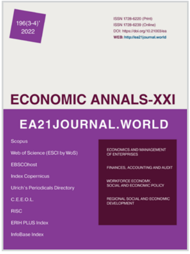

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Utilization of plant varieties for agribusiness supporting tourism and economy as an appropriate technology in Chrysanthemum production during the COVID-19 pandemic and beyond in Indonesia

Abstract
This study aims to determine chrysanthemums' business opportunities by utilizing varieties at the difference in height to chrysanthemum crops and the impact of chrysanthemum development on farmers' social institutions. The research was conducted purposively at the chrysanthemum production center and using the Complete Group Random Plan. The first factor is the height of the place: 300 m above sea level, 500 m above sea level, and 700 m above sea level. The second factor: chrysanthemum varieties are: Kusumaswasti, Sasikirana, Kusumapatria, Cintamani, Ratnahapsari Kusumasakti. Observed microclimate parameters: air temperature, the intensity of sunlight, and humidity of the air. Observed growth and yield parameters: height of plants, number of leaves, the diameter of stems, harvest time, and brightness of flower color. The socio-economic studies observed are business opportunities and the impact of farmers' social, institutional development. The results show the height of the place of 500 meters above sea level affects the increasing vegetative growth of all chrysanthemums planted. The height of 700 m above sea level affects the increase of crop yields, especially the diameter of the flowers of Sasikirana, Ratnahapsari, and Kusumapatria varieties and the influence on the sharpness of the color of chrysanthemums of all varieties. Chrysanthemum agribusiness has farming opportunities as it can increase farmers' income and social institutions dynamics. At the same time, introducing of innovations or new ventures to the farming community is not easy. This requires perseverance and the utmost patience, namely, in introducing of alternative commodities of high economic value.
Keywords: Appropriate Technology; Chrysanthemums; Business Opportunities; Agribusiness; Social Institutions
JEL Classification: Q01; Q16; Q13; R11

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1. Introduction

Chrysanthemum (Dendrathema Grandiflora Tzelev) is one of the public's trendy flowers because of the many types, shapes, and colors of flowers. Chrysanthemums are one of the most marketed cut flowers globally (Zandonadi et al., 2018). Chrysanthemums are also known as daisies or chrysanthemums. Chrysanthemum is a species of ornamental and medicinal plant (Yue et al., 2018). There are currently more than 1,000 species of chrysanthemums growing around the world. Various types of chrysanthemums grown in Indonesia are mostly the result of an introduction from abroad, such as the Netherlands, the United States, and Japan. Among traders, chrysanthemums are popular as a thousand-color flower because various colors are resulting from chrysanthemum crosses. The prospect of developing ornamental plants and cut flower agribusiness gives more hope to farmers. The development of flower agribusiness is not only for meeting domestic needs but for export needs. Chrysanthemums are one of the most economical ornamental plants globally (Kang, et al., 2019). Chrysanthemum is one of the most important ornamental plants, which shares the commercial market.

The strategic role of society (as strategic partners, fighters, administrative experts, agents of change) can make a significant contribution to labor productivity, family welfare, and green environmental performance. The ornamental plant business activities during the pandemic could not be separated from the community's reduced activity outside the home (Izzuddin et al., 2018). The efforts of ornamental plants during the pandemic in several Indonesian regions were quite reasonable, especially in the Special Region of Yogyakarta. Many people plant chrysanthemums in the yard.

Opportunities in developing chrysanthemum cultivation to meet the needs both at home and abroad are wide open - Indonesia exports chrysanthemums to Hong Kong, Malaysia, Japan, and Singapore. With the increasing demand for chrysanthemum flowers, agribusiness opportunities need to be continuously developed. The extension program is required so that the chrysanthemum flower agribusiness can continue to run and compete. The Agribusiness Extension Program is growing rapidly and has the support of the government. The extension program is expected to continue to provide solutions in facing various challenges and opportunities. It is hoped that the program implemented can improve the welfare of the community. Ornamental plants are essential for the agricultural agribusiness industry (Kim et al., 2020).

