

# Marketing efficiency perspective of sustainable *Andaliman* agroforestry in Humbang Hasundutan Regency

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**Abstract.** Indonesia has so many herbal medicinal plants and spices that are endemic and location-specific since it has a very vast tropical rainforest area. One of them is *Andaliman* (*Zanthoxylum acanthopodium* DC). This endemic species is very sensitive to climate and location changes so the farmers only have around 5 *Andaliman* trees planted in between any other kind of plants in their agroforestry land on average. There is an undeveloped and very promising future for the competitiveness improvement of Indonesia's herbs and spices. This study was accomplished to investigate the marketing efficiency of *Andaliman* agroforestry in Humbang Hasundutan Regency to accommodate stakeholders in formulating policies to progress *Andaliman*'s competitiveness. The results showed that all of *Andaliman*'s marketing channels in the research area were efficient. The most efficient was Channel II, followed by Channel III, and the last position was seated by Channel I. Marketing losses and labour costs were at the top of the list as the largest marketing costs, so they truly needed to be optimized at almost all channel levels and types of marketing channels to improve marketing efficiency. Therefore, referring to these results, we composed a suggestion to improve farmers' welfare by doing simple processing such as processing *Andaliman* into several dried and packaged products that are easier to use, long-last, and attractive, as well as combining more efficient production with distribution in shorter marketing channels. This will encourage farmers to maintain *Andaliman* agroforestry as a farming option that is more sustainable and natural.

## 1 Introduction

The agroforestry system is implemented by integrating plants' production systems directly in their natural habitats between trees or shrubs in the forest areas to obtain environmental, economic, and social benefits that are more sustainable. Farmers will diversify their production systems into tree crops and non-timber forest products with potential benefits economically, thereby helping support local communities and boosting the local economy. In the agroforestry system, farmers grow various plants on the same land, usually native plants in the forest area where the agroforestry land is located [1].

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Due to its very vast area with tropical climates, Indonesia has so many herbal medicinal plants and spices that are endemic and specifically grow in this country [2]. *Andaliman* (*Zanthoxylum acanthopodium* DC) is one of the wild plants that is grown in Indonesia's rainforest. This plant is grown wildy in the conservation area of Toba geopark and Tapanuli in North Sumatera Province [3–5]. Initially, it grows wildy in the forest surrounding the Lake Toba area. However, nowadays, a few small-scale farmers or businesses have started cultivating it with an agroforestry system. Mainly, *Andaliman* grows approximately 1,000 to 2,000 plants in one area, and the tree could produce about 7 to 10 kg/adult tree/year [2,4]. Since *Andaliman* seedlings are very hard to flourish due to the variety of seed dormancy duration, the farmers only seek and gather the *Andaliman* seedlings from the surroundings of mature *Andaliman* trees in the forest. On average, farmers only have around 5 *Andaliman* trees planted in between any other kinds of plants in their agroforestry land. *Andaliman* is planted in agroforestry land in order to keep it sustained, seeing that the endemic species is very sensitive to climate and location changes [2–4,6]. There are five types of endemic *Andaliman* grown in the forest surrounding Lake Toba, which are Simanuk, Sihorbo, Silokot, Sikoreng [2], and Sitanga [7]. Even so, only Simanuk and Sikoreng types are found in Humbang Hasundutan Regency [2]. Besides that, Simanuk is the best in terms of aroma [7].

