FRUIT MARKETING IN SAUDI ARABIA

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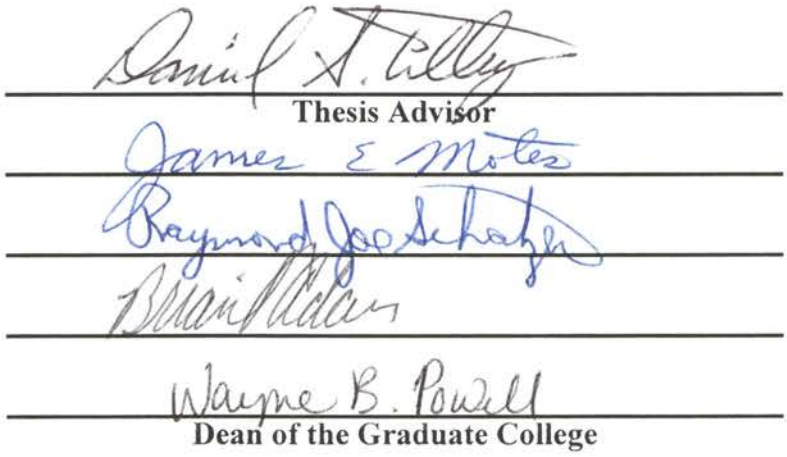

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PREFACE

The study was conducted to provide new knowledge about the impact of market institutions, quality characteristics and import demand on fruit price variations in Saudi Arabia. First, the market institutions were analyzed in order to give an idea about who operates the components of the fruit marketing system. Touring the three main fruit markets in Saudi Arabia and meeting with the key players resulted in a clear picture about how the market performed and how it can be improved in the future. Second, a model of hedonic prices - implicit prices of quality attributes - was developed for apples, grapes, peaches and pears. The relative importance of various quality attributes was estimated with regression analysis. Daily sales data of fruits for one season in Saudi Arabia was used. Results indicate that producer prices were sensitive to variation in variety, package, market and seasonality. Third, a Restricted Source-Differentiated, Almost-Ideal Demand System (RSDAIDS) was estimated for apples, grapes, almonds, pears and other imported fruit in Saudi Arabia. The RSDAIDS was found to provide an excellent explanation of variation in Saudi Arabia fruit imports from America (U.S. and Chile) and other sources.

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NOMENCLATURE

AIDS	Almost Ideal Demand System
C	Celsius (temperature)
F	Fahrenheit (temperature)
GDP	Gross Domestic Product
GNP	Gross National Product
HADCO	Hayel Agricultural Development Corporation
ICM	Input Characteristics Model
JADCO	Al-Jouf Agricultural Development Corporation
MOFNE	Ministry of Finance and National Economy
OLS	Ordinary Least Squares
OVIS	Orchard-Vineyard Irrigation System
PIGLOG	Parameterization of Price Independent Generalized Logarithmic
ROW	Rest of the World
RSDAIDS	Restricted Source Differentiated Almost Ideal Demand Systems
SHAZAM	Computer Package for Statistics Programs
SR	Saudi Riyal (currency)
TADCO	Tabuk Agricultural Development Corporation
USDA	United States Department of Agriculture

CHAPTER I

INTRODUCTION

Saudi Arabia is considered a one-product economy, heavily dependent upon oil. After the oil embargo in 1973, the Saudi government encouraged development of other sectors (especially the private sectors) and thus began diversifying the economy. The strategies of the current Saudi development plan are to decrease dependence on the oil sector and increase reliance on other economic forces such as private investment, personal and corporate taxation, and development of bond markets. Consequently, in the 1984/85 budget, oil and non-oil revenues contributed 40 and 60 percent, respectively of government receipts compared to 65 and 35 percent in the 1979/80 budget (Kahtani, 1989) which indicates Saudi Arabia has taken steps to diversify its economy.