Yogyakarta Special Region, with its specialties, is a city with a royal feel and is a city of tourism that can never be separated from the need for flowers. In certain events, the need for flowers and ornamental plants in Yogyakarta is relatively high. Various types of chrysanthemums with attractive colors are an attraction. Chrysanthemums become an ornamental plant that must be present at every event, both joyful and sad events.

In 2012, the expansion of the chrysanthemum area was directed at locations with suitable topography and agro-ecosystem. The destination area for expanding chrysanthemum fields is the incised hills, Samigaluh District, Kulonprogo Regency, with an altitude of 500-700 masl. The potential for regional development and the flower market's potential is relatively high to support chrysanthemum farming development. Chrysanthemums are ornamental plants grown under long-term artificial cultivation conditions (Dong et al., 2020).

Good chrysanthemum cultivation offers several advantages: the availability of high-quality flowers all year round. The variety of chrysanthemums is one of the right technology results to meet the need for higher interest rates in line with government support and tourism development programs in Indonesia. The dynamics of farmer groups developing ornamental plant-based tourism areas (chrysanthemum) are currently very good. The global response to the COVID-19 pandemic has brought significant changes to human mobility patterns and the work environment. Outdoor recreational activity increased by 291% during the pandemic relative to a 3-year average for the same day (Venter et al., 2020).

Chrysanthemum cultivation technology innovation is needed to improve chrysanthemum farming. Over the past two decades, genetic engineering of plants has resulted in significant scientific, commercial, and humanitarian successes worldwide (Miller & Silva, 2018). However, the chrysanthemum cultivation technique requires special skills and high investment input. Chrysanthemum market potential using various information varieties as a technology input is needed because of the demand for chrysanthemum every year. The increased demand for chrysanthemum flowers must be accompanied by a level of quality and quantity of production (Ilyushin & Mokeev, 2019). This study aims to determine chrysanthemums' business opportunities by utilizing varieties at the difference in height to chrysanthemum crops and the impact of chrysanthemum development on farmers' social institutions (Kang, et al., 2019). This research is expected to answer the challenges of domestic and foreign chrysanthemum demand by using various varieties and regional heights.

2. Methodology

The research was conducted purposively in the Chrysanthemum production center area, in Pakem Subdistrict, Sleman Regency, and Samigaluh Subdistrict, Special Region Yogyakarta. Adaptation test of 6 new superior varieties of chrysanthemums was conducted in 3 places of different heights: altitude 300 meters above sea level, 500 meters above sea level, and 700 meters above sea level. New superior varieties of chrysanthemums adapted include a) Ratnahapsari, (b) Kusumapatria, (c) Cintamani, (d) Kusumasakti, (e) Sasikirana, (f) Kusumaswasti. Data from the survey of chrysanthemum development opportunities were analyzed descriptively.

Data Analysis, quantitative data in the form of plant height, number of leaves, flower diameter, analyzed with Variance Analysis (ANOVA), and if there is a noticeable difference among the treatment group, then continued with Duncan's multiple range test (DMRT) at a confidence level of 95%. Qualitative data in the form of flower color brightness is analyzed descriptively. Chrysanthemum varieties tested for adaptation include a) Ratnahapsari, (b) Kusumapatria, (c) Cintamani, (d) Kusumasakti, (e) Sasikirana, (f) Kusumaswasti.

3. Results and Discussion

3.1. Chrysanthemum flower growth

Variant Analysis Result (ANAVA) in Table 1 indicates that there are noticeable differences in climatic conditions in the three locations of the planting site's height, which include temperature, humidity, light intensity, and pH. The highest result for temperatures is at an altitude of 300 m above sea level. The highest humidity is inversely proportional to the temperature, which is at the height of 700 m above sea level. Meanwhile, the highest light intensity is shown at an altitude of 300 m above sea level and for the most elevated pH of 700 m above sea level. This study showed that at an altitude of 300 with an average temperature of 30 °C is less qualified for the cultivation of chrysanthemum cut flowers production (Hanudin et al., 2017). Chrysanthemum cultivation is hampered by high temperatures resulting in the low quality of ray florets and reduced shelf life (Kang et al., 2019). Temperature affects the cultivation of chrysanthemum plants in the spread of flowers.

