Regular Article
pISSN: 2288-9744, eISSN: 2288-9752
Journal of Forest and Environmental Science
Vol. 35, No. 3, pp. 173-180, September, 2019
https://doi.org/10.7747/JFES.2019.35.3.173

JFES
Journal of Forest and Environmental Science

Estimating Economic Optimum Planted Area for Sustainable *Schisandra chinensis* Cultivation

Byoung-Hoon Lee*
College of Agriculture and Life Science, Kangwon National University, Chuncheon 24341, Republic of Korea

Abstract

This study determined the economic impact of environment-friendly cultivation and the optimal cultivation area of Omija (Korean for *Schisandra chinensis Baillon*) for full-time farmers by analyzing the management performance of existing Omija cultivators. The study divided the target income into urban household income and Omija farm income, and estimate the optimal cultivation area by substituting the target profit from the cost-volume-profit analysis model. The optimum cultivation area was 1.4 ha for general cultivation, 1.08 ha for organic cultivation, and 1.18 ha for pesticide-free farming cultivation considering the average urban household income as the target, and 0.81 ha for general cultivation, 0.63 ha for organic cultivation, and 0.69 ha for pesticide-free farming, considering the average 2012 farm household income as the target. Therefore, the study reached conclusion that it is necessary to secure the price of Omija farm and stable support for income increase. Therefore, the support plan for income stabilization of Omija farm should be considered. Especially, the central government should provide various policies and financial support to help the optimal cultivation area of Omija Farm.

Key Words: *Schisandra chinensis Baillon*, CVP (Cost-Volume-Profit), break-even point, optimal cultivation area

Introduction

Schizandra chinensis Baillon (Korean name: Omija) is a broad-leaved deciduous tree belonging to the Magnoliaceae family. This species in native to East Asian such as China, Japan, Korea Province. Also, Omija has contributed to farmers' household income growth because it is less man-powered and managed intensively with compared to other crops.

Omija is a root-knot plant, and its thin roots are suitable for cultivation because of its good water retention, good moisture retention, and high organic water content. The cultivation method is varied: abandonment, root division, folding, and grafting. However, since the rooting rate is low and it takes a long time from seed propagation to harvest, mass proliferation and seed propagation are possible (Ministry of Agriculture, Food and Rural Affairs (MAFRA) 2012;2013).

It grows at a height of 200-1,600 m and is cultivated all over Korea. In 2013, the region had 1,193 ha of Omija under cultivation in Gyeongbuk, 330 ha in Jeonbuk, 302 ha in Gyeongnam, and 241 ha in Gangwon, with the cultivation area increasing rapidly since 2010 owing to a trend of increasing consumption of healthy food (Korea Forest Service 2010; 2011; 2012; 2013). The Omija fruit is edible and has a unique taste that is sweet, bitter, sour, salty, and spicy. It also has medicinal uses. It has antibacterial properties, while its pharmacological effects include treatments for coughs

Received: September 21, 2018. Revised: August 23, 2019. Accepted: August 24, 2019.

Corresponding author: Byoung-Hoon Lee

College of Agriculture and Life Science, Kangwon National University, Chuncheon 24341, Republic of Korea
Tel: 82-33-250-8661, Fax: 82-33-259-5564, E-mail: bhleeok@kangwon.ac.kr

and asthma.

The cultivated area and production in the last five years has increased from 1,363 ha and 3,781 tons, respectively, in 2009 to 2,367 ha and 9,575 tons, respectively, in 2013. Over this time, the area under Omjia cultivation increased 1.7 times and production increased 2.5 times. Factors that increased the cultivation area include increased income owing to price increases, ease of cultivation, a stable market owing to consumption increase, and high income compared to input cost.

