Trends in
Agricultural Economics

Research Article
Value Chain Analysis of Pineapple in Gedeo and Sidama Areas, Southern Ethiopia

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Abstract

Background and Objective: Ethiopia has favourable agro-climatic conditions for the growth of fruits. Fruit products in particular are bulky and perishable and need series integrations of the chain actors actively participating in all chain functioning groups in the system. Effective communication and commitment for the smooth functioning of the value chain of the product for pineapple at each stage are necessary but insufficient in our country as well as in the study area. Production, processing and marketing challenges are hampering the expected benefits in the study area from the pineapple sub-sector in agriculture. Hence, this study was conducted to analyze the value chain of pineapple in the Sidama and Gedeo areas of Southern Ethiopia. **Materials and Methods:** A simple random sampling technique was employed to collect data from pineapple producers. From Sidama 57 and Gedeo 63, a total of 120 respondents were selected for this study. **Results:** The value chain actors of pineapple were input suppliers, producers, collectors, retailers, wholesalers, processors and end users. Value-added products were pineapple fruits which are sorted, sliced fruit, fruit punch and juice. Two stages least square regression model was employed to analyze the determinants of pineapple market supply. The model result showed that the amount of pineapple produced, extension services of fruits, education level, sex, use of the improved variety and farm size were significant determinants of the market supply of pineapple fruits. The descriptive statistics reveal that the structure of its market is an oligopoly (58.41%). Producers end users channel is the best channel in which farmers are getting the highest marketing margin. In addition, according to the survey result, the majority (51.67%) of the respondents reported that the pineapple price decision was set by traders. **Conclusion:** The results indicate that significant variables affecting the market supply of pineapple fruits need to be prioritized to improve the marketing aspect of pineapple in the study area. The lower bargaining power of pineapple producers was also a challenge as the producers were being manipulated by the traders and middlemen. Therefore, relevant policy interventions are required to improve the overall value chain.

INTRODUCTION

Ethiopia's diverse climate zones are suitable for a variety of agricultural production systems. Fruit cultivation is crucial to ensuring that various communities receive the nutritional advantages they require. Fruits (permanent crops) and vegetables (short-season crops) are two types of horticultural crops. Permanent crops are long-term plants that remain in place after being planted and are mostly harvested each year without requiring to be replanted following each crop, several years afterwards. These consist of tree crops like oranges, mangoes, bananas, papaya, coffee, enset, chat and avocado. Plants that produce citrus fruits, fruit trees include varieties of papayas, mangoes and others[1].

Agricultural products in general and fruit products, in particular, are bulky and perishable and need a series of integrations of the chain actors actively participating in all chain functioning groups in the system. Effective communication and commitment in processing and functioning of the value addition of the product at each margin are imperative. The value chain guarantees and increases the qualities and the standards of the products and creates competitive advantages and sustains superior performance that can benefit all value chain actors and final consumers. The farmers are stopping to produce pineapple fruits anymore and shifting their farming land to other cash crop growing activities[2]. Marketing of pineapples is complex and risky because of their perishable nature and bulkiness and therefore require a well-functioning marketing system to transfer it from the point of production to the point of consumption within a specified time when still fresh[3].

Despite the study area's potential, the pineapple sector is heavily dominated by smallholder producers and constrained by planting materials, a lack of proficiency with new technology, post-harvest loss and other related factors in the study area. In addition, the production and market constraints of pineapple in the area have been inadequately studied and not well documented.

Pineapple (*Ananas comosus* L.) is an important fresh fruit that is widely cultivated in tropical and subtropical areas[4]. Pineapple plants are drought-tolerant and well-adapted to sandy soils[5]. In Ethiopia, pineapple successfully grows in South and Southwestern parts as small-scale farming[6].

Majorly the Sidama and Gedeo areas of Southern Ethiopia's pineapple-producing woredas have challenges concerning production, processing and marketing. Additionally, earlier research did not cover all production locations in the Sidama and Gedeo woredas that could produce pineapples. In Aleta Chuko woreda, Mamo[2] and Gessesse *et al.*[7] studied the pineapple value chain. The types of value-added products, the degree of value addition and the entire value chain, from the local area to the end destination, were not mentioned in these studies. They were only concerned with factors influencing pineapple profitability.

As noted by van Keulen *et al.*[8] horticulture sector is required to increase its production and offer the international buyers reliable quantity and quality. Bearing this in mind, it is important to solve problems related to fruits production in general and pineapple production, marketing and processing problems in particular. Therefore, this study was conducted to analyze the value chain of pineapple in the Sidama and Gedeo Areas of Southern Ethiopia. It was specifically aimed to identify key actors, their linkage and roles in the pineapple value chain, map the value chain of pineapple in the study area, identify constraints in production, marketing, processing and post-harvest handling stages of pineapple and analyze factors affecting the market supply of pineapple.