The highest air humidity is indicated at 700 m above sea level, with the moisture of 72.58% of the humidity range with an area of 500 m above sea level of 6.08%. While the lowest humidity reaches 59.58% at 300 m above sea level, with a temperature range of 7.08%. According to (Shintiavira et al., 2020), chrysanthemum plants generally require high humidity conditions. Young plants to adulthood grow typically well at an air humidity of 70-80%. This study showed that at the three planting sites, the optimal air humidity requirement is at an altitude of 700 m above sea level

Table 1:
Climatic conditions in three planting altitude locations

Parameters	Height		
	300	500	700
Temperature	32.08 [c]	29.58 [b]	26.33 [a]
Air Humidity	59.58 [a]	66.50 [b]	72.58 [c]
Light Intensity	17300.00 [b]	14900.00[b]	9685.83 [c]
Ph	6.567 [a]	6.819[b]	6.900 [b]

Description: The number followed by the same letter on the same line shows no real difference in the DMRT test level 5%.

Source: Compiled by the authors

with a humidity of 72.58%. Meanwhile, the other two locations, 500 m above sea level and 300 m above sea level, are ineligible for chrysanthemum growth. Growth parameters (plant height, number of leaves) varied significantly (Kumar & Singh, 2017). Plants can be affected by the soil in which they are grown (Chen et al., 2018; Ma et al., 2017).

The intensity of sunlight shows a noticeable difference between the three locations. The intensity of the sun is positively correlated to temperature. The higher the temperature somewhere, the intensity of sunlight indicated is relatively high. The highest light intensity is shown at 300 m above sea level, followed by 500 m above sea level and 700 m above sea level. The intensity of sunlight has an enormous impact on physiological processes such as photosynthesis, breathing, growth, development, opening, the closing of stomata, and plants' movement. Sunlight illumination affects plant growth, production, and crop yield through photosynthesis. Advances can be facilitated by coordinated efforts in plant physiology, remote sensing, and eddy covariance flux observations (Gu et al., 2019).

The high measurement of vegetative phase plants (6 weeks after planting) is presented in Table 2.

Table 2:
Height of 6 varieties of chrysanthemum plants at the height of planting sites 300 m above sea level, 500 m above sea level, and 700 m above sea level in week 6

VUB	Height		
Chrysanthemums	300	500	700
Kusumaswasti	22.00^{a}	48.60^{f}	38.10^{e}
Sasikirana	29.20^{cd}	53.80^{g}	40.73^{e}
Kusumasakti	28.16^{bc}	53.26^{g}	42.46^{e}
Cintamani	24.00^{ab}	54.13^{g}	39.60^{e}
Ratnahapsari	27.93^{bc}	52.40^{fg}	38.73^{e}
Kusumapatria	32.86^{d}	56.33^{g}	48.90^{f}

Description: The number followed by the same letter on the same line shows a noticeable difference in the DMRT test level 5%.

Source: Compiled by the authors

Chrysanthemum plants planted at an altitude of 500 m above sea level showed the highest yield for all varieties, followed by lengths of 700 m above sea level and 300 m above sea level. Chrysanthemums were planted at the planting site of 500 m above sea level. Kusumapatria varieties showed the highest yield, followed by varieties Cintamani, Sasikirana, Kusumasakti, Ratnahapsari, and Kusumaswasti. At an altitude of 700 m above sea level, the highest yield was shown by Kusumapatria varieties followed by Kusumasakti, Sasikirana, Cintamani, Ratnahapsari, and Kusumaswasti varieties. At an altitude of 300 m above sea level, the highest yield is also shown by the Kusumapatria variety, followed by Sasiskirana, Kusumsakati, Ratnahapsari, Cintamani, and Kusumaswasti.

