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Araştırma
(Research)

Carapa procera production cost and profitability in the Ziguinchor Region of Senegal*

Mamadou Abdul BA[1*], Mehmet BOZOĞLU[1]

[1]Ondokuz Mayıs University, Faculty of Agriculture, Department of Agricultural Economics, Samsun/Turkey

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Sorumlu yazar: Mamadou Abdoul BA, e-posta: bmamadouabdoul@gmail.com

Abstract

Objective: Different parts of *Carapa procera* (leaves, fruits and seeds, bark, stems and roots) and its oil are used in the preparation of medicinal products for human and animal health. In this study, the cost and profitability of *Carapa procera* production were revealed.

Materials and Methods: The material of the research was obtained from face-to-face surveys with 151 *Carapa procera* producers in 13 villages representing the Ziguinchor region. In the study, the production cost and profitability of *Carapa procera* were determined using the partial budget analysis method.

Results: Variable and fixed costs in the total costs were accounted of 22.70% and 77.30%, respectively. As the Carapa land size increases, the production costs per decare increases. The highest costs were respectively determined as land rent (31.14%), capital interest (24.23%), depreciation (18.47%), oil cultivation (5.96%), tillage (4.97%) and others. The average gross profit per one liter oil in *Carapa procera* production was Fcaf 13805.57 and the gross profitability increased as the farm size increased.

Conclusion: In order to reduce *Carapa procera* production costs and increase profitability, farm size should be increased. For this, subsidized loans should be provided to the farmers to increase their land size and to develop their facilities.

Keywords: *Carapa procera*, production, cost, profitability, Ziguinchor

Senegal Ziguinçor Bölgesinde *Carapa procera* üretiminin maliyeti ve karlılığı

Öz

Amaç: *Carapa procera*'nin farklı kısımları (yapraklar, meyveler, tohumlar, ağaç kabuğu, gövde ve kökleri), insan ve hayvan sağlığına yönelik tıbbi ürünlerin hazırlanmasında kullanılmaktadır. Bu çalışmada *Carapa procera*nın üretim maliyeti ve karlılığı ortaya konulmuştur.

Materyal ve Yöntem: Araştırmanın materyali, Ziguinchor bölgesini temsilen seçilen 13 köyde 151 *Carapa procera* üreticisi ile yüz yüze yapılan anketlerden elde edilmiştir. Çalışmada *Carapa procera*nın üretim maliyeti ve karlılığı, kısmi bütçe analiz yöntemine göre belirlenmiştir.

Araştırma Bulguları: Toplam üretim maliyetinin %22,70'ini değişken masraflar, %77,30'unu ise sabit masraflar oluşturmaktadır. İşletme büyüklüğü arttıkça dekar başına üretim masrafları da artmaktadır. En yüksek maliyetleri sırasıyla arazi kirası (%31.14), sermaye faizi (%24.23), amortisman (%18.47), yağ ekimi (%5.96), toprak işleme (%4.97) ve diğerleri oluşturmaktadır. Çiftlikler genelinde bir litre yağ üretiminden ortalama 13,805.57 Fcaf brüt kar elde edilmiştir. İşletme büyüklüğü arttıkça, üretimden sağlanan brüt kar artmaktadır.

Sonuç: *Carapa procera* üretim maliyetlerini azaltmak ve karlılığı artırmak için işletme ölçeklerinin artırılması gerekmektedir. Bunun için Carapa işletmelerine arazi temini ve gerekli olanaklara

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kavuşmaları için sübvansiyonlu krediler sağlanmalıdır.

