; Karakayacı et al., 2019; Xie et al., 2021), and accessibility to main roads (Anyiam et al., 2021).

Few studies have attempted to combine the two perspectives in estimating farmland prices. Plantinga and Miller (2001) examined both of these components of farmland prices – that is, both the farm income value and the development value of a farm. They then investigated the influence of prospective land development on current farmland prices using a polynomial regression model, which was derived from a theoretical model of markets for developed and agricultural land. Hardie et al. (2001)

also explored the way in which non-farm factors might affect farmland prices in addition to changes in farm returns. Another noteworthy study is that of Plantinga et al. (2002). They proved that the value of options associated with uncertain land development was capitalised into current farmland prices. Their study was conducted using a regression model allowing for a spatially correlated error structure, which was also derived from a theoretical model of a spatial city with stochastic returns to future land development.

Although these three studies attempted to separate the price of farmland into agricultural use (for farming) and non-agricultural use (for development), their estimation results largely depended on the hypothesis that the effect of future development opportunities can be captured in the equilibrium farmland price model that they had assumed. In contrast, the analysis in this study was conducted empirically. Income data related to agricultural production were collected, pre-processed and analysed, instead of specifying an assumed equilibrium price model. Sales data were also collected and analysed in a similar manner, and the proportion of development value in the price of farmland was empirically derived.

This study also differs from prior studies in that farmland prices are investigated at the micro-spatial scale. Specifically, farmland prices are analysed at the county level in this study, considering that the size of a county in South Korea is far less than that of a US county. Generally, counties in South Korea are more comparable to sub-divisions of counties in the US or UK. The results presented in this study are expected to provide relevant guidelines for policymaking at a small spatial scale.

3. Estimating the income value and sale value of farmland

3.1 Income value

Rice paddies were analysed in this study because rice is a representative crop in South Korea, accounting for approximately 60% of the entire cultivation area (KOSIS, 2020). The income value of farmland can be defined as the capitalised value from the net income generated from agriculture, and the net income is estimated by subtracting production costs from revenues generated from farm produce. The income value derived in this manner forms the basis for gauging the profitability or productivity of farmlands.

Specifically, the income value is estimated as follows:

1. the yield of the rice crop is determined,
2. the gross revenue from rice sales is calculated,
3. the profit margin (%) is estimated,
4. the net income is calculated by multiplying the gross revenue by the profit margin, and
5. the capitalised value is derived by dividing the calculated net income by the appropriate capitalisation rate.

Table 1. Median rice yield and estimated gross revenue for each province

Province	Rice yield (tonnage)	Area (hectare)	Unit rice yield (kg per m²) ①	Gross revenue (KRW) per m² ②
Gyeonggi	413,916	80,750	0.51	956
Gangwon	166,396	30,714	0.54	1,013
Chungbuk	201,675	37,114	0.55	1,031
Chungnam	774,105	137,354	0.56	1,050
Jeonbuk	687,398	121,026	0.57	1,069
Jeonnam	846,236	166,444	0.51	956
Gyeongbuk	576,643	102,941	0.56	1,050
Gyeongnam	369,032	70,626	0.52	975

 Rice yield (tonnage) ÷ Area (hectare) ÷ 10

 KRW 150,000 ÷ 80 kg × Unit rice yield (kg per m²). The government purchase price of an 80 kg bag of rice was KRW 150,000 as of 2019.

Note: The unit rice yield and gross revenue per m² were estimated by the author, and the table was recreated based on statistics from agriculture, forestry, and fishery (KOSIS, 2020).

Table 1 presents the yield of the rice crop and estimated gross revenue per square metre. Although the underlying information was estimated at the county level (228 counties), the table is presented at the provincial level for readability.

Agricultural production costs include the cost of purchasing seedlings, fertilisers, agricultural chemicals, leasing fees for agricultural machinery, labour and the rent/opportunity costs associated with the paddy field itself. The Korea Rural Economic Institute (KREI) releases the overall trends in the production cost annually, and the profit margin (%) for rice production was estimated based on their reports. The profit margin was calculated at the county level, and Table 2 provides the information at the provincial level for readability. The typical level of net income per square metre ranges from 245 KRW to 381 KRW.

