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# Economic Value of Food Commodities and Labor Shift due to Rice Field Conversion in Batu City, Indonesia

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**ABSTRACT**

Increasing tourist activities in Batu City make agricultural land conversion unavoidable. This research purpose is to discover the lost economic value of food commodities due to converted agricultural land area and labor shift. The conversion area of agricultural land in all areas can be identified through Landsat image 8 ETM+ in 2017 and 2021. An overlay analysis using ArcGIS 10.2 software with seven variables was then utilized to discover land capability and suitability. Then, it was combined with the survey results of 334 land price points to determine the distribution of agricultural land prices in Batu City by using Kriging interpolation analysis. The researcher found that the agricultural land area has decreased in the past four years by 169.96 Ha, with a lost economic value of approximately 5 billion Indonesian rupiahs. The agricultural land price in Batu City is divided into four classifications. The results indicate that the agricultural land price is high, so it accelerates agricultural land conversion. Therefore, the government should pay close attention to land conversion.

**Keywords:** Economic Value, Labor Shift, Land Conversion

## INTRODUCTION

The land is an extremely fundamental aspect of life. In agricultural production, land as the main input for agricultural activities plays an irreplaceable role (Sitko & Jayne, 2014). Agricultural land is an effective wealth-generating resource for farmers and a crucial factor for economic growth (Prayitno, Surjono, Hidayat, Subagiyo, & Paramasasi, 2018; Prayitno, Ahari, & Rukmi, 2021). Especially for human survival, the ever-increasing population will definitely increase the demand for shelter and food. However, the area of land will be increasingly limited. So this is also the trigger for urban areas to experience the largest cases of land conversion (Lanz, Dietz, & Swanson, 2018). Changes in land use occur as a result of changes in the environmental conditions of the land itself, such as climate and soil characteristics, as well as human development, such as population growth and land use (Trisurat, Shirakawa, & Johnston, 2019). Changes in land use are also caused by technological advances in agriculture, market influences, and development policies (Msofe, Sheng, & Lyimo, 2019). Land use significantly impacts the functioning of socioeconomic and environmental systems with important tradeoffs for sustainability, food security, biodiversity, and socioeconomic vulnerability of people and ecosystems (Mishra Rai, & Rai, 2020).

Changes in land use in urban areas, namely from agricultural land to non-agricultural land (Luo et al., 2019). In addition, farmers have shifted from traditional to modern, which has implications for socio-cultural structures and changes in land use (Hoang et al., 2020). Moreover, most of the elderly are working in the agricultural sector, which is different from the younger generation, who choose to work in other sectors (Rigg, Salamanca, Phongsiri, & Sripun, 2018). Even so, the agricultural sector is very crucial in supporting poverty alleviation (Yamamoto, Shigetomi, Ishimura, & Hattori, 2019). As a result, the local agricultural economy may decline or disappear (Azadi et al., 2018). Meanwhile, urban farming can improve environmental conditions, especially for the poor, by reducing the impact of urban heat and the risk of flooding, creating green open spaces and sources of income (Nguyen & Kim, 2020). Urban areas are important for maintaining food security, given their resource base and proximity to urban cores. Not only that, but suburban agriculture plays a crucial role in urban sustainability by giving income opportunities, providing food and fiber, and inverting the environmental degradations trend in cities (Rondhi, Pratiwi, Handini, Sunartomo, & Budiman, 2018).

One of the cities in East Java, Indonesia, namely Batu City, is a city whose direction of development is based on *agropolitan* and tourism. From these emerged other activities that developed in support of development in Batu City. In general, the increase in tourism activities in all sectors in Batu City has led to a rise in the need for built-up land to support these activities. This resulted in overlapping land provisions between tourism activities and agricultural activities, which are the main source of income for Batu City.

Agricultural land conversion into built-up land to support tourism and housing sectors is carried out across Batu City, including the suburban area (Prayitno, Subagiyo, & Kusriyanto, 2020). Land conversion indirectly affects many sectors, from socioeconomic to household sectors (Dewi & Sarjana, 2015; Kusumastuti, Kolopaking, & Barus, 2018). Agricultural land conversion into non-agricultural land provides impacts rice provision (Basuki, Purwanto, Fajarningsih, & Ani, 2010), farmer's welfare (Ruswandi, Rustiadi, & Mudikdjo, 2016), environmental damage (Bryan, 2013; Mendoza-Ponce et al., 2021) and affect sustainable agriculture (Prayitno, Dinanti, Hidayana, & Nugraha, 2021). Therefore, it needs to be controlled. In addition, land conversion also causes an imbalance in space and its use (Agus & Irawan, 2006; Alipbeki et al., 2020; Prayitno, Subagiyo, Dinanti, Rahmawati, & Auliah, 2021).

The conversion of agricultural land has a significant effect on decreasing employment opportunities if it is seen from an economic perspective. The transformation of agricultural land has resulted in the loss of opportunities to earn income from rice cultivation because the land has been transferred to other uses. Those who are highly afflicted in this regard are those whose livelihoods are farmers or farm laborers. Thus, land conversion highly affects the decrease in agricultural income. Most landowners sell or convert more than half of their paddy fields. Agricultural production will be lost because paddy fields are converted (Fandani & Harini, 2020). So the conversion of paddy fields will reduce rice production (Widyawati, Nurbani, Prasetyo, Manurung, & Pebriadi, 2021). This considers a serious issue since this sector contributes a considerable amount of income to the community (Kimbal & Tangkau, 2021).