Anahtar kelimeler: *Carapa procera*, üretim, maliyet, karlılık, Ziguinchor

Introduction

Carapa is a tree belonging to the Meliaceae family. The genus Carapa is common in tropical Central and South America (Guillemot, 2004). In Senegal, the species of *Carapa procera* has been in the central and lower Casamance, as well as in the moist places and forest galleries of the savannas of eastern Senegal. Carapa is a species of economic and socio-cultural significance recognized by the rural population. The Carapa species is a very important forest crop in the Ziguinchor region (DeFilipps et al., 2004; Plowden, 2004). Carapa cultivation contributes to the diversification of income sources and economic stability of households. The oil extracted from the seeds has medicinal (anti-inflammatory, antitumor), cosmetic (hair and skin care) and biopesticide properties (Nonviho et al., 2014; Dembélé et al., 2015). The seed oil of *Carapa procera* is used in the manufacture of cosmetic products and local soap (Silva, 2004) and, all of Carapa's products can be used and marketed. Despite this, agricultural farms are not able to adequately evaluate the Carapa products. Namely; in the Carapa sector, there are problems such as low density of soil, aging of trees, unknown production costs, disorganization of the marketing chain, insufficient domestic and foreign markets. Evaluating economic performance will contribute to increase sustainability (Baser and Bozoglu, 2021). However, the economic performance of farms benefits by minimizing risk to the environment (Baser et al., 2017) and improving the rural environment, and sustaining natural resources in rural areas (Bozoglu et al., 2019). This study aimed to determine the production cost and profitability of *Carapa procera* seed and oil. The research findings will contribute to the economic sustainability of the farms.

Materials and Methods

Material

The Ziguinchor region of Senegal is located between 12°33' North Latitude and 16°16' West Longitude and constitutes 3.73% of the country's land with an area of 7339 km^2. It borders the Gambian Republics to the north and the Guinea-Bissau Republics to the south. There is the Sédhiou region at the east and the Atlantic Ocean at the west (Figure 1).

According to the 2013 General Population and Housing, Agriculture and Livestock Census, the population of Ziguinchor District was 549,151 (4% of the total population) and had a density of 75 people per km^2 (ANSD, 2015). The Ziguinchor Region has a hot and humid climate with an average temperature of 27°C. Ziguinchor Region is the wettest region of Senegal and offers a favorable climate for various agricultural products. Although precipitation was abundant in August and September, the average rainfall was 1253.83 mm over the last thirty years and it was very unevenly distributed over time and place (Charahabil et al., 2018).

The water regime of the Lower Casamance and the quality of the waters had a significant influence on the distribution of plant formations (Adam, 1962). The Ziguinchor Region has 1150 of the 2500 plant species listed in the country (MEPN, 1997). Soil in the Ziguinchor region has saline acid sulfate and hydromorphic or underdeveloped in valleys and it was characterized by weak ferralytic soils on geoclay, deep kaolinized plateaus and formations (CSE, 2011). The Ziguinchor Region has enormous socio-economic potential due to the richness and diversity of the climate, forest resources, agricultural production, animal husbandry, fishing, trade and crafts.

The dominant sectors of the region's economy were agriculture, forestry, fishing and animal husbandry, which employ 90% of the workforce for 3 to 4 months of the year (MCA-S, 2013). A rich and diversified tourism sector, associated with a remarkable socio-cultural wealth, hand crafts and trade also played an important role in the economy of the Ziguinchor Region (ANSD, 2013). Crops widely cultivated in the region were cereals, cash crops and market-oriented garden products.

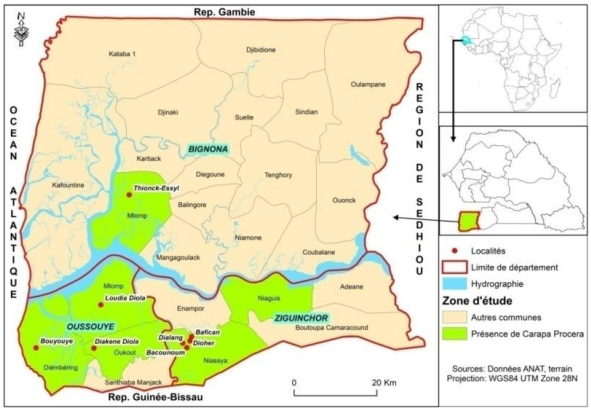

Figure 1. Map of Research Area

Methods

The Ziguinchor Region, where *Carapa procera* producers are common, was chosen as the study area. The primary data of the study were compiled from face-to-face surveys with 151 *Carapa procera* producers as the main activity using the snowball sampling method (Combessie, 2007; Malhotra, 2014). The distribution of the sample farms according to the village and municipalities was given in Table 1.

