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Land Suitability Evaluation for Wild-Simulated Ginseng Cultivation in South Korea

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Abstract: Wild-simulated ginseng (WSG) is highly sensitive to growth conditions. Nevertheless, the suitability evaluation of actual WSG cultivation sites for a sustainable yield has not been conducted in South Korea, nor at a global level. This study aimed to evaluate the suitability of actual WSG cultivation sites to understand the status of these sites and to present a methodology that can be applied to the determination of WSG cultivation sites by combining the major factors essential for WSG growth. Suitability was evaluated for the WSG cultivation sites using geographic information systems (GIS). The study region has a high forest coverage of 77%, of which 48.7% was possibly suitable (including suitable sites) for WSG cultivation. However, of the area of actual WSG cultivation sites, 43.6% was probably unsuitable (including unsuitable sites). The WSG yield showed a relatively low rate of increase compared to the rate of increase in the cultivation area, and the rate of increase in the production amount showed a tendency to decrease. In regions and countries with high forest coverage, the application of scientific techniques, such as GIS should be considered to identify suitable WSG cultivation sites. The application of the methodology of this study will be a useful method for the production of high-quality WSG and sustainable yield.

Keywords: geographic information system; growth condition; *Panax ginseng*; suitable site; sustainable yield

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1. Introduction

One of the recent changes in the consumption of agri-food in Korea, due to the global pandemic (COVID-19), is the increased intake of healthy functional foods, mainly those rich in vitamins and minerals, and ginseng [1]. This may be because ginseng is well-known for its ability to strengthen human immunity against harmful viruses and bacteria, among its other various effects [2,3]. As a result, sales of healthy functional foods are approximately 864% higher than those observed during the Middle East Respiratory Syndrome (MERS) outbreak [1].

In Korea, ginseng (*Panax ginseng* Meyer), a plant in the Araliaceae [4], is classified into wild ginseng (naturally growing), regular ginseng (field-cultivated ginseng), and wild-simulated ginseng (WSG) (mountain-cultivated ginseng) [5]. Here, "regular ginseng" refers to those cultivated using artificial soil improvement and facilities in farmland under the Law for Ginseng Industry, whereas "WSG" refers to ginseng (including dried) produced without the use of artificial facilities, such as light-shielding, in mountain areas under Article 2 No. 1 of the Management of Mountainous Districts Act [6]. Non-timber forest products (NTFPs) are defined as plants, parts of plants, fungi, or biological samples harvested from natural, artificial, or disturbed forests [7,8]. In Korea, WSG is both an NTFP and a "special forest product," for which all processes, from cultivation to production and distribution, have been managed and supervised under the Forestry and Mountain Villages Development Promotion Act since 2011 for consumer protection and quality assurance [9].

WSG has a greater pharmacological effect than ginseng in terms of efficacy [10]. With increasing interest in healthy food and the awareness of WSG, the supply of WSG has been increasing owing to the rise in demand [11]. As of 2019, the WSG cultivation area in Korea was 10,846 ha [12] and the WSG yield (as of the end of 2018) was 130,192 kg (USD 36,690 thousand) [13]. Additionally, during the past five years (2015–2019), 123,024 kg of WSG has been exported to 26 countries/territories, including China, Hong Kong, Taiwan, Thailand, the United States, Vietnam, and Japan (USD 24,584 thousand) [14].

WSG is highly sensitive to the cultivation environment [15,16]. It takes five to seven years or more of cultivation in the mountain area to yield WSG, and its survival rate is low until harvest, as it is cultivated without pesticides and fertilizers [17,18]. Additionally, WSG with the same growth period differs in thickness, length, and shape depending on the cultivation environment. Owing to this, WSG has low marketability and is sometimes neglected by consumers, making it difficult to sell [17]. Therefore, one of the most important prerequisites for the sustainable yield of high-quality WSG is to cultivate it in an optimal growing environment. The use of a geographic information system (GIS) as a scientific technique to select the optimal cultivation site can be an effective method [16,19,20]. GIS-based land suitability evaluation is a powerful tool for the integration of important and diverse levels of physical and environmental factors including expert knowledge in land suitability mapping [21–24].

Recent studies on WSG have mainly focused on the various pharmacological effects [10,25–28], cultivation environment, and cultivation characteristics [18,29,30]. Studies using GIS have been conducted to search for suitable cultivation sites for crops, fruits, and forest products [31–35]. Importantly, a technical study has been conducted to identify suitable WSG cultivation sites [16,19]. However, no study has evaluated the suitability of the actual current WSG cultivation sites for sustainable yield, the growth of which has a high sensitivity to the cultivation environment, including the characteristics of the soil parameters.

Land suitability evaluation is the first step towards the development and promotion of land use plans, protection of sustainable agricultural land, and optimal land use [24,36,37]. Additionally, land suitability evaluation is one of the most important steps in land-use planning to cultivate special crops at the regional level [37]. Therefore, in this study, a hypothesis was established that all actual WSG cultivation sites were suitable. To verify this hypothesis, the suitability of the actual WSG cultivation sites was evaluated using the identification results of the WSG cultivation sites based on GIS. Consequently, this study was conducted to understand the status of actual WSG cultivation sites and present a methodology that can be applied to the selection of cultivation sites for WSG, which is sensitive to the cultivation environment.

2. Materials and Methods

2.1. Study Region

This study was conducted in the forests of Hamyang-gun in Gyeongsangnam-do, Korea. Hamyang-gun is located in the northwestern tip of Gyeongsangnam-do and has the geographical coordinates of 35°18′ N–35°46′ N, 127°35′ E–127°52′ E. As of 2018, of the 72,545 ha of Hamyang-gun, the forest land is 55,899 ha; thus, the forest coverage is 77% (Figure 1) [38].

Based on the local topographical characteristics and high forest coverage, the local government of Hamyang-gun has been carrying out WSG-related policies (administrative work and budget support related to cultivation, production, and distribution) to promote WSG cultivation, a high-income clean forest product that must be produced in the mountain areas, and plans to hold the “Wild Ginseng Anti-aging Expo Hamyang, KOREA 2021”. Additionally, the WSG cultivation area in Hamyang-gun was 556 ha as of 2017 (733 ha as of August 2019), which is the largest area among local governments in Korea [39].

