In-Depth Quantitative Analysis of Saharanpur Wood Handicraft Industry on the Specific Issues of Availability and Supply of Raw Material

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Authors' contributions

This work was carried out in collaboration among all authors. Authors PD and SPS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors VS SD, AS and MD managed the analyses of the study. Author PM managed the literature searches. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

The study was undertaken with the objectives to survey the source and chain of procurement process of the various types of wood being used in the market, assess their requirement of the kind of suitable wood preferred for a particular item of woodcraft for marketing in the particular countries and to explore the potential of alternate wood species which can be adopted by an artisan with existing technology/up-gradation of technology. The study was conducted through the collection of secondary data and primary data. The primary data was collected through a preliminary survey, a standardized questionnaire survey of various components of stakeholder's namely (a) manufacturers and exporters, (b) commission agents/brokers, (c) traders, and(d) artisans. The present study revealed that 58% of manufactures and exporters and 86.38% of craftsmen agreed that the raw material procurement chain starts from the farmer's field to Middleman then

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Commission agents and goes to the Craftsman. The majority of stakeholders responded that the middleman is the most important in the supply chain of the wood procurement process. The survey indicated that there is 0-5% incremental cost in every stage of the raw material procurement process and the approximately total incremental cost of wood is between 5-10% due to the existing supply chain. The data analysis related to a sequence of most demanding wood species for wood carving work indicated that 60% of commission agents/brokers responded for the sequence of Mango>Shisham>Poplar>Other, whereas 56.50% manufacturers and others. 83.33% commission agents/brokers, 85.71% manufacturers, and exporters, 97.87% traders, 98.26% craftsman responded negatively to the existence of imported wood species in the Saharanpur wood market.

1. INTRODUCTION

The city of Saharanpur is worldwide famous for the finest wood carving cottage industry. Woodcraft artisans creating magic with the years. The uniqueness of Saharanpur woodcraft is the intangible property which is in the form of its reputation and goodwill for its excellent wood craftsmanship. A wide range of wood types like shisham (*Dalbergiasissoo*), Mango (*Mangiferaindica*), Babool (*Acacia nilotica*), Haldu(*Haldinacordifolia*), Papdi (*Holoptelea Integrifolia*), Toon (*Toonaciliata*), Teak (*Tectonagrandis*), Pine (*Pinusroxburghii*), silver oak (*Grevillea robusta*), are used to make products through the process of slicing,marking, cutting, surface sanding, carving, sanding, polishing, assembling. Craftsman specializes in one of these processes and therefore a chain of craftsman are involved in the production of final products. The present annual value of the wood carving industry of Saharanpur is pegged at more than 400 crores and it supports more than 1,50,000 artisans. The present study is focused on an in-depth analysis of the availability and supply of raw material.

2. MATERIALS AND METHODS

2.1 Study Site

The Saharanpur district is the north most of the district of Uttar Pradesh state of India. It is lies between 29° 57' 34.8984" N and 77° 32' 56.6052" E. [1]. It is situated between two holy rivers Ganga and Yamuna [2,3]. Its bordering states are Haryana, Himachal Pradesh, Uttrakhand, and close to the foothills of the Shivalik range. Its total area is 3890 square kilometers.

2.2 Collection of Data

After preliminary interaction with all stakeholders of the wood carving industry four target groups i.e (1). Manufaces and exporters (2). Commission agents and brokers (3). Traders (4). Artisans were identified. Common questionnaires were prepared which consists of descriptive and multiple-choice questions. The questionnaire was divided into 5 sections i.e 1. Organization of wood carving industry of Saharanpur 2. Personal profile of component 3. procurement and supply of raw material 4. Availability of alternative wood species. 5. Raw material and product certification questionnaire consist total of 68 questions. Questionnaire survey was taken in identified sample area representing target groups in the selected area of Saharanpur like mandisamiti road, khatakhedi, and lakkad bazar.

2.3 Statistical Design

The sample size of each component was calculated with the following formula (5):

N= N*X/(X+N-1)
Where $X=Za^2/Z*P*(1-P)/MoE^2$

And Z/a/Z is the critical value of the Normal distribution at a/Z(e.g. for a confidence level of 95% a is 0.05 and the critical value is 1.96) MoE is the margin error p is the sample proportion N is the population size [4].

The sample size of craftsman, manufacture, and exporters, Traders, and commission agents were calculated 385, 133, 47, and 24 representing at 95% confidence level.