An appropriate capitalisation rate must be determined to convert the estimated net income into a value. Table 3 presents the capitalisation

Table 2. Median estimated net income for each province (continued from Table 1)

Province	Gross revenue (KRW) per m^2	Profit margin (%)	Net income (KRW) per m^2
Gyeonggi	956	39.9	381
Gangwon	1,013	34.9	354
Chungbuk	1,031	33.3	343
Chungnam	1,050	30.3	318
Jeonbuk	1,069	29.6	316
Jeonnam	956	29.4	281
Gyeongbuk	1,050	23.3	245
Gyeongnam	975	31.1	303

Source: author's own work.

Table 3. Capitalisation rate

Land use	Capitalisation rate
Single-family house	3 – 5%
Office building, Shopping center	7 – 10%
Industrial property	4 – 7%
Farmland	3 – 4%
Forest	Less than 1.5%

Note: Guideline on capitalisation rate (KAPA, 2020)

Table 4. Median estimated income value for each province (continued from Table 2)

Province	Net income (KRW) per m^2	Income value (KRW) per m^2
Gyeonggi	381	9,525
Gangwon	354	8,850
Chungbuk	343	8,575
Chungnam	318	7,950
Jeonbuk	316	7,900
Jeonnam	281	7,025
Gyeongbuk	245	6,125
Gyeongnam	303	7,575

Source: author's own work.

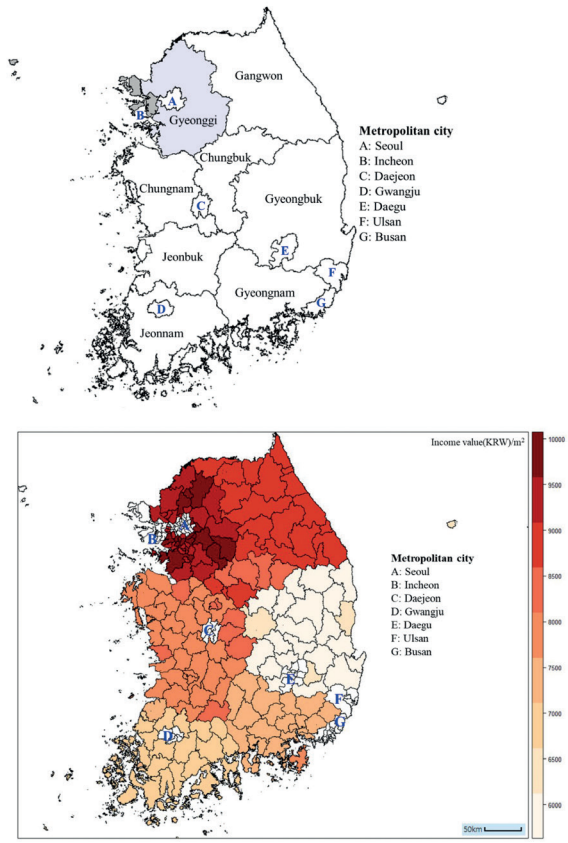

Fig. 1. Administrative divisions (upper map) and distribution of income value at the county level (bottom map)
Source: author's own work.

rates issued by the Korea Association of Property Appraisers (KAPA).

The appropriate capitalisation rate for farmland ranges from 3% to 4%, as shown in the table. Appraisers in agricultural land valuation generally apply a capitalisation rate of 4% to convert the net income to the value of farmland. The same 4% rate was applied in this study, following common valuation practice. Table 4 presents the median income values per province. The typical income value per square metre of rice paddy fields ranges from 6,125 KRW to 9,525 KRW (approximately 5.3 USD – 8.2 USD).

Figure 1 shows the distribution of farmland income values at the county level. Seven metropolitan cities, including Seoul, are shown on the map. A city with a population of over one million can be designated as a metropolitan city according to the Local Autonomy Act. Metropolitan cities were excluded from the calculation of income values because the area covered by farmland in these regions is negligibly small. Generally, counties near Seoul command relatively higher income values, and this income value level decreases as distance from Seoul increases. This trend can be attributed to the high transportation cost because of the increased distance to Seoul, which lowers the income value of farmland.

3.2 Sale value

The sale value is the amount of money farmland would attract if sold in the open market. Thus, the sale value of farmland reflects development potential as well as the profitability of current agricultural production activities. The transaction price of farmlands has to be filed with the relevant administration within 30 days from the date of the transaction contract according to the *Act on the report of real estate transactions*, etc. The government discloses this transaction information, and the transaction dataset was collected from a website maintained by the Ministry of Land, Infrastructure, and Transport (MOLIT). MOLIT provides transaction datasets on a monthly basis, and the farmland transactions in 2019 were used in this study.