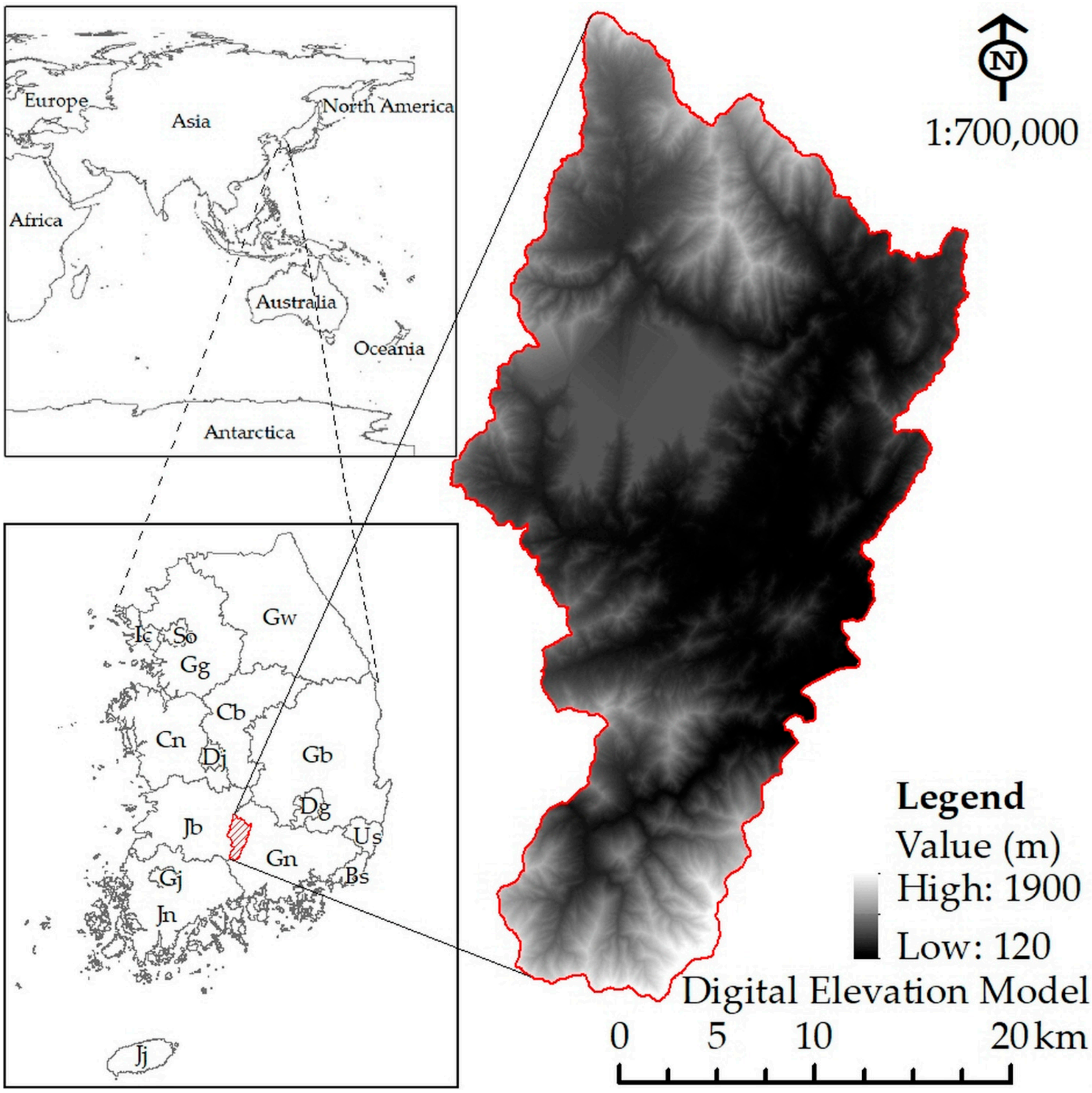


Figure 1. The location of Hamyang-gun of Gyeongsangnam-do in Korea. Note: So = Seoul-si, Ic = Incheon-si, Gw = Gangwon-do, Gg = Gyeonggi-do, Cb = Chungcheongbuk-do, Cn = Chungcheongnam-do, Dj = Daejeon-si, Jb = Jeollabuk-do, Jn = Jeollanam-do, Gj = Gwangju-si, Gb = Gyeongsangbuk-do, Dg = Daegu-si, Us = Ulsan-si, Gn = Gyeongsangnam-do, Bs = Busan-si, and Jj = Jeju-si.

2.2. Growth Factor, Primary Data Set, and Identification of Suitable WSG Cultivation Sites

To evaluate the suitability of the actual WSG cultivation sites based on GIS, the identification of suitable sites for WSG cultivation must be conducted. In addition, to identify a cultivation site for WSG using GIS, factors related to the growth of WSG must be selected. In this study, nine major growth factors and criteria were selected based on the results of a previous study [19] (Table 1). In the previous study, the nine major growth factors for WSG cultivation were selected based on the WSG cultivation guidelines issued by the Korean government and previous studies related to WSG cultivation.

Table 1. Nine growth factors and the detailed criterion of each for identifying the suitable WSG cultivation sites.

Growth Factor	Detailed Criterion	Rank
Elevation	Higher than 300 m	1
	Others	2
Aspect	North	1
	East, Northeast, Northwest	2
	Others	3
Slope	Less than 30°	1
	Others	2
Forest type(Tree species)	Hardwood forest, *Larix kaempferi*	1
	Mixed forest	2
	Others	3
Soil organic content	2–9%	1
	Others	2
Effective soil depth	Greater than 15 cm	1
	Others	2
Soil texture	Sandy loam, Loam, Silty clay loam	1
	Others	2
Soil moisture	Suitable moisture	1
	Others	2
Drainage	Good condition	1
	Others	2

The procedure for generating the thematic maps (30 m cell resolution) for each growth factor of WSG using GIS, identifying the cultivation sites, and evaluating the suitability of the actual cultivation sites is shown in Figure 2. The digital topographic map was provided by the National Geographic Information Institute, Korea, and the forest type map and forest soil map were provided by the Korea Forest Service, Korea.

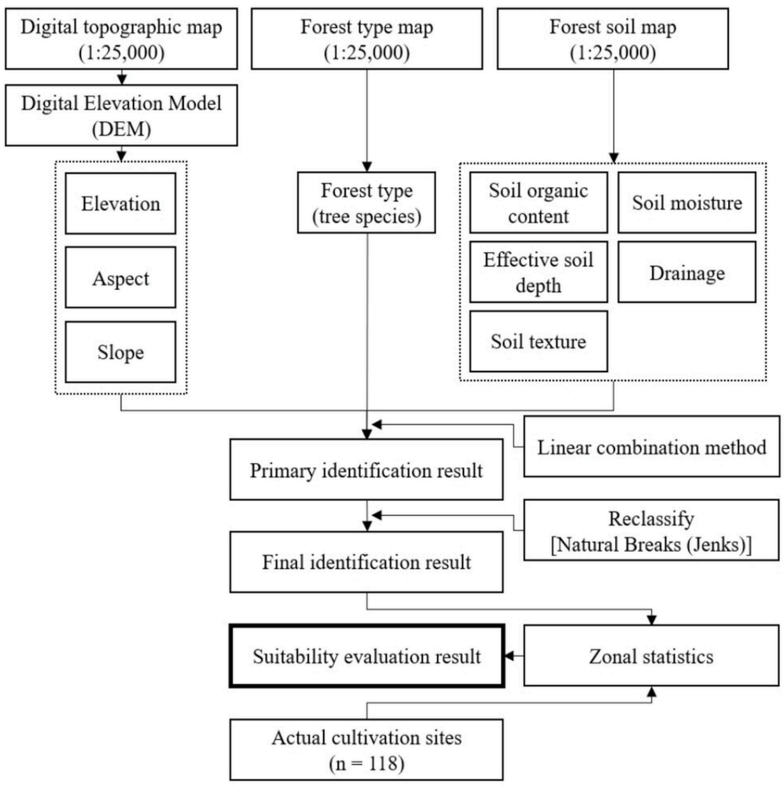


Figure 2. Flow diagram of the process followed in this study.