The competitiveness of Indonesia's herbs and spices is still undeveloped and has a very promising future to be improved. Indonesia's spices and herbs, which normally have a powerful and remarkable scent and taste, are very valuable and have a high economic value. *Andaliman* has been traded and exported to many areas outside North Sumatera at a premium price level, but only utilised by limited circles, typically still associated with Batak's tradition [3,4]. In Humbang Hasundutan Regency in which 30.60 Ha of *Andaliman* agroforestry area has taken place, the largest cultivation area is in Pollung Subdistrict (28.30 Ha), followed by Lintong Nihuta (1.10 Ha), Paranginan (0.70 Ha) and Dolok Sanggul (0.50 Ha) Subdistricts [8]. Since agroforestry farming is a way of life for the farmers, trying to enhance *Andaliman*'s competitiveness in the market is very crucial to improve their wealth. However, unlike conventional farming, in agroforestry, farmers cannot increase their production by simply increasing or efficiently using production inputs such as capital, labour, land area, seeds, fertilizers, or chemicals. According to MacFarland et al., to increase their income, farmers can sell their products directly to consumers, provide a good experience for consumers, and streamline production costs [1]. To increase sales, farmers must know the right marketing channel for their products, build good relationships with consumers, and market more creatively. Creative marketing can be performed, for example, by making several value-added processed products which are marketed through various marketing channels, including participating in various exhibitions and festivals related to local and ethnic products. We need to study many aspects of the supply, demand, and marketing of a commodity before formulating various policies related to that commodity's marketing to improve its competitiveness [9,10]. In order to read how *Andaliman*'s marketing has been implemented in Humbang Hasundutan Regency, this research was accomplished to investigate the marketing efficiency of *Andaliman* agroforestry in Humbang Hasundutan Regency. Enlightenment in this issue is expected to accommodate stakeholders in formulating policies to progress *Andaliman*'s competitiveness.

## 2 Methods

The estimation of margin, share margin, price spread, and efficiency of *Andaliman*'s marketing was executed on data taken from respondents. Determining respondents was done by using the Snowball Sampling Method, one of the sampling methods in the Nonprobability Sampling Technique. Respondents in this study were all parties involved in *Andaliman*'s marketing channels in Pollung Subdistrict, namely the retailers, the regency-level

middlemen, the village-level middlemen, and the farmers [11]. The sample had been traced from 10 *Andaliman* consumers at first, which led to 7 retailers, then flowed to 3 regency-level middlemen and 4 village-level middlemen, and ended at 25 farmers. Overall, 49 samples were interviewed using structured questionnaires. Data collection was accomplished in the Subdistrict with the widest *Andaliman* agroforestry area in Humbang Hasundutan Regency, namely Pollung Subdistrict, in March-July 2021. More than 90% of the *Andaliman* agroforestry businesses in Humbang Hasundutan settled in this subdistrict.

The marketing margin was examined using the following equations:

$$Mj_i = Ps_i - Pb_i \quad (1)$$

$$Mj_i = bt_i + \mu_i \quad (2)$$

$$\mu_i = Mj_i - bt_i \quad (3)$$

Afterwards, the total margin of marketing was acquired using the following formula:

$$M_j = \sum Mj_i \quad (4)$$

Then, the share margin was calculated using the following formula:

$$S_m = P_p / P_k \times 100\% \quad (5)$$

Subsequently, the price spread was counted by grouping the marketing costs according to the same components [12]. After that, the marketing efficiency was calculated using the following formula:

$$\varepsilon = (\gamma_p + \gamma_f) / (\beta_p + \beta_f) \quad (6)$$

Descriptions:

$Mj_i$  = Margin at the level  $i$  marketing agency;  $Ps_i$  = Selling price at the level  $i$  marketing agency;  $Pb_i$  = Purchasing price at the level  $i$  marketing agency;  $bt_i$  = Marketing costs at the level  $i$  marketing agency;  $\mu_i$  = Profit at the level  $i$  marketing agency;  $M_j$  = Total marketing margin;  $I = 1, 2, 3, \dots, n$  [13].  $S_m$  = Share margin, calculated in % (per cent);  $P_p$  = Prices received by the farmers and traders;  $P_k$  = The price paid by the final consumers.  $\varepsilon$  = Marketing efficiency;  $\gamma_p$  = Farmers' profit;  $\gamma_f$  = Middlemen's profit;  $\beta_p$  = Marketing cost at the farmers-level and Production cost at the farmers-level;  $\beta_f$  = Marketing cost at the middlemen-level.

