STUDY ON THE TRANSPORT OF FRESH FRUITS BY ROAD:

The Case of Fresh Mangoes For Export in the Province of Zambales

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Abstract: The objective of this paper is to examine the factors that contribute to the damages of mangoes transported via the road network. A mathematical model was developed to relate some transportation parameters to the amount of damages incurred. The resulting model showed that the high level of physical damages incurred was due to the combined effects of (a) the use of vehicles with greater shocks and vibrations', (b) rough roads that cause bumps and accelerate physiological deterioration of the fruits', (c) the type of packaging material; and (d) the manner of handling the goods. Cost-effectiveness analysis revealed that the use of high tonnage/heavy vehicles are more appropriate in transporting fresh mangoes for export instead of smaller vehicles with less than two ton capacity. Results of this study serve as valuable inputs on the development of an efficient inter-modal goods movement system that will improve the agriculture sector competitive position in the international market.

Key Words: physical distribution, logistics, goods movement, road transport

1. INTRODUCTION

1.1 Introduction

One of the most important components in the marketing system in the Philippines that needs attention is the **physical distribution system**. Transportation problems stand in the way of efficiently distributing the produce, thus forcing the production of bulky perishable goods to be located near the market or in consuming areas because of high transport cost. The transportation cost of goods depends on the nature of the commodity to be hauled. In the case of perishables such as fruits, vegetables, milk, and other livestock products, they must be moved quickly to get them to their destinations before they spoil. Thus **distance, time, and the mode of conveyance used** become the important factors. Each of these factors commands

a price that affects the cost of transportation. Poor and expensive means of transport increase marketing costs and decrease the farm price for all commodities. This situation discourages commercial production in distant areas.

1.2 Rationale and Importance of the Study

The flow of agricultural commodities in the Philippines has various intermediaries due to the geographical locations of the supply areas and the demand centers. The commodities are either transported by various means of transportation network either by land, air, water or a combination of these three means of available transportation network in the country. Transporting perishable agricultural products through the land transportation network is the common practice. However, previous studies indicate that there is a high rate of spoilage, and a high cost involved in moving the commodity from the time it is harvested until it reaches its final destination. These costs can be in the form of the operating costs in transporting the commodity i.e. **loading cost, unloading cost,** and **transport cost**. It could also be in the form of **opportunity loss** as a result of the substantial reduction in profit particularly when the commodity is rejected because of damages during handling and transit.

In the case of the Philippine mango industry, road transport is a major factor that hinders the industry's opportunity to compete in the world market. Mango is the third most important fruit crop, next to banana and pineapple, in terms of area of production. However, inefficiency of the transportation network system of the country leads to the adoption of multiple and small-capacity land-based transport operations. Such conditions results in the double handling of goods and the fruits become more susceptible to physical damages that hastens ripening of the fruit. These conditions contribute to the high cost of transporting commodities which, in turn have a compounding effect on the selling prices of the commodity. If selling prices are high, demand for agricultural products is dampened. If demand is low, inducement to produce more is likewise low (Unson III, Marid Digest, 1990).

There have been a considerable number of studies investigating the damage process in fresh horticultural products during handling and transportation. The main point arising in these studies is the identification of the important parameters that result in damages. There are also some controversies raised about the whole damage process and how dynamic inputs from transportation sources cause the damage. In general, however, it is presumed that shocks and vibrations are the primary causes of physical damages in fruit products at the end of the distribution channel. (Marcondes and Robertson, 1996)

In this advanced age of information communication and technology, modernizing the country's economic sector calls for a sound transportation system. Changes in economic and technological developments result in changes in the mobility patterns of goods and consumers. Local land use planning should consider a balanced urban and rural growth. In particular, road networks should be carefully planned to allow the efficient transportation of goods from the rural to urban areas and vice versa.

The results of the study can also be an important input on the formulation of a comprehensive planning and design of transfer facilities for surface transportation. Since inter-modal traffic is the pattern of physical distribution in the Philippines, the unique requirements of transporting perishables should be studied in order to build or design appropriate inter-modal transfer facilities like new terminals or markets.

1.3 Objectives:

In general, the study aims to examine the integrally related and inherent parts of the **flow** of fresh mangoes for export. This study aims to determine the type and magnitude of loss due to the damages incurred during transit and in determining the dominant characteristics of the flow of exportable fresh mangoes from the farm to the selected export trading centers in Metro Manila. It will also identify the associated costs within the flow.