The generated data for each factor were used for the identification of suitable WSG cultivation sites and a linear combination technique was used that provides different weights depending on the difference in detailed criteria for each factor. The weight value according to the detailed criteria for each growth factor by the linear combination method was calculated using Equation (1):

$$WeightValue_k = \frac{1}{n} \times (n - \sum_{k=1}^{n}(k-1)). \tag{1}$$

Here, $WeightValue_k$ indicates the weighted value for the detailed criterion of the kth rank within each growth factor, n indicates the number of detailed criteria within each growth factor, and k indicates the rank of the detailed criterion.

In general, the factor combination method and the linear combination method are mainly applied to the weights for factors in the identification of suitable cultivation sites for crops. However, the linear combination method was excellent for the identification of suitable WSG cultivation sites [19].

The primary identification results for the suitable WSG cultivation sites went through a reclassifying process, in which these results were reclassified into four grades (suitable, possibly suitable, probably unsuitable, and unsuitable) using the Natural Breaks (Jenks) classification method. This classification method groups similar values within the identification results and reclassifies them by maximizing the difference between grades [40].

2.3. Generating the Data of Actual WSG Cultivation Sites

To collect the location information of the actual WSG cultivation sites, WSG production declaration data reported to the administrative office of the study region (Hamyang-gun) by farming households, according to the relevant laws, for the past five years (2015–2019) were used. Among these data, information on the location of all 118 cultivated sites (lot numbers) was obtained, excluding overlapping lot numbers and lot errors.

Data on the actual WSG cultivation sites for the suitability evaluation based on GIS were generated by extracting the corresponding lot number from the digital cadastral map (National Geographic Information Institute, Korea) using the location information of the 118 cultivation sites (n = 118).

2.4. Evaluating the Suitability of Actual WSG Cultivation Sites

Suitability was evaluated for the actual WSG cultivation sites (n = 118) using the identification results of the suitable WSG cultivation sites. This study was based on GIS using ArcMap 10.3.1 by ESRI Inc. (Redlands, CA, USA), and the suitability evaluation of the actual WSG cultivation sites was conducted using the "Zonal Statistics as Table" function of the "Spatial Analyst Tools".

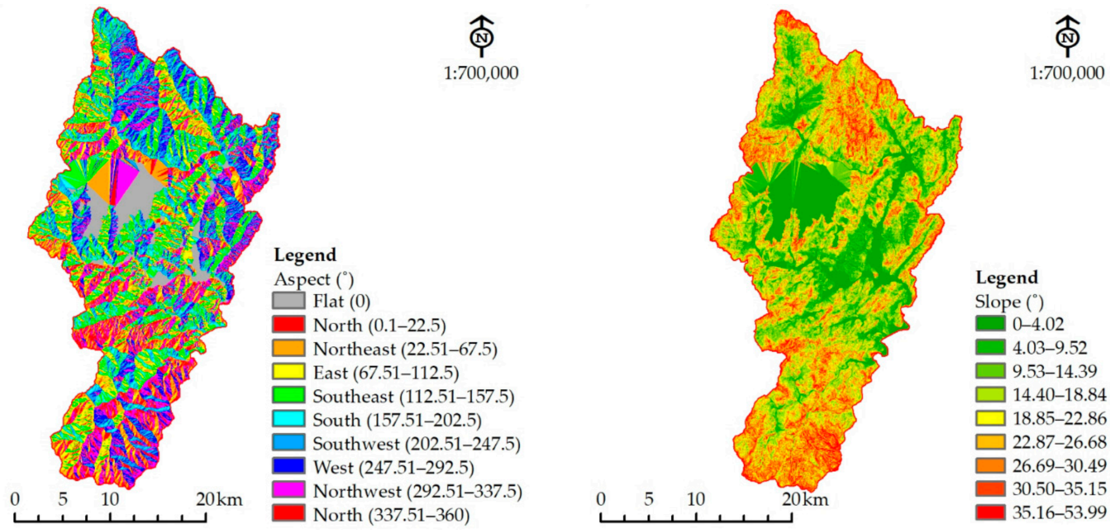
To verify the reliability of the suitability evaluation results, the trend of changes in the yield and production amount (2017–2019) of WSG in the study region (Hamyang-gun) was analyzed in connection with the cultivation area. Here, based on the assumption that WSG takes an average of five years from planting the seed and nursery to production, the cultivation area data (2012–2014) for the five years prior to the WSG production data were used. The data used in this comparison were internal data held by the administrative office of the study region (Hamyang-gun) due to the absence of any officially published statistical data.

3. Results and Discussion

3.1. Results of Creating Thematic Maps for each Growth Factor of WSG

3.1.1. Thematic Maps Related to the Growth Factors Using the Digital Topographic Map

A thematic map for each growth factor was created to identify suitable cultivation sites for WSG. Thematic maps for elevation, aspect, and slope were created using the digital topographic map among the selected growth factors of WSG. The altitude of the study area ranged between 120 m and 1900 m (Figure 1). The elevation data were reclassified into two categories (Table 1) for identifying suitable cultivation sites. The aspect of the study area was flat (0°), north (0.1–22.5° and 337.51–360°), northeast (22.51–67.5°), east (67.51–112.5°), southeast (112.51–157.5°), south (157.51–202.5°), southwest (202.51–247.5°), west (247.51–292.5°), and northwest (292.51–337.5°) (Figure 3a). The aspect data were reclassified into three categories (Table 1) for identifying suitable cultivation sites. The slope was found to range from 0° to 53.99° (Figure 3b). The slope data were reclassified into two categories (Table 1) for identifying suitable cultivation sites.



(**a**) (**b**)

Figure 3. Thematic map for each growth factor of WSG using the digital topographic map; (**a**) thematic map for aspects within the study area; (**b**) thematic map for slope within the study area.

