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Comparative economic evaluation of rosemary (*Rosmarinus officinalis L.*) and wheat (*Triticum aestivum L.*) cultivation in Ethiopia

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Spices and aromatic plants have been used for flavoring, coloring, enhancing aromas, and preserving food. In addition, spice products, essential oils, and oleoresin processors are expanding; hence, the demand for spices and aromatic and medicinal plants is increasing. This study aimed to analyze the economic performance of rosemary production and processing compared to wheat production in the selected areas. The study evaluated wheat production and its benefit–cost ratio to compare it with rosemary production. The average revenue obtained from wheat sales was ~34,024 birr, with an average cost of 15,173, resulting in a net revenue of 18,851 birr for the farmland condition. Rosemary production and the benefit–cost ratio were evaluated at the farm level. The average revenue obtained from rosemary sales was ~73,454 birr, with an average cost of 35,868, resulting in a net revenue of 37,585 birr for the farmland condition. The coverage area for rosemary was 0.14 ha, which was smaller than the coverage area for wheat. Even with the smaller area allocated for rosemary, it was found that a net revenue of 37,585 birr was obtained from rosemary sales compared to a net revenue of 18,851 birr from wheat sales in the farm condition.

KEYWORDS

average revenue, average cost, net revenue, farm level, Ethiopia

1 Introduction

Spices and aromatic plants have been used as flavoring, coloring, enhancing, aromatic agents and for food preservation. In addition, spice products, essential oils, and oleoresin processors are expanding; hence, the demand for spices and medicinal and aromatic plants (MAPs) is increasing. The importance of spices in cosmetics, perfumery, and personal care has been well-known since ancient times. The cosmetics and perfumery industries employ many spices' oils, blending them with other volatile and fixed oils, to make high-quality perfumes (Deribe, 2021).

In 2020, the top five spice-producing countries in the world are India, Ethiopia, Bangladesh, Türkiye, Indonesia, and China (FAOSTAT, 2022). However, Ethiopia is not yet recognized as a major exporter of spices, and spices contribute little to the national economy (ENTAG, 2018); this is supported by a database (FAOSTAT, 2022) showing that in 2020, the top five spice-exporting countries in the world are India, Türkiye,

China, mainland China, and Netherlands, while Ethiopia was 35th. A report (National Bank of Ethiopia, 2022) indicated that the volume of spice exports has decreased continuously since 2013/2014. This indicates that research is needed on the export performance of spices to maximize the export potential in the international market.

Despite the country having conducive environments for producing various spices and a favorable policy environment, spice production in Ethiopia is mostly performed conventionally on small plots of land by smallholder farmers (Herms, 2015; Tiru et al., 2017). A study (Tiru et al., 2017) identified that, except for certain spice crops, like capsicum, garlic, fenugreek, and black and white cumin, farmers do not set up their farmland well. In general, farmers concentrate mainly on food crops, giving little consideration to spice crops.

Although they play a significant economic role in the national economy, generating considerable income for producers, export earnings, or import substitutions; are used as traditional medicines; and provide raw materials for industries, spice and MAP production is below its potential. Despite the suitable agro-ecology base for spice production and a long history of spice cultivation and marketing in Ethiopia, the status of spice production and export in the country is far below expectations. So far, studies related to both the economics of producing spice, medicinal, and aromatic crops and their products and marketing at the national level in Ethiopia are very limited. Even the existing research and literature have not compared production and export at any time. Although not well-organized and documented, in a way, it can give enough information to policymakers and researchers in the country about the best use of the potential and untapped spice, medicinal, and aromatic crop production. Hence, conducting research on the economics of spice and medicinal and aromatic crop production and its products, processing, and marketing is essential. Also, identifying the opportunities and challenges of producing and processing spices and aromatic plants and their products in Ethiopia is important.

Spice and MAP production might be affected by different socioeconomic factors and production costs; hence, it needs investigation. However, scant studies are available that compare the cost–benefit analysis and financial viability of rosemary and wheat production. Rosemary production's economic potential has largely remained undefinable, and households are mostly seen as doubtful about investing in it. To increase rosemary production and use, the return from rosemary production should be evaluated and compared to wheat, which is one of the major cereal crops produced, to determine whether it is profitable, and households should be confident about it. Thus, this study is initiated to evaluate rosemary production's profitability compared to wheat production in the southern nations nationalities and peoples (SNNP) and Oromia regions of Ethiopia.

