

Transportation and Logistics Management in Banana Agribusiness: A Comparative Study of Jalgaon and Solapur Districts of Maharashtra

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Abstract — Banana is one of the major commercial fruit crops cultivated in Maharashtra, with Jalgaon and Solapur representing important banana-producing regions. The movement of harvested banana produce from farms to local markets, wholesalers, retailers, processors and other destinations involves several transportation and logistics activities. Since banana is a highly perishable agricultural commodity, the efficiency of transportation directly affects the physical condition of the produce, delivery time and the extent of transit-related losses. In this context, transportation should not be considered merely as a means of moving produce from one location to another; rather, it forms an important component of the overall agricultural supply chain. The present study focuses specifically on transportation and logistics management associated with banana agribusiness in Jalgaon and Solapur districts of Maharashtra. The study examines the transportation modes used by banana growers, vehicle arrangements, transportation distances, loading and unloading practices, route-related issues, transportation delays and transit losses. A comparative approach is adopted to identify differences in logistics practices between the two selected districts. For the purpose of developing the analytical framework, variables such as transportation mode, vehicle ownership or hiring arrangement, average distance travelled, loading practices, unloading practices, delay frequency and transit loss are considered. The study further attempts to identify major transportation constraints faced by banana growers and develop a management-oriented framework for improving transportation efficiency. The proposed framework integrates harvest planning, transport requirement estimation, vehicle allocation, loading preparation, route planning, transit monitoring, controlled unloading and post-delivery review. The study is expected to provide useful insights for banana growers, traders, transport operators, aggregators, farmer groups and agribusiness organizations involved in the movement of banana produce.

Keywords: Banana Agribusiness, Transportation Management, Logistics Management, Supply Chain, Transit Loss, Vehicle Management, Jalgaon, Solapur, Maharashtra

I. INTRODUCTION

Agriculture in India is increasingly being viewed not only as a production activity but also as an integrated value chain involving production, aggregation, transportation, storage, marketing and final distribution. In commercial horticultural crops, the movement of produce from the farm to the point of consumption is particularly important because the quality of the commodity may deteriorate during handling and transportation. Therefore, transportation and logistics management have become important components of modern agribusiness management.

Banana occupies an important position among India's fruit crops because of its commercial value, regular market demand and widespread cultivation. Maharashtra is

one of the important banana-producing states, and banana cultivation is concentrated in several districts with different production and market environments. Jalgaon is particularly known for its extensive banana cultivation, while Solapur has also developed significant banana-growing areas. Although both districts produce banana on a commercial scale, their geographical conditions, market destinations, road connectivity, transportation arrangements and operational practices may differ.

Transportation plays a critical role in the banana supply chain because harvested banana bunches and other forms of banana produce must be moved from farms to collection points, pack houses, wholesalers, markets, retailers or other destinations. Unlike durable agricultural commodities, banana requires careful handling because excessive pressure, vibration, improper loading, rough roads, unsuitable vehicles and delays can contribute to physical damage and quality deterioration.

From a management perspective, transportation involves much more than hiring a vehicle. A grower or supply-chain participant has to determine when the vehicle is required, what type of vehicle is suitable, how much produce can be loaded, how the produce should be arranged, which route should be followed, how long transportation will take and where unloading should occur. These decisions together constitute transportation management.

Logistics management provides a broader framework for coordinating these activities. It involves planning, implementation and control of the movement of goods and related information from the point of origin to the point of destination. In banana agribusiness, logistics management may include harvest scheduling, collection planning, vehicle arrangement, loading, transportation, unloading, delivery confirmation and documentation.

An inefficient transportation system may result in several operational problems. For example, if a vehicle is not available when the produce is ready for harvest, the farmer may face delays. If the vehicle is unsuitable or overloaded, the produce may suffer mechanical damage. If loading is not performed systematically, bunches may experience excessive pressure or abrasion. Similarly, poor road conditions and route selection may increase travel time and physical stress on the produce.

The importance of transportation becomes even greater when the distance between the production location and the final market is considerable. Banana-producing farmers may supply produce to markets located within the district, neighboring districts or distant states. Therefore, the transportation requirement may vary substantially from one farmer to another.