Specifically, the study has the following objectives:

- a. To describe the flow of moving fresh mangoes from the supply area to the trading centers. These include on knowing the participants of the flow, the mode of transport used, the practice of transportation arrangement, the status of vehicles used, the handling practices and materials used.
- b. To determine the type and magnitude of physical damages incurred at the intended destination.
- c. To determine the factors of damages and the various travel impediments encountered in moving the fruits.
- d. To identify the associated cost components of moving fresh mangoes by road and examine the magnitude of the cost incurred.
- e. To identify cost-effective means of transport by road used in the study area.
- f. To explore measures of improving the physical distribution by road of fresh mangoes for export.

1.4 Review of Related Literature

The many important points and areas of concerns in improving the transport of fresh fruits found in the review of previous studies are summarized as follows:

- Shocks and vibrations during transit are the primary causes of the appearance of physically damaged product at the end of the distribution channel. These damages are usually in the form of bruises and compressions.
- The type of vehicle that has softer suspensions provides a good ride to fruits since this type lowers the frequency and acceleration level of vibration, thereby reducing the effects of rough road surfaces.
- The quality of road and type of vehicle are the factors to be considered if fruit damages in transit have to be reduced.

 The type of packaging materials is also an important factor that can reduce crop damages during transit. Use of unnecessary and inappropriate packaging materials only add up to additional costs.

Moreover, the type of market is also another factor that needs to be considered. A cluttered type of market like those in Metro Manila where locations of re-packing stations and warehouses are not regulated result in locating these facilities to areas with road profile and intersections not suitable for a smooth maneuver particularly of heavy vehicles laden with fresh fruits.

2. RESEARCH DESIGN AND METHODOLOGY

2.1 Conceptual Framework

This study refers to the transport-related operation of moving the commodity. The study will investigate the inherently related parts of moving commodities with emphasis on the factors needed to operate the system. These factors include the infrastructure facilities, the means of transport, the packaging materials and the associated cost and time involved. The interrelationship of these parts and how they impact each other will be studied, so that losses in the form of physical damages, which in most instances resulted to commodity rejection, will be avoided. This study recognizes the constraints posed by inadequate and low level of technology in the transport of exportable fresh mangoes in Zambales.

2.2 Analytical Framework

Analysis on the magnitude of losses incurred shall be conducted by relating this to the condition of the road network system, the transfer facilities used, the type of vehicles used and the manner to which the fruits are handled. Likewise, analysis on the transport cost incurred for each type of operation will be done. It shall focus on the components of transportation costs incurred from operations such as loading cost, unloading cost, vehicle rental and other associated costs, which the respondents consider as part of the over-all transportation costs.

- Frequency distribution tables for all characteristics and aspects of the commodity flow being studied;
- Mathematical averages;
- Correlation matrices to determine the relationships of the identified variables (Only those variables that are statistically significant were included in the regression analysis);
- Regression analysis to test the statistical significance of the mean values particularly on the variable damages obtained from the frequency distribution tables. Series of iterations were conducted to arrive at the best-fit model. The criteria for model selection were (a) high value of R², to test the goodness-of-fit-of the model, i.e. larger value indicate that the

- Packaging materials plastic crates, boxes, bamboo crates, or mixed packaging materials (bamboo crates and plastic crates).
- Manner of handling refers to the actual load per trip where overloading and multiple piling are being practiced.
- Number of movements Each operation involves a minimum of three movements: loading, in transit, and unloading. The maximum number of moves practiced in the study area is five moves. These refer to operations using the double mode of transport.
- Condition of the routes used refers to the conditions as described by the respondents such as rough roads, narrow roads, and bridge under repair.

The effects of the above-mentioned factors on incurred damages are examined through multiple linear regression analysis. STATISTICA software permits the running of various regression models containing different factor combinations where dummy variables are used on variables which are qualitative in nature like using a value of 1 for the factor under study and 0 value otherwise. Initially, various variables were considered in the analysis but eventually dropped because of the insignificance of their values when combined with other variables. Only those that were highly correlated were used in the analysis, thus other parameters were dropped like distance and time. The variables used in the modeling and those were dropped out are as follows:

Variables of the meaningful model:

TRICYCLE - a small capacity means of transporting goods with a maximum capacity of 192 kilograms or 12 units of 12 kg bamboo crates;

HANDTRACTOR - medium capacity means of transporting goods with maximum capacity of 34 units of plastic crates;