Table 1. Distribution of the sample farms in the Ziguinchor Region by villages and municipalities

Ziguinchor District	Municipality	Village	Number of Participants	Sum
Ziguinchor Department	Nyassia	Bafican,	17	
		Dialang,	13	56
		Bakounome,	15	
		Dioher	11	
Bignona Department	Thionck-Essyl	Bougeutir	10	
		Batina	6	
		Djiweut	6	
		Bah	7	53
		Boulub	5	
		Elogogne	19	
Oussouye Department	Diembéring	Bouyouye	16	
	Oukout	Diakéne Diola	12	42
	Mlomp	Loudia Diola	14	
Sum			151	151

In the study, the production cost and profitability of *Carapa procera* were determined according to the partial budget analysis method. The operating expenses incurred by the farms for the activities of Carapa were divided into variable and fixed expenses. Variable costs in the Carapa production consisted of seed production, seed oiling, tillage, animal manure and compound fertilizer, pesticides, pruning, harvesting, seed crushing, electricity, water and marketing costs. The fixed expenses in Carapa production consisted of land rent, family labor costs, depreciation and capital interest costs. Actual expenditures were taken into consideration in the calculation of expenses such as seed crushing, food, marketing, water and electricity.

In calculating the depreciation of buildings and machinery, the average economic life was taken as 50 years for buildings and 10 years for tool machines. The real interest rate was based on half (4%) of the Central Bank's interest rate. General administrative expense was based on 3% of variable expenses. In the calculation of the repair and maintenance costs of the buildings, 1% of the building value and 2% of the maintenance and repair expenses were taken as the basis (Açıl, 1977). The repair and maintenance expenses of tools and machines are based on the total expenses actually incurred by the farmers. Since there was no activity other than *Carapa procera* in the farms, only Carapa production expenses were taken as the basis for partial cost. As indicators of income and profitability of *Carapa procera*, gross value of production (GDP), gross profit, net profit and relative profit were calculated.

The GDP in the Carapa production was calculated by multiplying the amount of Carapa seeds and the price of Carapa and then by adding the increase in the value of the Carapa plant. Gross profit was calculated by subtracting the sum of the variable expenses from the sum of the gross production value in the Carapa activity. The net profit was calculated by subtracting the total production costs of the Carapa activity from GDP. The relative profit shows the ratio of the gross production value to the production costs. The relative profit is an indication of how much revenue the farm has generated against the expense of Fcfa 1 for the *Carapa procera* production.

Results

The production costs in the Carapa production for the farms were given in Table 2. The average, variable and fixed costs per decare in *Carapa procera* production for all farms were calculated as Fcaf 16783.90, 3809.85 and 12974.05, respectively. Variable and fixed costs constituted 22.70% and 77.30% of the total production cost, respectively. The total variable cost of *Carapa procera* production indicated that the farms are generally small size. The shares of variable cost in the total cost were determined as 21.59% in the first layer, 24.39% in the second layer and 17.88% in the third layer. The highest cost items were land rent (31.14%), capital

interest (24.23%), depreciation (18.47%), oil processing (5.96%), tillage (4.97%), harvest (3.44%), pruning (2.88%) and others. The shares of land rent in the total cost were 26.52% in the first layer, 32.95% in the second layer and 41.55% in the third layer.

The unit cost and profitability results of Carapa oil production were given in Table 3. *Carapa procera* production was 15.40 kg in the first layer, 17.20 kg in the second layer and 21.47 kg in the third layer.