Jalgaon and Solapur provide an appropriate comparative setting for examining these issues because banana production in both districts is commercially significant but operates within different geographical and

market environments. A comparative study can therefore help identify common transportation problems as well as district-specific logistics practices.

The present study consequently concentrates on transportation and logistics management, rather than examining banana production economics, profitability or marketing efficiency. The central concern is how banana produce is physically moved, what transportation practices are followed, what operational difficulties are experienced and what management interventions can improve the movement process.

II. BACKGROUND OF THE STUDY

Agricultural logistics differs from logistics associated with manufactured products because agricultural commodities are generally produced at dispersed locations and may have biological characteristics that affect their movement and storage.

Banana is particularly sensitive to physical handling. During harvesting and transportation, the produce may be exposed to loading pressure, vibration, road shocks, temperature variation and repeated handling. Consequently, transportation decisions can influence the physical condition of the produce when it reaches the destination.

In traditional agricultural supply chains, transportation decisions are often made on an immediate or transaction-based basis. A farmer may contact a local vehicle operator when the produce is ready, negotiate the transportation charge and arrange transportation according to immediate availability. While this approach may work for small quantities, it may create operational difficulties when production volumes increase or when market destinations are distant.

A management-oriented logistics system requires greater coordination between harvesting and transportation. The expected quantity of produce should ideally be known before harvesting so that the appropriate vehicle can be arranged. Similarly, the loading point, destination and route should be identified before the vehicle arrives.

The increasing commercialization of banana cultivation makes these management issues more important. Farmers supplying larger quantities may need regular transportation arrangements rather than occasional vehicle hiring. Farmer groups, traders and aggregators may also require systematic scheduling of vehicles. Therefore, transportation management can be studied through several dimensions:

- 1) Mode of transportation
 - 2) Vehicle ownership or hiring
 - 3) Vehicle capacity
 - 4) Transportation distance
 - 5) Frequency of transportation
 - 6) Loading and unloading practices
 - 7) Route selection
 - 8) Travel time
 - 9) Transportation delays
 - 10) Transit-related physical losses
 - 11) Transportation constraints
 - 12) Coordination between harvest and vehicle availability
- These dimensions form the basis of the present study.

III. STATEMENT OF THE PROBLEM

Banana production involves considerable operational coordination after harvesting. The harvested produce must reach its destination within an appropriate time and in acceptable physical condition. However, transportation arrangements at the farm level may not always be systematically planned.

Farmers may depend heavily on locally available transport operators. Vehicle availability may fluctuate according to season, market demand and other agricultural activities. Transportation distances may vary considerably depending on the destination selected by the farmer or buyer.

Another important issue is loading and handling. Banana produce requires careful handling during loading and unloading because excessive pressure, rough handling and inappropriate stacking can result in physical damage. If loading is performed without considering vehicle capacity and produce arrangement, transportation efficiency may decline.

Road conditions also influence transportation performance. Poor roads, congestion, diversions and long-distance movement may increase travel time. For perishable commodities, such delays can become an important operational concern.

Despite the importance of transportation in agricultural supply chains, transportation management at the farm level often receives less systematic attention than production and market-related decisions. Therefore, there is a need to study transportation as an independent management function within banana agribusiness.

The present research attempts to address this gap by examining transportation and logistics practices in two major banana-producing districts of Maharashtra—Jalgaon and Solapur.

IV. OBJECTIVES OF THE STUDY

The study is proposed with the following objectives:

1) Objective 1

To examine the transportation modes and vehicle practices adopted for movement of banana produce in Jalgaon and Solapur districts.

This objective focuses on understanding the types of vehicles used, whether vehicles are owned or hired, vehicle capacity and the general method through which transportation is arranged.

2) Objective 2

To compare transportation distance, destination patterns and route-related characteristics between Jalgaon and Solapur districts.

The purpose is to determine whether the transportation requirements differ according to production location and market destination.

3) Objective 3

To examine loading, unloading, packaging and handling practices followed during banana transportation.

This objective concentrates on operational handling practices that may influence transportation efficiency and physical condition of the produce.

4) Objective 4

To identify and rank the major transportation and logistics constraints faced by banana growers.

The study seeks to identify practical problems such as vehicle availability, transportation charges, road conditions, delays, loading difficulties and inadequate coordination.