The most crucial aspect when analysing transaction prices is the removal of outliers from the initial dataset. In this study, outliers were identified by conducting a ratio analysis, a study of the relationship between the assessed values and market values (IAAO, 2013). In this study, the market values are indicated by the transaction prices. The ratio statistics are calculated as follows:

$$\text{Ratio} = \frac{transaction\ price}{assessed\ value} \quad (1)$$

The level of transaction prices is of common interest in ratio statistics. Because the assessed values are estimated by incorporating transaction prices into the assessment model, the ideal ratio of the transaction price over the assessed value is 1.00. Thus, transaction prices of which the ratio deviates considerably from 1.00 can be considered outliers. Following prior studies (Gloudemans & Almy, 2011; IAAO, 2013; Lee, 2019), ratio statistics greater than

Table 5. Sale value after removing outliers for each province

Province	Median sale value (KRW) per m²
Gyeonggi	129,018
Gangwon	31,920
Chungbuk	36,242
Chungnam	36,406
Jeonbuk	21,206
Jeonnam	15,882
Gyeongbuk	29,604
Gyeongnam	45,166

Source: author's own work.

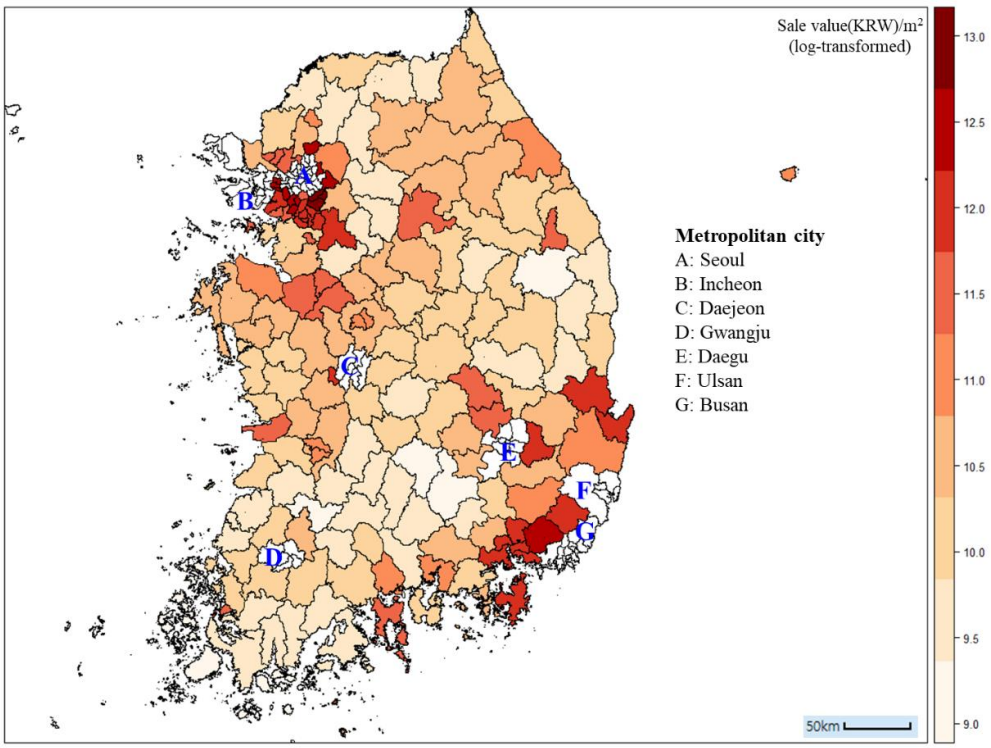

Fig. 2. Administrative divisions (upper map) and distribution of income value at the county level (lower map).
Source: author's own work.

2.00 or less than 0.50 were classified as outliers and thus deleted from the dataset.

Table 5 provides the median sale value based on the transaction prices reported in 2019 after removing the outliers. The figures in the table are presented at the provincial level for readability, although the initial dataset comprises the prices of individual lots. The typical sale value per square metre of rice paddy fields ranges from 15,882 KRW to 129,018 KRW (approximately 13.6 USD – 110.7 USD).