Since the start of the diversification, the agricultural sector has been one of the fastest growing sectors. An estimated 40 billion dollars has been spent on agricultural infrastructure and subsidized farm inputs during the last decade. As a result of this large subsidy, the annual average growth rate of the agricultural sector increased from 5.2 percent in the 1970's to 8.7 percent in the 1980-1985 period. The growth rate led to agriculture's contribution of about 5 percent in non-oil GDP for 1985 (Kahtani, 1989).

Saudi Arabia has achieved self-sufficiency in wheat, eggs, and dates. Also, there has been success in expanding production of broilers, dairy products, vegetables and fruits. The area under cultivation expanded from 150,000 acres in 1974 to about 2.3 million acres in 1984. Even though agricultural output has increased due to the heavy subsidies, Saudi Arabia still imports about 70 percent of its agricultural commodities from

international markets, which is estimated to be one of the world's highest per capita import levels.

The Saudi government policy goals include a high level of self-sufficiency in foodstuffs and stable prices of the basic food commodities. Those groups included in the agricultural and food subsidy system are producers and consumers. Producer subsidies include commodity price supports; free land grants; 45 percent subsidy on major farm implements; 50 percent subsidy on fertilizer, seed, and imported farm machinery; and interest free production loans. Direct consumer subsidies in 1984 were estimated at 20 percent on milk, 25 percent on cooking oil, 15 percent on sugar, and 70 percent on bread (Gardener, 1985).

During the last decade, the demand for basic food commodities increased dramatically in Saudi Arabia. There are several social and economic factors causing this rapid increase in consumption of basic foods. Population has grown from 13.61 million in 1987 to about 18.84 million in 1996 (Monthly Bulletin of Statistics, Jan. 1998). Because of high wages and a large increase in the number of development projects launched by the government, there are many foreign workers in Saudi Arabia drawn from all over the world. The census shows the number of foreign workers at about 1.5 million from the Middle East and East African countries; between 2 and 2.5 million are from India, Sri Lanka, Pakistan, Bangladesh, Thailand, Philippines, Malaysia, the republic of Korea, and Turkey; 100,000 are from the North African Arab countries; and about one million are from North America and Europe. Obviously, the level of consumption and personal preferences and tastes are varied among these groups.

Not only has the total population increased, but the structure and pattern of consumption has been changing among the Saudi population. Real per capita income grew from 26800 SR in 1990 to 27358 SR in 1996. The level of education has risen very sharply because of free education scholarships given to Saudi students for training abroad. This higher level of education has increased literacy levels and improved health standards. Improved medical care has reduced the infant mortality rate and extended the life expectancy of the average Saudi citizen. These factors, along with average real income, have improved the standard of living and changed significantly the structure and pattern of consumption.

Consumer subsidies also have had an impact on food demand. The total direct consumer subsidy was estimated to be about $6.619 billion for six years from 1980-1985 (Ministry of Finance and National Economy) (MOFNE). The Saudi government also heavily subsidizes water, electricity, and gasoline, which cause an increase in expenditure available to spend on food. Even with the decrease in oil revenues the last few years, Saudi Arabia is likely to continue providing government services and subsidies to maintain high standards of living for its people.

Problem Statement

Previous studies (Aphar, 1979) have concluded that Saudi Arabia has succeeded in increasing its agricultural production of cereals, fruits, and vegetables. Recently, the government policy of reducing the wheat production has led to the increase in fruit and vegetable production. Though natural water is in short supply, agribusiness firms have successfully produced these crops making large investments using modern irrigation technology (Figure 1).