Moreover, since the 1990s, the imports of Chinese Omija have continued, and imports are expected to increase further as the Korea-China Free Trade Agreement becomes effective. As a result, the domestic and Chinese markets for Omija are expected to intensify competition. However, price competition is no longer meaningless because the price of Chinese Omija is cheaper than Korean Omija for the cultivation of general mainstream method. In order to avoid the competition, instead of the cultivation of general Omija, the cultivation of environment-friendly Omija has been increasing recently by the domestic Omija farmers. Because Chinese Omija is not environment friendly Omija.

Therefore, Korea Omija farmers must be very curious to know which of the cultivation methods of Omija is more profitable. More information will be needed on which options are more reasonable. Unfortunately, Omija-related studies focused mainly on the chemical and pharmacological effects of Omija, its use as a food additive, and how to dry and store Omija (Jung et al. 1998; Park et al. 2010a; Lee et al. 2016). In addition, there were several studies on economic evaluation and commercialization of other forest products (Won et al. 2017; Kang et al. 2018; Mogomotsi et al. 2018), but there were no studies on economic evaluation of Omija products.

The purpose of this study is to identify the cultivation area, income structure, and management structure between general and environment-friendly farmers of Omija. In addition, this study aims to analyze the economic value of environment-friendly Omija as a cash crop and to suggest the appropriate optimum cultivation area for cultivation by full-time farmers through analysis of the management performance of Omija. Based on the results of the analysis, this study would be useful information for policy makers to have various policy options stabilizing farm household income and improving structure of Omija farming, and for individual farm of Omija to effectively manage their farming

Materials and Methods

Subjects and survey content

The survey was conducted in five cities, namely, Gangwon-do Inje-gun, Hoengseong-gun, Yeongwol-gun, Samcheok-si, and Taebaek-si. In total, 30 farm households were analyzed. The analysis was undertaken using agricultural income data (Rural Development Administration 2012;2013) for comparative analysis with nationwide farms.

This study aimed to investigate the reasons for the increase in the cultivation area of Omija in order to understand the cultivation type, management cost, and production level.

Methods

To analyze the management performance of farmers, this study investigated the economic effect of environment-friendly cultivation of Omija by comparing general farms with environment-friendly farms.

To diagnose the management performance and obtain the decision data of farms, this study used the break-even point analysis technique known as cost-volume Kang et al. 2018 profit (CVP). There are several analysis techniques to diagnose the management performance for the profitability of general or environmentally friendly cultivation farmers. Lee et al. (2016) used the cost and benefits of the three farming type, Park et al. (2010b) adopted the investment beneficial analysis, and the other studies used similar methods which are the best known and proven method among various methods.

CVP is a technique for analyzing the relationship between sales, production cost, and profits and can be used as an important means for management decision making. CVP analysis

can be used to increase profits by changing capacity, that is, sales (output and price) or production cost, and enables decision making.

To obtain the break-even point of a farm, the unit sales price, total fixed costs, and variable costs are required. Total fixed costs are the sum of depreciation, fixed capital service cost, floating capital service cost, land capital service cost, and repair cost. Variable cost is the cost excluding production cost.

The break-even point is the point at which sales and total cost coincide, that is, where loss and profit are both zero (π=0). In other words, the break-even point can be expressed by using the profit equation Profit (π) can be expressed as subtracting total cost from total revenue. In addition, total revenue and total cost can be expressed as ($P \times Q$) and ($v \times Q + FC$), respectively.

Results

Increase cultivation area and consumption situation

In the past 5 years, the price of commodities that contain Omija has risen 2.2 times from 15.11 dollars in 2009 for 600 g, to 32.89 dollars in 2013 for the same quantity, while the cultivated area has increased 1.7 times from 1,363 ha to 2,367 ha (Table 1). The certified cultivation area was 368 ha in 2013, accounting for 15.5% of the total cultivation area. Production has increased 2.5 times from 3,781 tons in 2009 to 9,575 tons in 2013. The main reason for the increase in cultivation area was the increase in income owing to a price increase, the ease of cultivation, and the stable market size (Table 2).