5) Objective 5

To develop a management-oriented framework for improving transportation efficiency and reducing transit-related losses in banana agribusiness.

The final objective is not simply to identify problems but to develop a practical logistics framework that can be used by growers, farmer groups, aggregators and other supply-chain participants.

V. RESEARCH QUESTIONS

The study attempts to answer the following questions:

- 1) What transportation modes are predominantly used for banana movement in Jalgaon and Solapur?
- 2) What proportion of farmer use owned vehicles and hired vehicles?
- 3) What are the typical transportation distances involved?
- 4) What loading and unloading practices are followed?
- 5) What are the major transportation-related delays?
- 6) What types of transit losses are reported?
- 7) What are the major logistics constraints faced by banana growers?
- 8) Are transportation practices different between Jalgaon and Solapur?
- 9) How can transportation activities be better coordinated with harvesting and delivery schedules?
- 10) What management framework can improve banana transportation efficiency?

VI. REVIEW OF LITERATURE

Transportation and post-harvest logistics form an important part of agricultural supply-chain management. Existing studies on banana supply chains indicate that the movement of banana produce involves multiple participants and operational stages.

Jadhav et al. (2020), in their study of post-harvest losses in banana under Jalgaon conditions, examined losses associated with banana handling and post-harvest operations. Their work demonstrates the importance of examining losses beyond the production stage. For the present research, the study provides useful background for considering transportation and handling as potential contributors to post-harvest losses.

Karamshibhai, Vahoniya and Rajwadi (2024) examined the banana supply chain in Navi Mumbai. Their work provides evidence of the complexity of banana movement through different supply-chain participants. The study is relevant to the present research because transportation forms an important connecting activity between production areas and market destinations.

Wanjari and Ladaniya (2004) studied banana marketing in selected districts of India. Their research provides historical evidence regarding the movement of

banana through marketing channels and the role of transportation in agricultural distribution.

The Ministry of Food Processing Industries/NABCONS study on post-harvest losses provides broader evidence concerning losses occurring across agricultural value chains. Such studies emphasize that post-harvest management requires attention to handling, transportation, storage and related operational processes.

Although previous studies have examined banana marketing, economics, production and post-harvest losses, there remains scope for a focused management study that treats transportation and logistics as the primary unit of analysis.

The present research therefore attempts to build upon earlier studies while maintaining a clearly differentiated research focus.

VII. RESEARCH GAP

A review of the available literature indicates that considerable research has been undertaken on banana cultivation, production economics, marketing channels, farmer income and post-harvest losses. However, transportation is frequently considered as one component of a broader agricultural study rather than being examined as an independent management function.

The present research attempts to address this gap in three ways.

- First, it focuses specifically on transportation management rather than treating transportation merely as one cost component.
- Second, the study adopts a comparative district-level approach, examining Jalgaon and Solapur simultaneously.
- Third, the study attempts to connect transportation practices with broader logistics management, including vehicle planning, loading coordination, route selection, delivery scheduling and transit monitoring.

Thus, the study is designed as a management-oriented investigation of the physical movement of banana produce.

VIII. RESEARCH METHODOLOGY

A. Research Design

The study adopts a descriptive and comparative research design.

The descriptive component is used to document existing transportation practices among banana growers. The comparative component is used to examine differences between Jalgaon and Solapur districts.

The research does not attempt to establish that one district's transportation system is universally superior. Instead, it examines differences in operational characteristics and identifies areas where logistics management can be improved.

B. Study Area

The study covers selected banana-growing areas of:

- 1) Jalgaon District
- 2) Solapur District

These districts were selected because of their relevance to banana cultivation and the researcher's existing research context.

C. Population of the Study

The population consists of banana growers involved in commercial banana cultivation and associated transportation activities in the selected study areas.

Depending on the actual field design, respondents may be selected from different villages and production clusters to ensure adequate representation.