The impact of agricultural land conversion into built-up land is one of the issues which is associated with the decline in the productivity of agricultural land for food crops (Nurliani & Rosada, 2016). The decrease in productivity of agricultural food land leads to a decrease in the economic value of agricultural activities in Batu City. Economic value can be assessed from the direct use value of the price of yielded agricultural products and the indirect use value obtained from the production of grain/straw from rice plants or the value obtained from the use of products other than agricultural products (Soemarno, 2010). The agricultural land conversion area can be identified from the data of the Department of Agricultural on land use changes and by using satellite imagery as a form of utilizing the existing remote sensing data and the available open-source spatial data (Salas López et al., 2020; Winkler, Fuchs, Rounsevell, & Herold, 2021). Remote sensing data and spatial data in the form of thematic maps can be used to map land suitability factors for the provision of agricultural land, and it is carrying capacity (Nugraha, Rahmawati, Auliah, & Prayitno, 2022; Prayitno et al., 2018).

The results of land suitability are utilized to determine the agricultural land conversion area of the agricultural land with suitable designation, which is prioritized as sustainable food agricultural land (Hossain, Amin, Sultana, & Siddique, 2020; Kandari, Kasim, Limi, & Karim, 2015; Rizqiyah, 2018; Widiatmaka, Mulya, Panuju, Ambarwulan, & Hamzah, 2019). Alternatively, the land that is not suitable for agricultural land is prioritized to be developed for other alternatives (Suharyanto, Hartono, Irwansyah, Tuwu, & Umanailo, 2021). This research attempts to identify the loss from the changes in agricultural land conversion in the form of currency and to determine the exact amount of the loss. Therefore, the researcher selected this phenomenon to discover the loss of value of agricultural land conversion activities and shifts in productivity and labor. This research aims to identify the area of land use change and the capability and suitability of agricultural land. Moreover, its purpose is to examine the economic value of food commodities and labor shifts due to agricultural land conversion in Batu City. This research offers insights into regional and urban planning, particularly in identifying the impacts of land conversion. Furthermore, this research serves as an input for future research to determine the impacts of changes in agricultural land on economic value as well as provides input in spatial planning, especially for Batu citizens as the users.

## LITERATURE REVIEW

Traditional location theory is specify into two parts: Von Thunen's analysis of agriculture and Weber's analysis of the industry. Von Thunen's analysis has traditionally been at the aggregate level, whereas Weber's analysis has been at the firm level. Despite their apparent contradiction, the two theories can be combined in one analysis, namely the agricultural location theory (Isard, 1956).

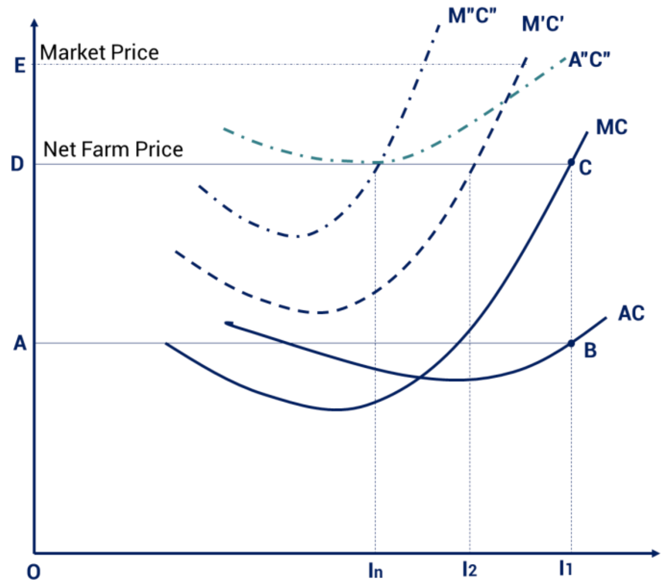
Land rent differences are always central in agricultural location theory. Because agricultural enterprises' internal spatial coverage is generally relatively large, differences in land prices associated with different spatial positions are the primary determining factors for site selection. Differences in land rent play the same role for agricultural firms as differences in labor costs for firms in labor-intensive industries or differences in energy costs for firms in energy-intensive industries.

It is critical for agricultural firms to investigate the substitution relationship between land rental costs and transportation costs. In this regard, agricultural enterprise location theory is identical to industrial enterprise location theory. Both are based on a comparison of differential costs and an investigation of substitution relationships among costs. The only significant difference is that many agricultural firms cultivate the majority of the major crops, and the market concentration at certain points allows for a more detailed locational analysis of the agricultural sector than other sectors.

Consider the farm operator's decisions regarding his business's location (concerning of the distance from the market), the products to be cultivated, the proportion of factors to be used, and the interrelated production intensity. Some of these connections can be seen in the graphs created by Edward Dunn (Isard, 1956).

Each agricultural operator is represented by a set of price and cost curves in Figure 6. OE represents the market price for the specific product it cultivates. The net farm price, denoted by OD, is the market price minus the cost of transporting each unit of product to market, as demonstrated by ED. The solid curves, AC and MC, represent the average and marginal cost curves, respectively; they exclude land lease payments, implying that land prices are zero. If the land price is zero, the operator will increase output to level 0I1, where the marginal cost equals the net farm price (marginal revenue). In other words, the market price equals the gross marginal cost (including transportation costs to market) (gross marginal revenue). Thus, the area of the rectangle, ABCD, represents the total surplus.