Omija can be used for medicinal and edible purposes. Due to its nature, its distribution period is very short (within 2 days), and it is mostly sold as a dry product in the medicines market.

The raw materials are contractually distributed through intermediate distributors, such as consumer direct dealer Hansallim. The standard price for 600 g of the dried product is 32.89 dollars, however, the average domestic price of Omija is too high for ordinary people. Therefore, Omija is considered by consumers to be a premium agricultural product.

Production yield & management

Production yield by region

Generally, Omija is a perennial that is planted in the spring and harvested from the autumn of its third year. The amount of production varies greatly according to the official year for each region and farm. As of 2012, the average production of Omija was 460 kg per 10 are, with the highest in Gyeongbuk (604 kg) and the lowest in Jeju (120 kg) (Table 3).

The reason for the large difference in production between regions is the time taken from planting Omija to its production based on the receipt of seedlings and the average cultivation area of farmers surveyed, which is 78 are.

Management performance by cultivation type

In 2012, the average income of ordinary farmers from Omija was 3,079.11 dollars/10 are. By contrast, the analysis of the management performance of environment-friendly farms showed that their production yield was lower by 6.1% for organic farms (432 kg per 10 a) and 8.7% for pesticide-free farms (420 kg per 10 a), compared with the general production (460 kg per 10 a). In addition, 1 kg of Omjia produced through organic farming is sold for 12.89 dollars while the same quantity produced through pesticide-free farming is sold for 12.4 dollars, which are 30% and 25% higher, respectively, than the price of Omjia produced through general farming (9.94 dollars). Income per 10 a of organic farming is 3,920.89 dollars and that of pesti-

Table 2. Selective motivation (unit: person)

	High income	Advice suasion	Secure sales	Ease of cultivation	Other
Respondent	17	3	4	4	2
Ratio (%)	57	10	13	13	7

Table 1. Planting area and price in recent 5 years (Korea Forest Service 2014) (unit: ha, ton, $)

	2009	2010	2011	2012	2013
Planting area	1,363	1,109	1,749	1,972	2,367
Production	3,781	3,670	6,892	9,122	9,575
Price	15.11	18.96	24.59	30.52	32.89

Price=based on 600 g dry. Seoul Kyungdong Medal Market.

Table 3. Production yield by region (as of 2012) (unit: kg/10are)

	Nation	Gyeong-gi	Gang-won	Chung-buk	Chung-nam	Jeonbuk	Jeonnam	Gyeong-buk	Gyeon-nam	Jeju
Yield	460	314	271	269	388	404	382	604	340	120

Survey of Agricultural Income. Rural Development Administration.

Table 4. Analysis of management performance by cultivation type

	Units	General cultivation (1)	Environment-friendly cultivation		Environment general ratio	
			Organic farming (2)	Pesticide-free farming (3)	Organic general (2)/(1)	Pesticide-free general (3)/(1)
Revenue (a)	$/10 a	4,572.60	5,568.00	5,208.00	1.22	1.14
Quantity (kg)	kg/10 a	460	432	420	0.94	0.91
Sales price	$/kg	9.94	12.89	12.4	1.3	1.25
Operating expense (b)	$/10 a	1,493.42	1,647.53	1,672.63	1.1	1.12
Income (a-b)	$/10 a	3,079.18	3,920.47	3,535.37	1.27	1.15
Total labor hours (ratio)	Hours	126	146	162	1.16	1.29

Table 5. Break-even point analysis by cultivation type (unit: $, kg)

	Salesprice (A)	Variable cost (B)	Totalfixed cost (C)	Contri-bution.profit (D=A-B)	Break-evenquantity (E=C/D)	Break-even sales (E×A)
General	9.94	2.46	361.68	7.48	48.4 kg	480.65
Organic	12.89	2.56	361.68	10.33	35.0 kg	451.44
Pesticide-free	12.4	2.7	361.68	9.7	37.3 kg	462.12

cide-free farming is 3,535.11 dollars, a 27% and 15% income increase, respectively, compared with the income per 10 a of general farming (3,079.18 dollars) (Table 4).