D. Sample Size

For the purpose of demonstrating the analytical procedure, a sample of 200 respondents is considered:

District	Respondents	Percentage
Jalgaon	100	50.00%
Solapur	100	50.00%
Total	200	100.00%

Table 1: Number of Respondents

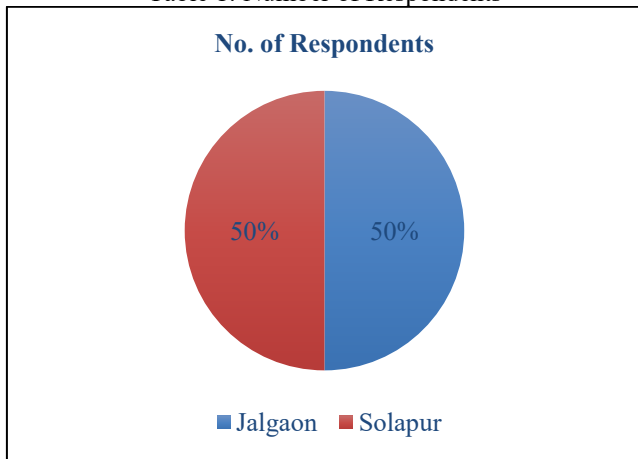


Fig. 1: Number of Respondents

IX. VARIABLES CONSIDERED IN THE STUDY

The following variables can be collected through the questionnaire:

A. Transportation variables

- Type of transportation vehicle
- Owned/hired vehicle
- Vehicle capacity
- Transportation distance
- Transportation frequency
- Transportation charge
- Travel time
- Vehicle availability
- Waiting time
- Route condition

B. Handling variables

- Loading method
- Number of workers involved in loading
- Packaging method
- Stacking arrangement
- Unloading method

- Handling frequency
- Damage during loading/unloading

C. Logistics performance variables

- Delivery delay
- Transit loss
- Vehicle utilization
- Route efficiency
- Coordination between harvesting and transportation
- Delivery scheduling

10. DISTRICT-WISE TRANSPORTATION PROFILE

Particular	Jalgaon	Solapur	Total
Owned vehicle users	14	11	50
Hired vehicle users	36	39	150
Short-distance transport	24	20	89
Medium-distance transport	19	20	76
Long-distance transport	7	10	35
Total	100	100	200

Table 2: Distribution of Respondents

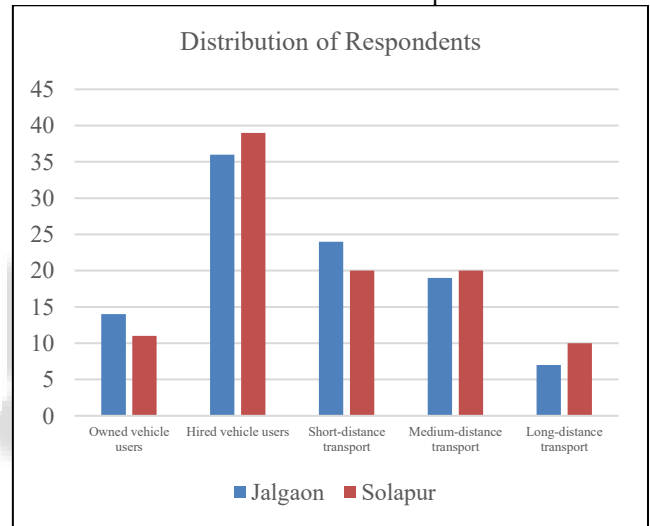


Fig. 2: Distribution of Respondents

D. Interpretation

The distribution suggests that hired transportation may be more common than owned transportation in both districts. This may be because banana growers do not necessarily find it economically or operationally convenient to maintain dedicated transportation vehicles.

The higher dependence on hired vehicles also indicates that transportation availability can become an important logistics variable. When many growers depend on the same local transport network, vehicle availability during peak harvesting periods may become constrained.

The proportion of long-distance transportation is also relevant because longer distances generally require greater planning concerning vehicle capacity, route selection, travel time and delivery scheduling.