**Figure 1.** Agricultural Firm Price and Cost Curves



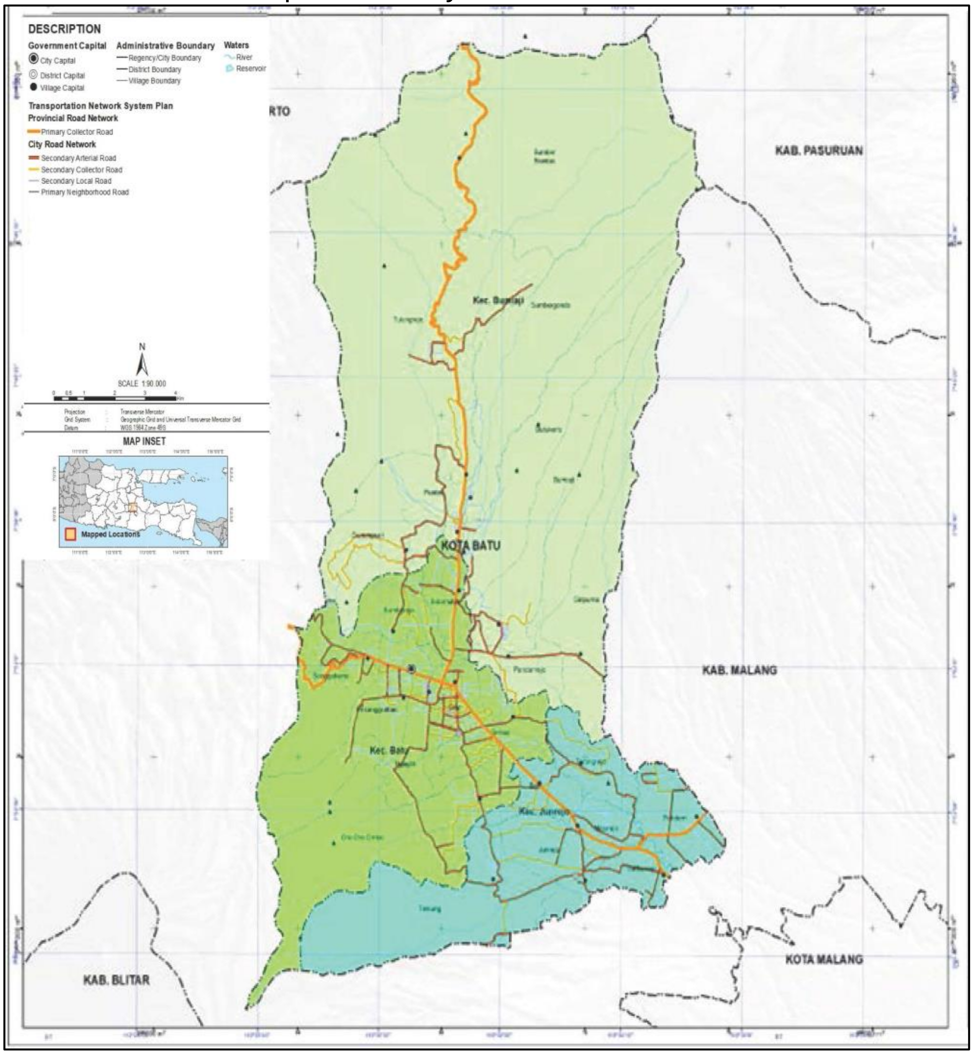

Source: Adapted from Isard (1956)

## RESEARCH METHOD

### Research Location

The scope of this research area is in Batu City, East Java Province, Indonesia, with a total administrative area of Batu City covering 197,087 km2 (BPS Kota Batu, 2019). Based on the research objectives, this research focuses on agricultural land spread over 3 (three) subdistricts in Batu City, namely Junrejo District, Batu District, and Bumiaji District.

**Figure 2.** Administrative Map of Batu City




### Research Variables

This is descriptive-evaluative research to identify actual conditions in the field in order to seek factual and detailed information, to identify and evaluate with a qualitative approach to compare existing conditions with the theories that are used as a framework for determining research variables.

Descriptive-evaluative research is conducted by identifying the representative of agricultural land use change and evaluating the suitability of agrarian land in Batu City, as well as determining the total economic value of suitable agricultural land in Batu City. The evaluation results will serve as suggestions for the agricultural land locations and the total monetary value for the government of Batu City. Research variables are variables with parameters based on specific theories and previous studies that can be used for data processing in achieving research objectives. The research variables to find out the economic value of agricultural land conversion in Batu City is shown in Table 1.

**Table 1.** Research Variables

| Objective | Variable | Sub-variable |
|---|---|---|
| To identify land conversion, land capability, and suitability of agricultural land in Batu City | Land cover | ▪ Types of land cover<br>▪ Land cover area<br>▪ Agricultural land area |
| | Capability and suitability of agricultural land | ▪ Slopes<br>▪ Geomorphology<br>▪ Geology<br>▪ Topography<br>▪ Hydrogeology<br>▪ Watershed |
| To study the economic value of the agricultural land conversion | The economic value of agricultural production | ▪ Crop production value<br>▪ Crop production cost |
| | The economic value of land price | ▪ Land price<br>▪ Productivity<br>▪ Livelihood |

This research used qualitative and quantitative approaches. According to (Sugiyono, 2013), qualitative research uses data sourced from primary data according to the actual situation obtained through observation and interview. Meanwhile, analysis in the quantitative approach uses numerical data to be processed using statistical methods (Creswell, 2014). It is necessary to decide the number of samples for data collection. The samples were obtained using the Krejcie-Morgan approach (Figure 3) (Krejcie & Morgan, 1970).