The marketing efficiency test criteria were as follows:

If  $\varepsilon \geq 1$ , then the marketing was efficient; If  $\varepsilon < 1$ , then the marketing was inefficient [14].

### 3 Results and discussion

The motivation of farmers is very crucial for the sustainability of *Andaliman* agroforestry. One of the stimulating factors, in order to boost the motivation of farmers, is an improvement in welfare through increased sales and income. For this reason, farmers must know the right and best marketing channel for their products [1]. The right marketing channel can be known after calculating its marketing efficiency. Starting from our preliminary study [11], we found 3 types of *Andaliman*'s marketing channels in Humbang Hasundutan Regency. Afterwards, from the previous study, we calculated the purchasing price, selling price, marketing cost, and profit margin, which are described in Table 1.

At the farmers-level, the biggest marketing costs were spent on plastic sacks in all channels. At the village-level Middlemen, the largest marketing costs on Channel I consecutively were spent on marketing losses, labour, and transportation. At the regency-

level middlemen, the biggest marketing costs on Channel I consecutively were spent on transportation, marketing losses, and labour. Then, the biggest marketing costs on Channel II consecutively were spent on marketing losses, labour, and transportation. At the retailers-level, the biggest marketing costs on Channel I consecutively were spent on labour, marketing losses, plastic bags, and transportation. Then, the biggest marketing costs on Channel II consecutively were spent on labour, marketing losses, plastic bags, and transportation. Likewise, on Channel III, the largest marketing costs consecutively were spent on labour, marketing losses, plastic bags, and transportation. All of those costs could and should be optimized to get better marketing efficiency.

**Table 1.** The purchasing price, selling price, marketing cost, and profit margin on *Andaliman's* marketing channels.

No.	Descriptions	Channel III Value (IDR/Kg)	Channel II Value (IDR/Kg)	Channel I Value (IDR/Kg)
1	<b>Farmers</b>			
	Total Production Costs	<b>17,128.94</b>	<b>12,360.19</b>	<b>23,815.53</b>
	Marketing Costs:			
	- Plastic Sack	431.11	284.00	505.61
	- Plastic Strap	78.43	47.17	95.34
	1,688.89			
	Total Marketing Costs	<b>2,198.43</b>	<b>1,531.17</b>	<b>600.95</b>
	Profit Margin	<b>47,339.30</b>	<b>29,108.64</b>	<b>22,726.38</b>
2	<b>Village-Level Middlemen</b>			
	Purchasing Cost	-	-	<b>42,500.00</b>
	Marketing Costs:			
	- Equipment	-	-	29.38
	- Labour	-	-	725.00
	- Transportation	-	-	562.50
	- Plastic Sack	-	-	154.50
	- Plastic Strap	-	-	56.00
- Marketing Loss	-	-	932.50	
	Total Marketing Costs	-	-	<b>2,459.88</b>
	Profit Margin	-	-	<b>9,040.13</b>
3	<b>Regency-Level Middlemen</b>			
	Purchasing Cost	-	<b>60,000.00</b>	<b>47,500.00</b>
	Marketing Costs:			
	- Equipment	-	100.00	51.52
	- Labour	-	1,000.00	290.91
	- Transportation	-	500.00	348.48
	- Plastic Sack	-	150.00	104.55
	- Plastic Strap	-	50.00	26.52
- Marketing Loss	-	1,200.00	290.91	
	Total Marketing Costs	-	<b>3,000.00</b>	<b>1,112.88</b>
	Profit Margin	-	<b>22,000.00</b>	<b>28,887.12</b>
4	<b>Retailers</b>			
	Purchasing Cost	<b>81,666.67</b>	<b>85,000.00</b>	<b>75,000.00</b>
	Marketing Costs:			
	- Labour	2,166.67	2,000.00	7,500.00
	- Transportation	333.33	300.00	1,000.00
	- Rent	250.00	200.00	666.67
	- Plastic Sack	172.22	200.00	600.00
	- Plastic Strap	37.50	30.00	83.33
- Plastic Bag	577.78	600.00	1,300.00	
- Marketing Loss	1,020.83	850.00	2,166.67	
	Total Marketing Costs	<b>4,558.33</b>	<b>4,180.00</b>	<b>13,316.67</b>
	Profit Margin	<b>38,775.00</b>	<b>45,820.00</b>	<b>21,683.33</b>
5	Consumers			
	Purchasing Price	120,500.00	120,500.00	120,500.00