3. RESULTS AND DISCUSSION

Data revealed that the response of the different stakeholders on the correct supply chain has been very clear. 50.10% commission agents/ brokers and 69.15% traders responded that raw material flow in the market from the Forest-Forest depot-Contractor- Commission agents-Wood craftsman. But 58% of manufacturers and exporters and 86.38% of craftsmen responded

that the raw material procurement chain starts from the Farmer's field to Middleman then Commission agents and goes to the Craftsman. Statistically, the manufacture and exporters (II) are the most valuable stakeholders for the procurement of the raw materials as their kurtosis and skewness values (5.30 and 2.26) [5] are highest amongst all the stakeholders (Tables 1 & 1.1). This finding indicates that traditionally the source of timber including shisham was from the adjoining forest which was operated by the UP Forest Development Corporation and auctioned from the forest depot. After the auction of timber lots, it reached craftsmen through a contractor and commission agent. Since the forest department is selling a large volume of timber in the form of a minimum of one lot which may not be possible for the artisan to buy directly from the forest department. The contractor and commission agents can procure timber on large scale and then sell to individual craftsman and also manufacturer units.

The result dealt with the response of stakeholders on the main component in the wood supply chain. It was found that 75% commission agents/brokers, 83.46% manufactures and exporters, 97.87% traders, 75.36% craftsmen unanimously said that the middleman is the most important in the supply chain of the wood procurement process. Statistically, kurtosis and skewness value obtained highest for manufacture and exporters 7.58 and 2.74 respectively (Tables 2 & 2.1). The main profession of the middleman is to procure timber and distribute it to various manufacturing units and craftsman and earned his livelihood [6].

The results are related to the view of different stakeholders for the elimination of middlemen from the wood supply chain. The majority of the stakeholders answered yes to eliminate the middle man from the procurement chain. 83.33% commission agents and brokers, 88.72% manufactures and exporters, 97.87% traders responded yes on the issues of the elimination of the middleman but 61.16% of craftsmen said that middleman is the important component for the sustainable supply of the wood in the wood market and therefore the view craftsmen on the elimination of middleman are negative (Table 3).

The results analyzed the commission involved in every stage of the wood supply chain. It was found that all four categories of stakeholders in the wood carving industry answered that it is within 0-5% price increment in every stage of the raw material procurement process. 54.17% commission agents/brokers, 62.41% manufactures and exporters, 95.74% traders, 85.80% craftsman responded in favor of option A. (0-5%) price increment. Statistically, kurtosis and skewness values (5.66 and 2.31) for manufacturers/exporters are high among all stakeholders (Tables 4 & 4.1). It can be interpreted from the response of the stakeholders that the longer the supply chain and the more the final price of the wood. To reduce the supply chain, the government may consider the establishment of a forest depot for the suitable supply of timber species to the woodcraft industry at Saharanpur or nearby areas where the craftsman can procure timber directly from the forest depot. However, there is a risk of loss of time for wood craftwork which may impact overall production and a certain group of people may lose their livelihood. There is a need to consider a fixed price of timber at a discount rate from the government forest depot used exclusively in the woodcraft industry [7].

Table 1. Response percentage of the stakeholders on the supply chain of raw material for the wood carving industry

Stakeholders/Response (%)	A	B	C	D	A&B	B&C	A&C	Mean
Commission agents/Brokers	10.17	50.10	26.17	2.33	6.17	3.10	2.00	14.29
Manufactures and Exporters	10.00	20.31	58.00	6.00	2.51	2.00	1.50	14.32
Traders	0.00	69.15	25.10	0.00	0.00	5.80	0.00	14.29
Craftsman	0.00	13.25	86.38	0.00	0.00	0.00	0.00	14.29
Mean	5.04	38.20	49.01	2.08	2.17	2.73	0.88	

A. Forest–Contractor-Forest Depot-Commission Agents-Wood craftsman, B. Forest–forest depot- Contractor-Commission agents–Wood craftsman, C. Farmer's field-Middleman–Commission agents- Wood craftsman, D. Others

Table 1.1. Statistical analysis results

Analysis results/ Stakeholders →	I	II	III	IV
Kurtosis	1.00	5.30	4.16	3.51
Skewness	1.08	2.26	2.03	1.87

I-Commission agents/Brokers, II- Manufactures and Exporters, III- Traders, IV- Craftsman

Table 2. Response percentage of the stakeholders on main components in the wood supply chain between the source of raw material and wood craftsman