Figure 2 shows the distribution of farmland sale values at the county level. The value was log-transformed because the raw sale values varied widely from less than 10,000 KRW to greater than 150,000 KRW at the county level, thereby making a visual comparison difficult. Counties close to metropolitan cities (indicated by letters A through G) generally have higher sale values.

4. Results and discussion

4.1 Results

The proportion of the development value in farmland price is calculated as follows:

$$\text{Proportion of development value} = \frac{(sale\ value - income\ value)}{sale\ value} \quad (2)$$

where the difference between the sale value and income value is considered to indicate the development value in this study. Figure 3 shows the distribution of the proportion: the median proportion of the development value is 0.78, and the minimum and maximum proportion is 0.19 and 0.98, respectively. As shown in the figure, the proportion of the development value of counties surrounding metropolitan cities is consistently higher. As the distance to a nearby metropolitan city decreases, the development potential of the farmland increases, increasing the proportion of the development value of the total price of the farmland.

Other than the spatial pattern observed in counties close to metropolitan cities, the proportion of the development value varies significantly across counties, ranging from nearly 0.2 to close to 1.00, implying that the pressure to convert to urban land differs drastically among counties. Counties for which the proportion of the development value is less than 0.2 are largely observed in the south-western region of the Korean peninsula.

4.2 Implications

On average, the value of development potential was found to account for 80% of the current price of farmland in South Korea. This is contrary to the result of the study by Plantinga et al. (2002), which is the most similar to ours in several respects, except that the prior study is based on an assumed equilibrium price model. Plantinga et al. (2002)

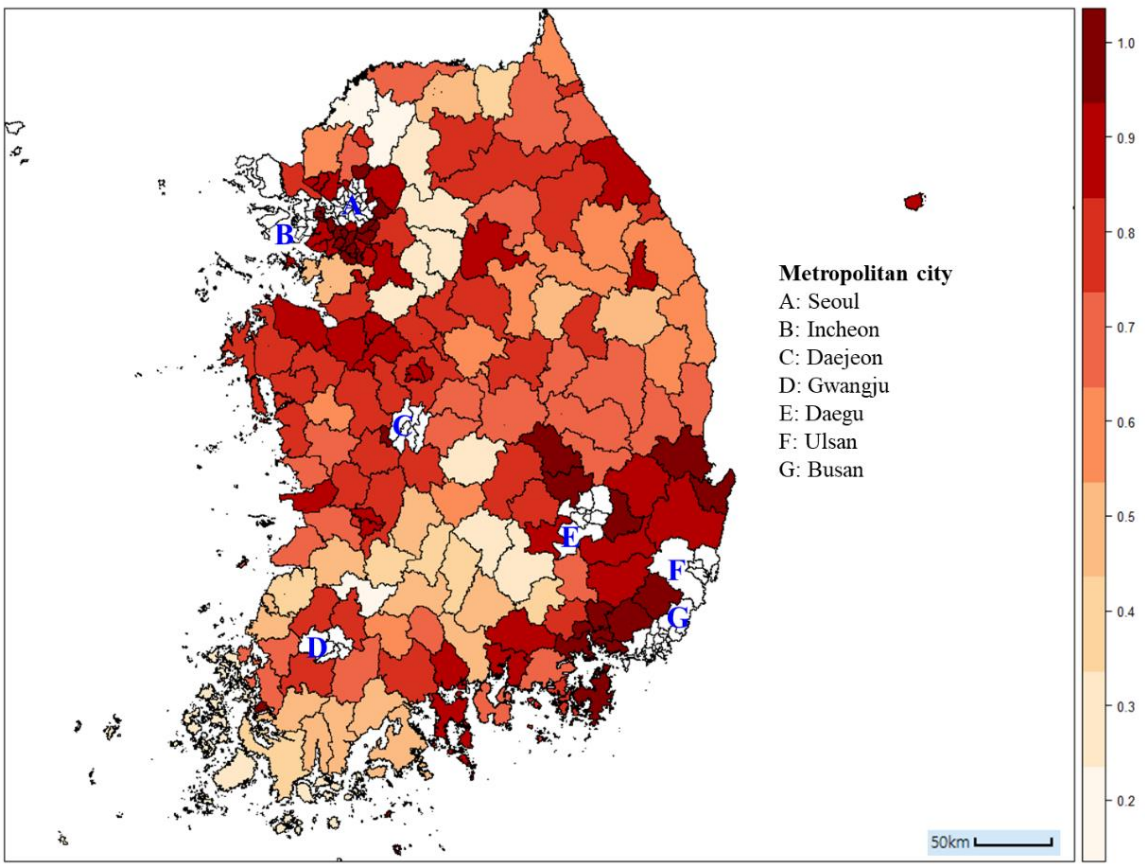

Fig. 3. Proportion of development value in the price of farmland.
Source: author's own work.