3.1.2. Thematic Map Related to the Growth Factor Using the Forest Type Map

A thematic map for forest type (tree species) was created using the forest type map among the selected growth factors of WSG. The study area consisted of 26 forest types (tree species), including Korean red pine (*Pinus densiflora*), Japanese larch (*L. kaempferi*), needle fir (*Abies holophylla*), other broadleaf trees, Mongolian oak (*Quercus mongolica*), oriental cork oak (*Q. variabilis*), and other oak species (Figure 4). Forest type (tree species) data were reclassified into three categories (Table 1) for identifying suitable cultivation sites.

3.1.3. Thematic Maps Related to the Growth Factors Using Forest Soil Map

Thematic maps for soil organic content, effective soil depth, soil texture, soil moisture, and drainage were created using the forest soil map among the selected growth factors of WSG. The analysis indicated that the soil organic content in the study area was distributed from 0% to 6.1% or higher (Figure 5a). The effective soil depth was distributed from 0 cm to 47 cm (Figure 5b). The soil texture was composed of sandy loam, loam, silty loam, silty clay loam, and sandy clay loam (Figure 5c). The soil moisture was divided into drying, incomplete drying, suitable, and semi-wet, and the drainage of the soil was classified as poor, normal, good, and very good (Figure 5d,e). The soil organic content, effective soil depth, soil texture, soil moisture, and drainage were all reclassified into two categories (Table 1) for identifying suitable cultivation sites.

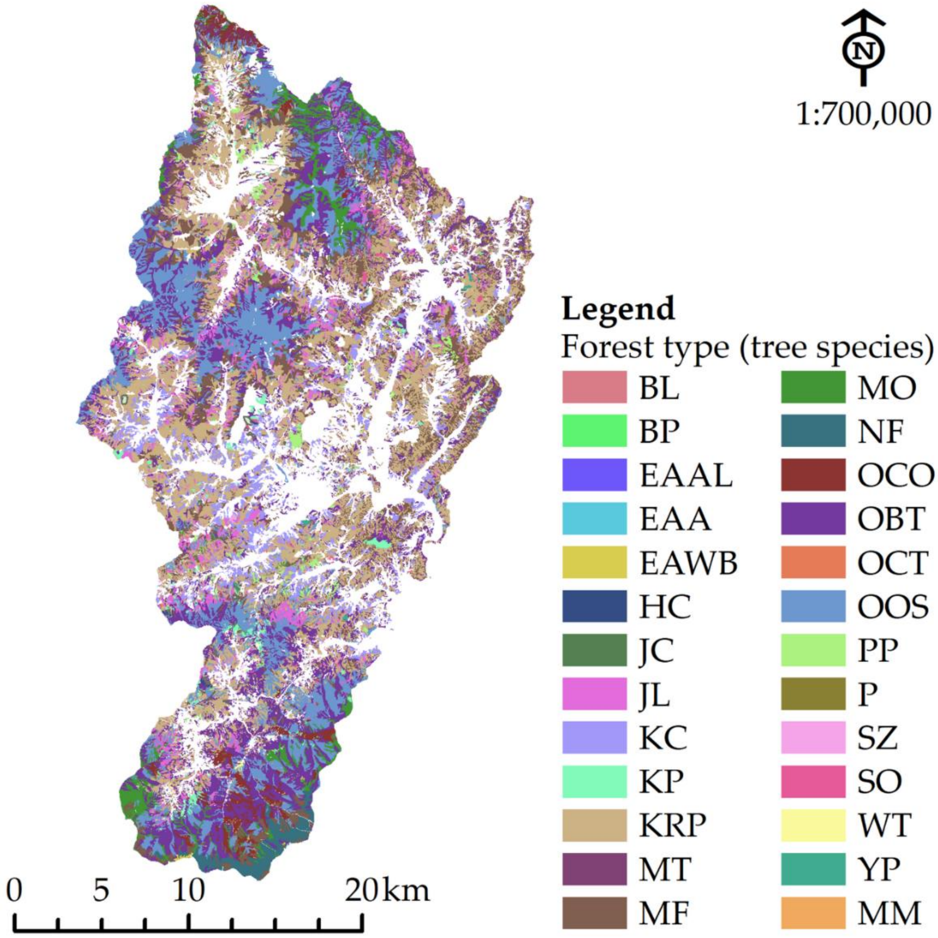


Figure 4. Thematic map for growth factor (forest type (tree species)) of WSG using the forest type map. Note: BL = Black locust, BP = Black pine, EAAL = East Asian alder, EAA = East Asian ash, EAWB = East Asian white birch, HC = Hinoki cypress, JC = Japanese cedar, JL = Japanese larch, KC = Korean castanea, KP = Korean pine, KRP = Korean red pine, MT = Maidenhair tree, MF = Mixed forest, MO = Mongolian oak, NF = Needle fir, OCO = Oriental cork oak, OBT = Other broadleaf tree, OCT = Other coniferous tree, OOS = Other oak species, PP = Pitch pine, P = Poplar, SZ = Sawleaf zelkova, SO = Sawtooth oak, WT = Walnut tree, YP = Yellow poplar, and MM = Mono maple.

3.2. Identification of Suitable WSG Cultivation Sites

For the suitability evaluation of the actual WSG cultivation sites, suitable WSG cultivation sites were identified for the forest land of the study region (Hamyang-gun). First, the suitable cultivation sites were identified by assigning weights to the detailed criteria of the thematic maps using the linear combination method for each growth factor of WSG. As a result, each study area was determined to have weighted values ranging from the 5.16 at the lowest to the 8.98 at the highest (Figure 6). These values, analyzed by the ArcGIS's "Raster Calculator" function, become the primary data for determining suitable cultivation sites.