**Figure 3.** Krejcie-Morgan Sample (1970)

| N | S | | | N | S | | | N | S | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1% | 5% | 10% | | 1% | 5% | 10% | | 1% | 5% | 10% |
| 10 | 10 | 10 | 10 | 280 | 197 | 115 | 138 | 2800 | 537 | 310 | 247 |
| 15 | 15 | 14 | 14 | 290 | 202 | 158 | 140 | 3000 | 543 | 312 | 248 |
| 20 | 19 | 19 | 19 | 300 | 207 | 161 | 143 | 3500 | 558 | 317 | 251 |
| 25 | 24 | 23 | 23 | 320 | 216 | 167 | 147 | 4000 | 569 | 320 | 254 |
| 30 | 29 | 28 | 27 | 340 | 225 | 172 | 151 | 4500 | 578 | 323 | 255 |
| 35 | 33 | 32 | 31 | 360 | 234 | 177 | 155 | 5000 | 586 | 326 | 257 |
| 40 | 38 | 36 | 35 | 380 | 242 | 182 | 158 | 6000 | 598 | 329 | 259 |
| 45 | 42 | 40 | 39 | 400 | 250 | 186 | 162 | 7000 | 606 | 332 | 261 |
| 50 | 47 | 44 | 42 | 420 | 257 | 191 | 165 | 8000 | 613 | 334 | 263 |
| 55 | 51 | 48 | 46 | 440 | 265 | 195 | 168 | 9000 | 618 | 335 | 263 |
| 60 | 55 | 51 | 49 | 460 | 272 | 198 | 171 | 10000 | 622 | 336 | 263 |
| 65 | 59 | 55 | 53 | 480 | 279 | 202 | 173 | 15000 | 635 | 340 | 266 |
| 70 | 63 | 58 | 56 | 500 | 285 | 205 | 176 | 20000 | 642 | 342 | 267 |
| 80 | 71 | 65 | 62 | 600 | 315 | 221 | 187 | 40000 | 563 | 345 | 269 |
| 85 | **75** | **68** | **65** | 650 | 329 | 227 | 191 | 50000 | 655 | 346 | 269 |
| 90 | 79 | 72 | 68 | 700 | 341 | 233 | 195 | 75000 | 658 | 346 | 270 |
| 95 | 83 | 75 | 71 | 750 | 352 | 238 | 199 | 100000 | 659 | 347 | 270 |
| 100 | 87 | 78 | 73 | 800 | 363 | 243 | 202 | 150000 | 661 | 347 | 270 |
| 110 | 94 | 84 | 78 | 850 | 373 | 247 | 205 | 200000 | 661 | 347 | 270 |
| 120 | 102 | 89 | 83 | 900 | 382 | 251 | 208 | 250000 | 662 | 348 | 270 |
| 130 | 109 | 95 | 88 | 950 | 391 | 255 | 211 | 300000 | 662 | 348 | 270 |
| 140 | 116 | 100 | 92 | 1000 | 399 | 258 | 213 | 350000 | 662 | 348 | 270 |
| 150 | 122 | 105 | 97 | 1050 | 414 | 265 | 217 | 400000 | 662 | 348 | 270 |
| 160 | 129 | 110 | 101 | 1100 | 427 | 270 | 221 | 450000 | 663 | 348 | 270 |
| 170 | 135 | 114 | 105 | 1200 | 440 | 275 | 224 | 500000 | 663 | 348 | 270 |
| 180 | 142 | 119 | 108 | 1300 | 450 | 279 | 227 | 550000 | 663 | 348 | 270 |
| 190 | 148 | 123 | 112 | 1400 | 460 | 283 | 229 | 600000 | 663 | 348 | 270 |
| 200 | 154 | 127 | 115 | 1500 | 469 | 286 | 232 | 650000 | 663 | 348 | 270 |
| 210 | 160 | 131 | 118 | 1600 | 477 | 289 | 234 | 700000 | 663 | 348 | 270 |
| 220 | 165 | 135 | 122 | 1700 | 485 | 292 | 235 | 750000 | 663 | 348 | 271 |
| 230 | 171 | 139 | 125 | 1800 | 492 | 294 | 237 | 800000 | 663 | 348 | 271 |
| 240 | 176 | 142 | 127 | 1900 | 498 | 297 | 238 | 850000 | 663 | 348 | 271 |
| 250 | 182 | 146 | 130 | 2000 | 510 | 301 | 241 | 900000 | 663 | 348 | 271 |
| 260 | 187 | 149 | 133 | 2200 | 520 | 304 | 243 | 950000 | 663 | 348 | 271 |
| 270 | 192 | 152 | 135 | 2600 | 529 | 307 | 245 | 1000000 | 664 | 349 | 272 |

As presented in Table 1, the degrees of freedom are set at 5% or 0.05, meaning that the tolerated error rate is at 5%. The population of this study is agricultural land identified from the remote sensing analysis, which covers 8406 plots of rice fields. Based on the results of sample calculation, 334 plots of land were used as the samples which spread across Batu City. The researcher identified the land based on the closest distance from the road and divided it based on the dominant road class in Batu City. This study used the following analysis methods.