Table 2. Production costs in the *Carapa procera* production

	1st Layer		2nd Layer		3rd Layer		OverallAverage	
Variable Cost	Average (da)	%	Average (da)	%	Average (da)	%	Average (da)	%
Oil processing	730.05	4.92	1219.68	6.85	1244.95	5.52	1000.86	5.96
Soil management	741.41	4.99	932.19	5.24	761.00	3.38	834.94	4.97
Animal manure	81.31	0.55	59.78	0.34	83.23	0.37	71.03	0.42
Compound fertilizer	99.85	0.67	94.15	0.53	72.53	0.32	95.28	0.57
Drug	10.67	0.07	7.98	0.04	9.51	0.04	9.29	0.06
Pruning	411.45	2.77	498.43	2.80	190.25	0.84	438.85	2.61
Harvest	476.32	3.21	643.07	3.61	777.65	3.45	576.89	3.44
Seed crushing	439.78	2.96	538.66	3.03	368.61	1.63	482.87	2.88
Electricity	44.41	0.30	71.18	0.40	55.89	0.25	58.11	0.35
Water	162.45	1.09	180.51	1.01	183.12	0.81	172.55	1.03
Marketing	8.31	0.06	96.27	0.54	285.37	1.27	69.18	0.41
Total Variable Cost	3206.00	21.59	4341.90	24.39	4032.10	17.88	3809.85	22.70
Land rent	3937.54	26.52	5863.86	32.95	9346.02	41.45	5226.98	31.14
Family labor force	600.65	4.05	557.07	3.13	594.53	2.64	579.17	3.45
Depreciations	3069.92	20.68	3047.56	17.12	3696.55	16.40	3100.59	18.47
Capital interest	4033.29	27.16	3988.35	22.41	4876.10	21.63	4067.30	24.23
Total Fixed Cost	11641.40	78.41	13456.84	75.61	18513.20	82.12	12974.05	77.30
Total Cost	14847.40	100.00	17798.74	100.00	22545.30	100.00	16783.90	100.00

The average Carapa oil production was 2.09 liters in the first layer, 2.87 liters in the second layer and 2.57 liters in the third layer. The sales price per liter was Fcaf 6864.95 in the all farms, Fcaf 6814.05 in the first layer, Fcaf 6839.09 in the second layer and Fcaf 7237.54 in the third layer. Sales prices increased as the farm size increases. Average gross profit of one liter oil production was Fcaf 13805.57 in the all farms, Fcaf 11044.36 in the first layer farms, Fcaf 15272.72 in the second layer and Fcaf 21871.58 in the third layer farms. The relative profit ratio in *Carapa procera* oil production was 1.05 in the overall farms, 0.96 in the first layer, 1.10 in the second layer and 1.15 in the third layer.

Table 3. Carapa oil production cost and profitability

	1st Layer	2nd Layer	3rd Layer	Overall Average
Yield (seed)	12.55	17.20	21.47	15.40
Yield (oil)	2.09	2.87	3.58	2.57
Unit cost (seed)	1,183.12	1,034.75	1,049.87	1,089.98
Unit cost (oil)	7,099.54	6,205.94	6,299.20	6,540.90
Sale price	6,814.05	6,839.09	7,237.54	6,864.95
GSUD	14,250.37	19,614.61	25,903.69	17,615.42
Gross profit	11,044.36	15,272.72	21,871.58	13,805.57
Net profit	-597.04	1,815.88	3,358.38	831.52
Relative profit	0.96	1.10	1.15	1.05

Discussion

The discussion section focused on production costs and revenue in the reults of *Carapa procera* oil production. The research results showed that the share of variable costs in the *Carapa procera* production were 4.99% in the first layer, 6.86% in the second layer and 5.52% in the third layer. The main reason for this was the low level of technology use (especially variable inputs) in the procera production. Tiétiambou et al., (2016) also stated that the most producers use their internal inputs in production. However, in the study of Baser (2021), the share of variable costs varied from 82.06% to 93.30% in different cattle farm size. Bozoglu (2020) found the share of variable costs in the chestnut farming as 53.14%. The income from the sale of *Carapa procera*

is very important for the livelihood of rural people. They contribute to the improvement of their life conditions. Net income from the sale of *Carapa procera* oil varied from Fcaf 11044.36 to Fcaf 21871.58. Paraïso et al. (2011) also stated that the Carapa production is economically profitable.

Conclusion

This study revealed the production costs and profitability of *Carapa procera* seed and oil in the Ziguinchor region of Senegal. Due to the fact that variable input usage was not widespread in Carapa production, a large part of the total costs was consisted by fixed costs. The highest cost items in the fixed cost were land rent and capital interest, while the highest cost items in the variable cost were tillage and oil processing. In order to reduce production costs and increase profitability in *Carapa procera* seed and oil production, the land size and modern input use should be increased. For this, the government should support the land and modern input purchases of the farms.

Conflicts of Interest

The authors declare no conflicts of interest.

Authorship contribution statement

MAB: Contributed to the procurement of materials required for the research.

MB: Contributed to the stages of analysis, obtaining and evaluating data, and the datas converted the results into articles.

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