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An Analysis of Market Structure of Apple Fruit using Gini Co-Efficient and Lorenz Curve: A Case Study of Himachal Pradesh

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ABSTRACT

Background: The present study has made an attempt to analyse the market structure of apple fruit in four selected markets of Himachal Pradesh as our state is the second top most apple producing state in India, so, it becomes relevant to analyse it's market structure.

Methods: The present study has analysed the market structure of apple fruit using Gini co-efficient and Lorenz curve by purposely selecting four apple wholesale markets of Himachal Pradesh *i.e.* Dhali market of Shimla, Solan wholesale market, Bhuntar wholesale market of Kullu and Takoli wholesale market in Mandi district involved in procurement of apple in Himachal Pradesh and a sample of 40 intermediaries (wholesalers and retailers) from selected markets was taken and analysed using suitable statistical tools.

Result: It was revealed that 20 per cent of the wholesalers in the size of >3000 MT/year were handling 23.52 per cent of apple sales in Dhali market and the Gini concentration ratio of 0.31 was low for apple in this market which revealed that it was a relatively highly competitive market. Also, in Dhali wholesale market, the Lorenz curve was somewhat nearer to line of equality which led us to the conclusion the income inequality was less among wholesalers and income was equally distributed among wholesalers. Government should also improve their policies to improve the market sturcture of apple which can help in reducing income inequalities.

Key words: Gini co-efficient, Lorenz curve, Market concentration, Wholesale market.

INTRODUCTION

Market structure is an important factor that influences the performance and efficiency of a tacticand it primarily leads or even decides the market conduct of the various actors in the market. In fact, the changes in concentration have been used more and more in recent years to argue that the intensity of competition is decreasing, that the growth of large firms with high market shares is driving up profits, harming innovation and productivityand increasing inequality. The adage "a good farmer has one eye on the plough and the other eye on the market" perfectly captures the significance of marketing in the agricultural industry (Junagond and Hugar, 2011). In the past, agriculture was primarily practiced for sustenance; but, today, Indian agriculture has become commercialized. Since independence, India's agricultural output has grown significantly (Rani, 2019). In agriculture, fruits and vegetables has shown increasing trend from the past decade due to their high demand and nutritional value. Also, among fruits, apple has been grown on higher scale in Himachal Pradesh after J and K (Rani *et al.*, 2024). So, while, discussing about marketing of apple, it is a well-fact that Himachal Pradesh's economy is dependent on apple fruit (Rani *et al.,* 2025). The weather conditions and topography of our state is compatible with its growth, but with change in climate, the apple belt has shifted towards high hills (Rani and Prasher, 2020; Rani and Prasher, 2021; Shivani *et al.*, 2023; Rani *et al.,* 2025). However, primarily because of an inefficient marketing system, this greater production has not translated into a corresponding rise in farm revenue (Barwal *et al.*, 2023).

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The producer's share is not properly reflected in consumer prices because of ineffective marketing strategies. No nation in the world is able to control agricultural income to the satisfaction of farmers or strike a balance between output and demand (Adinya *et al.*, 2007). India appears to have resolved the production issue, but still there is a great need to improve the distribution one. Although in India, there is no compulsion on the producer to sell their produce in APMC market yards, as producers are quite free to sell directly to private companies or private market yards or farmers-consumer market under amended APMC Act (Hussain and Singh, 2017). In Himachal Pradesh, this act has been adopted in the form of "Himachal Pradesh Agricultural and Horticultural Produce Marketing (Development and Regulation) Act, 2005" of which regulates the marketing of apples and other produce

through established markets, often referred to as APMC mandis. APMC plays an important role in strengthening the apple economy of the state as the changes made in the APMC Act, direct marketing, contract farming, corporate entry, promotion of agri processing and exports etc have begun to make inroads into agricultural marketing in the country. Moreover, an improvement in method of sale, rate of market fee, rate of commission and construction of link road in area has been found (Sharma and Singh, 2022). Further, it showed a better performance in income, employment, production, technical know-how and area of apple cultivation in the state. It advocated that Himachal Pradesh is the 2nd largest apple producing State in India that produces on large scale for commercial purposes and achieving a prestige status "Apple State of India" (Rani, 2025). Analysis of the functionaries' market power and market concentration typically forms the basis of market structure (Sujata *et al.*, 1989). The degree to which market shares are concentrated among a limited number of companies is measured by market concentration. The general theory is that the marketing system will become less effective as the relative market concentration of buyers and sellers increases. It is frequently used as a stand-in for the level of competition. The concentration ratio below 0.5 indicates a low market concentration and low inefficiency, meaning that traders are handling nearly the same demand of apples. So, present study has made an attempt to investigate the nature and pattern of apple wholesale market structure using Lorenz curve and Gini-concentration ratio.