1.1 Objectives

1. Analyze the economic performance of rosemary production and processing.
2. Compare the profitability of rosemary production to wheat production in the study.

2 Methodology

2.1 Description of the study area

The study was conducted in major MAP-growing regions of the country: Oromia and the SNNP, MAP-producing areas. The survey followed a household approach and covered conventional households. Major MAP-growing zones were also selected from each of the regions: the Guraghe zone and Siltie zone from the SNNP and Sheger from the Oromia region.

2.2 Sample size and data collection method

To meet the objectives and requirements of the survey, a two-stage stratified cluster sample approach was employed to select the sampling units. The primary sampling units were the zones and woredas selected from the two regions. In the second stage, households were selected from each of the woredas based on snowball sampling and the random walk procedure. Therefore, the study captured a total sample size of 252 households.

2.3 Data analysis methods

The data were analyzed and interpreted using qualitative, statistical, graphical, and mathematical tools. Descriptive and cost–benefit analysis techniques were used to identify and compare farmers' net returns and cost–benefit ratios. The definitions of some terms and the methods of calculations are as follows:

Average yield: This is the quantity of output produced per unit area. Yield is expressed in kg/ha.

Output prices: We used farm gate prices to compute returns. The farm gate price of the output is the value (price) farmers receive or can receive for their harvested crops, in other words, the price farmers receive at the end of the production process.

Gross Return: The gross return is the product of the farm gate price of the output and the adjusted yield. Farm gate prices have been derived from a field survey conducted. Therefore, the profitability of wheat and rosemary production was identified using the following formulas: The total revenue (TR) and simple benefit–cost ratio (BCR) were calculated:

Total Revenue (TR)

$$TR = Q^{*}P, \tag{1}$$

where
TR = total revenue,
Q = total quantity of rosemary or wheat produced in kg, and
P = selling price per kg of rosemary or wheat.

$$NR = TR - TC, \tag{2}$$

where
NR = net return (profit),
TC = total cost of rosemary or wheat production, and
TR = total revenue of rosemary or wheat production.
BCR

It is the ratio of the present worth of the benefit stream to the present worth of the cost streams, that is,

BCR = sum of benefit/sum of the present worth of costs.

Mathematically, it can be shown as

$$\mathrm{BCR} = \sum \mathrm{Bt}/\mathrm{Ct}, \tag{3}$$

where

BCR = benefit–cost ratio,

Bt = benefit of rosemary or wheat sale, and

Ct = cost of rosemary or wheat production.

Using a simple BCR, rosemary or wheat production is feasible if the BCR is >1. If it is <1, this indicates that the production of rosemary or wheat is not feasible:

$$\mathrm{BCR} = \frac{GR}{TVC},$$

where BCR = is benefit–cost ratio,

GR = gross return, and

TVC = total variable cost.

3 Results and discussion

3.1 Demographic characteristics of the study area

Table 1 presents the characteristics of the sample households. The average age of the MAP-producing household head was 42 years old. The average household education level was 2, and the household head had ∼9 years of MAP farming experience. This implies that the MAP production is in its infant stage in the study area.

3.2 Cereal crop production

The analysis of household income sources indicates that the primary revenue stream for farm households comes from crop sales, representing the most significant contributor to overall earnings. Following closely behind is income derived from MAP sales, suggesting that these specialized crops play a meaningful role in a household's financial stability.

In terms of wheat production, farmers utilize an average land size of 0.4 ha for cultivation. The yield assessment shows that wheat productivity reaches ∼463.30 kg/ha, reflecting the output level under the current farming conditions. Despite this, the amount of wheat sold per household averages 208.96 kg, indicating that the harvest portion may be retained for household consumption, storage, or other uses rather than immediate sale.

Market pricing data reveal that the average price of wheat stands at 30.00 Ethiopian birr (ETB)/kg, shaping the profitability of wheat farming. Meanwhile, production costs per hectare are recorded at 8,121.68 ETB, covering essential expenditures such as seeds, fertilizers, labor, irrigation, and post-harvest processing. This financial breakdown underscores the importance of cost management, market access, and optimized agricultural practices for enhancing overall profitability.

To improve economic returns from wheat farming, farmers may benefit from strategies such as yield optimization, soil fertility improvement, access to competitive markets, and agricultural extension services that facilitate informed decision-making (Table 2).

3.3 Rosemary production in the study area

The study found that rosemary cultivation was carried out on an average land size of 0.14 ha per farm, with an estimated yield of 289.7 kg/ha. This indicates the productivity level of rosemary farming in the study area, reflecting both the influence of agronomic practices and environmental conditions on output.