MATERIALS AND METHODS

Description of the study area: Southern Nation Nationalities and Peoples Regional State lie geographically 4°43"-8°58" North latitude and 34°88"-39°14" East longitude. It is bordered by Kenya in the South, South Sudan in the Southwest, Gambella Region in the Northwest and surrounded by the Oromia Region in the Northwest, North and East directions. The total area of the region is estimated to be 109,015 km², which is 10% of the country and the total population size is 20 million. The economy of the region is mainly driven by agriculture. The Southern Nation Nationalities and Peoples Regional State are endowed with different agro-ecological diversity with a diversity of crops namely teff, wheat, maize, sorghum, barley, etc. It has very diverse agro-ecology classified as lowlands, mid and highlands covering 57.4, 34 and 8.6%, respectively[9]. This study was undertaken by taking the Gedeo zone from SNNPR and the Sidama Region's potential woredas in pineapple production from December, 2021 to September, 2022 by conducting a household survey using structured questionnaires.

Methods of data collection: To collect the primary data, both the household survey and participatory rural appraisal (PRA) tools were employed. The PRA techniques employed here include focus group discussions (FGDs), key informant

interviews (KII) and observations. While the household survey was conducted by using structured questionnaires. The household survey was administered to sample respondents by a trained enumerator. Besides, the household survey questionnaires were pre-tested to check the clarity of the content and include new information, which would eventually enable modification of the questions. Key informants' interviews were conducted with district experts of horticulture and one focus group discussion was held in each kebele by organizing a group of eight farmers.

Sampling technique: A two-stage sampling technique was employed to draw the sample from the study area. First, the major potential pineapple-cultivating woredas were selected purposefully. Accordingly, Aleta Chuko, Dara, DillaZuria and Wonago woredas were selected. Then, two kebeles were selected from each woreda. Lastly, representative sample farmers were selected randomly. Thus, from Sidama (Aleta Chuko and Dara, 57) and Gedeo (DillaZuria and Wonago, 63) a total of 120 farmers were selected from four selected woredas. The Snowball sampling technique was employed to select traders due to their interconnected channels. Based on channel references, representative traders, processors and end users were selected.

Data analysis: Both descriptive statistics and econometric models were used for the analysis. For descriptive statistics mean, frequency and percentage were used to describe demographic and socioeconomic data. For the econometric analysis, a two-stage least square regression model was employed to analyze determinants of the pineapple fruit market supply. The basic multiple regression model for the econometric part following[10] is specified as:

$$Y = \beta X + \varepsilon \tag{1}$$

Where:
Y = Pineapple market supply
β = A vector of estimated coefficient of the explanatory variables
X = A vector of explanatory variables
ε = Disturbance factor

The concentration ratio was used to measure the size of the distribution of pineapple traders. The market concentration ratio is the common method of measuring market structure.

$$CR = \sum_{i=1}^{n} S_i \tag{2}$$

where, S_i represents the market share of ith firm and n is the number of largest firms for which the ratio is going to be calculated.

Market conduct was evaluated in terms of payment mechanisms and pricing strategy. The market performance was analyzed using marketing margin that is calculated using consumer and producer (in this case pineapple growers) price and marketing cost. Mathematically margins can be calculated as follows:

$$TGMM = \frac{\text{End buyer price-First seller price}}{\text{End buyer price}} \times 100 \tag{3}$$

Where:
TGMM = Total gross marketing margin

$$GMMp = \frac{\text{End buyer price-Marketing gross margin}}{\text{End buyer price}} \times 100 \tag{4}$$

Where:
GMMp = Producer's gross marketing margins (producers share) from the consumer price

$$NMM = \frac{\text{Gross margin-Marketing costs}}{\text{End buyer price}} \times 100 \tag{5}$$

Where:
NMM = Net marketing margin

The SPSS and the STATA software were used for the analysis.

Conceptual framework: The demographic, socioeconomic and institutional factors that affect the pineapple market supply in the study area were indicated in Fig. 1. It is in this framework that pineapple market supply is affected by constraints of production, processing and marketing along the value chain.

Hypothesized explanatory variables
Dependent variable:

- **Market supply of pineapple:** Refers to the amount of pineapple supplied to the market in one year in quintals. It is a discrete variable
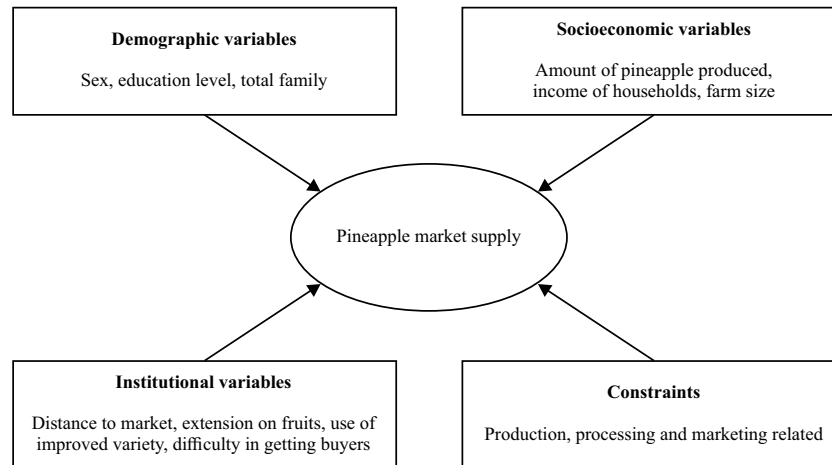
Fig. 1: Pineapple market study conceptual framework
Source: Own sketch

Independent variables:

- **Amount of pineapple produced:** The total amount of pineapple produced in one year in quintals. It was expected to have a positive relationship with the pineapple market supply. It is a discrete variable