BAMBOO - type of packaging material used with a maximum capacity of 12 kilograms;

MIXED - type of packaging material used, a combination of a 24-kg plastic crates and a 12 kg bamboo crates;

LOADPERTRIP - the volume of actual loading of fresh fruits in a vehicle per trip;

ROUGHROAD - the overall condition of the road of the routes used from the farm to the buying stations as described by the respondents;

Variables used in the analysis but eventually dropped:

NARROWROAD - condition of the road and the routes used from the farms to the buying stations;

BRIGDUNDER- condition of the bridges within the routes used

DISTANCE - the distance traveled in kilometers

TRAVTIME - the length of travel in minutes

LOADSPEED - speed of loading in kilograms per minute

TRAVSPEED - speed of travel in kilometers per minute

UNLDSPEED - speed of unloading in kilograms per minute

The variables that were dropped became insignificant when combined with other variables. Their presence affects the model's good fit by either lowering the value of R^2 or making significant explanatory variables insignificant, or both. These variables when added to the equation, affects the sign of the other variables making the theory illogical. Hence, for

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the fruit. Thus, the longer and heavier the force applied to the fruits the more deformation can appear on the fruits. Black blemishes appear over a period of time as evidence of the physical damages.

An ocular inspection on some buying stations and farms was done at the study area. The study area (Zambales) is located at the western coast of Central Luzon sharing common boundaries with Pangasinan on the north, Tarlac and Pampanga on the east, Olongapo City and Bataan on the south, and the China Sea on the west. The province grows agricultural crops, engages in commercial fishing and contributes almost half of central Luzon's mango output.

3. ANALYSIS OF FACTORS OF PHYSICAL DAMAGES AND COST-EFFECTIVENESS OF TRANSPORT OPERATIONS

3.1 Analysis of the Factors of Damages

The complex operation of protecting the goods from damages during transport prompted the researcher to empirically explain the possible factors that could affect the occurrence of damages. A multiple-linear regression analysis is conducted to test the relationship between the levels and the factors of damages. The purpose of determining the sources of damage is to be able to avoid them. The analysis considers the damage at the end of the intended distribution channel, which, in this case, the buying stations within the province of Zambales (i.e. for the province flow only).

This study illustrates two commodity flows. The first one involves the flow of fruits from the supply area to the buying stations located within the province, while the second flow of fruits is from the supply areas brought directly to the exporters' warehouse in Metro Manila. The buying stations at the province are the exporters' collection centers where fresh fruits are evaluated for export. Analysis on the factors of damages was conducted during operations at the buying stations where big volumes of fresh mangoes are rejected for export due to physical damages.

It is assumed that physical damage (Y) (expressed in percent) is a direct function of the combined effects of transport and handling factors. Results of the survey reveal various factors influencing the high occurrence of physical damages. For purposes of analysis, these factors are considered the explanatory variables (X1, X2...Xn) that influence the occurrence of the damages (Y). Thus, the equation that expresses the occurrence of damages are the following: (a) mode of transport; (b) type of packaging materials; (c) the manner of handling; (d) number of movements; and (e) the condition of the routes used. When these factors were combined depending upon the participants' choice of transport, different levels of physical damages are produced to the load of fruits are made, as follows:

• Mode of transport for the province flow usually employ a single mode or a double mode of transport as follows: for the single mode, the use of a one-tonner passenger type jeepney, tricycle, or hand-tractors alone; for the double mode – a combination of any of the available means of transport such as walking, tricycle, motorboat, and/or owner type jeep.

- Packaging materials plastic crates, boxes, bamboo crates, or mixed packaging materials (bamboo crates and plastic crates).
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- Number of movements Each operation involves a minimum of three movements: loading, in transit, and unloading. The maximum number of moves practiced in the study area is five moves. These refer to operations using the double mode of transport.
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The variables that were dropped became insignificant when combined with other variables. Their presence affects the model's good fit by either lowering the value of R^2 or making significant explanatory variables insignificant, or both. These variables when added to the equation, affects the sign of the other variables making the theory illogical. Hence, for

purposes of this study, only seven models that garnered good results were considered. Out of these models, model number seven is meaningful in capturing the explanatory factors that influence the high occurrence of damages. The seventh iteration came out to be the model that explains the high occurrence of physical damage by considering the "p"-values of the explanatory variables.