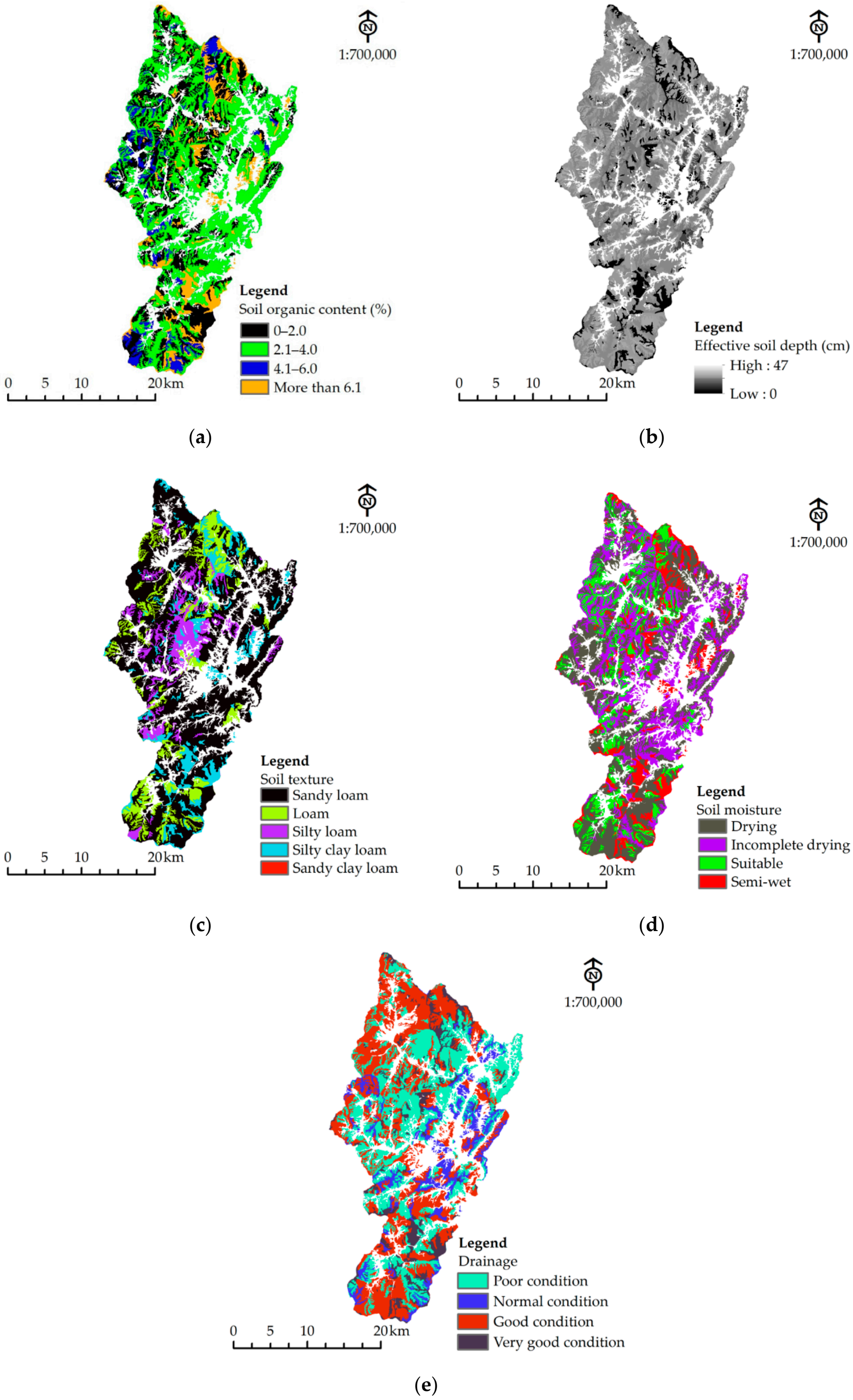


Figure 5. Thematic map for each growth factor of WSG using the forest soil map; (**a**) thematic map for soil organic content aspects within the study area; (**b**) thematic map for effective soil depth within the study area; (**c**) thematic map for soil texture within the study area; (**d**) thematic map for soil moisture with the study area; (**e**) thematic map for drainage within the study area.

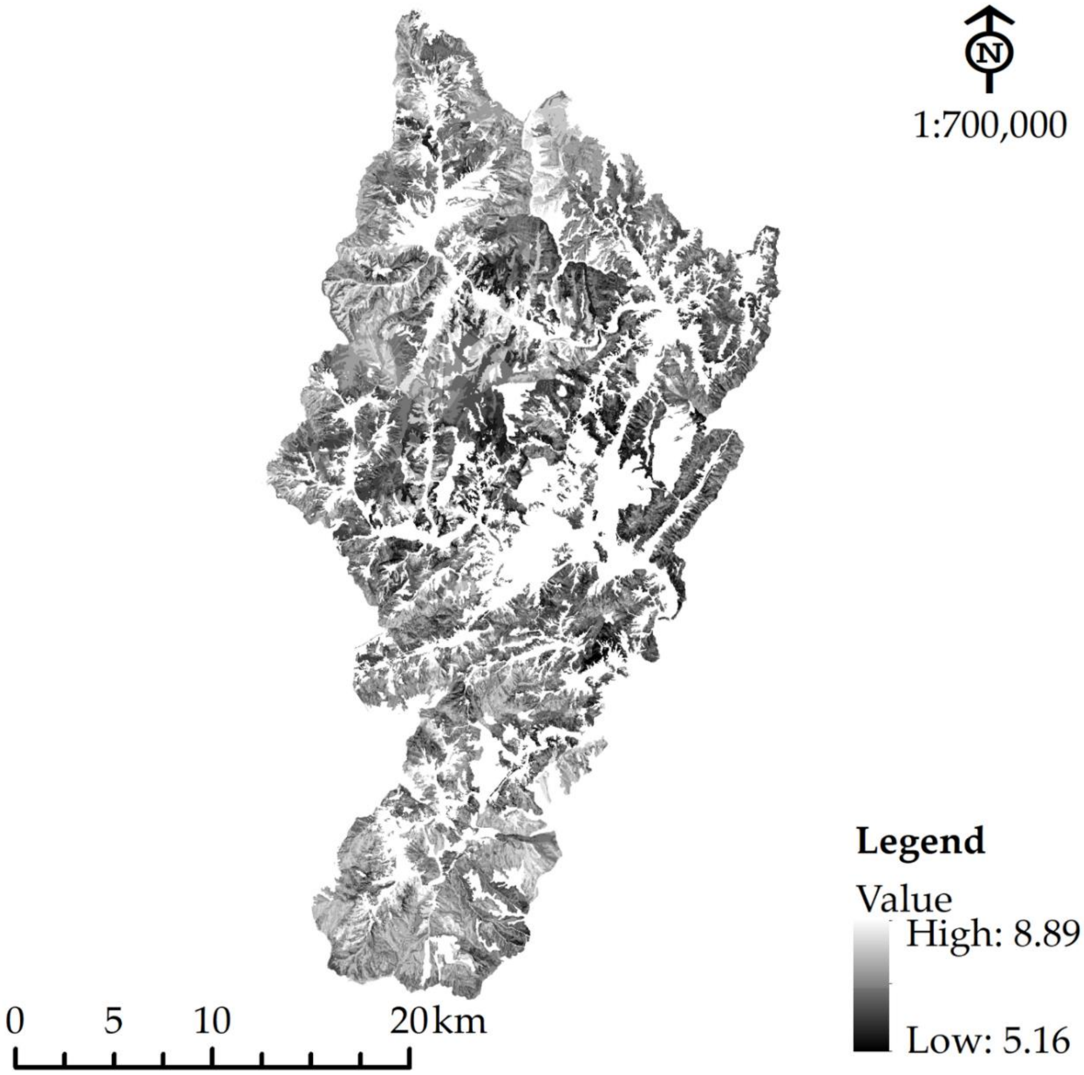


Figure 6. Primary data calculated by assigning weights to detailed criteria for each growth factor of WSG.