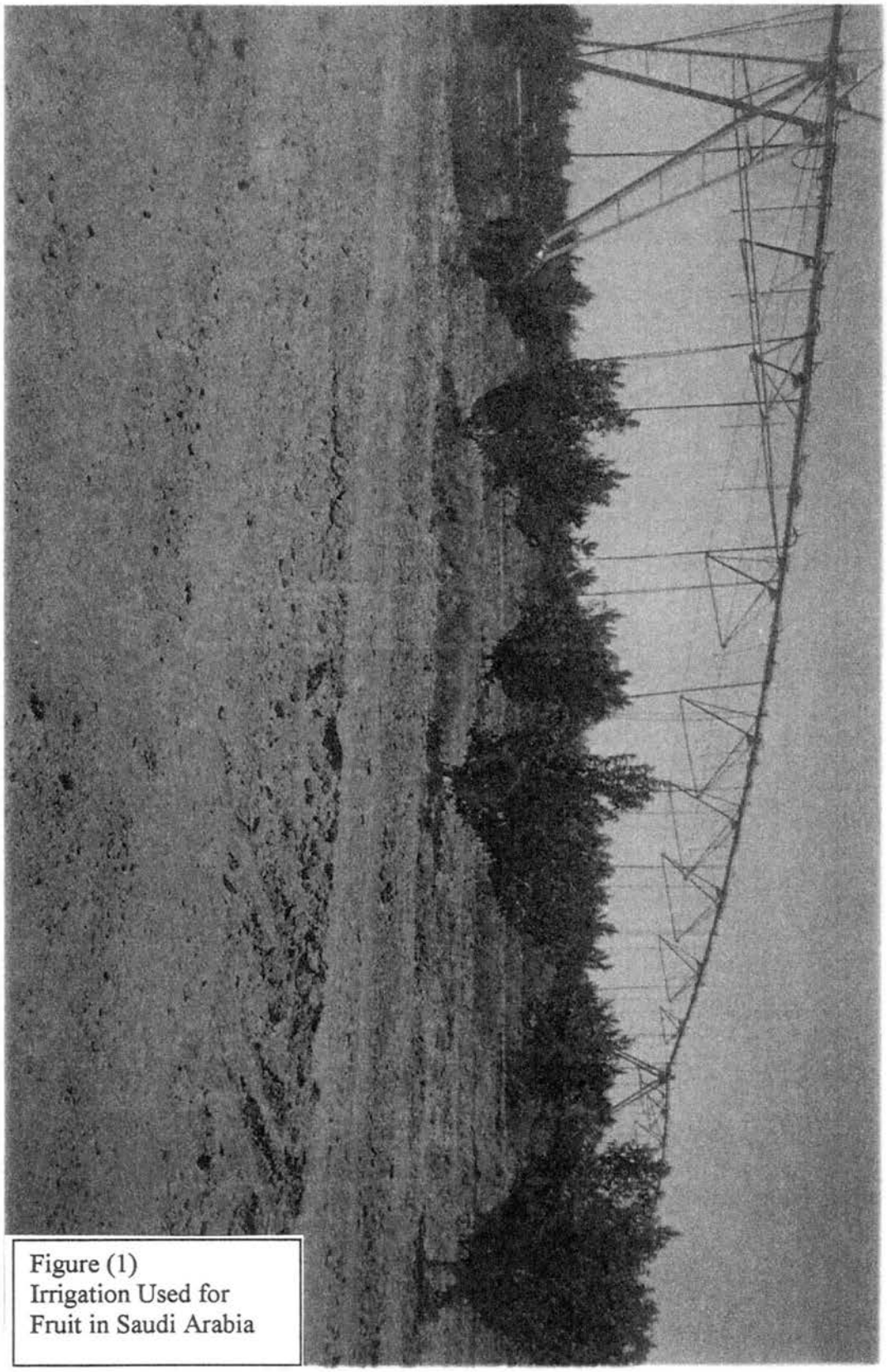

Figure (1)
Irrigation Used for
Fruit in Saudi Arabia

Government incentives for the projects, which have contributed heavily in the agricultural development planned by the government, include free land and long-term loans without interest. As a result, there has been excess supply of these crops during the harvest season. Unfortunately, the agribusiness firms have planned for successful production without an adequate evaluation of competition from imports or a marketing plan. Table 1 shows the total production of some types of fruits produced by TADCO, A Saudi agribusiness firm. Numerous fruit-marketing problems have constrained the full development of the production capacity. Inadequate evaluation of the importance of product characteristics and limited information about the nature of the market for imported fruits have been translated into lower producer prices and higher prices paid by the consumers. Fruit producers do not know what the consumers want, and they do not know the value of their product relative to imports. Agribusiness firms, who believe that the problem is not excess fruit supply but the free trade and the open market that Saudi Arabia has, have asked the government for policies to reduce or prevent fruit imports during the domestic harvest seasons. They believe that such restrictions may eliminate the problem and improve their share of the consumers' incomes without affecting the consumers. The Saudi government has not accepted this approach because of long-term trade agreements. However, the government is willing to keep these firms in business as an important part of the agricultural development projects and because of the investment made in the production sector. Studying market institutions is important in knowing who performs the marketing process, what is the nature of the market, and the role of the government. The value of fruit products is characterized by many factors. Different varieties, grades, and seasonality have a vital role in determining fruit prices paid by the consumers. Fruit producers should

know the value of quality attributes when making production and marketing decisions. The analysis of the values of various quality factors falls under the area of hedonic pricing. Lastly, in consideration for competition, it is important for fruit producers to know the nature of the fruit import market. Mainly, there are three important research questions to be answered. First, who operates the components of the fruit marketing system and under what conditions? Second, do the fruit product characteristics such as variety, grade, and seasonality matter when making economic decisions? Third, what is the nature of the fruit import market, specifically, quantities, value and source of origin.

Objectives of the Study

The overall objective is to increase the marketing efficiency of the fruit marketing system for the Saudi agribusiness firms and to provide information that both private sector and government officials can use to improve decision making in the development planning process. The three specific objectives are to:

1. Analyze the marketing institutions to answer the question of who operates the components of the marketing system.
2. Determine the role of product characteristics in explaining variation in prices of heterogeneous products, and
3. Determine the nature of the Saudi fruit market and to estimate fruit import demand functions together using a source differentiated model.

Importance of the Study

It is important that both the government of Saudi Arabia and the private sector anticipate the effects of these changes on growth of food demand and to focus on food policies that contribute to the overall development goals of private sector orientation to

market development. However, the analytical and empirical research base in Saudi Arabia is limited in providing policy makers in both the public and private sector an understanding of the potential impacts of these changes. The private sector in Saudi Arabia and more specifically the agribusiness firms have contributed heavily in the development planning set by the government. Marketing institutions will be analyzed using Tabuk Agricultural Development Company (TADCO) as an example to illustrate the vital role of the agribusiness firms in agricultural production and marketing. Then analysis of hedonic pricing model, which will help in improving knowledge fruit prices by estimating how seasonality, variety, package, and grade affect fruit prices for TADCO. Finally, the analysis of fruit import demand system by source of origin would be a helpful tool in providing information to policy makers in both the public and private sector for formulating and evaluating economic plans and future policies.

Neither hedonic fruit pricing or fruit import demand systems have been estimated in Saudi Arabia. An overview and historical background about Saudi Arabia will be presented to make the picture clear.

Organization of the Study

An overview and background about Saudi Arabia will be given in Chapter 2. Fruit markets with detailed qualitative and quantitative descriptions of the market institutions are presented in Chapter 3. The fruit hedonic pricing model is estimated in Chapter 4, and the fruit import demand system is estimated and presented in Chapter 5. Finally, a summary and conclusions are presented in Chapter 6.

CHAPTER (2)

THE KINGDOM OF SAUDI ARABIA

Introduction

Saudi Arabia (Figure 2) extends over an area of about 2.25 million square kilometers, which is equivalent to about four-fifths of the Arabian Peninsula (El Khatib, 1980). The Arabian Peninsula extends between altitude North 12° and North 38°. The Peninsula is only 12° above the equator. This location makes the peninsula a hot desert zone (Al-Ibrahim, 1990). In the past, it was difficult to acquire dependable statistics about the population in Saudi Arabia because of the continuous movement of the nomadic Bedouins to wherever they could find grazing and water. The government of Saudi Arabia made it easy for the Bedouins by the great agricultural settlement projects. As a result, now it is easy to get an accurate population census. The latest total national population was estimated to be 18.84 million in 1996 (Monthly Bulletin of Statistics, 1998).