The resulting statistical estimate of the physical damage function (Y) is as follows:

% Damage (Y) = -5.74 + 12.16TRICYCLE + 15.17HANDTRACTOR + 9.96BAMBOO + 7.24 MIX + 4.07NUMMOVES + 0.007LOADTRIP + 4.72ROUGHROAD

Equation (1.)

where:

TRICYCLE: equal to 1 if tricycle is used; 0 otherwise HANDTRACTOR: equal to 1 if hand-tractor is used; 0 otherwise BAMBOO: equal to 1 if bamboo crates packaging materials are used; 0 otherwise MIXED: equal to 1 if mixed packaging materials are used; 0 otherwise NUMMOVES: equal to 1 if number of moves are 3; 0 otherwise

ROUGHROAD: equal to 1 if it uses routes with rough roads; 0 otherwise.

The chosen model, which has a coefficient multiple determination (R^2) of 0.5507, indicates that about 55 percent of the variation in the level of physical damages is explained by the changes in (a) the use of vehicle (i.e from tricycle or hand-tractors to other means); (b) use of packaging materials (i.e from bamboo and mixed to other types); (c) number of movements (i.e from three movements to five movements); (d) volume of actual load per trip (i.e from overloading to under-loading); and (e) the routes used and the roughness of the roads. Details of the attributes of the chosen model are shown in Table1.

N=48	BETA	ST. ERR. OF BETA	ndition of B by the resp	ST. ERR. OF B	T(40)	P=LEVEL
Intercept			-5.74477	10.01653	573529	.569497
TRICYCLE	.330464	.145835	12.16352	5.36782	2.266009	.028934
HANDTRACTOR	.629880	.145835	15.16588	3.53074	4.295382	.000108
BAMBOO	.327706	.146641	9.95740	3.36900	2.955592	.005211
MIXED	.437444	.110876	7.24012	2.57292	2.813968	.007553
NUMMOVES	.432134	.155455	4.07158	1.87950	2.166308	.036303
LOAD TRIP	.710395	.251560	.00671	.00238	2.823955	.007360
ROUGHROAD	.250266	.112413	4.71603	2.11833	2.226301	.031692

Table 1. Multiple Regression Result for Dependent Variable: DAMAGES

The empirical result of the model shows that utilization of hand tractor is positively correlated with the damages identified in the sample. One possible reason for this is that this vehicle does not have a good shock absorber or strong suspension relative to the weight it carries. The up-and-down motion of the vehicle while traveling on rough roads affects the packed goods inside the vehicle. Furthermore, this type of vehicle jerks when started causing injury to the commodity even at the start of the travel.

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These results are supported by the positive relationship between the number of transfers before the goods reach their destination and damages incurred. The utilization of bamboo packaging materials is also a reason for the high probability of damage. Results are the same when the packaging used is of mixed materials. Bamboo crates and the use of mixed packaging materials have been proven in earlier studies as unsuitable for transporting perishables especially if the objective is to maintain the quality of the fruits while in transit. Bamboo crates are not strong enough in protecting perishables considering the volume to be transported and the distance to be traveled. Likewise, bamboo crates are not easy to handle because of their rough materials.

The quality of the roads can explain the extent of damages. Compounded by the fact that the vehicle used easily jerks, trips covering short distances on rough roads may also result in large number of damaged mangoes. This can also be related to the practice of overloading. The pressure applied by the load on top to the goods underneath during transit adds to the damages of the goods.

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3.2 The Least-Cost and Cost-Effective Means of Transport

Least cost and cost effective analyses of the transport operations were performed only in the provincial flow and the small and medium-capacity vehicles due to limited data.

Cost-effective analysis was conducted to determine which of the various transport operations is most cost-effective i.e. which has the **least cost** and the most efficient means of transport operation. Transport operation refers to the combination of the choice of transport arrangement (i.e. delivery or pick up), status of the vehicle used whether owned or rented, and the means of transport used for each trip in transporting fresh mangoes from the supply areas to the intended destinations (for this analysis, the destinations are the buying stations in the province only).

In particular, least-cost analysis is done to compare the cost and effectiveness ratio of the various options of operations. The effectiveness-cost (E-C) ratio is then derived using the volume of fresh mangoes accepted for export as the criteria for effectiveness. The accepted volume is computed using the estimated damages discussed earlier. For this study, the resulting E-C ratio that yields the highest value is considered the most cost effective operation in transporting fresh mangoes.