Management and making decision

There are many methods within management analysis, such as absolute comparison and relative comparison, but this study uses the CVP analysis model. CVP analysis, or break-even analysis, involves a break-even point in balance with no gain or loss. Break-even point analysis is the most basic analytical method of management analysis, because it can easily determine the actual sales amount and the sales amount to be achieved in order to avoid loss from stock management activity, and the production volume and sales price to meet the target profit. The break-even point quantity is the capacity level at which gross profit and total cost coincide, and can be expressed by the following formula.

$$\text{Break-even point quantity} = \frac{\textit{Fixed Cost}}{\textit{Contribution profit per unit}} \qquad (1)$$

Profit (π) can be expressed as subtracting total cost (TC) from total revenue (TR), and can be shown as follows. $\pi = px - (bx + F) = (p - b)x - F$. If this is converted, the break-even point sales quantity formula can be derived as follows. Break-even point sales Quantity (x) = fixed cost (F)/{sales price (p) − variable cost (b)}.

Contribution profit per unit refers to the deduction of the variable cost from the sales price per unit. Dividing the fixed cost by the contribution margin per unit becomes the break-even point quantity. In this study, break-even point analysis by general farmers and eco-friendly farmers is as follows (Table 5).

If the sales price of Omija at the time of general cultivation were 9.94 dollars per kilogram, 7.48 dollars, considering a variable cost of 2.46 dollars per unit, would be the contribution profit. The break-even point quantity of 48.4 kg is derived by dividing the fixed cost of 361.68 dollars per 10 are by the contribution profit of 7.48 dollars. This study multiplies the sales price by 9.94 dollars to calculate the break-even point sales as 480.65 dollars. In the same way, break-even point analysis for environment-friendly cultivation shows that the break-even point amount is 35 kg and the sales amount is 451.44 dollars when the sales price is 12.89 dollars for organic cultivation. Pesticide-free cultivation has a break-even quantity and amount of 37 kg and 462.12 dollars, respectively (Table 5).

Fig. 1 shows the break-even point in general cultivation.

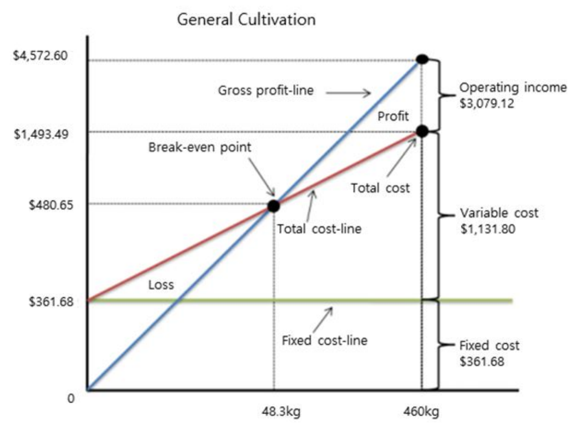

Fig. 1. General cultivation break-even point ($/10 a).

The 45° straight line starting from the origin indicates the total number of groves. The sales amount of 460 kg of general farms is multiplied by the sales price of 9.94 dollars, giving total income of 4,572.6 dollars. Fixed costs are constant regardless of the unit of production, and thus, the fixed cost per 10 are is 361.68 dollars, which is shown horizontally on the horizontal axis. The total cost line is expressed as the sum of the fixed cost and variable cost. The break-even point is where the cost line, which starts at the fixed cost of 361.68 dollars meets the total revenue line. In the figure, the lower left area of the break-even point indicates loss, and the upper right area indicates the magnitude of profit. In the case of general farm households, the total income per 10 are is 4,572.6 dollars, minus includes the fixed cost of 361.68 dollars and the variable cost of 1,131.80 dollars and 3,144.59 dollars in operating income. Here, the operating income is the same as the income obtained by subtracting operating expenses from revenue (sales) used in the agricultural income survey analysis, and the sum of the variable costs and fixed costs equals the operating expenses of 1,493.42 dollars.