X. TRANSPORTATION MODE

Transportation Mode	Jalgaon	Solapur	Total
Tractor/Trolley	25	30	55
Pickup Vehicle	38	32	70
Truck	30	32	62
Other	7	6	13

Total	100	100	200
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Table 3: Transportation Modes

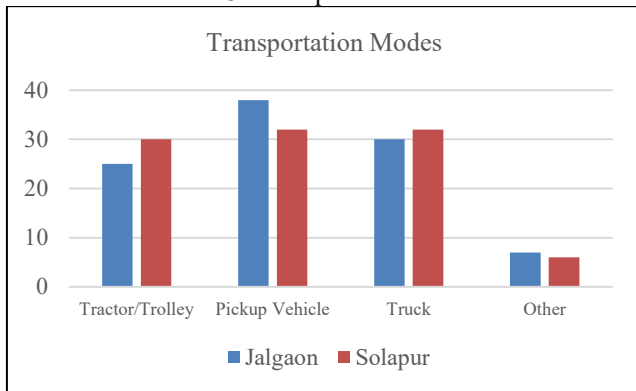


Fig. 3: Transportation Modes

A. Interpretation

The table illustrates the possible variation in transportation modes between the two districts. Pickup vehicles may be preferred for relatively smaller consignments and shorter distances because of their flexibility. Trucks may be preferred when larger quantities need to be transported to distant destinations.

Tractor/trolley arrangements may also be used, particularly for local transportation or movement from farm locations to nearby collection points.

From a logistics management perspective, vehicle selection should be based on quantity, distance, road conditions, loading requirements and destination rather than simply on immediate availability.

XI. VEHICLE OWNERSHIP AND HIRING

Vehicle Arrangement	Jalgaon	Solapur	Total
Own vehicle	27	22	49
Hired vehicle	69	65	134
Cooperative/shared vehicle	4	13	17
Total	100	100	200

Table 4: Vehicle Arrangement

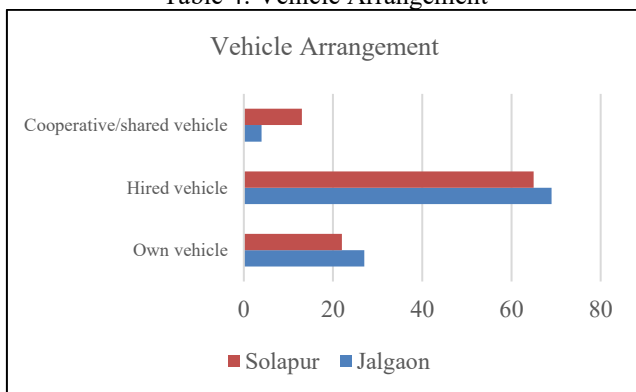


Fig. 4: Vehicle Arrangement

A. Interpretation

The figures indicate significant dependence on hired vehicles. This has important implications for logistics planning.

A grower dependent on hired transportation cannot fully control vehicle availability. If harvesting is completed but the vehicle arrives late, the entire delivery schedule can be affected.

A possible management response is the development of pre-arranged transportation networks. Farmer groups or aggregators could maintain a list of reliable vehicle operators and schedule vehicles according to expected harvesting quantities.

XII. TRANSPORTATION DISTANCE

Distance	Jalgaon	Solapur	Total
Up to 50 km	48	41	89
51–100 km	37	39	76
Above 100 km	15	20	35
Total	100	100	200

Table 5: Distance Classification

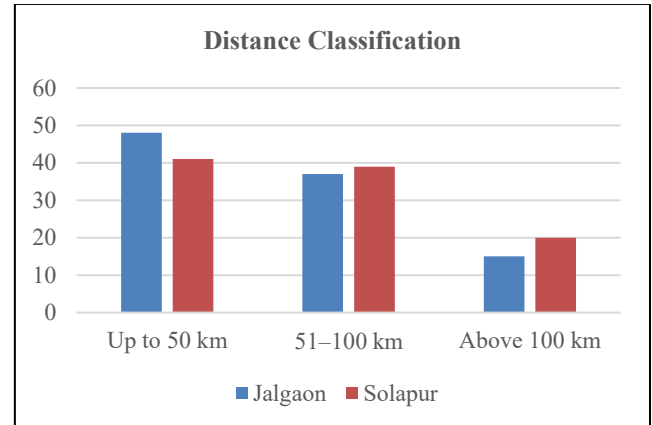


Fig. 5: Distance Classification

A. Interpretation

Transportation distance is an important logistics variable because distance affects travel time, vehicle requirement, fuel consumption and exposure of produce to handling and road conditions.

Short-distance movement may be comparatively easier to coordinate because the vehicle can complete multiple trips within a day. Long-distance movement requires more careful planning because a delay in departure can significantly affect the delivery schedule.