Stakeholders/Response (%) →	A	B	C	D	A&B	B&C	A&C	Mean
Commission agents/Brokers	75.00	12.50	4.17	12.50	0.00	0.00	4.17	15.48
Manufactures and Exporters	83.46	4.51	3.01	11.28	0.00	0.75	0.75	14.82
Traders	97.87	0.00	2.13	0.00	0.00	0.00	0.00	14.29
Craftsman	75.36	0.00	12.46	70.14	0.00	0.00	0.00	14.29
Mean	83.02	4.25	5.02	9.32	0.00	0.19	1.23	

A. Forest–Contractor-Forest Depot-Commission Agents-Wood craftsman, B. Forest–forest depot- Contractor-Commission agents–Wood craftsman, C. Farmer's field-Middleman–Commission agents- Wood craftsman, D. Others

Table 2.1. Statistical analysis results

Analysis results/Stakeholders →	I	II	II	IV
Kurtosis	1.50	7.58	3.99	3.50
Skewness	0.55	2.74	2.00	1.82

I-Commission agents/Brokers, II- Manufactures and Exporters, III- Traders, IV- Craftsman

Table 3. Response percentage of the stakeholders on the elimination of middleman from the wood supply chain

Stakeholders/Response (%) →	Yes	No
Commission agents/Brokers	83.33	16.67
Manufactures and Exporters	88.72	11.28
Traders	97.87	2.13
Craftsman	38.84	61.16
Mean	79.29	20.71

The analysis of the data indicates that the majority of stakeholders in all four categories replied in favor of the total increment on the raw material is between 5-10%.The detail percentage is 58.33% for commission agent/brokers, 38.24% for manufactures and exporters, 78.72% traders, and 43.19% craftsmen responded unanimously in the favor of option B (5-10%). Statistically, traders are more responded in the favor of option B, and the kurtosis and skewness values (6.23 and 2.47) also justify the highest response of the

traders amongst all stakeholders (Tables 5 & 5.1). The response of the trader is also important from the point of view related to the marketing of wood handicrafts. The incremental cost due to 5-10% commission is not very high in the present scenario of the number of components involved in the supply chain and availability of local self-employment to a large number of people the data analysis indicates the approximate distance of wood supply from Saharanpur wood market. The response of stakeholders was variable. 80.85%

of traders responded that the raw material procured within the 10-20 km distance from the Saharanpur wood market. Whereas,41.67%of commission agents and brokers answered in favor of option D. (40-80 km), 40% of manufacturers/exporters favored option A (0—10 km). Statistically, traders responded above the mean value, and kurtosis and skewness values (7.61 and 2.74) were found highest for the traders (Tables 6 & 6.1). It is also supported that adjoining areas are growing those species like mango, shisham which are more in demand in the woodcraft industry at Saharanpur. It is also beneficial to the wood growers/farmers to get a market for timber at nearby place Saharanpur [8].

The data analyzed the response of different stakeholders on the tax range on wood transportation. It shows that 33.33% of commission agents and 45% of craftsmen responded in the favor of option B (5-10%). But 66.92% of manufacturers and exporters and 93.62% of traders responded for option A (0-5%). Statistically, manufacturers and exporters responded above the mean value, and kurtosis and skewness value (8.56 & 2.86) found highest for the traders amongst all stakeholders (Tables 7 and 7.1). issued by the forest department. It is necessary to reduce the cost of timber wherever possible to get the minimum cost of handicraft production resulting in a better profit margin.

Table 4. Response percentage of the stakeholders on the % commission in the wood supply chain

Stakeholders/Response (%)	A	B	C	D	Mean
Commission agents/Brokers	54.17	25.00	20.83	0.00	25.00
Manufactures and Exporters	62.41	18.05	8.27	11.28	25.00
Traders	95.74	4.26	0.00	0.00	25.00
Craftsman	85.80	14.20	0.00	0.00	25.00
Mean	74.58	15.33	7.28	2.82	

A. 0-5%, B. 5-10%, C. 10% or above, D. Other

Table 4.1. Statistical analysis

Analysis results/Stakeholders	I	II	II	IV
Kurtosis	1.50	5.66	3.96	3.44
Skewness	0.55	2.31	1.99	1.85

I-Commission agents/Brokers, II- Manufactures and Exporters, III- Traders, IV- Craftsman

Table 5. Response percentage of the stakeholders on the total % of increment on raw material in the supply chain