Meteorology

The Arabian Peninsula is characterized by a hot climate, which is subjected for most of the year to northerly winds moving from the eastern Mediterranean toward the Arabian Gulf. Average annual air temperature is 33.4° C. in summer and 14° C. in winter (El Khatib, 1980). Average daily temperature during the summer months exceeds 38° C. and sometimes reaches 49° C. in the eastern, central, and western parts of the nation (Al-Ibrahim, 1990). Relative humidity is low except along or near the coastal zone where it exceeds 90 percent.

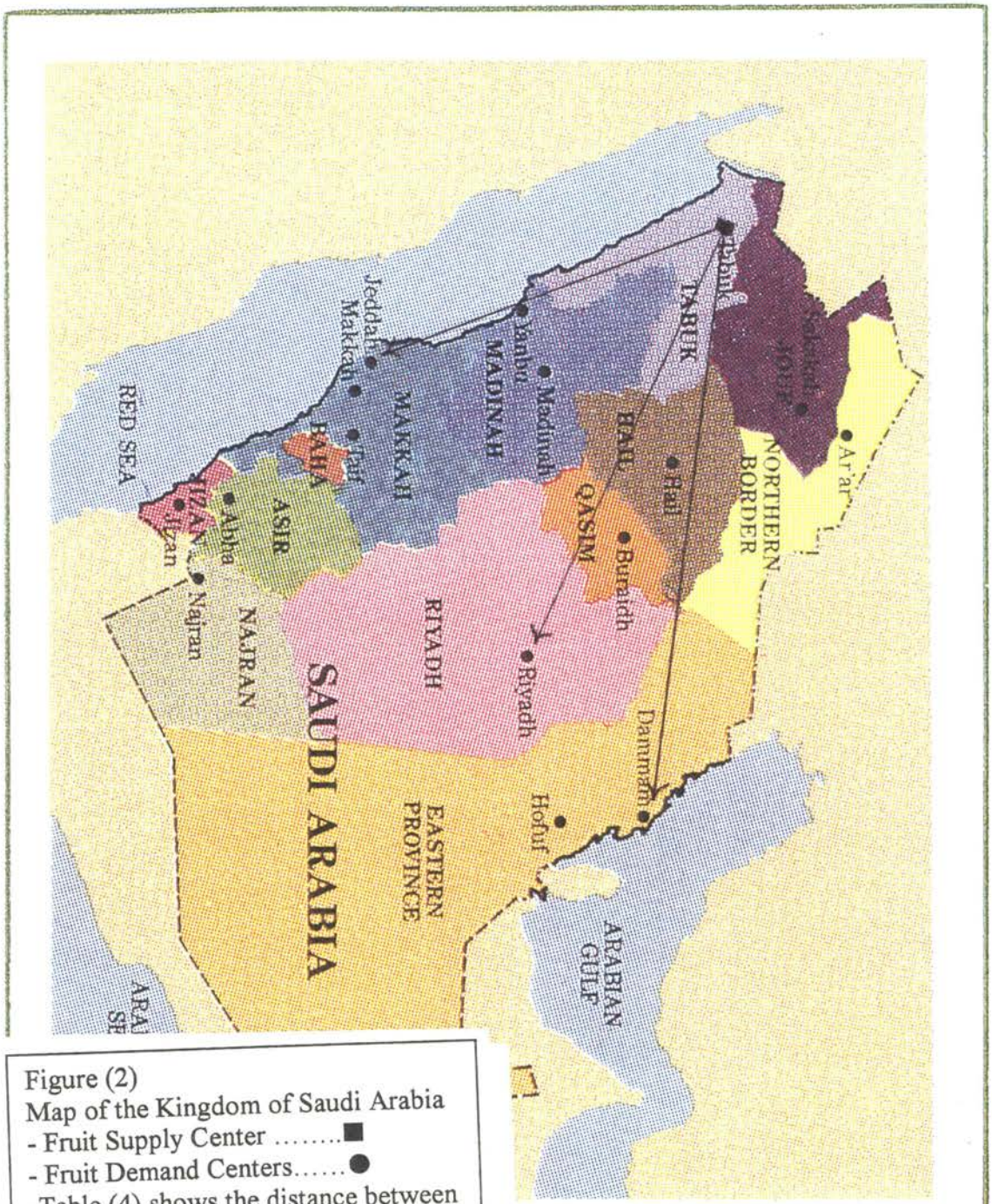

Figure (2)
Map of the Kingdom of Saudi Arabia
- Fruit Supply Center .....■
- Fruit Demand Centers.....●
-Table (4) shows the distance between supply center and demand centers.

Precipitation in the upper two-thirds of the nation is extremely low, unpredictable and erratic. There is high variation from one year to another and long periods are without rain. Rainfall is very local when it occurs and often takes the form of violent storms of short duration. The intensity of the rainfall during such storms is far in excess of the capacity of the land to absorb it. Thus, the high rates of runoff leads to a rapid filling of wadi beds and sometimes severe erosion and destruction. The average annual rainfall is less than 100 millimeters. Most of it falls between December and March and serves mainly for the development of range vegetation (El Khatib, 1980), which indicates the low average rainfall. The average annual rainfall varies from 20 millimeters in the northern part of the nation to 500 millimeters in the southern parts of the nation (Al-Ibrahim, 1990).

Soils

Saudi Arabia contains three main geologic regions: the coastal plains, the Arabian shield, and the sedimentary Basin. The soils in these geologic regions, except for wadis and oases, are generally coarse textured and shallow overlying lithic or paralithic contact. The subsoil often contains gypsic and/or clacic horizons. The common soils in those zones are members of the great soil groups: i) torripsamments; ii) calciorthids.