In terms of market sales, farmers reported selling an average of 276.94 kg of rosemary, demonstrating a high proportion of harvested produce being commercialized. With an average market price of 48.4 ETB/kg, rosemary farming presents a viable economic opportunity for producers. The pricing structure suggests a steady demand, potentially influenced by consumer preferences, market availability, and quality standards.

The production cost analysis revealed an average expenditure of 8,975 ETB/ha, covering essential inputs such as seeds, fertilizers, labor, irrigation, and post-harvest handling. The financial investment required for rosemary farming underscores the importance of efficient resource management, cost optimization, and strategic market positioning to maximize profitability.

Encouraging improved agronomic techniques, enhanced market linkages, and access to extension services could further boost the economic and productivity potential of rosemary cultivation in the region.

3.4 Average cost of production and sale of rosemary in the study area

1. The study found that rosemary cultivation was carried out on an average land size of 0.14 ha per farm, yielding ∼3 quintals of harvested rosemary. This relatively low yield may be attributed to suboptimal agronomic practices, as many farmers continue to rely on traditional cultivation methods rather than modern, scientifically backed agricultural techniques.

2. Traditional rosemary production methods often involve limited soil preparation, inadequate fertilization, and a lack of structured irrigation management, all of which can hinder plant growth and productivity. In addition, insufficient pest and disease control measures may contribute to lower yields, as plant health is affected by environmental stresses and nutrient deficiencies.

3. Improving agronomic management practices—such as adopting optimized planting techniques, integrating soil fertility enhancement measures, implementing better irrigation strategies, and using organic or chemical treatments for pest control—could potentially lead to higher yields and better quality rosemary production. Encouraging training programs, technical support, and access to improved agricultural inputs could further empower

TABLE 1 Household characteristics of the study area (n = 252).

Variable	Mean	Std. Dev.	Min	Max
Sex HH	0.849	0.36	0	1
Age of HH	42.18	12.15	19	88
Edu level HH	2.09	1.33	1	7
Distance of residence from nearest FTC in km	4.79	2.88	0.2	15
Distance of local market from residence in km	2.76	2.39	0.02	20
Distance of district market from residence in km	3.31	2.73	0.01	20
Experience of MAPs production in years	8.90	8.03	0.5	75

Source: Own data collection, 2018.
HH, head of household; FTC, farmers training center; MAPs, medicinal and aromatic plants.

TABLE 2 Average wheat area coverage, production, and price.

Items	Mean (n = 252)
Average wheat area in ha	0.40
Average wheat production in kg	463.30
Average wheat sold in kg	208.96
Average wheat price per kg in ETB	30
Average wheat cost of production in ETB	8,121.68

Source: Own data, 2018.
ETB, Ethiopian birr.

TABLE 3 Rosemary production area, amount produced in kilograms.

Variable	Mean (n = 252)
Average rosemary area in ha	0.143
Average rosemary amount produced	289.713
Average rosemary amount sold in kg	276.942
Average rosemary price in ETB	48.419
Average cost of production of rosemary in ETB	8,975

Source: Own data, 2018.
ETB, Ethiopian birr.

farmers to maximize their productivity and commercial viability (see Table 3).

3.5 Wheat BCR

1. The study analyzed the production and profitability of wheat, comparing its economic viability with rosemary cultivation. Findings revealed that the average revenue generated from wheat sales amounted to ∼34,024 ETB. Meanwhile, the total production cost, encompassing expenditures on labor, seeds, fertilizers, and other essential inputs, was recorded at 15,173 ETB.

2. As a result, the net revenue earned from wheat farming stood at 18,851 ETB under the prevailing farmland conditions. The BCR assessment underscores wheat's financial returns relative to its production expenses, providing valuable insights into its profitability compared to other crops, such as rosemary.

3. These findings highlight wheat's economic potential in the agricultural sector, with opportunities to optimize resource allocation, improve yield efficiency, and enhance market access to maximize returns for farmers (see Figure 1).

3.6 Rosemary BCR

1. The evaluation of rosemary production and its economic viability at the farm level revealed significant financial outcomes. On average, farm households generated revenue of ∼73,454 ETB from the sale of rosemary. Meanwhile, the total production cost, including expenditures on labor, inputs such as seeds, fertilizers, irrigation, and other operational expenses, amounted to 35,868 ETB. This resulted in a net revenue of 37,585 ETB under existing farmland conditions.