**Land Cover Analysis (Mallupattu & Reddy, 2013)**
The researchers used remote sensing supervised classification or guided classification based on the maximum likelihood method. This is intended to facilitate the classification of the same object with the closest distance to be grouped in the same class. The results of this analysis are the land cover in Batu City of 2017 and 2021 with six land use classifications according to the spatial pattern of Spatial and Regional Planning of Batu City for the period of 2010-2030.

**Land Capability and Suitability Analysis (Abdelrahman et al., 2016; Prayitno et al., 2018)**
After determining the changes in agricultural land cover during the four years span, the researcher used the results of land cover in the existing year. The standards refer to the Regulation of the Minister of Public Works Number 20 of 2007 on Technical Guidelines for Analysis of Physical and Environmental, Economic, and Socio-Cultural Aspects in the Preparation of Spatial Plans and with the suitability of existing agricultural land to the applicable spatial regulations in Batu City. The results of land capability and suitability analysis were used to discover the economic value of agricultural production in Batu City. In general, this analysis concept applied the superimpose/overlay technique with predetermined land capability unit variables to identify the capability and suitability of agricultural land.

**Analysis of the Economic Value of Agricultural Production**
Following the analyses described earlier, an economic analysis of lost productivity is conducted (Soemarno, 2010) to determine lost productivity based on agricultural production.

***Economic Value of Crop Production (NEPT)***

$$NEPTij = NPTij – BPSij' \quad [1]$$

| | | |
|---|---|---|
| NEPTij | : | Economic value of crop production (Rp/year) |
| NPTij | : | Crop production value -I (Rp/year) |
| BPTij | : | Crop production cost -i (Rp/year) |

***Crop Production Value (NPT)***

$$NPTij = PRTij \times hPi \times LS \quad [2]$$

| | | |
|---|---|---|
| NPTij | : | Crop production value -i (Rp/year) |
| PRTij | : | Average product of crop type -i at land unit-j (ton/ha) |
| hPi | : | Price per type of production -I (Rp/kg) |
| LS | : | Rice field area of entire land unit (ha) |
| i | : | Types of plant at each land unit |
| j | : | Rice field unit |

***Crop Production Cost (BPT)***

$$BPTij = IRTij \times hIi \times LS \quad [3]$$
$$IRTij = JITi / LSj$$

| | | |
|---|---|---|
| BPTij | : | Crop production cost -I (Rp/year) |
| IRTij | : | Average input of crop type -i at land unit -j (kg/ha) |
| JITi | : | Total production input of crop type -i (kg) |
| LSj | : | Rice field area at land unit -j (ha) |

| | | |
|---|---|---|
| hIi | : | Price per type of production input -i (Rp/kg) |
| LS | : | Rice field area of entire land unit (ha) |
| i | : | Type of production input at each land unit |
| J | : | Rice field unit |

The Economic Value of Agricultural Production:

$$NEPTij = NPTij - BPTij \quad [4]$$

**Analysis of the Economic Value of Agricultural Production**

The next analysis technique was the Kriging method to discover the value of agricultural land prices in accordance with the agricultural land price surveys. This analysis utilized the software ArcGis 10.2. This spatial analysis used an interpolation pattern, which is an estimated value in areas excluded as samples and is measured to determine the distribution pattern of values across the region. Adjacent sample points would have similarities, as well as sample points that were located far apart. The weights used in the Kriging method were not only based on the distance between the size and location of the predicted points but also on the overall point to measure. The results of the Kriging analysis were used as the basis for agricultural land prices in Batu City.

## RESULTS

**Characteristics of Study Area**

Geographically, Batu City is located at 111°90 – 112.11 East Longitude and 7°1'' – 8°4'' South Latitude. It has three classifications of annual average rainfall ranging from 1750-2000 mm/year, 2000-2250 mm/year, and greater than 2250 mm/year. The topography of Batu City is mostly steep. The slopes and geographical conditions at the research location in Batu City can be observed from two aspects, that are slopes and height. There are 5 classifications of slopes in Batu City: 3-8%, 8-15%, 15-30%, 30-45%, and 45-65%. The hilly condition of Batu City contributes to the greatest slope of >40%, which is 10,556.41 ha or equal to 53.02% of the total area. Meanwhile, the altitude is divided into five classifications 0-1000 masl, 1000-1500 masl, 1500-2000 masl, 2000-2500 masl, and >2500 masl. An altitude of more than 2000 masl is not suitable to be used as an agricultural location, while an area below 2000 masl is still possible to be used as an agricultural location.

**Identification of Changes of Land Cover in Batu City 2017 and 2021**

The image classification process used the composite band 432 to determine built-up and non-built-up land. The composite band 654 to view more measurable types of vegetation and to identify the difference between rice fields and plantations. The next classification step was to prepare a Region of Interest (ROI) to determine the sample of land cover objects after conducting the land survey. The land cover objects as the samples were built-up land, mixed plantation (apples, oranges, vegetables, and fruits), bare land (open/seasonal agricultural land), rice fields, shrubs, and forest. From the results of the identification, it can be seen which cover area is the most rapidly growing in Batu City within a period of 4 years (2017-2021), as illustrated in Table 2.

**Table 1.** Changes of Land Cover in Batu City 2017 and 2021

| Year | Built-up Land | Plantation | Rice Field | Shrubs | Bare Land | Forest | Cloud cover/ unidentified |
|---|---|---|---|---|---|---|---|
| 2017 | 2,741.64 | 1,321.85 | 1,143.49 | 617.48 | 1,186.62 | 12,386.59 | 511.05 |
| 2021 | 3,117.08 | 1,471.65 | 973.53 | 587.83 | 1,072.77 | 12,178.64 | 507.22 |
| changes | 375.44 | 149.8 | -169.96 | -29.65 | -113.85 | -207.95 | -3.83 |

**Land capability and suitability of Batu City**

The land capability analysis in Batu City resulted in special classes and subclasses obtained from the Land Capability criteria based on existing regulations, as demonstrated in Table 3 and Figure 3.