found that the value of land development constituted approximately 10% of the value of US farmland and suggested that the potential development of land posed limited threats to the food supply. This difference can be attributed to the fact that the US is a vast tract of land with a relatively low population density of 36 persons per square kilometre, whereas South Korea has limited land mass with a high population density of 512 persons per square kilometre (United Nations, 2019). South Korea is a densely populated country, and this contributes to the high portion of development value of farmland prices. The difference in time between the study of Plantinga et al. (2002) and this study could also be pointed out as being responsible for the discrepancy in the results. Urbanisation is a global trend, and the urban population has increased rapidly in recent decades (Sun et al., 2020). Therefore, the influence of urbanisation has become more substantial, thereby increasing the pressure to convert farmland. Overall, the potential threat to farmland as a result of conversion can be said to be stronger in South Korea than in the US.

Another noteworthy pattern is that the portion of the development value – that is, the magnitude of the threat of farmland loss – varies markedly among counties, ranging from nearly 0.2 to close to 1.00. This implies that a farmland preservation policy optimised for local conditions should be implemented. In counties where farmland prices are found to be composed of higher capitalised rents from prospective development, stricter regulation of land-use conversion may be warranted to prevent the loss of arable land.

According to the *Farmland Act*, a person who intends to convert land approved for agricultural use into land for non-agricultural use has to pay a charge for the preservation and creation of farmland, known as the farmland preservation charge. The results of the study suggest that farmland preservation charges need to be imposed in proportion to the development value of farmland. For example, a higher charge for a person who intends to convert farmland with a high development value could be considered as one of the alternatives. Under this policy framework, the level of farmland preservation charges would be correspondingly higher in counties with high pressure to convert farmland, thereby effectively deterring the undesirable conversion of farmland in those areas. However, farmland markets are shaped not only by economic factors but also by various other factors such as owners' attitudes toward the cultural and symbolic value of farmland (Marks-Bielska, 2013). Thus, the suggested alternative should be implemented following careful consideration of other unintended side effects.

5. Conclusion

Farmland prices were estimated from two perspectives. First, income-based values were derived based on agricultural revenue and production costs. Then, market-based values were calculated by collecting transaction records and removing outliers. Higher income values were observed in counties near Seoul, and the level of income value decreased as the distance to Seoul increased. As for the sale value, a higher sale value was found in counties close to metropolitan cities, and the level declined as the distance to the closest metropolitan city increased. Finally, the proportion of development value in the price of farmland price was shown to be high in counties adjacent to metropolitan cities, where the proportion was close to 1.00. Overall, the median proportion of development value in the price of farmland is 0.78, indicating that most of the value of farmland is attributable to the development potential.

Various policies for farmland preservation are currently under enforcement in South Korea: limiting the ownership of farmlands by urban residents, providing an agricultural subsidy for rice production, imposing farmland preservation charges on a person who changes the use of farmland into non-agricultural use, etc. Most of these policies are implemented uniformly across the nation, with local adaptation not being allowed. However, as shown in Fig. 3, the proportion of development value in the price of farmland varies considerably across counties, ranging from less than 0.2 to greater than 0.9. This indicates that the conversion pressure differs significantly per county; thus, policies for farmland preservation should be adapted at the local level. A farmland preservation charge has been suggested as an example. The amount charged would need to

differ depending on the level of conversion pressure to ensure that farmlands are preserved effectively.

This study proposes a county-scale analysis of the price of farmland. However, an investigation on a smaller scale (the micro-scale) would have to be conducted in future, by decomposing farmland prices at the neighbourhood or individual parcel level. An analysis at the micro-scale would enable the neighbourhoods or parcels of land with the highest probability for conversion to be identified and considered when designing local policies for farmland preservation.

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