Finally, the suitable cultivation sites of WSG were reclassified into four grades (suitable, possibly suitable, probably unsuitable, and unsuitable site) using the primary data calculated by assigning weights to the detailed criteria for each WSG growth factor. Based on the forest type map, of the 46,550 ha of forest land, excluding bamboo and unstocked forest land in the study region (Hamyang-gun), 4756 ha (10.2%) of land was suitable for WSG cultivation, 17,941 ha (38.5%) was possibly suitable, 16,352 ha (35.1%) was probably unsuitable, and 7501 ha (16.1%) was unsuitable (Figure 7).

A previous study on the identification of suitable WSG cultivation sites in different regions showed that the ratios of lands considered suitable, possibly suitable, probably unsuitable, and unsuitable for WSG cultivation were 51.1%, 38.6%, 7.8%, and 2.6%, respectively [19]. In particular, there was a large difference (>40%) in the ratio of suitable sites for WSG cultivation identified in this study. Although geographic differences and physical and chemical characteristics of soil vary, the application of scientific techniques such as GIS should be actively considered for the identification of suitable WSG cultivation sites in regions or countries with high forest rates, such as Korea.

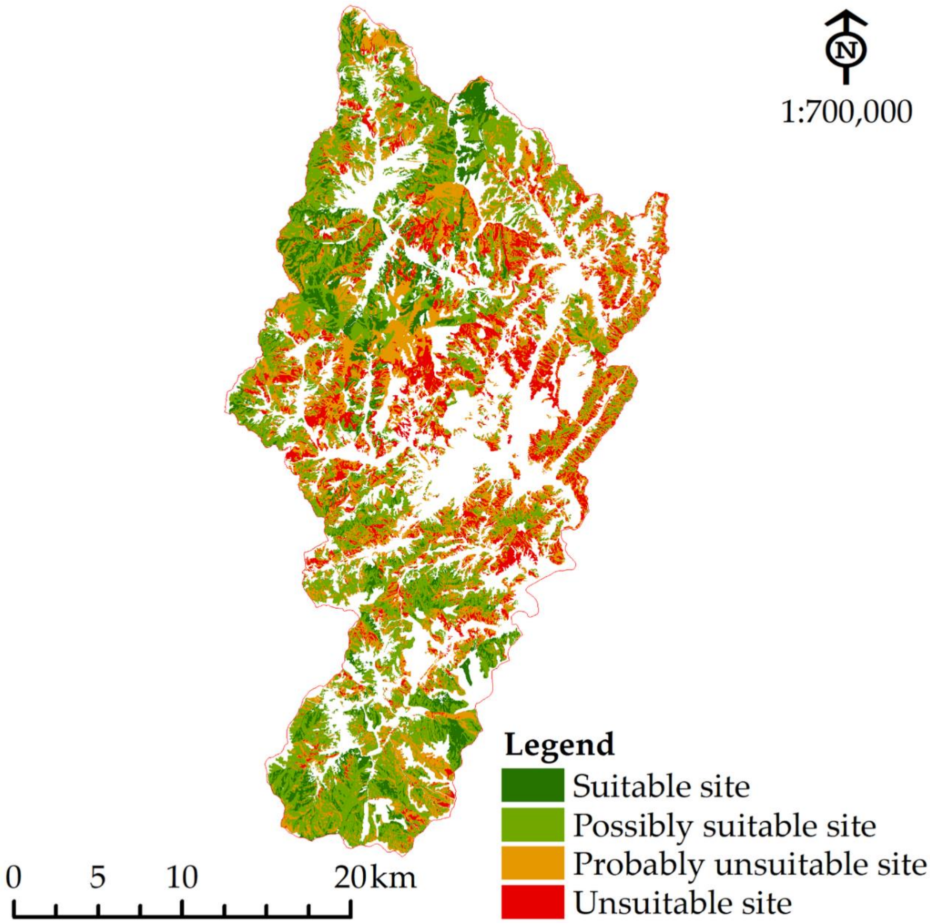


Figure 7. Map of the identification results of suitable WSG cultivation sites in Hamyang-gun forests. Note: Dark green color = suitable site (4756 ha), green color = possibly suitable site (17,941 ha), orange color = probably unsuitable site (16,352 ha), and red color = unsuitable site (7501 ha).

3.3. Suitability Evaluation of Actual WSG Cultivation Sites

For the suitability evaluation of actual WSG cultivation sites, the actual cultivation sites in the study region (Hamyang-gun) and the identification results for the suitable WSG cultivation sites based on GIS were analyzed using Zonal statistics. The actual WSG cultivation area during the last five years was 1457 ha (118 sites), of which only 254 ha (17.4%) were deemed to be suitable, 568 ha (39.0%) were possibly suitable, 464 ha (31.8%) were probably unsuitable, and 171 ha (11.7%) were unsuitable (Table 2).

Table 2. Results of suitability evaluation of the actual WSG cultivation sites during the last five years (2015–2019).

Classification	Area (ha)
Suitable site	254 (17.4)
Possibly suitable site	568 (39.0)
Probably unsuitable site	464 (31.8)
Unsuitable site	171 (11.7)
Total	1457 (100.0)

Values in parentheses indicate the percentage of total actual cultivation area.

Furthermore, the changes in the WSG cultivation area (2012–2014) in the study region (Hamyang-gun) and the yield and production amount over the last three years (2017–2019) were analyzed. The rate of increase for the WSG cultivation area in 2013 and 2014 compared to the previous year increased significantly to 6.3%, and 17.3%, respectively. WSG yield showed only a slight increase in 2018 (1.5%) and in 2019 (4.5%) when compared to the previous year. We find that WSG was planted in the "probably unsuitable" or "unsuitable" sites even prior to the year in which the analysis was conducted, as per the result of the suitability evaluation in this study. As a result, it was thought that the rate of increase in yield was relatively lower than that of the cultivation area. In addition, the production amount increased by 4.2% in 2018 compared to that of the previous year but decreased by 2.7% from that in 2018 to 1.5% in 2019. As of 2019, despite the increase in yield, the rate of increase in production amount decreased. This change may be a result of the unit sales price being lowered due to the decline in the quality of the WSG produced (Table 3).

Table 3. Status of WSG cultivation area, yield, and production amount in the entire study region.