2. The profitability assessment further highlights the BCR of rosemary cultivation, indicating that the economic returns outweigh production expenses, making it a financially attractive crop for farmers. These findings suggest that rosemary farming presents an opportunity for increased agricultural income, provided that farmers optimize resource utilization, market access, and sustainable cultivation practices.

The results of the study by Guta (2020, 2019), Geyo et al. (2021), Geyo et al. (2024) are shown in Figure 2.

4 Conclusion and recommendation

It is interesting to note that Ethiopia is among the world's top producers of spices and MAPs. Nevertheless, despite its potential, the nation confronts difficulties boosting spice and MAP exports. Ethiopia may be able to more successfully utilize its potential for spice exports with the aid of research and strategic planning. The study's locations were the main MAP-growing regions in Oromia and the SNNP. These are important regions for producing MAPs. The survey used a household approach and included households with typical living arrangements. To evaluate and interpret the data, a variety of qualitative, statistical, graphical, and mathematical approaches were used. The data provided indicate that agricultural sales were the primary source of income, with revenue from the sale of MAPs coming in second. Wheat yielded 463.30 kg/ha on average, grown on an average of 0.4 ha of land. The average

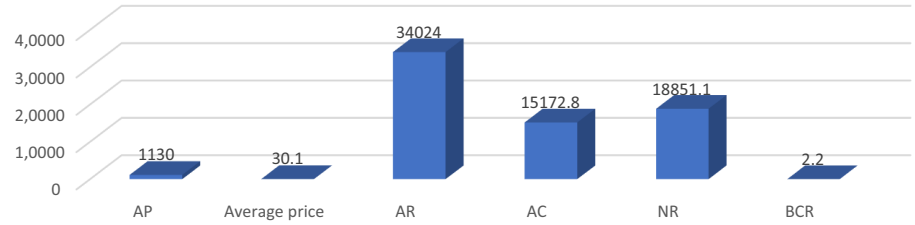

FIGURE 1
Wheat benefit and cost ratio. AP, average production; AR, average revenue; AC, average cost; NR, net revenue; BCR, benefit–cost ratio.

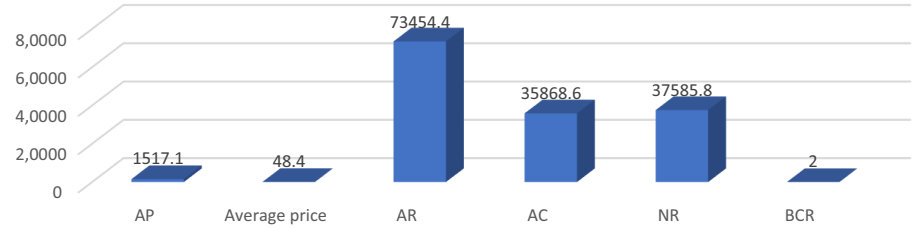

FIGURE 2
Rosemary benefit and cost ratio. AP, average production; AR, average revenue; AC, average cost; NR, net revenue; BCR, benefit–cost ratio.

amount of wheat sold was 208.96 kg, with an average price of 271.41 ETB/kg. The average cost of producing wheat was 8,121.68 ETB/ha. Similarly, the average area of land used for rosemary production was 0.14 ha, with an average yield of 289.7 kg/ha. The average amount of rosemary sold was 276.94 kg, with an average price of 48.4 ETB/kg. The average cost of producing rosemary was 8,975 ETB/ha. The study evaluated wheat production and its BCR to compare it with rosemary production. The average revenue obtained from wheat sales was ~34,024 ETB, with an average cost of 15,173 ETB, resulting in a net revenue of 18,851 ETB under farmland conditions. The rosemary production and BCR were evaluated at the farm level. The average revenue obtained from rosemary sales was ~73,454 ETB, with an average cost of 35,868 ETB, resulting in a net revenue of 37,585 ETB under the farmland conditions. The area under rosemary was 0.14 ha, which was smaller than the wheat area coverage. With this even smaller area allocated for rosemary, it was found that a net revenue of 37,585 ETB was obtained from rosemary sales compared to a net revenue of 18,851 ETB from wheat sales under farm conditions. But further study is needed on the social, environmental, and marketing (both domestic and export) aspects as this study covered only two regions and focused on a financial cost–benefit comparison of the two crops.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

GB: Writing – original draft, Writing – review & editing.

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The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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