Leaves are one of the growth parameters that can be observed due to environmental changes. The development of leaves is susceptible to environmental changes, such as temperature, humidity, and light intensity. The shape of the leaves is an important quality characteristic of the plant (Ilyushin & Mokeev, 2019). The leaves are photosynthetic in plants, such as the synthesis of carbohydrates and other metabolites (Moskovsky et al., 2017). Leaves are indispensable as growth parameters and as supporting data for the explanation of the growth process. The variant analysis results (ANOVA) showed that the interaction between the variation in water availability and light intensity had a significant influence on the number of chrysanthemum leaves shown in Table 3.

From the results of Variant Analysis (ANAVA) in Table 4, it is known that the height of the place affects the number of chrysanthemum leaves. The height of 500 m above sea level was found to have the highest compensation for the number of leaves of all Chrysanthemum varieties. Chrysanthemums were planted at an altitude of 500 m above sea level. Sasikirana varieties showed the highest number of leaves, followed by Kusumasakti, Kusumapatria, Kusumaswasti, Cintamani, and Ratnahapsari. While at an altitude of 700 m above sea level, the Kusumaptria variety showed the highest yield for the number of leaves, followed by the varieties Saikirana, Kusumasakti, Kusumaswasti, Cintamani, and Ratnahapsari.

The diameter of the chrysanthemum flower is one of the factors affecting the standard cut flower selling price. The analysis of the diameter of the chrysanthemum stem can be seen in Table 4.

Table 3:
The number of leaves of 6 varieties of chrysanthemum plants at the height of planting sites 300 m above sea level, 500 m above sea level, and 700 m above sea level in week 4

Parameters	Height		
	300	500	700
Kusumaswasti	8.13 b	14.40 h	9.80 cde
Sasikirana	8.20 b	15.20 h	11.53fg
Kusumasakti	10.93 ef	15.07 h	10.27 def
Cintamani	8.93 bcd	14.13 h	8.87 bcd
Ratnahapsari	6.67 a	12.73 g	7.67 ab
Kusumapatria	8.67 bc	14.47 h	11.67 fg

Description: The number followed by the same letter on the same line shows no noticeable difference in the 5% Duncan's test.

Source: Compiled by the authors

Table 4:
Flower diameter six varieties of chrysanthemum plants at the height of planting sites 300 m above sea level, 500 m above sea level, and 700 m above sea level

VUB Chrysanthemums	Height		
	300	500	700
Kusumaswasti	76.9800 de	75.1533de	77.5400 de
Sasikirana	77.0267 de	71,2333d	86.4600 fg
Kusumasakti	60.7267c	79.7333 ef	77.7000 de
Cintamani	33,0067 a	48.4887b	35.0973 a
Ratnahapsari	36.9000 a	60.5573c	37.3407a
Kusumapatria	77.8214 de	86.5733 fg	87.5400 g

Description: The number followed by the same letter on the same line shows no noticeable difference in the 5% Duncan's test.

Source: Compiled by the authors

At each altitude location, Kusumapatria varieties show the highest flower diameter compared to other standard types of varieties. As for the type of spray, at each height, Ratnahapsari varieties show higher results than Cintamani. The diameter of the flower tends to increase as the height of the planting site increases. The higher a place, the lower the temperature in the environment. In this study, the temperature at an altitude of 700 m above sea level, showing the lowest results compared to the altitude of 500 m above sea level, or 300 meters above sea level.

The harvest time or flowering age of plants is strongly influenced by internal (plant) and external (environmental) factors. A very influential ecological factor is the height of the place because it will affect the climate and weather. Data on the measurement of the harvest time of chrysanthemum plants planted in three altitude locations are presented in the following Table 5.