Highlights of the analysis are as follows:

- In terms of type of vehicle, the tricycle has lesser damages incurred per trip compared to the hand-tractor.
- Considering that the exporters' minimum requirement per transaction is half ton, the study shows that the volume of rejects resulting from the use of the small and medium capacity vehicles depend on the type of packaging materials used.

• If the cost of transport and packaging materials are considered, the use of a mediumcapacity vehicle (hand-tractor) and a bamboo crate as the packaging material is a costeffective means of transporting fruits.

4. FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

- intoco ctates are not strong enough in protecting perishables considering the volume to be reported and the distance to be traveled. Likewise, hamboo crates are not easy to handle cause of their rough materials. and the statistic states are not easy to handle the second states are rough materials.
- There are two major commodity flows in the study area (Figure 1.0). These are the flow of fresh mangoes from the supply areas to the buying stations within the province and the flow of the commodity from the supply areas directly to the exporters' warehouses located in Metro Manila. Both systems of commodity flows are participated by growers, sprayer-traders, contract-buyers, and the exporters. The participation of growers in the Metro Manila flow is a good indication that multiple handling of fresh mangoes in Zambales can be minimized.



Figure 1.0 Flow of Fresh Mangoes for Export in the Study Area

- Notably, the survey show a combination pattern of motorized and non-motorized means of transport as follows:
 - one-tonner passenger type jeepney
 - three-tonner truck
 - tricycle
 - hand-tractor
 - walking/tricycle
 - animal driven cart/ tricycle
 - motorboat/owner type jeep
- Consolidation of mangoes for export at the exporters' buying stations is still the dominant practice of product distribution in the study area. Product distribution involves multiple handling of the goods resulting in damages. The load of fresh mangoes brought to the buying stations were in turn transported in bulk to the exporters' packaging houses or warehouses located in Metro Manila. However, the presence of buying stations in the study area encourages farmer-growers to bring their mangoes to trading centers located within the province instead of bringing them directly to Metro Manila.
- The means of transport that is widely used in the provincial flow are the medium and small capacity vehicles (less than one ton and half ton respectively). The use of rented vehicles in transporting fresh mangoes is the dominant practice. This is an indication of various factors such as (a) small scale production of mangoes in the study area; (b) lack of large capacity vehicles in the study area; or (c) an accessibility problem by large capacity motorized means of transport in the area.
- The types of packaging materials used are bamboo crates, plastic crates, boxes and a mixed of bamboo and plastic crates. Growers prefer to use bamboo crates for their packaging to cut down on their operating expenses. This could be due to the low capital position of the growers. The unit cost of the packaging materials are as follows:
 - For a 12-kg bamboo crate unit cost is PhP 15 each
 - For a 12-kg box unit cost is PhP 60 each.
 - For a 24-kg plastic crate unit cost is PhP 300 each (returnable or re-usable)
- The most common types of physical damages incurred in transporting fresh mangoes in the study area are bruises and compressions. Notably, most of the physical damages incurred were bruises. These damages are due to the combined effects of the mode of vehicles used together with the other factors that go with the use of the vehicles such as unsound and multiple handling, use of bamboo crates and mixed packaging materials, and passing through rough roads. The impact of the above mentioned factors to damages result in a high level of product rejection for export that subsequently result to reduced benefits.
- The resulting damage estimator shown in equation 1 indicates that physical damages relating to transport and handling of fresh mangoes in the study area are explained by the physical factors that affect transport operations rather than the time factor. This could be influenced by the larger magnitude of the respondents (mostly growers) in the province flow (Figure 1.). With the participants using both highways and rural access roads, its is shown that damages are brought about by a combination of the following factors:

- using vehicles such as hand-tractors and tricycles that do not have good shock absorbers or strong suspensions;
- use of bamboo crates and mixed packaging materials;
- passing through rough roads that aggravate the ill effects of vehicles described earlier and it causes bumps and mechanical damage thereby accelerating physiological deterioration of the fruits and
- the practice of unsound handling such as multiple piling and overloading.
- The presence of the abovementioned physical factors is contributory to the occurrence of damages in fresh mangoes traded in the study area. The estimated volume of damaged mangoes per trip using equation 1 are as follows:
 - Using a tricycle:
 - 0.048 ton using bamboo crates
 - 0.043 ton using mixed packaging materials
 - 0.036 ton using plastic crates
 - 2 0.029 ton using boxes and large mand of answords term of equationary sense vibule
 - Using a hand-tractor:
 - 0.167 kilograms using bamboo crates
 - 0.151 ton using mixed packaging materials
 - 0.130 ton using plastic crates
 - 0.108 ton using boxes

These findings are estimates of the mathematical model derived from the processed data using the resulting physical damage estimator shown in equation 1.