- **Education level of household head:** Continuous variable referring to the number of years spent by the household head in formal education. It was expected to have a positive relationship with the pineapple market supply

- **Extension on fruits:** Refers to whether the respondents had access to extension services regarding fruit production and marketing. It is a dummy variable. It was expected to have a positive relationship with the pineapple market supply. It's 1 for those who get an extension on fruits and 0 for those who were not addressed in the extension service

- **Difficulty in getting buyers:** Dummy variable referring to whether respondents or pineapple producers encountered challenges in finding buyers. If there were challenges it is 1 and 0 if there were no challenges

- **Use of improved variety:** Dummy variable referring to whether pineapple produces used recent variety (in the study areas case Smooth Cayenne) as compared to old-aged Red Spanish and other local varieties. It was expected to have a positive relationship. It is 1 if they used improved variety and 0 if not

Sex of household: Dummy variable 0 for female and 1 for male.

Distance to the market: Continuous variable measured in kilometres. It was expected to have a negative relationship with the pineapple market supply. It is a continuous variable.

Income of households: It is the total income of the household head in one year excluding. It was expected to have a negative relationship with the pineapple market supply. It is a continuous variable.

Total family: Refers to the total number of members of the household. It was expected to have a positive relationship with the pineapple market supply. It is a discrete variable.

Farm size: Refers to the size of land holding of pineapple producers it was expected to have a positive relationship to the market supply of pineapple.

RESULTS AND DISCUSSION

Demographic and socio-economic characteristics: Demographic and socio-economic characteristics are presented in Table 1 and 2.

Land allocation and income sources: The land allocation in the study area was indicated in Table 3. Coffee, chat, enset and pineapple take the upper hand in terms of lands allocated in order of mean lands in hectares. This result was in line with that of Gessesse *et al.*[7], who reported in their finding that pineapple, chat, coffee and enset were practised under the agro-forestry system in the study area. In terms of income sources, chat, coffee, livestock, annual crops and fruits including pineapple are the sources of income for sampled households.

Table 1: Summary of dummy/categorical variables

Sex	Frequency	Percent
Male	101	84.17
Male	19	15.83
Total	120	100.00
Extension on fruits		
Yes	97	80.83
No	23	19.17
Total	120	100.00
Use of an improved variety		
Yes	26	21.67
No	94	78.33
Total	120	100.00
Difficulty in getting a buyer		
Yes	82	68.33
No	38	31.67
Total	120	100.00

Source: Survey result, 2021

Table 2: Summary of continuous/discrete variables

Variable	Mean	Std. Dev.	Min	Max
Market supply of pineapple (quintal)	4.48	1.81	1.42	7.80
Amount of pineapple produced (quintal)	5.05	1.53	2.80	7.92
Distance to market	4.89	2.46	3.10	13.00
Education level	4.35	1.91	0.00	9.00
Ln_income	9.05	1.22	3.25	11.71
Total family	6.50	2.41	2.00	13.00
Farm size	1.09	0.87	0.20	3.00

Source: Survey result, 2021

Table 3: Summary of land allocation

Land allocation (ha)	Mean	Std. Dev.	Min	Max
Coffee	0.52	0.21	0.01	1.11
Chat	0.36	0.18	0.02	0.84
Enset	0.25	0.12	0.03	0.55
Pineapple	0.14	0.09	0.01	0.38
Income sources (ETB)	Mean	Std. Dev.	Min	Max
Pineapple	1228.07	252.23	560.32	1720.69
Other fruits	501.92	141.05	123.98	891.28
Annual crops	922.14	230.23	359.75	1510.35
Livestock	4534.77	1345.87	430.59	7640.03
Coffee	2388.45	456.68	1379.17	3575.60
Chat	12095.64	2102.13	6960.79	17466.26

Source: Survey result, 2021

Table 4: Production, consumption, selling and post-harvest loss statistics

Fruit type	Production (%)	HH consumption (%)	Amount sold (%)	Postharvest loss
Banana	45.30	12.50	81.88	5.62
Pineapple	78.60	9.40	81.19	9.41
Avocado	92.00	39.80	38.62	21.52
Papaya	64.90	21.40	72.90	5.70
Guava	18.60	28.60	67.30	4.10
Mango	26.28	26.47	56.39	17.14

Source: Survey result, 2021

Table 5: Summary statistics of production by woredas

Region	Obs.	Mean (Qtl)	Std. Dev.	Min	Max	T	Pr (T>t)
Sidama	57	6.47	0.85	5.03	7.92	20.30	0.0000
Gedeo	63	3.77	0.59	2.80	4.98		
Total	120	5.05	1.53	2.80	7.92		

Source: Survey result, 2021

Fruits production and household consumption of fruits in the study area: Table 4 indicated the percentage of fruit production in the study area as well as the household consumption and amount sold to the market. The result showed that there was high production percentage (78.6%) for pineapple fruit next to avocado (92%) in the study area. The household (HH) consumption percentages of fruits are also listed for different fruits. Accordingly, from the result, it was noted that avocado, guava and mango consumption were higher than other fruits. Moreover, bananas, pineapple and papaya account for more percentage concerning the number of fruits sold to market. Postharvest loss is higher in the case of avocado, mango and pineapple.