Stakeholders/Response (%)	A	B	C	D	E	A&B	B&C	Mean
Commission agents/Brokers	16.67	58.33	12.50	8.33	4.17	0.00	0.00	14.29
Manufactures and Exporters	23.53	38.24	10.50	11.20	8.82	1.50	0.75	14.30
Traders	14.89	78.72	4.26	2.13	0.00	0.00	0.00	14.29
Craftsman	27.25	43.19	24.06	5.51	0.00	0.00	0.00	14.29
Mean	22.59	53.64	13.79	6.74	3.25	0.38	0.19	

A. 0-5%, B. 5-10%, C. 10-15%, D.15-20%, D. Others

Table 5.1. Statistical analysis results

Analysis results/Stakeholders ⟶	I	II	II	IV
Kurtosis	4.13	1.94	6.23	-1.28
Skewness	1.99	1.74	2.47	-0.76

I-Commission agents/Brokers, II- Manufactures and Exporters, III- Traders, IV- Craftsman

Table 6. Response percentage of the stakeholders for the procurement of raw material from the adjoining area

Stakeholders/ Response (%)	A	B	C	D	E	A&B	B&C	C&D	E&D	Mean
Commission agents/ Brokers	12.50	12.50	16.67	41.67	16.67	0.00	0.00	0.00	0.00	11.11
Manufactures and Exporters	40.00	22.58	36.00	7.53	3.01	0.00	0.00	0.75	0.75	11.28
Traders	10.64	80.85	2.13	2.13	4.26	0.00	0.00	0.00	0.00	11.11
Craftsman	0.09	3.80	3.16	2.26	0.78	0.00	0.09	0.00	0.00	11.28
Mean	18.25	42.42	22.79	19.40	7.67	0.19	0.19	0.19	0.19	

A. 0-10 km, B. 10-20 km, C. 20-40 km, D. 40- 80 km, E. Others

Table 6.1. Statistical analysis results

Analysis results/Stakeholders ⟶	I	II	II	IV
Kurtosis	4.44	-0.71	7.61	0.55
Skewness	2.08	1.05	2.74	1.23

I-Commission agents/Brokers, II- Manufactures and Exporters, III- Traders, IV- Craftsman

Table 7. Response percentage of the stakeholders on the tax range on wood transportation

Stakeholders/ Response (%)	A	B	C	D	E	A&B	B&C	C&D	A&C	Mean
Commission agents/ Brokers	25.00	33.33	29.17	8.33	4.17	0.00	0.00	0.00	0.00	11.11
Manufactures and Exporters	66.92	12.78	5.26	9.02	8.27	0.00	0.00	0.00	0.00	11.26
Traders	93.62	2.13	0.00	4.26	0.00	0.00	0.00	0.00	0.00	11.11
Craftsman	25.50	45.00	20.00	0.00	0.00	0.25	6.20	0.00	1.16	11.26
Mean	52.76	23.31	13.61	5.40	3.11	0.06	1.55	0.00	1.38	

A. 0-5%, B. 5-10%, C. 10-15%, D. 15-20%, E. Others

The data analysis of the sequence of most demanding wood species for the wood carving work to the craftsman for manufacturing wood items. In this regard the response of the stakeholders shows that 60% commission agents/brokers favors the option (B) Mango >Shisham> Poplar > Other, 56.50% manufacturers and exporters, 78.72% traders and 85% craftsman responded with the option A-Shisham> Mango >Jamun> Acacia > Others.

Statistically, traders responded above the mean value, and kurtosis and skewness values (4.12 and 2.25) were found highest for the traders amongst all stakeholders (Tables 8 & 8.1). These results can also be correlated with less availability of shisham after 2005 due to mass scale mortality of shisham and high prices. Woodcraft industry searched for alternate species that are available in the adjoining area, cheap and workable. The Mango timber was found most suitable after Shisham the artisans adopted it for woodcraft work. The visual characteristics are also similar to the teak and therefore it is preferable to the buyers.

The data are related to the response of stakeholders regarding imported wood species available in Saharanpur wood Mandi. The response percentage of all categoriesof stakeholders reflects that 83.33% commission agents/brokers, 85.71% manufacturers and exporters, 97.87% traders, 98.26% craftsman responded negatively regarding the existence of imported wood species in the Saharanpur wood market. As per informal discussion with various groups, it was learned that there was not much attempt made for woodcraft work on imported wood. However, the MDF (medium-density fiberboard) is being used for various wood carvings at Saharanpur. Presently, mango wood is the most popular among artisans and also easily available at a reasonable price.