The variant analysis results (ANOVA) show there is a noticeable difference in the flowering time that is influenced by the height of the place. The formation of flower buds and flowering on chrysanthemums occurs under conditions of short days (Dong et al., 2017).The average for the fastest harvest time is indicated by chrysanthemums planted at an altitude of 500 m above sea level, followed by an altitude of 700 m above sea level and 300 m above sea level. At the height of 500 m above sea level, the fastest flowering time is the Ratnahapsari variety with a harvest

Table 5:
Harvest Time 6 varieties of chrysanthemum plants at the height of planting sites 300 m above sea level, 500 m above sea level, and 700 m above sea level

VUB Chrysanthemums	Height		
	300	500	700
Kusumaswasti	92.33 c	89.00 b	98.67 e
Sasikirana	114.00 i	96.00 d	103.00 g
Kusumasakti	103.00 g	89.00 b	98.67 e
Cintamani	109.00 h	96.00 d	98.33 e
Ratnahapsari	96.00 d	86.00 a	99.33 e
Kusumapatria	89.00 b	89.00 b	96.00 d

Description: The number followed by the same letter on the same line indicates no significant difference on the DMRT test level of 5%.

Source: Compiled by the authors

time of 99 days after planting, followed by varieties Kusumaswasti, Kusumasakti, Kusumapatria, Cintamani, and Sasikirana. At an altitude of 700 m above sea level, the varieties with the fastest harvest time are Kusumapatria, Ratnahapsari, Kusumaswasti, Kusumasakti, Cintamani, and Sasikirana. While at an altitude of 300 m above sea level, the variety with the fastest harvest time is the Ratnahapsari variety, followed by Kusumaswasti, Kusumapatria, Kusumasakti, Cintamani, and Sasikirana varieties with the most recent flowering time. The height of Ratnahapsari varieties shows the fastest average harvest time compared to other varieties from each location. Ratnahapsari planted at an altitude of 500 indicates the fastest harvest time compared to other heights. Varieties of Kusumaswasti, Kusumasakti, and Kusumapatria grew at an altitude of 500 m above sea level show the shortest harvest time compared to 700 m above sea level and 300 m above sea level. Chrysanthemum growth in the lowlands will be slower and easily damaged when compared to the highlands (Sanjaya et al., 2018).

3.2. Chrysanthemum Business Opportunities in Pandemic COVID-19

The last condition of 2019 is the number of chrysanthemums in the Pakem subdistrict, Sleman regency as many as 15 screen house but actively producing as many as six ones. The average area per greenhouse area is about 100 m^2 assuming a plant population per 4000 stems. In such a way, it is estimated from the number of 15 units x 4000 rods = 60,000 chrysanthemum stems. Chrysanthemum planting arrangement is undoubtedly not simultaneously planted as many as 15 screen houses in one planting period but arranged and rotated according to the time, energy, cost, and willingness to plant places or areas. Thus, it is expected that at any time can harvest and sell according to the consumer demand market's calendar.

Similarly, other chrysanthemum development locations are found in the hilly area of Menoreh, precisely in Gerbosari Village, Samigaluh Subdistrict, Kulonprogo Regency. In 2019, 10 screen houses were built, then until 2018, it increased to 32 screen houses managed by 32 farmers. The chrysanthemums area is on average 100 m^2 with a plant capacity of 4000 cuttings chrysanthemum stems per sling and has been produced. Institutional farmer group formed they named Seruni Menoreh Group, engaged in the cultivation of chrysanthemums. If you pay attention to human resources that manage chrysanthemum plants are generally relatively young, 30-55 years old, so still excited because the physical energy is always intense. The division of tasks in each field in the institutional group is quite solid, including sub-fields of cultivation, post-harvest, and sub-fields of promotion and marketing.