Almost at every level of the marketing channels, the costs of marketing losses and labour were ranked as the largest marketing costs, so they could and surely needed to be optimized at almost all channel levels and types of marketing channels to improve marketing efficiency. Especially marketing losses, this cost will be reduced by doing simple processing as has been done by several Micro-Small-Medium Enterprises (MSMEs). They have processed *Andaliman* into several dried and packaged products that are easier to use, long-last, and attractive. This is because *Andaliman* can be stored longer when post-harvest processing, such as drying and packaging, is carried out [7,11,15]. Subsequently, we counted the price spread dan share margin on *Andaliman*'s marketing channels, which are described in Table 2.

**Table 2.** The price spread dan share margin on *Andaliman*'s marketing channels.

No.	Component of Costs	Channel III		Channel II		Channel I	
		Price Spread (IDR/Kg)	Share Margin (%)	Price Spread (IDR/Kg)	Share Margin (%)	Price Spread (IDR/Kg)	Share Margin (%)
1	Production Cost of Farmers	<b>17,128.94</b>	14.21	<b>12,360.19</b>	10.25	<b>23,815.53</b>	19.76
	Profit Margin of Farmers	<b>47,339.30</b>	39.28	<b>29,108.64</b>	24.15	<b>22,726.38</b>	18.86
2	Marketing Costs:						
	- Equipment	-	-	100.00	0.08	80.89	0.06
	- Labour	2,166.67	1.79	3,000.00	2.48	8,515.91	7.06
	- Transportation	2,022.22	1.67	2,000.00	1.65	1,910.98	1.58
	- Rent	250.00	0.20	200.00	0.16	666.67	0.55
	- Plastic Sack	603.33	0.50	634.00	0.52	1,364.66	1.13
	- Plastic Strap	115.93	0.09	127.17	0.10	261.19	0.21
	- Plastic Bag	577.78	0.47	600.00	0.49	1,300.00	1.07
	- Marketing Loss	1,020.83	0.84	2,050.08	1.70	3,390.08	2.81
	Total Marketing Costs	<b>6,756.76</b>	5.60	<b>8,711.17</b>	7.22	<b>17,490.37</b>	14.51
3	Profit Margin of Village-Level Middlemen	-	-	-	-	<b>9,040.13</b>	7.50
4	Profit Margin of Regency-Level Middlemen	-	-	<b>22,000.00</b>	18.25	<b>28,887.12</b>	23.97
5	Profit Margin of Retailers	<b>38,775.00</b>	32.17	<b>45,820.00</b>	38.02	<b>21,683.33</b>	17.99
6	Purchasing Price of Consumers	<b>120,500.00</b>	100	<b>120,500.00</b>	100	<b>120,500.00</b>	100