Comparison of production by study areas: There is a statistically significant mean difference in pineapple production in quintals in Sidama and Gedeo areas as shown in Table 5. Comparatively, Aletachuko and Dara woredas started to use improved varieties primarily Smooth Cayenne through the involvement of Hawassa University, Hawassa Agricultural Research Center and other non-governmental organizations. Whereas, DillaZuria and Wonago woredas seem lagging in terms of improved pineapple varieties as Red Spanish is the only available old-aged variety in the latter two woredas.

Pineapple propagation, sources of planting material and varieties in the study area: Pineapples are grown from suckers and the recommended way is to use the suckers produced from branches. The pineapple plant will produce branch suckers in the second year following its first harvest. Land preparation includes clearing, ploughing and harrowing. Most farmers construct a fence from woods of dried plants, crop residues and thorns to protect the farm from animals and thieves. Farmers conduct weeding during the onset of the rainy season around April. The source of the planting material is through exchange among farmers. The major planting time for pineapple in the study area is in April and the next planting season is around July. Before this time land preparation is conducted before April starting from February. When the source of income, perennial crops like chat and coffee are utilized entirely, farmers turn their face to pineapple as a supplementary source of income. Intercropping pineapple with other crops like coffee, chat and, enset is customary due to the shortage of land. Major types of varieties available in the study area are Smooth Cayenne and Red Spanish. Red Spanish variety was introduced into the area by sourcing the planting material from Jima agricultural research center. The seedling producer farmers association has been established in Aleta Chuko. However, it was not functional due to a lack of land for

Table 6: Operation cost of pineapple production

Average yield per hectare	8 quintals
Operations	Cost per Quintal
Land preparation	120
Planting materials	-
Sack	50
Weed control	45
Tax paid	5
Harvesting	40
Total cost per quintal	260
Selling price per quintal	$40 \times 25 = 1000$
Profit per quintal	740

Source: Survey result, 2021

Table 7: Summary of actors and their roles/value addition practices

Actors	Forms of value addition/role	Magnitude of value addition in birr per fruit	Value added product
Producers	Produce pineapple, cut the fruit from the mother plant and sell without adding value	-	Raw fruit
Collectors	Assemble the fruit in bulk and made them ready to be transported to another area	15	Sorted Fruit
Wholesalers	Transport the fruits to town and handle them to retailers, supermarkets	10	Sorted Fruit
Retailers	They sell pineapple fruits to town consumers by getting margin either as fruit or	15	Sorted Fruit
	peeling the pineapple, removing eye sand core and making sliced fruit	5	Slice
Processors	They peel the surface of pineapple, make sliced fruit and make it readily edible or	5	Slice
	make juices and fruit punches using pineapple fruits as an ingredient	16	Fruit punch
		10	Juice
End users	-	-	-

Source: Survey result, 2021

planting material propagation. As per the evaluation of horticulture experts and farmers, from among locally available varieties, Smooth Cayenne was easy to harvest due to its less thorny surface. Farmers tend to protect ripening pineapple fruits from the effect of excessive sunlight by covering them with crop residues.

Cost of pineapple production: After deducting the cost of pineapple per quintal from the average selling price, it was found that the average profit per quintal was 740 birr (Table 6). This result was comparable to that of Mamo[2], who stated the profit as 776 birrs. The costs of land preparation, harvesting and sack price have shown an increment since 2018 which was the result of a deviation in profit per quintal.

Value chain actors and key stakeholders: Value chain actors of pineapple were input suppliers, producers, collectors, retailers, wholesalers, processors and end users. The value chain stages, actors, supporters, or enablers of the pineapple value chain, which are involved in acquiring farm inputs required for production, transporting produce from the farm to various market destinations and processing and trading to reach the consumers as illustrated in Fig. 2. It is a network of horizontal and vertically integrated value chain actors that are jointly aimed toward providing products to a market. It's

important to note that different actors in the value chain have different roles with different magnitudes of value addition on pineapple (Table 7).

Value chain governance: In the study area, collectors and wholesalers were well-networked, but their linkage was informal. Collectors are moving to collect at a time when prices of pineapple are dealt with and amounts to be collected are specified and come into consensus. The smallholder pineapple producer farmers are not linked and have no role in governing the value chain. They are price takers and hardly negotiate the price, farmers get market information from collectors or farmers who had already sold pineapple fruit at the marketplace or farm gate.