Category	2012	2013	2014	2017	2018	2019
Cultivation area (ha)	370 (–)	393 (6.3)	461 (17.3)			
Yield (ton)				6.6 (–)	6.7 (1.5)	7.0 (4.5)
Production amount (USD thousand)				2249 (–)	2344 (4.2)	2378 (1.5)

Values in parentheses indicate the rate (%) of increase from the previous year. Source: Internal data of the administrative office of Hamyang-gun. 2020. References related to WSG.

From the forest land in the study region (Hamyang-gun), 10.2% was suitable for WSG cultivation and 48.7% was possibly suitable (including suitable sites). WSG can be cultivated in the study region (Hamyang-gun) owing to its high forest coverage of 77% [38] and the considerable interest in WSG by the local government, in addition to this being the largest area among local governments in Korea [39]. However, despite such topographical conditions and status, the results of the suitability evaluation of the actual WSG cultivation sites were poor. From the actual WSG cultivation area, 11.7% of the forest land was unsuitable for WSG cultivation and 43.6% was probably unsuitable (including unsuitable sites), which indicates that it was difficult for farming households to produce high-quality and high-yield WSG in almost half of the total cultivation area.

The poor results for the suitability evaluation of actual WSG cultivation sites were attributed to the consideration of convenient accessibility for cultivation and management and vague intuition, rather than the high sensitivity of WSG growth to the cultivation environment, by farming households [15,16]. If this continues, not only will the yield ratio of high-quality WSG, compared to the total yield produced by farming households decrease significantly but the total yield will also decrease. Ultimately, the income of farming households will decrease, and a chain reaction will occur, in which all WSG-related industries, such as cultivation, production, processing, and distribution will collapse.

4. Conclusions

It was found that both WSG growers and policy authorities neglected the suitability evaluation of actual WSG cultivation sites or planned WSG cultivation sites, which should be the basis for determining the sites to be used. As a clear demonstration of why this information should be used in decision-making, this study suggests a lower rate of yield or a reduction in the increasing rate of production in these poorly suited areas, compared to the increasing rate of the WSG cultivation area.

The determination of suitable cultivation sites for WSG, which must be cultivated in a mountain area according to the relevant law [9], can ensure a more efficient and reliable search for cultivation sites by applying scientific techniques, such as GIS. The application of the methodology used in this study, which can provide information to farming households by evaluating the suitability of planned cultivation sites for WSG, which is sensitive to the cultivation environment, will be a useful method for the production of high-quality WSG and sustainable yield.

The most important basic data for evaluating the suitability of actual WSG cultivation sites are the results identifying the suitable WSG cultivation sites. Therefore, to increase the accuracy of these initial data, further studies that use additional factors (e.g., temperature, rainfall, and solar radiation) to determine suitable WSG cultivation sites should investigate whether the accuracy of the suitable cultivation sites is improved according to changes in the weight difference for each factor by the expert group (analytic hierarchy process; AHP) [23,34,37]. Further studies should also evaluate whether the accuracy of the suitable cultivation sites is improved according to the reclassification methods of the primary identification results. In addition, it will be necessary to establish a monitoring area to facilitate comparisons of the yield per unit area for each analyzed site type (suitable, possibly suitable, probably unsuitable, and unsuitable site) and to monitor the yield over the course of several years.

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References

1. Kim, S.H.; Hong, Y.A.; Heo, S.Y.; Ji, J.H. *Korea Rural Economic Institute (KREI) Issues Analysis: Analysis of the Effects of COVID-19 Spread on the Agrifood Consumption Sector*; KREI: Naju, Korea, 2020; Volume 74, pp. 1–11. (In Korean)
2. Kim, M.J.; Jung, N.P. The effect of ginseng saponin on the mouse immune system. *Korean J. Ginseng Sci.* **1987**, *11*, 130–135, (In Korean with an Abstract in English).
3. Shim, J.Y.; Jung, I.S.; Kim, C.W.; Yun, Y.S.; Song, J.Y. Comparison between immunostimulatory activity and molecular structure of different polysaccharides. *Immune Netw.* **2004**, *4*, 94–99. [CrossRef]
4. KFS (Korea Forest Service). *Standard Cultivation Guidelines for Forest Products for GAP*; KFS: Daejeon, Korea, 2020; p. 669. (In Korean)
5. Hamyang-gun. The Difference between Wild-Simulated Ginseng and Regular Ginseng. 2020. Available online: https://www.expo-wg.com/00283/00311.web (accessed on 15 December 2020).
6. KFS. Quality Control Technique for Wild-Simulated Ginseng. 2020. Available online: www.law.go.kr/%ED%96%89%EC%A0%95%EA%B7%9C%EC%B9%99/%EC%82%B0%EC%96%91%EC%82%BC%EC%97%90%EA%B4%80%ED%95%9C%ED%92%88%EC%A7%88%EA%B4%80%EB%A6%AC%EC%9A%94%EB%A0%B9/(2020-21,20200401) (accessed on 15 December 2020). (In Korean).
7. Chamberlain, J.; Bush, R.; Hammett, A.L. Non-timber forest products: The other forest products. *For. Prod. J.* **1998**, *48*, 10–19.
8. Kruger, S.D.; Munsell, J.F.; Chamberlain, J.L.; Davis, J.M.; Huish, R.D. Projecting medicinal plant trade volume and value in deciduous forests of the Eastern United States. *Forests* **2020**, *11*, 74. [CrossRef]
9. KFS. Forestry and Mountain Villages Development Promotion Act. 2020. Available online: http://extwprlegs1.fao.org/docs/pdf/kor108388.pdf (accessed on 15 December 2020). (In Korean).
10. Moon, H.K. Quality Characteristics and Anti-Diabetic Effect of Mountain-Cultivated Ginseng (Sanyangsam). Ph.D. Thesis, Kyungpook National University, Daegu, Korea, 2015. (In Korean with an Abstract in English).
11. KFS. Detailed Implementation Plan for 2020 Major Tasks. 2020. Available online: http://www.forest.go.kr/kfsweb/cop/bbs/selectBoardArticle.do?nttId=3140483&bbsId=BBSMSTR_1008&pageUnit=9&ntcEndDt=&mn=NKFS_06_09_05 (accessed on 15 December 2020). (In Korean).
12. Korea Forestry Promotion Institute. Wild-simulated Ginseng Cultivation Status. 2020. Available online: https://sam.kofpi.or.kr/front/prstus/wcgsPsstus.do (accessed on 15 December 2020). (In Korean).
13. KFS. *Statistical Yearbook of Forestry*; KFS: Daejeon, Korea, 2019; p. 299. (In Korean)