**Table 2.** Land Capability of Batu City

| Classification of land capability | Area (Ha) |
|---|---|
| Very low development capability | 156.74 |
| Low development capability | 1,971.05 |
| Medium development capability | 5,146.57 |
| High development capability | 5,285.13 |
| Very high development capability | 6,859.14 |

In reference to the land capability of Batu City, the majority area has very high development capability with an area of 6,859.14 Ha. The very low development classification covers an area of 156.74 Ha. Therefore, Batu City is potential for conversion into other land uses that can support urban activities. However, restrictions need to be made so that the conversion of agricultural land does not continue to expand. This is because Uncontrolled land conversion will reduce the production and supply of food, goods, and ecosystem services (Rondhi, Pratiwi, Handini, Sunartomo, & Budiman, 2018). In addition to land capability, the land suitability of Batu City was presented in Table 4 and Figure 4.

**Table 3.** Land Suitability of Batu City

| Classification | Direction |
|---|---|
| Direction of agriculture | Annual plant |
| Direction of building height | Building >4 floors |
| Direction of raw water | Excellent |

Based on the results of the analysis, the direction of land suitability for agriculture in Batu City is an annual plant with excellent raw water availability.

**Land Suitability of Rice Field in 2017 and 2021**

The results of the land cover changes in Batu City in 2017-2021 in Batu City indicate agricultural land conversion in detail. Below are the changes in agricultural land area in Batu City from the results of Landsat 8 image classification in 2021 (time series).

**Table 4.** Suitable and Unsuitable Agricultural Land Area in 2017 and 2021

| Year | Area (Ha) | | Total |
|---|---|---|---|
| | Suitable | Unsuitable | |
| 2017 | 998.64 | 144.85 | 1143.49 |
| 2021 | 856.70 | 116.83 | 973.53 |

The results show that agricultural land that is suitable to its capability decreased by 141,934 ha during 2017-2021. The rice field that is not suitable for its land capacity has decreased by 28.03 ha in the period of 2017-2021. At the same time, the decrease in the overall rice field area is 169.96 ha. Land use must be in accordance with the characteristics of the soil quality on the land itself; if land use in agricultural planting activities does not match the characteristics of the land, it will damage land quality (Vasu et al., 2018). As a consequence, it is crucial to recognize the capability of the land so that its use is in accordance with its characteristics (Ziolkowska, 2018).

### Shifts Due to Land Use Change

Shifts due to the land use change phenomenon led to changes in various aspects/sectors. One of which is related to land prices, productivity, labor, GRDP, to other sectors, which will continue to change following the conversion of existing land. Changes in the use of paddy fields are mainly caused by the low productivity of paddy fields, especially the decrease in land quality so that economic farming activities cannot be carried out. Changes in land use, especially in the highly productive paddy fields, have had a negative impact on food supply and environmental quality. Therefore, several regulations are needed to control land conversion. One of the efforts to control land conversion is to increase the economic value of rice production (Nurliani & Rosada, 2016).

**Figure 4.** Land Capability Map

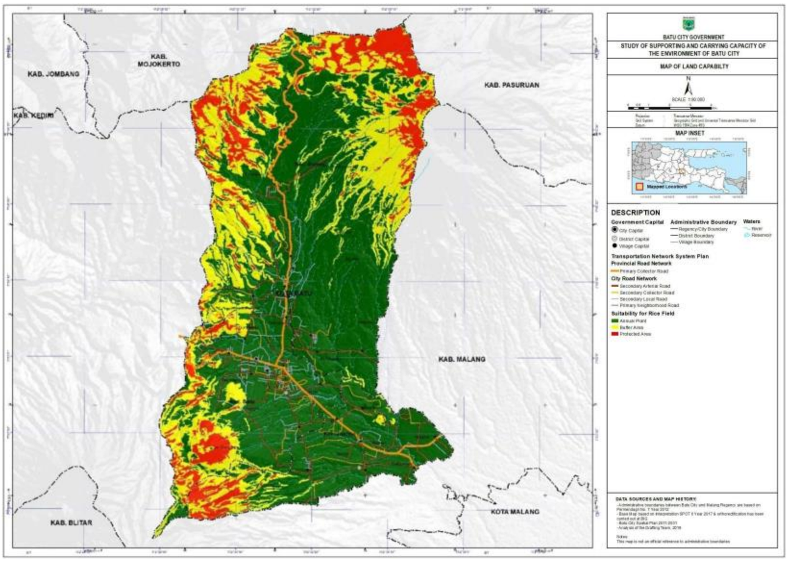
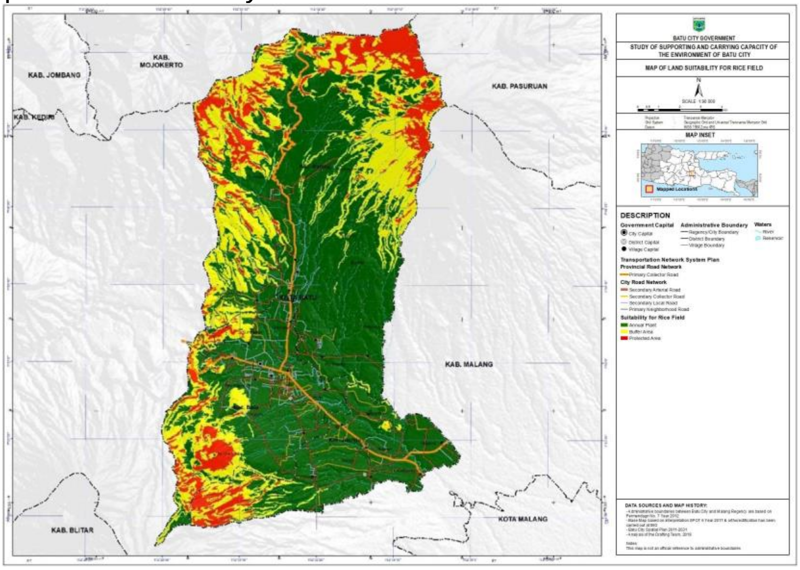