Places of marketing and marketing routes of pineapple fruits: The results indicate that of the sampled respondent farmers, 66.67% of respondents indicated that they sold pineapple fruits at the farm gate, whereas, 33.33% sold at nearby markets by going there in search of traders. As the major destinations from the assembly point of Teso kebele of Aleta Chuko woreda are Hawassa, Shashemene, Addis Ababa and Adama. The surrounding area fruits are brought from Dilla Zuria and Wonago after accounting for some retail at Dilla. Then it is destined for Teso kebele as wholesalers and collectors met there.
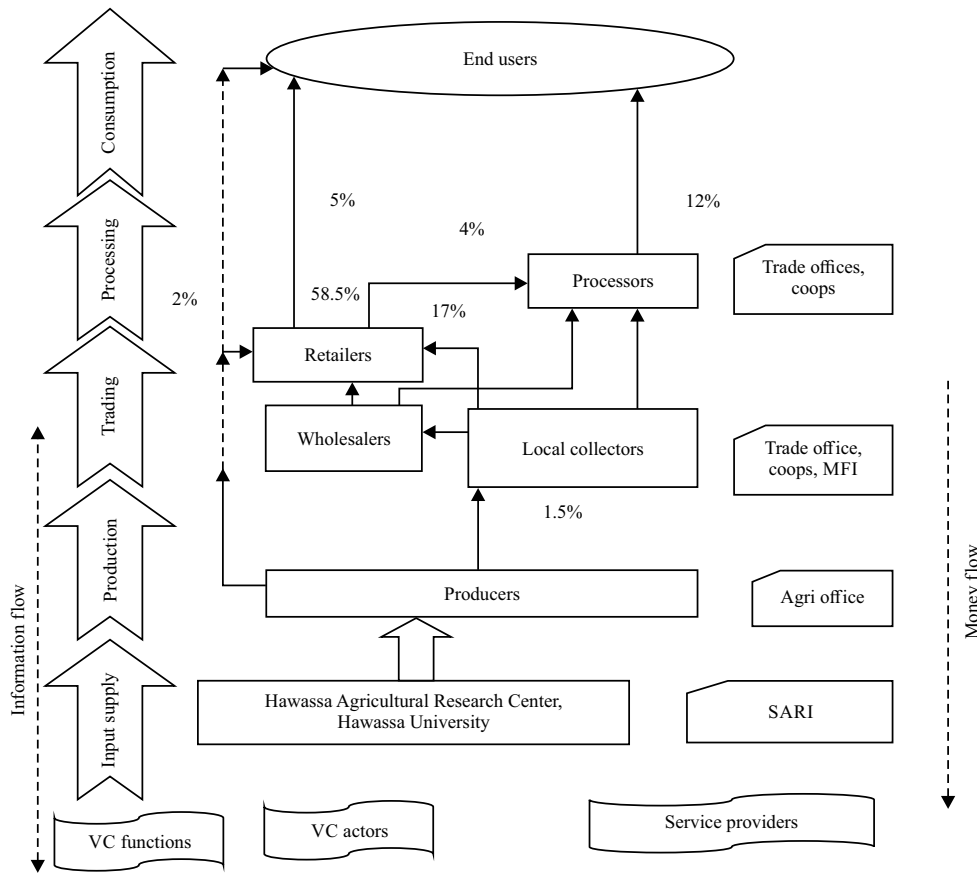
Fig. 2: Value chain map of pineapple
  Source: Own sketch

Existing pineapple market channels: In the study area, seven market channels were found, with the first, third and fifth being relatively dominant in terms of the volume of pineapple moving through them. The engagement of collectors and wholesalers who handle each other and take pineapple to areas where there is the most demand relative to the local retail-level consumer-based market could be one of the reasons for these channels' popularity.

Producers---Collectors---Wholesalers---Retailers---End users (58.5%)
Producers---End users (2%)
Producers---Collectors---Retailers---End users (17%)
Producers---Retailers---End users (5%)
Producers---Collectors---Processors---End Users (12%)
Producers---Retailers---Processors---End Users (4%)
Producers---Collectors---Wholesalers---Processors---End users (1.5%)

Market structure, conduct and margin

Market structure: The market concentration ratio has been calculated to analyze the type of market structure that prevailed in the study area. The calculation was conducted by taking the annual or total volume of pineapple purchased by sample traders in market areas of the study area. Table 8 indicated that, the pineapple market in the study area was a strong oligopoly. Measures of market concentration ratio showed that the top four biggest traders controlled 58.41% of the pineapple market, which indicates that the structure of the market was strongly oligopolistic in the study area. This result was in line with the finding of Gessesse *et al.*[7], who reported in their finding that the existence of collusive agreement among the whole sellers who controlled the market.

Market conduct: According to the survey result, 51.67% of the respondents reported that the pineapple price decision was set by traders. About 33.33% of the respondents reported that the market price was through the negotiation of producers and traders. The remaining 15% reported that they decide on the price of their product taken to market themselves. This result indicated the lower bargaining power of pineapple producers. All respondents indicated that the payment mechanism was cash hands-based transactions.

Table 8: Market structure of pineapple in the study area

Frequency of trader	Cumulative frequency	Total volume of purchase	Share of purchase (%)	Cumulative share of purchase (%)
4	4	314.00	58.41	58.41
1	5	92.00	17.11	75.52
5	10	27.00	5.02	80.54
6	16	64.00	11.91	92.45
3	19	32.00	5.95	98.40
7	26	3.00	0.56	98.96
9	35	5.56	1.04	100.00
35	35	537.56	100.00	100.00