14. KFS. Forest Products Import and Export Statistics: Status by Items. 2020. Available online: http://www.forest.go.kr/newkfsweb/kfi/kfs/soft/selectPrTradeList.do?mn=KFS_02_03_03_05_01 (accessed on 15 December 2020). (In Korean).
15. Woo, S.Y.; Lee, D.S. A study on the growth and environments of *Panax ginseng* in the different forest stands (I). *Korean J. Agric. For. Meteorol.* **2002**, *4*, 65–71, (In Korean with an Abstract in English).
16. Kang, H.M.; Choi, S.I.; Kim, H. Identification of suitable sites for mountain ginseng cultivation using GIS and geo-temperature. *Springerplus* **2016**, *5*, 394. [CrossRef]
17. Kang, H.M.; Cho, S.J.; Choi, S.I.; Sato, N.; Kim, H. Revitalizing mountain ginseng cultivation in North Jeolla province, South Korea. *Small Scale For.* **2016**, *15*, 497–516. [CrossRef]
18. Kim, K.Y.; Um, Y.R.; Jeong, D.H.; Kim, H.J.; Kim, M.J.; Jeon, K.S. The correlation between growth characteristics and location environment of wild-simulated ginseng (*Panax ginseng* C.A. Meyer). *Korean J. Plant Res.* **2019**, *32*, 463–470, (In Korean with an Abstract in English).
19. Beon, M.S.; Park, J.H.; Kang, H.M.; Cho, S.J.; Kim, H. Geographic information system-based identification of suitable cultivation sites for wood-cultivated ginseng. *J. Ginseng Res.* **2013**, *37*, 491–495. [CrossRef]
20. Selim, S.; Koc-San, D.; Selim, C.; San, B.T. Site selection for avocado cultivation using GIS and multi-criteria decision analyses: Case study of Antalya, Turkey. *Comput. Electron. Agric.* **2018**, *154*, 450–459. [CrossRef]
21. Carver, S.J. Integrating multi-criteria evaluation with geographical information systems. *Int. J. Geogr. Inf. Syst.* **1991**, *5*, 321–339. [CrossRef]
22. Malczewski, J. GIS-based land-use suitability analysis: A critical overview. *Prog. Plan.* **2004**, *62*, 3–65. [CrossRef]
23. Chivasa, W.; Mutanga, O.; Biradar, C. Mapping land suitability for maize (*Zea mays* L.) production using GIS and AHP technique in Zimbabwe. *S. Afr. J. Geomat.* **2019**, *8*, 265–281.
24. Jayasinghe, S.L.; Kumar, L.; Sandamali, J. Assessment of potential land suitability for tea (*Camellia sinensis* (L.) O. Kuntze) in Sri Lanka using a GIS-based multi-criteria approach. *Agriculture* **2019**, *9*, 148. [CrossRef]
25. Lee, I.H.; Kim, P.K.; Ryu, S.P. Mountain-cultivated ginseng ripened into persimmon vinegar ingestion on fat storage and metabolic protein expression in diet-controlled rats. *J. Korean For. Soc.* **2015**, *104*, 67–75, (In Korean with an abstract In English). [CrossRef]
26. Yoo, S.J.; Ko, S.K.; Kim, H.J. Clinical trial for the heat-rising action of ginseng and cultivated wild ginseng to the subject diagnosed as heat pattern by cold-heat patternization. *J. Korean Obstet. Gynecol.* **2017**, *30*, 45–58.
27. Kim, N.E.; Lee, M.O.; Jang, M.H.; Chung, B.H. Angiogenic effects of wood-cultivated ginseng extract and ginsenoside Rg5 in human umbilical vein endothelial cells. *Korean J. Food Sci. Technol.* **2018**, *50*, 349–355, (In Korean with an Abstract in English).
28. Ahn, C.H. Physicochemical Properties and Antioxidative Activity of Wild Simulated Ginseng Traditional Vinegar. Ph.D. Thesis, Semyung University, Jecheon, Korea, 2019. (In Korean with an Abstract in English).
29. Kim, E.G.; Kim, D.H. Estimation on economic value for cultivated wild ginseng using choice experiment. *J. Korean For. Soc.* **2013**, *102*, 338–344, (In Korean with an Abstract in English).
30. Kim, K.Y.; Jeong, D.H.; Kim, H.J.; Jeon, K.S.; Kim, M.J.; Um, Y.R. A study on growth characteristics of wild-simulated ginseng (*Panax ginseng* C.A. Meyer) by direct seeding and transplanting. *Korean J. Plant Res.* **2019**, *32*, 160–169, (In Korean with an Abstract in English).
31. Wang, D.; Li, C.; Song, X.; Wang, J.; Yang, X.; Huang, W.; Wang, J.; Zhou, J. Assessment of land suitability potentials for selecting winter wheat cultivation areas in Beijing, China, Using RS and GIS. *Agric. Sci. China* **2011**, *10*, 1419–1430. [CrossRef]
32. Kim, Y.W.; Jang, M.W.; Hong, S.Y.; Kim, Y.H. Assessing southern-type garlic suitability with regards to soil and temperature conditions. *Korean J. Soil Sci. Fertil.* **2012**, *45*, 266–271, (In Korean with an Abstract in English). [CrossRef]
33. Li, B.; Zhang, F.; Zhang, L.W.; Huang, J.F.; Jin, Z.F.; Gupta, D.K. Comprehensive suitability evaluation of tea crops using GIS and a modified land ecological suitability evaluation model. *Pedosphere* **2012**, *22*, 122–130. [CrossRef]
34. Dedeoğlu, M.; Dengiz, O. Generating of land suitability index for wheat with hybrid system approach using AHP and GIS. *Comput. Electron. Agric.* **2019**, *167*, 105062. [CrossRef]
35. Jurišić, M.; Plaščak, I.; Antonić, O.; Radočaj, D. Suitability calculation for red spicy pepper cultivation (*Capsicum annum* L.) using hybrid GIS-based multicriteria analysis. *Agronomy* **2020**, *10*, 3. [CrossRef]
36. Baroudy, A.A.E. Mapping and evaluating land suitability using a GIS-based model. *Catena* **2016**, *140*, 96–104. [CrossRef]
37. Tashayo, B.; Honarbakhsh, A.; Akbari, M.; Eftekhari, M. Land suitability assessment for maize farming using a GIS-AHP method for a semi- arid region, Iran. *J. Saudi Soc. Agric. Sci.* **2020**, *19*, 332–338. [CrossRef]
38. Hamyang-gun. *Statistical Yearbook of Hamyang*; Hamyang-gun: Hamyang, Korea, 2019; pp. 35–37. (In Korean)
39. Hamyang-gun. The Uniqueness. 2020. Available online: https://www.expo-wg.com/00283/00315.web (accessed on 15 December 2020).
40. ESRI. Classifying Numerical Fields for Graduated Symbology: Standard Classification Methods in ArcGIS. 2018. Available online: https://desktop.arcgis.com/en/arcmap/10.3/map/working-with-layers/classifying-numerical-fields-for-graduated-symbols.htm (accessed on 15 December 2020).