- Using the model as the estimator of damages, the study shows that using packaging materials of lesser cost increases the benefits of transporting fresh mangoes than in reducing the transport cost and the time incurred in travel and handling. In particular, using boxes as packaging materials and a medium capacity vehicle (hand-tractor) as a means of transport is a cost-effective means of transporting the fruits. It will generate a net benefit of PhP 20,607.84 for every half-ton traded at PhP 31.00 per kilo compared to a net benefit of PhP 19,076.06 using the tricycle as the means of transport. For small capacity vehicles, the benefits for the minimum volume of half ton accepted for export are reduced by almost half 44.50% if plastic crates or boxes are used while for medium capacity vehicles, the benefits are reduced by about 43.00%.
- Considering the transport operation, the use of large vehicle has the least cost in transporting the fruits. The transport cost for large vehicles per ton-km in the province flow is only PhP 31.00 compared to the small capacity vehicles that ranges from PhP 802.00 per ton-km to PhP 1,589.00 per ton-km.
- In terms of the damages incurred, the equivalent amount of loss for using a tricycle ranges from PhP 807.67 to PhP 1,514.19 per trip based on the buying price at PhP 31 per kilogram for export and PhP 22 per kilogram for non-export quality. Using hand-tractor will incur damages ranging from PhP 1,002.61 to PhP 1,766.27 per trip.
- The study finds that more damages are incurred more with the use of hand-tractors and bamboo crates although the cost of bamboo crates are much lesser compared to the other

types of packaging materials. This could be the major reason for the dominant use of this type of packaging material in the study area. For long-term operations, the use of plastic crates is more advisable since this type of packaging material is re-usable. In terms of vehicle capacity, large capacity vehicles (at least one ton capacity) are more advisable because these entail lesser transport cost in terms of the volume transported and incur lesser physical damages.

4.2 Recommendations

The following measures are proposed to address (a) the issue on high levels of physical damages incurred during transit and handling, and (b) opportunities for improving the physical distribution system for fresh fruits:

- Conduct of information campaign and training on (a) proper choice of transport; (b) use of appropriate packaging materials and; (c) sound handling such as minimization or avoidance of overloading and multiple piling;
- A collaborative effort with the concerned national government units, Local Government Units (LGUs) and the financing institutions in providing technical, managerial, and financial assistance to the small-scale growers. The assistance required should aim at establishing a commodity collection center for bulk handling to be managed by an association of mango growers. Consolidating the association into a federation is a good strategy for mobilizing resources to enhance the economic position of the growers to avail of necessary technical and financial assistance from formal institutions. Specifically, the assistance to be extended to mango growers should result in (a) the enhancement of their capital for the procurement of packaging materials; (b) the procurement of large vehicles for bulk handling; and (c) training on various techniques necessary for reducing physical damages during transit and handling.

4.3 Further Direction of the Study

The complexity of protecting fresh fruits from damage during transit and handling has a wide potential for research and planning. This study therefore suggests the following directions for future studies:

- Determining the volume of produce consolidated in the province of Zambales through the buying stations and transported to Metro Manila focusing on (a) the transport operations, and (b) the type and magnitude of damages incurred;
- Improving indigenous packaging materials considering the type of vehicles available and the road profile;
- Minimizing damages of fresh fruits during transit by simulating the effects of the type of road profile, the type of packaging materials, and the type of vehicle used;
- Comparing the physical damages and transport costs incurred among various supply areas focusing on the transport operations employed in each area.

- Feasibility study for the establishment of a collection center managed by growers with the purpose of engaging trucking businesses not only for fresh mangoes but also for other agricultural commodities.
- A cost-benefit analysis for upgrading the farm-to-market roads in areas with a high production of exportable fresh mangoes.
- A study that identifies the location and design of the needed infrastructure, ensure that market terminals are accessible, and transfer facilities and storage facilities are efficient for the transfer of goods, while at the same time maintaining access of customers to each of these areas.
- A study that explores/recommends possible standards/criteria for the prioritization of infrastructure development projects that will improve the country's transportation services focusing on supporting the distribution of perishables.
- A study that can trigger/spearhead the establishment of a physical distribution system that includes integrated cold room facilities at production sites, transportation means to markets, and cold storage facilities at retail outlets.

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