Source: Survey result, 2021

Table 9: Marketing margin of actors at different channels

Actors	Indicator	I	II	III	IV	V	VI	VII
Producers	Purchase price	-	-	-	-	-	-	-
	Marketing cost	-	2	-	4	5	5	-
	Selling price	25	25	25	25	25	25	25
	Gross profit	25	23	25	21	20	20	25
	GMMp	50	100	50	50	41.67	41.67	41.66
Collectors	Purchase price	25	-	25	-	25	-	25
	Marketing cost	2	-	1	-	3	-	3
	Selling price	40	-	40	-	40	-	40
	Gross profit	13	-	24	-	12	-	12
	GMMcoll	25	-	25	-	25	-	25
Retailers	Purchase price	50		40	25		25	-
	Marketing cost	0.50		0.50	0.50		1	-
	Selling price	55		55	55		55	-
	Gross profit	4.50		14.50	29.50		29	-
	GMMr	8.33		25	50		50	-
Wholesalers	Purchase price	40	-	-	-	-	-	40
	Marketing cost	2	-	-	-	-	-	3
	Selling price	50	-	-	-	-	-	50
	Gross profit	8	-	-	-	-	-	7
	GMMws	16.67	-	-	-	-	-	16.67
Processors	Purchase price	-	-	-	-	40	55	50
	Marketing cost	-	-	-	-	2	1	1
	Selling price	-	-	-	-	60	60	60
	Gross profit	-	-	-	-	18	4	9
	GMMcoop	-	-	-	-	33.33	8.33	16.67

Source: Survey result, 2021

Marketing margin: The gross marketing margin of actors was summarized in Table 9. Producers' marketing margins were highest in channel II (100%). This means that when they sell directly to end users, their margin increases. The GMM received by collectors was the same throughout the channels, which was 25%. This was because they make marketing easier by gathering pineapple fruits from farmers and preparing them for transit to anybody who comes to the same marketing hub in the study area. They are directly linked to producer farmers as the ultimate outlet. As indicated in the list of market channels. Retailers derived the highest GMM relative to other actors in channels IV and VI, which was 50%. The higher GMM of wholesalers was 16.67% in channels I and VII because they are cautious not to involve recklessly in every available channel. Their marketing involvement is exclusive to collectors as they prepare the fruits in the required amount in bulk. The processors' share of GMM was highest in channel V (33.33%).

The study conducted by Mamo[2], on the value chain of pineapple in the Aleta Chuko District concluded that producers' margin was 33.33%, collectors' margin was 44.44% and retailers' margin was 22.22%. However, the results lack clarity in showing a comparison among better channels for each actor.

Production constraints: Major production constraints in order of rating by farmers were a shortage of modern varieties (95.83%) and a shortage of training on management practices (75%). Modern varieties availability is a challenge in the study as farmers are using the old mother plant of pineapple for propagation purposes. This was contrary to the recommended 48 months of using one pineapple plant for propagating the new ones. The result from Gessesse *et al.*[7] identified awareness about advanced pineapple production and processing technologies as a production challenge for pineapple in Aleta Chuko woreda.

Fig. 3: Efforts of traders to forcefully make pineapple fruit ripen
Source: Own sketch

Table 10: Summary of pineapple marketing constraints

Marketing constraint	Percent	Rank
Low margins for the producer farmers	95.00	1
Lack of farmers based associations	90.83	2
Involvement of illegal traders	79.16	3
Lack of proper market linkage	66.67	4
Lack of access to credit	58.33	5

Source: Survey result, 2021

Marketing trend: Assemblers deal directly with farmers at the farm gate, manipulate farmers and after purchasing from farmers they sell directly to traders who sell at towns like Dilla, Hawassa, Shashemene, Adama and Addis Ababa. Only some traders are licensed and known by the trade and market development bureau which made margins going to different market actors unfair and inclined to traders.

Marketing constraints: Marketing constraints in order of importance in the study areas were indicated in Table 10. Farmers are not benefitted to the maximum due to the involvement of collectors and wholesalers who dominated the pineapple trading in the study area. Farmers-based associations are not available in the study areas in fruit production in general and in a pineapple in particular. Illegal traders are also prevalent who are not regulated by the trade bureaus. Their involvement was the major cause of complaints not only by producer farmers. Regulated traders who conduct marketing of pineapple by paying relevant taxes also raise the same issue. The market linkage is poor and as a result, few traders dominated the flow of market information. There are no specific credit sources for pineapple marketing as farmers get credit for overall agricultural activities if they get such chances. This result was in line with the finding of Gessesse *et al.*[7], who identified low prices for the product at

harvest time, poor product handling and packaging, imperfect pricing system and lack of transparency in the market information system as pineapple marketing-related problems in Aleta Chuko woreda. The result from Kayitesi[11] finding showed that low sale prices and lack of access to credit are the main constraints that hinder pineapple production in Rwanda.

Processing constraints: The first ranked challenge is limited knowledge of processing which is confined to towns in the forms of juices and fruit punches. Agro-processing industries in the study area are currently working on common bean and coffee processing. They didn't start working on pineapple processing. The misconception of processors takes the second rank since processors say that pineapple makes juices thin when added as an ingredient is another problem.

Post-harvest related problems: The perishability nature of the pineapple fruits is a challenge and no remedial measures for this problem. Traders prefer to transport fruits at night. Farmers also tend to pick/harvest immature fruits of pineapple before they fully it is ripened. Quality losses during harvesting by farmers are other challenges. The thorny natures of the fruits prevent easy harvesting since there are no available technologies in the study area to deal with the problem.

Quality problems: Local collectors collect unripe pineapple fruits from the farms of producer farmers. Then as indicated below, they try to forcefully ripen them by exposing the fruits to the sunlight and covering them with plastic materials. As a result of this action, one who buys pineapples on the roadsides can find that the edible part of the pineapple becomes watery (Fig. 3).