Table 2 shows that the largest farmer profits and the smallest marketing costs were obtained in the shortest marketing channel, namely Channel III, followed by Channel II, and the longest Channel I provided the lowest profit and the largest marketing cost. So, to improve the welfare of farmers and marketing efficiency, it is highly recommended for farmers to market their products directly to retailers or consumers without going through various middlemen. In all marketing channels, the largest costs were incurred for labour, transportation, and marketing losses. Where the largest labour costs were incurred on the longest Channel I, followed by Channel II, and finally the shortest Channel III. The longer the marketing channel traversed, the more labour is needed, thus rising labour costs. On the other hand, the highest transportation costs were incurred on Channel III which was the shortest, followed by Channel II, and finally, Channel I which was the longest. The shorter the marketing channel traversed, the greater the distance that must be travelled from the

production centre to the end marketing place, thereby rising transportation costs. Similar to labour costs, the largest marketing losses were incurred on the longest Channel I, followed by Channel II, and finally the shortest Channel III. The longer the marketing channel traversed, the longer it will take to reach consumers, thereby increasing the number of damaged products due to the perishable nature of agricultural products and rising marketing losses costs. On Channel I, the one who got the biggest marketing profit margin was regency-level middlemen, while on Chanel II and III were retailers. Then the total marketing costs of each *Andaliman*'s marketing channels are described in Table 3.

**Table 3.** The total marketing costs on each *Andaliman*'s marketing channels.

No.	Marketing Agencies	Channel III (IDR/Kg)	Channel II (IDR/Kg)	Channel I (IDR/Kg)
1	Farmers	2,198.43	1,531.17	600.95
2	Village-Level Middlemen	-	-	2,459.88
3	Regency-Level Middlemen	-	3,000.00	1,112.88
4	Retailers	4,558.33	4,180.00	13,316.67
Total Marketing Costs		<b>6,756.76</b>	<b>8,711.17</b>	<b>17,490.38</b>
<b>Marketing Efficiencies</b>		<b>3.60</b>	<b>4.60</b>	<b>1.99</b>

Table 3 shows that there are differences in price spread, share margin, and profit share earned by each marketing institution. The highest total marketing costs in *Andaliman*'s marketing channels were found in Channel I, the second position was seated by Channel II, while the smallest was found in Channel III. The gap between Channel I to Channel II was dramatic enough since the total costs of the marketing system in Channel I was more than double the total costs in Channel II. The big gap was caused by labour costs in the longest Channel I which were large and almost 4 times the shortest Channel III, in addition to other costs which also multiplied 2-3 times.

All of *Andaliman*'s marketing channels in the research area were efficient, with marketing efficiency values exceeding 1. Although in terms of marketing, of course, Chanel II was better since it was more efficient, results showed that Channel III would be able to improve the welfare of farmers better since it provided a higher profit margin to farmers. However, Channel II was more efficient due to farmers on Channel II produced *Andaliman* more efficiently so the production costs were low. To further improve the welfare of farmers simultaneously with achieving efficient marketing, it is necessary to combine more efficient production of farmers on Channel II and sales made on Channel III. Better farmer welfare will encourage farmers to continue maintaining *Andaliman* agroforestry as a better farming option that is more sustainable and in synergy with the environment numbers.

## 4 Conclusions

To summarize everything in this study, we could see the differences in price spread, share margin, and profit share earned by each *Andaliman*'s marketing institution in Humbang Hasundutan Regency. All of *Andaliman*'s marketing channels in the research area were efficient, with Channel II being the most efficient, followed by Channel III, and the last position was seated by Channel I. Marketing losses and labour costs were at the top of the list as the largest marketing costs, so they certainly needed to be optimized at almost all channel levels and types of marketing channels to improve marketing efficiency. Therefore, referring to these results, we composed a suggestion to improve farmers' welfare by doing simple processing such as processing *Andaliman* into several dried and packaged products that are more convenient to use, long-last, and attractive, as well as combining more efficient

production with distribution in shorter marketing channels. This will encourage farmers to maintain *Andaliman* agroforestry as a farming option that is more sustainable and natural.

The Research Institute of Universitas Sumatera Utara funded this study based on the Contract of Universitas Sumatera Utara's TALENTA Researches in the Fiscal Year 2021 between the Rector and the Research Institute's Chairman of Universitas Sumatera Utara Number: 6789/UN5.1.R/PPM/2021, dated on June 16th 2021.

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