For long-distance banana movement, route planning and vehicle suitability become particularly important.

XIII. LOADING AND HANDLING PRACTICES

Loading Practice	Jalgaon	Solapur	Total
Manual careful loading	46	42	88
Semi-organized loading	38	40	78
Rapid/less controlled loading	16	18	34
Total	100	100	200

Table 6: Loading Practices

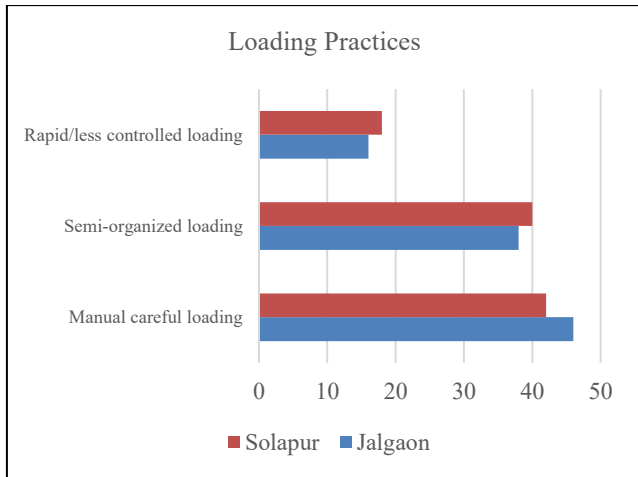


Fig. 6: Loading Practices

A. Interpretation

Loading is one of the most important operational stages in banana transportation.

Even if the vehicle itself is appropriate, improper loading can create physical damage. Produce should be positioned systematically so that excessive pressure, falling, abrasion and unnecessary movement are minimized.

The data show that a proportion of respondents may use less controlled loading practices. This represents an opportunity for logistics improvement through standardized loading procedures.

A simple loading protocol can include:

- 1) Preparing the vehicle before harvesting.
- 2) Cleaning the loading area.
- 3) Ensuring adequate vehicle capacity.
- 4) Avoiding excessive stacking.
- 5) Using appropriate cushioning/protective material where required.
- 6) Distributing weight properly.
- 7) Minimizing repeated handling.
- 8) Ensuring safe unloading at the destination.

XIV. MEAN TRANSPORTATION DISTANCE AND DELAY

Indicator	Jalgaon	Solapur
Mean transportation distance	71 km	78 km
Mean transportation delay	1.7 hours	2.0 hours
Mean transit loss	2.5%	2.8%

Table 7: District Comparison

A. Interpretation

The values suggest that Solapur respondents may experience slightly higher average transportation distance and delay. However, this should not be interpreted as an actual district-level finding until verified with field data.

The purpose of this table is to demonstrate how district-level logistics indicators can be compared.

Once actual data are collected, statistical tests can be applied to determine whether the observed differences are statistically meaningful.

XV. TRANSIT LOSS

Transit loss is an important logistics-performance indicator in the transportation of perishable agricultural commodities.

Transit loss may arise from:

- Physical bruising
- Improper stacking
- Excessive vibration
- Road shocks
- Overloading
- Rough handling
- Repeated loading and unloading
- Delay in transportation
- Unsuitable vehicle arrangement

Transit Loss	Jalgaon	Solapur
Below 2%	35	29
2–4%	51	54
Above 4%	14	17
Total	100	100

Table 8: Transit Loss Categories

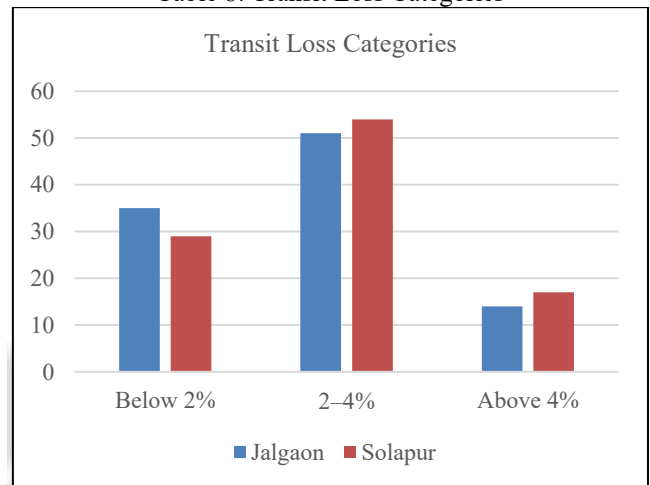


Fig. 7: Transit Loss Categories

A. Interpretation

The distribution indicates that a substantial proportion of respondents may experience transit loss between 2% and 4%.