Three vast areas of sand and dunes overlie about 40 percent of the Arabian Peninsula as well as Saudi Arabia:

1. The great Nefud that covers some 375000 km^2.
2. The Rub Al-Khali desert which extends for about 1200-1500 km North-East to the Arabian Gulf, and

3. The Dahna Desert that connects the great Nefud with the Rub Al-Khali. Because of the arid climate and physiographic features of Saudi Arabia, the desert soils, which cover the great parts of the nation, are mostly saline and alkaline.

Water Resources

Potential national water resources exist naturally in the form of groundwater and surface water. The sources are hydrological connected at some places. Such connection occurs when surface runoff infiltrates into the subsurface to form groundwater. Groundwater is the most essential water source in Saudi Arabia. It accounts for more than 83 percent of the national water resources (Saudi Fifth Development Plan, 1990).

Surface water is the second essential water source in Saudi Arabia. The potential annual supply of surface water is estimated at about 900 million cubic meters if the existing dams are used efficiently (Bahanshal, 1989; Al-Ibrahim, 1990). The Saudi government allocated a substantial amount of public investment to develop new water sources including seawater desalination plants and wastewater treatment plants.

Agricultural Lands

Agriculture in Saudi Arabia has traditionally centered on scattered oases and wadi channels where springs and shallow groundwater are available or where rainfall alone is sufficient for cropping. In the past, Saudi Arabia did not have secondary industries for processing agricultural products because of the harsh climatic conditions and a lack of irrigation water for agriculture. The lack of irrigation water, the absence of adequate storage facilities, and the high cost of transportation restrained efforts to expand national production above the subsistence level (El Khatib, 1980). Modern irrigation technology such as the dripping, sprinkler, and trickle systems has been widely used in agriculture. It

has been concluded that the sprinkler irrigation system is superior over the other irrigation systems (Al-Abdulgader, 1996).