Figs 2 and 3 show the break the break-even point for organic farming is derived in the same way as that for general cultivation. When the sales price per kilogram is 12.89 dollars, the break-even point quantity is 35 kg and the sales amount is 451.44 dollars. In the case of general cultivation, the break-even point rate per 10 are is 48 kg, whereas that for organic cultivation is reduced by 13 kg, because the sales price is 30% higher than the general price, and thus, the break-even point rate decreases accordingly. Thus, the

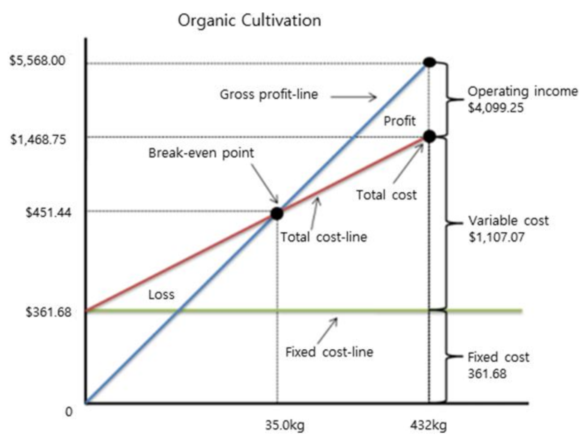

Fig. 2. Organic cultivation break-even point ($/10 are).

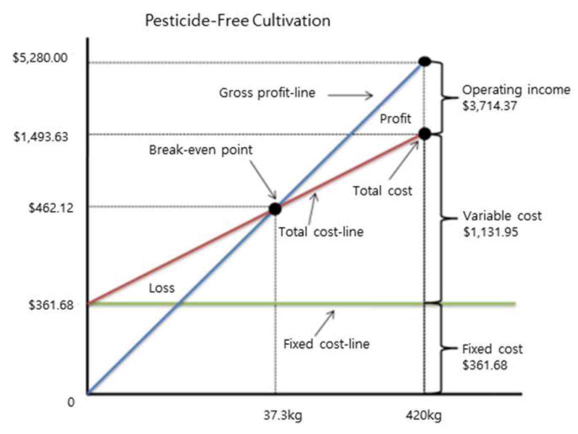

Fig. 3. Pesticide-free cultivation break-even point ($/10 a).

break-even point includes a variable cost and a fixed cost when the unit sales price is constant, and the break-even point quantity increases as the fixed cost becomes higher than the variable cost.

Optimal area for omija full-time farmers

The biggest problem with the cultivation of Omija is that there is a considerable difference in production numbers between areas and farms. A full-time farmer is one whose household members are engaged only in farming and have not earned income from non-farming activities within the last 30 days. The analysis shows that the majority of farmers operate a mixed farming type rather than full-time farming. Therefore, as a medicinal crop, Omija requires full-time farming or at least a practical scale that guarantees a certain level of income.

In this study, the target income for full-time farmers who cultivate Omjia is set as the 2012 average urban household income of 47,920.00 dollars and farm household income of 27,582.22 dollars; then, break-even point quantity analysis that can achieve these targets is carried out. (Tables 6 and 7).

In 2012, the break-even point quantity to achieve the urban household income of 47,920 dollars was 6,455 kg (64,163.56 dollars) when the average sales price per kg was 9.94 dollars in general cultivation. Meanwhile, the break-even point quantity to obtain a target farm household income of 27,582.22 dollars was 3,736 kg and the amount was 37,135.11 dollars.