MATERIALS AND METHODS

Different markets dealing with the wholesale apple marketing in the state *viz.* Dhali market of Shimla, Solan wholesale market, Bhuntar wholesale market of Kullu and Takoli wholesale market in Mandi district involved in procurement of apple in Himachal Pradesh were selected purposively for the present study as Shimla and Bhutar are one of largest wholesale market of apple in Himachal Pradesh from last few decadesand solan and Takoli are one of the emerging and connected markets of apple in their respective districts to reduce the transportation cost of apple and attain good market price. So, a sample of 20 intermediaries (10 wholesalers and 10 retailers) from each selected market was selected to study the market structure. Lorenz curve is a graphical representation of distribution of income within the wholesalers. It showed the cumulative wholesalers' population against cumulative income or their wealth and was developed Max O Lorenz in 1905. The Gini co-efficient, or Gini index, is the most used measure of inequality. It was developed by Italian statistician Corrado Gini and is named after him. It measures inequality on a scale from 0 to 1, where higher values indicate higher inequality. This can sometimes be shown as a percentage from 0 to 100 percent, this is then called the 'Gini Index'. A value of 0 indicates perfect equality-where everyone has the same income showing higher market competitiveness among the wholesalers. A value of 1 indicates perfect inequality-where one wholesaler receives all the income and everyone else receives nothing causing monopoly in the markets. So, the Gini co-efficient captured how far the Lorenz curve fell from the 'line of equality' by comparing the areas A and B, as calculated in the following way:

$$\text{Gini coefficient} = \frac{A}{A + B}$$

If incomes were shared perfectly equally, the Lorenz curve was just the 'line of equality', so, the area A was 0and hence so was the Gini co-efficient.

RESULTS AND DISCUSSION

So, in the present study, the market concentration for selected apple wholesale markets was studied by analyzing the share of wholesalers in total sales of apple produce in a given number of wholesale markets. In order to analyse the situation, the quantity transacted (MT/year) was grouped together into seven categories based on the volume of transactions made in the market during a year. A share of wholesalers in the total quantity transacted and the proportion of wholesalers handling the respective volume of apple sales for different markets were presented in Table 1 to 4. Also, the market concentration of wholesalers for selected markets in the present study was also assessed by working out the Gini concentration ratio. By analysing of Dhali wholesale market which was one of the important markets for apple in India, for market concentration, degree of market competition and the distribution of wholesalers according to volume of transaction for apple from Table 1, it was revealed that 3 per cent of wholesalers were in the size group of those selling 1000-1500 MT/year and were handling 21.76 per cent of apple sales in the market. 20 per cent of the wholesalers in the size of >3000 MT/year were handling 23.52 per cent of apple sales in the market. The Gini concentration ratio

Table 1: Concentration of market share among wholesalers in Dhali wholesale market.

Class intervals for quantity transacted (MT/Year)	Per cent of wholesalers to the total	Per cent of quantity transacted (MT/ year) to the total
0-500	-	-
500-1000	30.00	14.67
1000-1500	30.00	21.76
1500-2000	10.00	9.77
2000-2500	10.00	13.90
2500-3000	10.00	16.37
>3000	10.00	23.52
Total	10 (100.00)	15803.48 (100.00)
Gini concentration ratio (GCR)		0.31

worked out for apple for Dhali wholesale market. The degree of competition as suggested by Gini concentration ratio of 0.31 was low for apple in this market which revealed that it was a relatively highly competitive market.

It was revealed from the Table 2 that Takoli wholesale market by analysing it for market concentration, degree of market competition and the distribution of wholesalers according to volume of transaction for apple, 30 per cent of wholesalers were in the size group of those selling 0-500 MT/year and were handling 7.46 per cent of apple sales in the market. 30 per cent of the wholesalers in the size of 1500-2000 MT/year were handling 53.23 per cent of apple sales in the market. The Gini concentration ratio for apple, it was revealed that Takoli wholesale market by Gini concentration ratio of 0.36 was low for apple which revealed that it had a high degree of competitiveness in Takoli. From the Table 3, it was reported that the 30 per cent of wholesalers were in the size group of those selling 1000-1500 MT/year and were handling 27.58 per cent of apple sales in the market. 10 per cent of the wholesalers in the size of 2500-3000 MT/year were handling 22.17 per cent of apple sales in Solan wholesale market. The Gini concentration ratio for apple was also worked for this market which was 0.32 was low for apple which revealed that there was a high degree of competitiveness in Solan. For Bhuntar wholesale market, it was revealed from Table 4 that the 30 per cent of wholesalers were in the size group of those selling 1000-1500 MT/year and were handling 25.32 per cent of apple sales in the market. 10 per cent of the wholesalers in the size of 2500-3000 MT/year were handling 20.38 per cent of apple sales in the market. The Gini concentration ratio for apple was also worked for this market and it was reported that it was 0.28 which was quite a low value for apple which revealed that it was a highly competitive market. By analysing the results of market concentration ratios for selected markets, it can be concluded that apple markets under study were operating under the conditions of perfect competition. In case of Bhuntar wholesale market, it was also obtained that it was a prominent market for sale of apple produce due to highest degree of competitiveness as compared to other selected markets under the study. But, in overall, it can be concluded that all the selected markets in the present study were working under perfectly competitive market situations.