Exports of agricultural products have been limited to non-perishable commodities such as wheat, dates, and livestock. Some vegetables such as onions, potatoes, tomatoes, and watermelon are exported to neighboring countries. Between 1987 and 1990, average annual exports of agricultural products were 1.7 million tons, 85 percent of which was wheat. Over the same period, total F.O.B. export values increased from 835 to 1174 million Riyals. Imports of agricultural products, on the other hand, declined by about 55 percent between 1987-1990, from 7904 to 3569 million tons. Consequently, the C. I. F. value of imports fell over the same time period by 12 percent, from 7332 to 6450 million Riyals (Agricultural Production and its Impact on Foreign Trade, 1994).

Land title particularly in cultivated regions has relied mainly on memory because there is no central land registry authority through which ownership of land can be established. There are main four categories of land ownership: (1) the dead or wasteland, (2) public land, and (3) waqf, which is a private property handed over to religious foundations. The average size of farm holdings estimated at about 2.2 hectares. The irrigation regimes vary from one area to another and there is no apparent principle of organization.

Prior to 1940 the agriculture sector was the corner stone of the Saudi economy and was the principle occupation of most of the population. The country was considered to be self-sufficient because most of the basic food was produced domestically. Before 1962 it was estimated that about 60 percent of the Saudi population derived their living

from agriculture and livestock production. By 1974 this percentage had dropped to 37 (Quotah, 1979).

The increase in the price and production of oil in 1972-73 was a welcomed shock to the Saudi Economy but caused a certain amount of instability among the various economic sectors in the country. The GDP increased by 20 percent in 1972-73 and 15 percent in the 1973-74.

Agribusiness Firms in Saudi Arabia

As a part of the agricultural development plan, the government of Saudi Arabia has encouraged the private sector to participate in agribusiness firms. There is at least one agribusiness firm in each region of the country. The land is given free to the agribusiness firms who are financially and technically qualified to invest in the agricultural projects. Tabuk Agricultural Development Corporation (TADCO), Hayel Agricultural Development Corporation (HADCO), and Al-Jouf Agricultural Development Corporation (JADCO) have taken the lead in this sector, and have succeeded in agricultural production taking advantage of the unlimited support from the government. TADCO (Figure 3) occupies approximately 35,000 hectares of land of which approximately 13,000 hectares are cropped each year. The project includes more than 150 center pivots for irrigation. Primary products are wheat (4,000 h.), barley (1,000 h.), forage (primary alfalfa, 4,000 h.), potato (seed, 200h. and table. 1250 h.), onions (200 h.), Egyptian soybeans, (50 h.), fruit (1,400-h. total including peaches, nectarines, apricots, plums, grapes, almonds, apples, pears, and olives). More than 200 tunnel green houses are used to produce trees and vines for their orchards and vineyards as well as residential landscaping plants.