**Figure 5.** Map of Land Suitability for Rice Field




## Shifts in Labor and GRDP in the Agricultural Sector

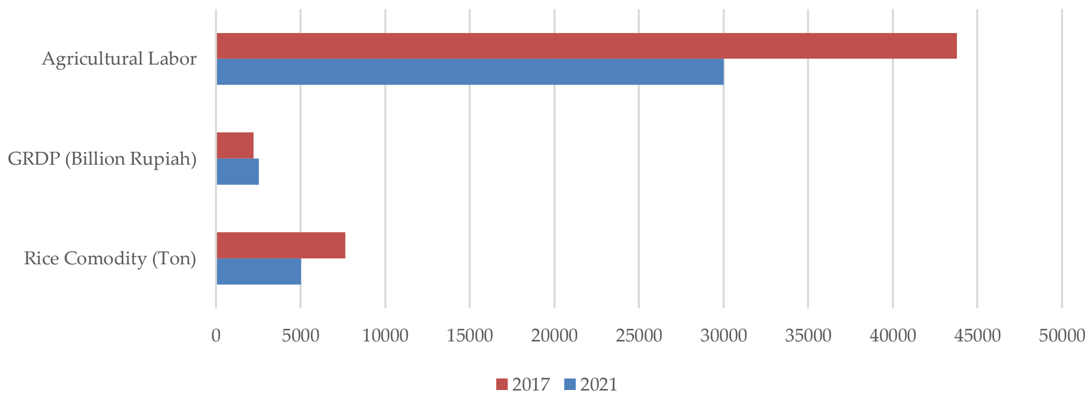
One of the sectors that have experienced changes in land conversion is the agricultural sector which causes shifts in labor, GRDP, and especially agricultural rice production. The data of these changes are presented in Table 6 and Figure 6.

**Table 6.** Impacts of Rice Field Conversion on Other Agricultural Activities

| Year | Agricultural Labor | GRDP (Billion Rupiah) | Rice Commodity (Ton) |
|---|---|---|---|
| 2017 | 43785 | 2227.6 | 7654.92 |
| 2021 | 30001 | 2527.3 | 5025.83 |
| Changes | **-13784** | **299.7** | **-2629.09** |

In accordance with the resultss analysis, the labor sector and the linear rice commodity sectors have decreased due to the decreasing rice field area and is marked with minus (-).

**Figure 6.** Chart of Impacts of Rice Field Conversion on Other Agricultural Activities




Meanwhile, the GRDP of the agricultural sector continued to increase since, in addition to agricultural production, the development of companies or the increase in regional revenues related to the agricultural industry and others was developed as well. Thus, rice field conversion has no effect on the GRDP of the agricultural sector.

## DISCUSSION

### Economic Value of Land Based on Agricultural Production

The model proposed by Soemarno (2010) to calculate the impacts of the conversion of productive agricultural land on food crop production is as follows:

$$NEPT = NPT - BPT \quad [5]$$

Crop production value (NPT) is the value of productivity of agricultural land. So, NPT can be interpreted as the income obtained by farmers in one production per year. In this research, the researcher further processed the data from the Department of Agriculture to determine the crop production value. To determine the average crop product (PRT) on one unit of land, the researcher obtained data from the Department of Agriculture Batu City (2021) that 1 Ha of rice field could produce 6.3-6.6 tons of GKP (Dried Unhulled Rice Harvest), while for HP (Price per Type of Production), it is taken from the data of PIP Batu City for Recapitulation in August 2021 which states the price of the dried unhulled rice harvest in Batu City was Rp. 4,900 per kilogram.

Crop Production Costs (BPT) are the costs incurred in one crop production. In this research, the researcher obtained input on the average crop production costs from the data of the Department of Agricultural and literature sources from the Regulation of the Minister of Agriculture Number 69 of 2016 on Allocation and Maximum Retail Price (MRP) of Subsidized Fertilizers for FY 2017-2021.

The input of crop production costs in one production process is in the form of costs for purchasing fertilizers (ZA, Urea, NPK, SP, and Phonska) and costs for purchasing seeds (hybrid seeds). From the analysis calculation of the lost agricultural productivity, it can be identified the loss is due to changes in non-built-up land converted to built-up land. The calculation results of the lost agricultural productivity are shown in Table 7.