Lorenz curve allows comparing of the level of income inequality between different wholesalers in the selected markets. It is a graphical representation of income inequality or wealth inequality developed by American economist Max O Lorenz in 1905. So, present study had used this curve to show the inequality among the wholesalers in selected wholesale markets. In Dhali wholesale market, the Lorenz curve was somewhat nearer to line of equality which led us to the conclusion the income inequality was less among wholesalers and income was equally distributed among wholesalers (Fig 1). In Takoli wholesale market, the Lorenz curve was also somewhat

Table 2: Concentration of market share among wholesalers in Takoli wholesale market.

Class intervals for quantity transacted (MT/Year)	Per cent of wholesalers to the total	Per cent of quantity transacted (MT/ year) to the total
0-500	30.00	7.46
500-1000	20.00	12.24
1000-1500	20.00	27.07
1500-2000	30.00	53.23
2000-2500	-	-
2500-3000	-	-
>3000	-	-
Total	10	9862.44
	(100.00)	(100.00)
Gini concentration ratio (GCR)	0.36	

Table 3: Concentration of market share among wholesalers in Solan wholesale market.

Class intervals for quantity transacted (MT/Year)	Per cent of wholesalers to the total	Per cent of quantity transacted (MT/ year) to the total
0-500	10.00	3.56
500-1000	30.00	14.48
1000-1500	30.00	27.58
1500-2000	10.00	13.54
2000-2500	10.00	18.67
2500-3000	10.00	22.17
>3000	-	-
Total	10	10580.02
	(100.00)	(100.00)
Gini concentration ratio (GCR)	0.32	

Table 4: Concentration of market share among wholesalers in Bhuntar wholesale market.

Class intervals for quantity transacted (MT/Year)	Per cent of wholesalers to the total	Per cent of quantity transacted (MT/ year) to the total
0-500	-	-
500-1000	40.00	22.85
1000-1500	30.00	25.32
1500-2000	10.00	13.51
2000-2500	10.00	17.95
2500-3000	10.00	20.38
>3000	-	-
Total	10	12900.49
	(100.00)	(100.00)
Gini concentration ratio (GCR)	0.28	

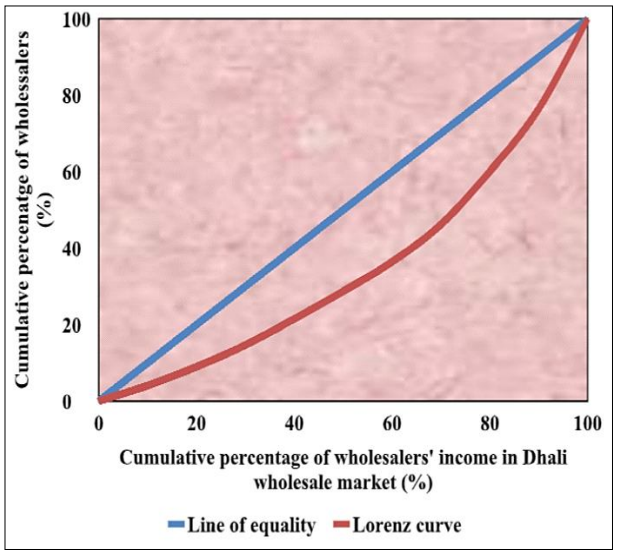


Fig 1: Lorenz curve in Dhali wholesale market.

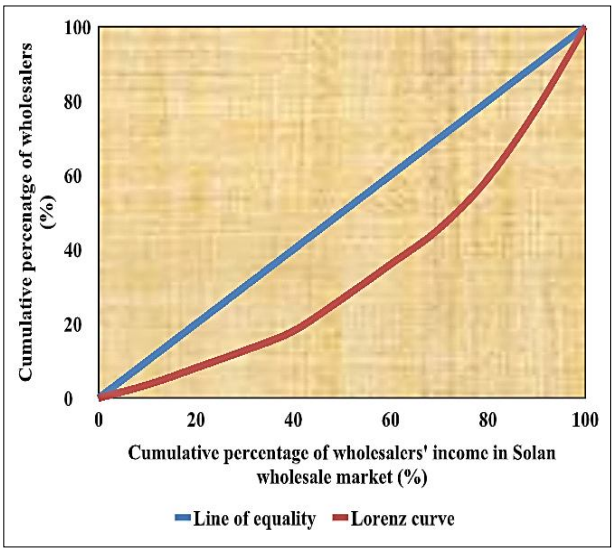


Fig 3: Lorenz curve in Solan wholesale market.