In the period of two years running from 2012 to 2013, the development of chrysanthemum business in Samigaluh subdistrict, Kulon Progo district obtained very positive results because of social changes in the community through the application of chrysanthemum cultivation technology innovations can directly increase farmers' income. Initially, the number of members in the farmer group «Guyub Rukun» who carried out chrysanthemum cultivation was only six members. Then the number of new flower houses about three pieces with an area between 70-100 m^2. The development of chrysanthemum production through Guyub Rukun farmer group of 3 screen houses produces 3000 stems /season per screen house. From 3 screen house obtained 9000 stems, and the average selling price per tie Rp.10.000. Hence, the season income from 3 screen house reaches Rp.9.000.000 (Nine million rupiah).

The quantity of development or increase in the area of planting area and the number of screen houses until 2019 has reached 32 screen houses and five farmer groups. The total number of greenhouses produced by chrysanthemum during the pandemic was 14. The average production of 14 screen houses reaches 4000 rods per season, so obtained the result of 14 x 4000 = 56,000 rods (5600 ties) x Rp.10.000 = Rp.56.000.000 (Fifty six million rupiah) per season (not cut production costs). This chrysanthemum farming activity is still running until now, 2021. The number is increasing to 5 farmer groups with 30 members. The development of chrysanthemum cultivation, especially in the Special Region of Yogyakarta, began from adaptation test assessments from BPTP, developed in sleman regency and Kulonprogo regency. Considering the agroecosystem conditions and requirements of chrysanthemum growth and support from various related parties, finally developed chrysanthemum crops that until now are very popular with farmers because they can economically help increase income. As production increases, the demand for seeds also increases. Chrysanthemum propagation is mainly done by cuttings because it is simple, economical and can be done in ex vitro conditions (Tung et al., 2018).

Introducing innovations or new ventures to the farming community is not easy. This requires perseverance, perseverance, and the utmost patience for the program to improve the welfare of the organization or farmers can be realized, namely introducing alternative commodities of high economic value. Suppose you look at the potential condition of natural resources that are quite supportive for the development of chrysanthemum commodities as well as the relatively narrow ownership of farmers' land, of course. In that case, a mature plan and strategy are needed in its management. Various obstacles and problems must occur in the implementation, since land preparation, provision of seeds, fertilizers and pesticides, and other supporters in streamlining chrysanthemum farming.

Opportunities to develop the cultivation of chrysanthemum crops, further developed with government programs accompanying the development of ecological-based tourism areas to restore tourism in the pandemic COVID-19. Also, chrysanthemums are still needed to meet domestic and foreign countries' needs that remain open. Along with the increasing demand for chrysanthemums, agribusiness opportunities need to continue to be developed. Considering chrysanthemums are short-day plants with a critical point of illumination of 14.5 hours, while the climate in Indonesia is a short illumination of sunlight (12 hours), so to get the maximum yield (simultaneous harvest), chrysanthemum plants must be extended irradiation by adding irradiation for three to four hours. Another obstacle also chrysanthemum plants are vulnerable to pest attacks of disease. Therefore, it is necessary to make possible modifications, one of which is planting in the screen house by lighting. Lighting at the end of the day or during the middle of the night can control the flowering of ornamental plants that grow in a short time (Meng & Runkle, 2017).

4. Conclusion

The use of appropriate technology through the innovation of several varieties of chrysanthemums can move the business of ornamental plants in DIY even during the COVID-19 pandemic. It shows the maximum vegetative growth of chrysanthemums at an altitude of 500 m above sea level compared to 700 and 300 m above sea level. The height of the place 500 m above sea level obtained the maximum height of chrysanthemum plants is 107.67 cm, the number of leaves as much as 15 strands. Altitude 300 with an average temperature of 30 °C is less qualified to cultivate chrysanthemum cut flowers production. At the three planting sites, the optimal air humidity requirement is at an altitude of 700 m above sea level with humidity of 72.58%. According to the theory, in both locations, 500 m above sea level and 300 m above sea level, the theory is not eligible for chrysanthemum growth. The height of 700 m above sea level affects the increase of crop yields, especially the diameter of the flowers of Sasikirana, Ratnahapsari, and Kusumapatria varieties and the influence on the sharpness of the color of chrysanthemums of all varieties.

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