The management implication is that even relatively small physical losses can become important when large quantities are transported regularly. Therefore, transit loss should be monitored systematically rather than treated as an unavoidable component of agricultural trade.

A logistics monitoring system can record:

Quantity loaded → Quantity delivered → Difference → Reason for difference

This would allow repeated problems to be identified.

XVI. MAJOR TRANSPORTATION CONSTRAINTS

Constraint	Mean Score	Rank
Vehicle availability during peak period	4.18	I
Poor road conditions	4.02	II
Transportation delay	3.91	III
High transportation charges	3.84	IV
Loading/unloading difficulties	3.62	V
Lack of route planning	3.41	VI
Lack of transport coordination	3.27	VII

Table 9: Ranking of Transportation Constraints

A. Interpretation

Vehicle availability can become a significant constraint during periods of concentrated harvesting. When several growers require transportation simultaneously, available vehicles may be insufficient.

Road conditions are another important operational factor. Poor road surfaces can increase travel time and expose the produce to greater vibration.

Transportation delays can arise from vehicle non-availability, late harvesting, loading delays, traffic conditions, route problems or destination-related waiting.

High transportation charges represent another operational concern, particularly when the distance to the destination is high.

The ranking framework can help identify which logistics problems require management attention first.

XVII. PROPOSED BANANA LOGISTICS MANAGEMENT MODEL

Based on the management orientation of the study, the following logistics framework can be developed:

A. Step 1: Harvest Forecasting

Estimate the quantity expected to be harvested during a particular period.

B. Step 2: Transportation Requirement Estimation

Determine:

- Quantity
- Destination
- Distance
- Required vehicle capacity
- Expected delivery time

C. Step 3: Vehicle Allocation

Arrange a suitable vehicle before harvesting begins.

D. Step 4: Loading Preparation

Prepare the vehicle and loading area.

E. Step 5: Controlled Loading

Load the produce carefully and systematically.

F. Step 6: Route Planning

Identify the appropriate route considering:

- Distance
- Road condition
- Traffic
- Destination
- Expected travel time

G. Step 7: Transit Monitoring

- Monitor departure time, route and expected arrival.

H. Step 8: Controlled Unloading

- Ensure careful unloading at the destination.

I. Step 9: Delivery Verification

Record:

- Quantity delivered
- Delivery time
- Damage/loss

- Destination confirmation

J. Step 10: Logistics Performance Review

Review:

- Delay
- Transit loss
- Vehicle utilization
- Transportation cost
- Operational problems

This creates a closed-loop logistics management system rather than a simple transportation arrangement.

XVIII. DISCUSSION

The study emphasizes that transportation should be treated as an integrated management activity within banana agribusiness.

The first important aspect is coordination between harvesting and transportation. Harvesting without confirmed transportation can create unnecessary waiting time. Similarly, arranging a vehicle without knowing the expected quantity can lead to underutilization or overloading.

The second aspect is vehicle selection. Different quantities and distances require different vehicle arrangements. A small vehicle may be suitable for local movement, whereas larger consignments may require trucks.

The third aspect is loading management. Transportation efficiency cannot be evaluated only by vehicle speed or travel distance. The way the produce is loaded can significantly influence its physical condition.

The fourth aspect is route management. A shorter route is not necessarily the most efficient route if road conditions are poor. Therefore, route selection should consider both distance and travel time.

The fifth aspect is transport monitoring. A basic record of dispatch time, arrival time and delivered quantity can help identify recurring transportation problems.

The sixth aspect is performance measurement. Transportation management requires measurable indicators. Suggested indicators include:

- Average transportation distance
 - Average delivery time
 - Average delay
 - Transit loss percentage
 - Vehicle utilization
 - Number of delayed deliveries
 - Transportation cost per unit
 - Number of loading-related damage incidents
- These indicators can be monitored monthly.

XIX. MANAGERIAL IMPLICATIONS

The findings of the proposed study can have practical implications for different stakeholders.