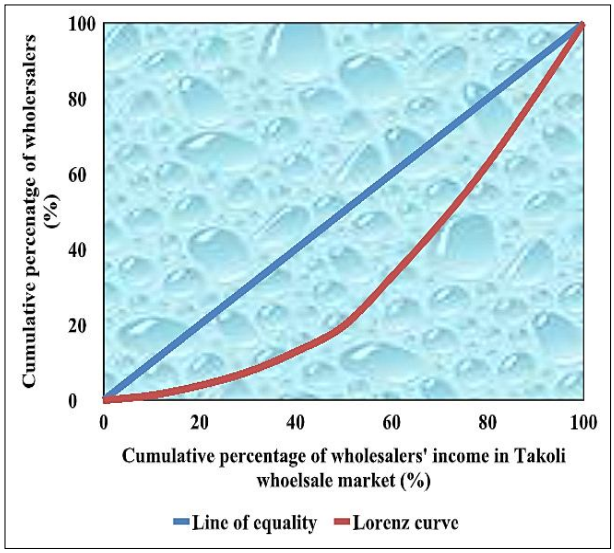


Fig 2: Lorenz curve in Takoli wholesale market.

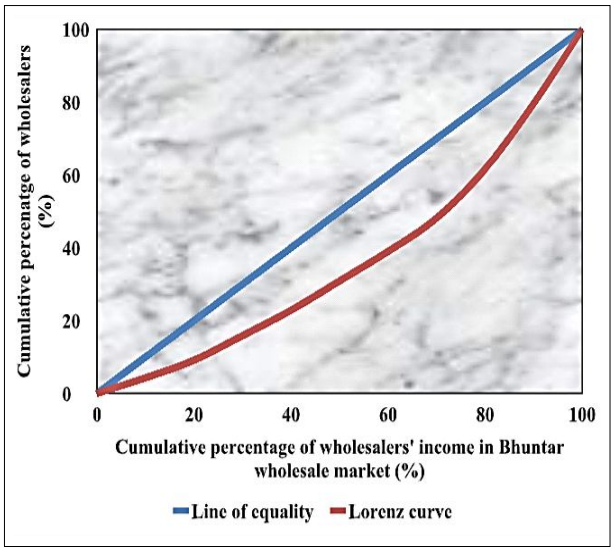


Fig 4: Lorenz curve in Bhuntar wholesale market.

nearer to line of equality but less than Dhali wholesale which led us to the conclusion the income inequality was somewhat less among wholesalers and income was almost equally distributed among wholesalers (Fig 2). In Solan wholesale market, the Lorenz curve was also nearer to line of equality even more than Dhali wholesale which led us to the conclusion the income inequality was comparatively less among the wholesalers and income was almost equally distributed among wholesalers (Fig 3). In Bhuntar wholesale market, the Lorenz curve was also nearer to line of equality even more than Solan wholesale which led us to the conclusion the income inequality was comparatively less among the wholesalers and income was almost equally distributed among wholesalers as compared to other selected markets (Fig 4). Overall analysis of results of all selected markets revealed that income equality was less among wholesalers in Takoli had highest value as its Lorenz was the farthest from line of equality and lowest value among Bhuntar wholesale market as its Lorenz curve was nearest among all the selected wholesale markets.

CONCLUSION

The above study has led us to the conclusion that by and large the apple wholesale market is dominated by various primary and secondary wholesalers. This market behaviour would go long way in bringing the apple market more and more close towards the perfect competition. Therefore, such market behaviour needs to be encouraged. There is also sufficient number of retailers operating in the market, but farmers first meet wholesalers operating in the market and after that these wholesalers sell their product to these

retailers further. This would not only widen market for apple but also contributes greatly in making apple wholesale market more competitive and dynamic. Grading of apple is also necessary due to their specific demand for particular taste and size. Farmers are of the opinion that there is no proportionate reward to the less graded apples in the market. However, with introduction of purchase of other grades apart from Grade-A apple for processing has solve this problem to some extent. Government should also improve their policies to improve the market sturcture of apple which can help in reducing income inequalities. Policy measures like the APMC act of our state and Market Intervention Scheme also enable direct sales to consumers and contract farming sponsors, bypassing the traditional middlemen and help in potentially securing better prices.

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Conflict of interest

The authors have no conflict of interest.

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