Causes of post-harvest losses: As indicated by sample respondents, the major causes of post-harvest losses in the order of rating by farmers were lack of storage facility (58.33%), long distance to the main market hub for pineapple (29.17%) and being rejected by collectors for immaturity (12.50%).

Econometric model results: Before embarking on the model, different tests were conducted to check the validity of variables. The multicollinearity test of the variance inflation factor result shows that the mean-variance inflation factor was 1.61, which suggests no such problem. Also, Breusch-Pagan/Cook-Weisberg test for heteroscedasticity showed no problem of such with chi^2 (1) = 0.3150, Prob>chi^2 = 0.0000. Two-stage least square regression was used because an endogeneity problem was found with test

Table 11: 2SLS results for determinants of market supply of pineapple

Market supply	Robust coefficient	Robust standard error	Z	P>z
Amount of pineapple produced	0.6976646***	0.1123007	6.21	0.000
Distance to market	0.0082624	0.0146091	0.57	0.572
Extension on fruit	0.7236356***	0.1804904	4.01	0.000
Education level	0.0890741***	0.0338665	2.63	0.009
Sex	0.6771987***	0.1693367	4.00	0.000
Use of an improved variety	0.6115983***	0.1642035	3.72	0.000
Ln_income	-0.0358136	0.0343824	-1.04	0.298
Total family	-0.0199558	0.0216658	-0.92	0.357
Farm size	0.1110174**	0.0526549	2.11	0.035
Difficulty in getting the buyer	0.0523291	0.1047351	0.50	0.617
_cons	-0.7963737	0.5167568	-1.54	0.123

*,**,***Indicate levels of significance at 10, 5 and 1%, respectively

statistics values: Robust score chi^2 (1) = 10.1814 (p = 0.0014), robust regression F (1,103) = 25.0208 (p = 0.0000). After running two stages least square regression model (robust), the amount of pineapple produced, extension services of fruits, education level, sex, improved variety use and farm size were found to be statistically significant (Table 11). The elaboration of each significant variable in the model was discussed below.

The amount of pineapple produced: It is positively related to the amount of pineapple supplied to the market at 1%. This showed that as the amount of pineapple produced increases by one quintal, the amount supplied for sale increases by about 0.70 quintals. This indicated that as the production amount increases, more is supplied to the market as a market surplus. This result was in line with the finding of Wondim and Desselgn[12], who indicated that total amount of potato produced significantly affect potato market supply of household positively.

Extension on fruits: Positively related to the market supply of pineapple. This result was in line with that of Endris *et al.*[13], who found that extension contact significantly affected onion producers market outlet choice. It also concedes with Urgessa[1], who revealed that lack of marketing institutions safeguarding farmers' interest and rights over their marketable produce, a lack of coordination among producers to increase their bargaining power, poor product handling and packaging, an imperfect pricing system, lack of transparency in market information system mainly in the export market as constraints of fruit marketing. Extension agents could have played their role in disseminating market information if there were modern databases for the market in the study area.

Education level of the household head: It has shown a positive effect on the amount of pineapple supplied to the market in quintals at a significance level of 1%. The survey

results revealed that if the pineapple producer gets aware, the amount of pineapple supplied to the market increases by 0.09 quintals, keeping other factors constant. The probable implication here is those who can read and write stand a better chance of understanding things faster and are well encouraged to produce and market. The result of research finding from Teka *et al.*[14] also reported that, education was a significant factor affecting the volume of mango market supply. The result of finding from Hassen and Gebissa[15] also found that educational level significantly and positively affected the market orientation of teff producers.

Use of improved variety: It was positively related to the amount of pineapple supplied to the market at a one percent significance level. For those who used improved varieties compared to those who used local and Red Spanish varieties of pineapple, the supply to the market increased by 0.61 quintals, holding other variables constant. This result was in line with the finding of Jaji *et al.*[16], who stated pineapple varieties had a positive and significant with the quantity of pineapple supplied.

Sex of the household head: It had a positive effect on the market supply of pineapple at a 1% significance level. Being a male household increases the amount of pineapple supplied to the market by 0.68 quintals per year. The probable reason is males have better access and control over resources than females and produce and supply more to the market. This result was in line with the research result of Sori[17], who stated that sex statistically and significantly affected the market supply of groundnut.

Farm size: It had a significant and positive relationship with the quantity of pineapple supplied to the market. On average, an increase in the farmers' farm size by one-hectare results in a 0.11 quintal increase in the amount of pineapple supplied to the market holding other variables constant. The finding from

that Osmani and Hossain[18] revealed that, the probability of being a commercial farmer is positively significant by the farm size under cultivation while, cultivated land size positively determines the marketable supply from total production.

RECOMMENDATIONS

In light of the results from this study, solving overall pineapple value chain constraints in production, marketing, processing and post-harvest is of paramount importance. Promoting the channel with the highest margins for producers is required to minimize the challenges of collectors who controlled the channel unfairly. Improvements in the bargaining power of pineapple producers are required by establishing cooperatives as there is no cooperative society exclusively meant for pineapple growers in the study area. Prioritizing and working on significant variables that affected the market supply of pineapple by the further provision of extension services of fruit production, awareness creation and encouraging farmers to allot more farmland to pineapple production are recommended.