A. Implications for Banana Growers

Growers can improve transportation planning by arranging vehicles before harvesting. Maintaining contact with reliable vehicle operators can reduce uncertainty.

Farmers can also maintain basic transportation records to compare vehicle operators, travel time and transit losses.

B. Implications for Farmer Groups

Farmer groups can develop collective transportation arrangements.

Instead of every farmer arranging transportation independently, a group can consolidate produce and coordinate vehicles according to destination. This may improve vehicle utilization and reduce unnecessary trips.

C. Implications for Aggregators and Traders

Aggregators can introduce standardized loading and unloading procedures.

They can also maintain vehicle schedules and destination-wise dispatch plans.

Digital records can be used to monitor the movement of consignments.

D. Implications for Transport Operators

Transport operators can improve service quality by:

- Providing suitable vehicles
- Maintaining vehicle cleanliness
- Avoiding overloading
- Following agreed schedules
- Selecting appropriate routes
- Communicating delays in advance

E. Implications for Agribusiness Organizations

Agribusiness organizations dealing with banana can establish a basic logistics control system.

A centralized transportation register may contain:

- Date
- Farmer
- Quantity
- Vehicle
- Driver
- Destination
- Dispatch Time
- Arrival Time
- Loss

Such a system can provide management with useful operational information.

XX. PROPOSED KEY PERFORMANCE INDICATORS FOR BANANA TRANSPORTATION

A professional logistics system can use the following KPIs:

- 1) On-Time Delivery Rate
Percentage of consignments delivered within the planned time.
- 2) Transit Loss Percentage
Percentage difference between quantity dispatched and acceptable quantity received.
- 3) Vehicle Utilization
Extent to which available vehicle capacity is effectively utilized.
- 4) Average Transportation Delay

Average additional time beyond the planned transportation duration.

- 5) Transportation Cost per Unit
Transportation expenditure calculated against the quantity transported.
- 6) Loading Time
Time required from vehicle arrival until completion of loading.
- 7) Unloading Time
Time required to complete unloading at destination.
- 8) Vehicle Availability Rate
Percentage of planned transportation requirements for which vehicles were available when required.

XXI. CONCLUSION

Transportation and logistics management represent important but comparatively under-examined dimensions of banana agribusiness. The movement of banana produce involves several interconnected activities, including harvest coordination, vehicle arrangement, loading, route selection, transportation, unloading and delivery verification.

The comparative study of Jalgaon and Solapur is intended to provide a district-level understanding of these transportation practices. The study specifically focuses on operational logistics rather than production economics, profitability or marketing performance.

The proposed analytical framework considers transportation mode, vehicle arrangement, distance, loading practices, delays, transit losses and logistics constraints. By examining these variables systematically, the study can identify areas where transportation management can be strengthened.

A major management implication emerging from the framework is the need to shift from reactive transportation arrangements to planned logistics management. Instead of arranging vehicles only after harvesting begins, transportation requirements can be estimated in advance based on expected quantity, destination and delivery schedule.

Similarly, standardized loading procedures, route planning, delivery monitoring and post-transport performance review can improve operational control.

The proposed Banana Logistics Management Model provides a practical framework connecting harvesting with transportation planning, vehicle allocation, controlled loading, route selection, transit monitoring, unloading and performance evaluation.

Ultimately, efficient banana transportation requires coordination among growers, transport operators, traders, aggregators and other supply-chain participants. The proposed study provides a management-oriented framework that can be empirically tested using primary data from banana growers in Jalgaon and Solapur districts.

XXII. LIMITATIONS OF THE STUDY

The study has the following potential limitations:

- 1) The research is geographically limited to selected areas of Jalgaon and Solapur districts.
- 2) Transportation practices may differ across villages and production clusters.

- 3) Some transportation information may depend on respondent recall.
- 4) Transportation conditions may vary according to season.
- 5) Road conditions and vehicle availability may change over time.
- 6) Transit loss may be influenced by factors other than transportation, including harvesting and handling practices.
- 7) The study focuses primarily on transportation and logistics and therefore does not attempt to provide a complete analysis of the entire banana marketing system.
- 8) The tables presented in the research framework are not actual field findings and must be replaced with verified primary data.

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