In the analysis of the break-even point change by the type of environment-friendly cultivation by the same method, the break-even quantity to obtain urban household income was 4,676 kg (60,264 dollars) when the price per kg was 12.89 dollars in organic cultivation and the amount was 2,706 kg (34,879.11 dollars) to achieve the average farm household income. In particular, when the price of pesticide-free farming was 12.4 dollars, the break-even point amount to obtain urban household income was 4,975kg (61,689.78 dollars) while that for farm household income was 2,879 kg (35,704 dollars) (Table 7).

Based on the calculation of the break-even point quantity of Omija cultivation by professional farmers, this study divided the break-even point quantity in general cultivation by the average production yield of 460 kg/10 are in 2012, and obtained an appropriate cultivation scale of 1.40 ha for an urban household target income of 47,920 dollars. In addi-

Table 6. Break-even point change for achieving target income by cultivation type (unit: $, kg)

		Income (A)	Fixed cost (B)	Target income (C=A+B)	Sales price (D)	Variable cost (F)	Contri.profit (E=D-F)	Break-even quantity (C/E)
General	Urban household	47,920.00	361.68	48,281.68	9.94	2.46	7.48	6,455 kg
	Farm household	27,582.22	361.68	27,943.90				3,736 kg
Organic	Urban household	47,920.00	361.68	48,281.68	12.89	2.56	10.33	4,676 kg
	Farm household	27,582.22	361.68	27,943.90				2,706 kg
Pesticide-free	Urban household	47,920.00	361.68	48,281.68	12.4	2.7	9.7	4,975 kg
	Farm household	27,582.22	361.68	27,943.90				2,879 kg

Table 7. Calculation of the optimal size by break-even point quantity analysis

		Break-even quantity (A)	Break-even amount	Optimal area (B)	Remarks
General	Urban household	6,455 kg	$64,163.56	1.40 ha	B=A/460 kg
	Farm household	3,736 kg	$37,136.00	0.81 ha	
Organic	Urban household	4,676 kg	$60,264.00	1.08 ha	B=A/432 kg
	Farm household	2,706 kg	$34,879.11	0.63 ha	
Pesticide-free Farming	Urban household	4,975 kg	$61,689.78	1.18 ha	B=A/420 kg
	Farm household	2,879 kg	$35,704.00	0.69 ha	

tion, 0.81 ha was required to obtain a target income of 27,582.22 dollars (compared with the average farm household income) through general cultivation. Furthermore, for the break-even point in organic farming by the average production yield of 432 kg/10 are in 2012, the optimal cultivation scale for urban household income was estimated to be 1.08 ha and 0.63 ha for farm household income. In the case of pesticide-free farming, this study divided the break-even point quantity by the average production number of 420 kg/10 are in 2012, and found the appropriate cultivation scale to obtain urban household income and farm household income was 1.18 ha and 0.69 ha, respectively.

Conclusion

This study was conducted to present the economic effects of environment-friendly cultivation and the optimal cultivation area of full-time farmers by analyzing the management performance of Omija cultivators whose growing area has been increasing in the recent past. The cultivation area of Omija increased 1.7 times in 2013 from 2009, reaching 2,367 ha, and production increased 2.5 times to 9,575 tons. The area under environment-friendly cultivation is 368 ha, accounting for 15.5% of the total. This study analyzed the increase in the area under Omija cultivation as an income effect from a price increase, and found that the initial investment cost was low, and it was easy to cultivate and sell Omija.

Income per 10 are of surveyed farms was 3,063.11 dollars for general cultivation, 3,920 dollars for organic cultivation, and 3,535.11 dollars for pesticide-free farming. The increase in income for environment-friendly cultivation was found to be 127% for organic cultivation and 115% for pesticide-free farming. The CVP analysis of farmers' management showed that the break-even point quantity and amount per 10 are were 48 kg and 480.65 dollars, respectively, for general cultivation, 35 kg and 451.44 dollars, respectively, for organic cultivation, and 37 kg and 462.12 dollars, respectively, for pesticide-free cultivation. All the surveyed farms exceeded the break-even point quantity and amount, showing good overall management performance.