CONCLUSION

The input suppliers, producers, collectors, retailers, wholesalers, processors and end customers were pineapple value chain participants in the study area. Fruits that are sliced, fruit punch, juice and fruits that have been thorn-cleaned were value-added pineapple commodities. Measures of the market concentration ratio revealed that the top four traders held 58.41% of the market for pineapples, indicating a significantly oligopolistic market structure in the research area. The survey's findings indicated that 51.67% stated traders were responsible for setting the price of pineapples. About 33.33% of those surveyed said that producers and traders would negotiate the market price. The remaining 15% said they set the pricing of their product before it could be brought to market. This result indicated the lower bargaining power of pineapple producers. All respondents indicated that the payment mechanism was cash hands-based transactions. Producers get the highest GMM through the second, Producers---End users channel. The amount of pineapple produced, extension service of fruits, education level, sex, improved variety use and farm size were significant determinants of pineapple market supply. Therefore, prioritizing and working on significant variables that affected the market supply of pineapple by producers is needed.

SIGNIFICANCE STATEMENT

The purpose of this work is to identify key challenges along the value chain of pineapple in the study area so that required policy interventions are made based on research findings to optimize the benefit from the pineapple sub-sector. This study will also act as input for the coming researchers who want to make further investigations concerning pineapple in the study area in the future.

REFERENCES

1. Urgessa, H.T., 2020. Review on constraints of fruit marketing in Ethiopia. Am. J. Theor. Appl. Bus., 6: 6-12.
2. Mamo, L.G., 2018. Analysis of pineapple value chain and factors affecting the producer's profitability in Aleta Chuko District, Sidama Zone, Ethiopia. J. Emerging Technol. Innovative Res., 5: 246-255.
3. Okal, J.O., 2018. Constraints and opportunities of pineapple marketing in Bureti Sub County, Kericho County, Kenya. Int. J. Sci. Res., 7: 870-875.
4. Ajema, L. and N. Tafa, 2020. Growth and biomass production response of pineapple (*Ananas comosus*) seedling to compost with top soil ratio nursery media preparation. Int. J. Res. Agric. For., 7: 6-12.
5. Ubi, W., H. Igwe, S. Ekpe and O. Ibor, 2005. Preliminary trial of fertilizer types on pineapple (*Ananas Cosmosus*) grown in coastal acid sands of Cross River State, Nigeria. Global J. Pure Appl. Sci., 11: 457-460.
6. Tewodros, M., S. Mesfin, W. Getachew, A. Ashenafi and S. Neim, 2018. Effect of inorganic N and P fertilizers on fruit yield and yield components of pineapple (*Annanas comosus* Merr L. var. Smooth cayanne) at Jimma, Southwest Ethiopia. Agrotechnology, Vol. 7. 10.4172/2168-9881.1000178.
7. Gessesse, G., Z. Demrew and T. Olana, 2019. Value chain analysis of pineapple (*Ananas comosus*) production and marketing from traditional agroforestry system, Southern Ethiopia. Food Sci. Qual. Manage., 84: 1-10.

8. van Keulen, Rik, P. Rumenera, G. Banjara, M. Colantuoni and J. Muthamia-Mwenda, 2022. Horticulture Value Chain Analysis: Opportunities For Youth Employment in Rwanda. FAO, Rome, Italy, ISBN: 978-92-5-135616-6, Pages: 238.

9. Abuye, F., M. Haile, W. Haile and B.G. Hanna, 2021. Soil fertility status, fertilizer application and nutrient balance in SNNPR, Southern Ethiopia in contrasting agro-ecological zones of Ethiopia. Afr. J. Agric. Res., 17: 1433-1452.

10. Greene, W.H., 2002. Econometric Analysis. 5th Edn., Prentice-Hall, Hoboken, New Jersey, ISBN-10: 0130661899, Pages: 1024.

11. Kayitesi, R., 2011. Factors Affecting Small Scale Farmers' Pineapple Production: The Case Study of Ngoma District, Rwanda. Larenstein University of Applied Sciences, Wageningen, Netherlands, Pages: 41.

12. Wondim, A. and M. Desselgn, 2019. Market chain analysis of potato and factors affecting market supply in West Gojam Zone, Ethiopia. J. Dev. Agric. Econ., 11: 43-51.

13. Endris, E., J. Haji and B. Tegegne, 2020. Factors affecting vegetable producers market outlet choice in case of Habru District, North Wollo Zone, Ethiopia. Eur. Bus. Manage., 6: 1-9.

14. Teka, Y., H. Malin and A.O. Wolde, 2019. Analysis of factors affecting mango market supply in Gomma District, Southwest Ethiopia. Agric. Socio-Econ. J., 19: 181-189.

15. Hassen, S. and B. Gebissa, 2020. Determinants of Teff producers market orientation in Horo Buluk District of Horo Guduru Wollega Zone, Ethiopia. Eur. J. Bus. Manage., 12: 55-58.

16. Jaji, K., N. Man and N.M. Nawi, 2018. Factors affecting pineapple market supply in Johor, Malaysia. Int. Food Res. J., 25: 366-375.

17. Sori, O., 2021. Factors affecting groundnut market supply in Western Oromia, Ethiopia. Heliyon, Vol. 7. 10.1016/j.heliyon.2020.e05892.

18. Osmani, A.G. and E. Hossain, 2015. Market participation decision of smallholder farmers and its determinants in Bangladesh (Bosnian). Econ. Agric., 62: 163-179.