The data analysis on the choice of alternative wood species due to the unavailability of shisham indicates the preference of mango wood as an alternative of the shisham wood for the carving work at Saharanpur. The recent market trend also showed the replacement of shisham wood with mango, whereas 84.67% commission agents/broker, 86.00% manufacturers/exporters, 88.00% traders, and 76.89% craftsman supported option A i..e.mango wood as the best replacement at present which is available locally from a various orchard in the adjoining area. Statistically, the trader's response for the mango wood is the highest to the mean value and kurtosis and skewness (6.90 and 2.58) were also found highest amongst all the stakeholders (Tables 10 & 10.1).

Table 7.1. Statistical analysis results

Analysis results/Stakeholders ⟶	I	II	III	IV
Kurtosis	-2.68	8.56	6.95	4.33
Skewness	-0.44	2.86	2.63	2.07

I-Commission agents/Brokers, II- Manufactures and Exporters, III- Traders, IV- Craftsman

Table 8. Response percentage of the stakeholders on the most demanding wood species for the wood carving industry at Saharanpur (U.P.)

Stakeholders/Response (%) ⟶	A	B	C	D	E	A&B	Mean
Commission agents/Brokers	40.83	60.00	0.00	0.00	0.00	0.00	16.71
Manufactures and Exporters	56.50	40.75	0.00	10.53	0.00	2,50	16.63
Traders	78.72	23.40	0.00	2.13	4.26	0.00	16.78
Craftsman	85.00	15.25	0.00	0.00	0.00	0.00	16.71
Mean	68.83	34.85	0.00	0.00	1.07	0.63	

A. Shisham> Mango >Jamun> Acacia > Others, B. Mango >Shisham>Jamun> Poplar > Others,C. Kekar>Shisham> Mango > Others, D. Other combinations

Table 8.1. Statistical analysis results

Analysis results/Stakeholders ⟶	I	II	III	IV
Kurtosis	-1.73	0.87	4.12	3.61
Skewness	0.75	1.51	2.25	1.89

I- Commission agents/Brokers, II- Manufactures and Exporters, III- Traders, IV- Craftsman

Table 9. Response percentage of the stakeholders on the existence of imported wood species in the Saharanpur wood market

Stakeholders/Response (%) →	Yes	No
Commission agents/Brokers	16.67	83.33
Manufactures and Exporters	14.29	85.71
Traders	2.12	97.87
Craftsman	1.74	98.26
Mean	8.71	91.29

Table 10. Response percentage of the stakeholders on the availability of alternative of Shisham for the wood carving industry at Saharanpur

Stakeholders/Response (%) →	A	B	C	D	E	A&B	Mean
Commission agents/Brokers	84.67	7.83	8.50	0.00	0.00	0.00	16.68
Manufactures and Exporters	86.00	9.00	0.00	0.00	0.00	0.00	16.67
Traders	88.00	10.67	2.13	0.00	0.00	0.00	16.68
Craftsman	76.89	9.39	7.27	0.00	0.00	7.80	16.67
Mean	83.89	8.99	5.57	0.00	0.00	1.60	

A. Mango, B. Jamun, C. Neem, D. Poplar, E. Other

Table 10.1. Statistical analysis and results

Analysis results/Stakeholders →	I	II	III	IV
Kurtosis	6.85	6.48	6.90	-2.52
Skewness	2.55	2.48	2.58	0.41

I - Commission agents/Brokers, II- Manufactures and Exporters, III- Traders, IV- Craftsman

4. CONCLUSION

The main source of raw material- wood is from the forest depot of government and farmer's field and therefore the most important procurement supply chain of wood identified as '*Farmer's field - Middleman - Commission agents – Craftsman*' and '*Forest-Forest Depot-Contractor - Commission agents - Wood craftsman*'. The majority of the stakeholders recognized the middleman in the supply chain of procurement is most significant in facilitating the procurement of wood to manufacturers and artisans. However, all categories of stakeholders except artisans were in favor of eliminating the middle man from the supply chain subject to a better option of procurement of wood at a reasonable price. The survey indicated that there is 0-5% incremental cost in every stage of the raw material procurement process and the approximate distance of most of the procurement of timber is 10-20 km from the Saharanpur wood market. It was suggested to establish Forest Depot at Saharanpur city for direct purchase of timber by the manufacturers and craftsmen and also evolve a strategy for a fixed price at a discount rate by the government, being labor intensive woodcraft industry. The Mango wood and Medium Density Fiberboard (MDP) was found most suitable alternate species after shisham.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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