The optimum cultivation area was 1.4 ha for general cultivation, 1.08 ha for organic cultivation, and 1.18 ha for pesticide-free cultivation. In order to obtain the target profit of the farm income level, 0.81 ha of general cultivation, 0.63 ha of organic cultivation and 0.69 ha of pesticide-free farming cultivation were analyzed. These show that the environment-friendly cultivation method is more reasonable than general cultivation methods.

As the results, it is necessary to support Omija farms for income increase and stably secure the price of Omija. Therefore, the following support plans should be considered to stabilize income of Omija farms. Firstly, the central government should provide various policies and financial assistance to help build the optimal cultivation area of Omija. Secondly, Omija farm association has to effort in order to increase the added value, it is necessary to develop various processed foods using Omija. Thirdly, it is necessary to establish a branding and marketing strategy for expanding sales volume. The limitations of this study are that the number of farmers used in the break-even analysis is very small. Therefore, the further studies have to conduct that the results of the analysis will be generalized only if more farmers are included.

Acknowlegements

This study was supported by 2016 Research Grant from Kangwon National University (No 520160531).

References

Jung GT, Ju IO, Choi JS. 1998. Studies on drying and preservation of Omija (Schizandra chinensis BAILL.). Korean J Postharvest Sci Technol 5: 217-223.

Kang BR, Kim HT, Jang JY, Woo HS, Woo JC. 2018. Value Chain Optimization in Timber Supply Chain: Case Study in Gangwon-do. J For Environ Sci 34: 304-312.

Korea Forest Service. 2010. Statistical Yearbook of Forestry (2010). Daejeon.

Korea Forest Service. 2011. Statistical Yearbook of Forestry (2011). Daejeon.

Korea Forest Service. 2012. Statistical Yearbook of Forestry (2012). Daejeon.

Korea Forest Service. 2013. Statistical Yearbook of Forestry (2013). Daejeon.

Korea Forest Service. 2014. Statistical Yearbook of Forestry (2014). Daejeon.

Kwak JS, Jang KJ, Jung YO, Sung HG. 2007. Cultivation and Use of Medicinal Crops. Blue Happiness, pp 52-57.

Lee S, Nguyen TT, Poppenborg P, Shin HJ, Koellner T. 2016.

Conventional, partially converted and environmentally friendly farming in south korea: profitability and factors affecting farmers' choice. Sustainability 8: 704.

Ministry of Agriculture, Food and Rural Affairs (MAFRA). 2012. Production of Special Crops. Sejong.

Ministry of Agriculture, Food and Rural Affairs (MAFRA). 2013. Production of Special Crops. Sejong.

Mogomotsi PK, Mogomotsi GEJ, Gondo RK. 2018. Utilisation of non timber forest products in botswana: the case of commercialisation of Mopane Worms (*Imbraisia belina*) in Central district, botswana. J For Environ Sci 34: 24-30.

Park LY, L SH, Kim SJ. 2010a. Preparation and sensory characteristics of bread containing Schizandra chinensis Baillon (a traditional korean medicinal plant). Korean J Food Presery 17: 637-643.

Park YB, Kim JS, Kim KD. 2010b. Investment beneficial analysis of culture of mountain medical plant resources - open field culture of schizandra-. J Korean For Soc 99: 808-815.

Rural Development Administration. 2012. Agricultural Income Survey Manual. Jeonju.

Rural Development Administration. 2013. Agricultural Income Survey Manual. Jeonju.

Won HK, Jeon HS, Han H, Lee SJ, J BH. 2017. Combining timber production and wood processing for increasing forestry income: a case study of 6th industrialization in Korean forestry. J For Environ Sci 33: 355-360.