**Table 7.** Impacts of Conversion of Productive Agricultural Land Conversion on Economic Value of Food Production

| Conversion Year | NPT (Rp) | BPT (Rp) | NEPT(Rp) |
|---|---|---|---|
| 2017 | 36980466600 | 2153262150 | 34827204450 |
| 2021 | 31483960200 | 1792558800 | 29691401400 |

From the results above, it shows that the conversion of productive agricultural land in Batu City for the period of four years (2017-2021) is estimated to experience changes in the productive agricultural land use into non-agricultural land of 169.96 Ha. The impacts of productive agricultural land conversion on the loss of income from rice farming in Batu City as calculated in rupiah is as follows:

NEPT =NEPT 2021 – NEPT 2017
=Rp 29,691,401,400-Rp 34,827,204,450
= - Rp 5,135,803,050

Therefore, it can be concluded that within the period of 4 years (2017 – 2021), it is assumed that there is a change in the productive agricultural land use into non-agricultural land, and it has an impact on the loss of income from rice farming sector by Rp 5,135,803,050.

**Economic Value of Land Based on Agricultural Land Prices**

According to the results of Landsat 8 image classification in 2017 and 2021, 10 out of 23 villages in Batu City have productive rice fields. The survey results show that the price of agricultural land is strongly affected by its proximity to the collector roads/main roads and local roads in Batu City. From the approach to calculating an economic value based on land prices, it can be seen which agricultural land has the potential for conversion based on the land prices. The closer to the urban area in Batu City and to the main road, the higher the price of agricultural land, and it is more potential to be transform into non-agricultural land. The details of land price and land area are listed in Table 8.

**Table 8.** Shifts in Rice Field Prices in Batu City 2021

| Land Price Based On Community (Rp) | Area (Ha) | Land Price Based On Market Price (Rp) | Area (Ha) |
|---|---|---|---|
| 2,217,124-3,289,965 | 423.3 | 2,609,205-4,918,806 | 468.33 |
| 3,289,965-4,443,269 | 287.71 | 4,918,806-6,049,825 | 276.6 |
| 4,443,269-5,811,142 | 190.12 | 6,049,825-7,478,480 | 158.9 |
| 5,811,142-7,983,646 | 72.4 | 7,478,480-9,829,809 | 69.7 |
| Total Area | 973.53 | Total Area | 973.53 |

The distribution of agricultural land prices in Batu City is divided into four classifications based on Kriging analysis, while the price of agricultural land is divided into 2, which are the rice field prices based on the community and based on the market. The lowest price of rice fields based on the community ranged from Rp2,217,124–- 3,289,965/m2 with a land area of 423.3 ha, and the highest price is Rp5,811,142 -7,983,646/m2 with an area of 72.40 ha. Meanwhile, the lowest market price for rice fields ranged from Rp2,609,205–- 4.918,806/m2 with a land area of 468.33 ha, and the highest price is Rp7,478,480-9,829,809/m2 with an area of 69.70 ha. It can be concluded that the land price based on the community is very different from the market price. In general, the market price is much higher than the price perceived by the landowners.

Studying the impact of the conversion of agricultural land and calculating the economic value of agricultural land is needed as an effort to control land conversion (Lanz et al., 2018). Therefore in this study, it is important to know the impact of land conversion in Batu City, which results from research that land conversion has an impact on the loss of farming income of Rp5,135,803,050. The results indicated that in the labor sector and linear agricultural productivity decreased due to reduced agricultural land to non-agricultural land. While GRDP has increased along with the growth of other activities (agricultural industry and others), so it is not correlated with a decrease in production paddy field. This is in line according to (Fandani & Harini, 2020), the conversion of agricultural land has an impact on reduced employment opportunities in the agricultural sector. Factors influencing a farmer's decision to sell their land include negative impacts on quality of life, loss of income, access to alternative incomes, heavy workload, problems related to access to education and support (Song & Liu, 2017). In addition, due to the low selling price of agricultural products and the decrease in annual household income, the economic pressure on farming families is increasing, and they have to face the problem of whether to leave farming or change agricultural land use to make a living (Song & Liu, 2017). Furthermore, an economic value significantly influences the farmer’s decision to sell or not to sell their land (Rondhi et al., 2018). The high value of agricultural land will prevent farmers from selling it for non-agricultural uses. However, the value of the land is high, whereas the productive fruit of the land itself is low. This will then become a factor in the farmer’s decision to sell or not to sell their land (Milczarek-Andrzejewska et al., 2018). Therefore, it is important to know the condition of agricultural land in Batu City, which has decreased based on the results. This is because even though land prices are always increasing. However, in terms of area, it continues to decline and there is a large gap between the price felt by farmers/community and the market price. Therefore, those are also the influence of the conversion of agricultural land (rice fields). Finally, changes in agricultural land use impact the agricultural productivity, economy, and labor sectors, as well as the increase in land prices.

## CONCLUSION

The conclusion based on the research's result in terms of land capability and suitability shows that agricultural land in Batu City mostly has very high development and is suitable for seasonal crops. The agricultural land in Batu City in 2017-2021 for the suitable land category decreased by 141.934 ha, and unsuitable land decreased by 169.96 ha. We found that it is essential to take into account the economic valuation of agricultural land conversion, considering its function is to determine the lost economic value.

## LIMITATIONS

This study focuses on the economic value of agricultural land in particular. Indeed, numerous studies have found that agricultural land can be directed by on the resulting social and environmental values. Thus, the agricultural land appraisal must be based on a more comprehensive aspect, including the social and environmental benefits resulting from agricultural land protection for the community.

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## DECLARATION OF CONFLICTING INTERESTS
The author declares there is unknown competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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