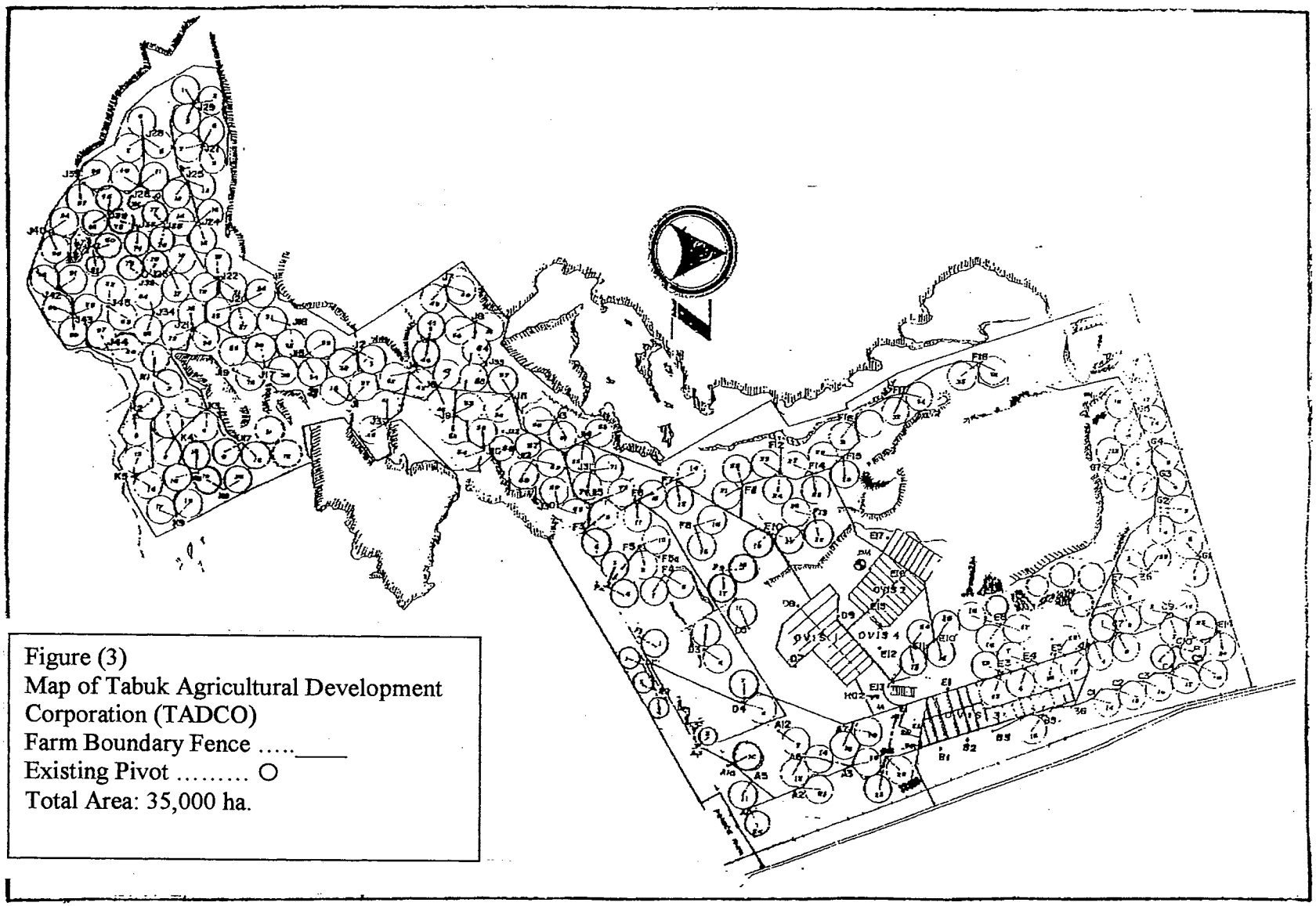

Figure (3)
Map of Tabuk Agricultural Development Corporation (TADCO)
Farm Boundary Fence ....._____
Existing Pivot ..... O
Total Area: 35,000 ha.

Agribusiness enterprises include a seed processing facility for wheat and barley, an olive oil extraction factory, and a polystyrene box plant for fruit packages and retail outlets for fruit and landscape plants in the same region (Tabuk). In addition, a potato storage operation is used to assure availability throughout the season.

TADCO has, in recent years, greatly diversified by reducing cereal production in favor of alfalfa, vegetables, and fruit production. Table 1 shows the total production of some types of fruits produced by TADCO in 1996. The change has been implemented because of reduction in subsidies provided for wheat. The 1000 hectares of barley are the only crop currently delivered to the government under a requested quota system. Wheat subsidies for large farms like TADCO are no longer available.

TADCO is organized as a joint stock company, the same can be said about all of the agribusiness firms in Saudi Arabia, with approximately 31,000 owners of its 2,000,000 shares of stock. A Board of Directors to whom a General Manager of the company reports heads TADCO. TADCO has many stakeholders in their operations. First and foremost are their investors who provided more than 200 million Saudi Riyals (SR) to establish TADCO in 1983. In addition, other stakeholders include the government of the Kingdom of Saudi Arabia who have encouraged development of agricultural projects by providing land, capital, price supports, and quotas for some crops. Consumers and market middlemen that participate in the marketing are also important TADCO stakeholders that depend on TADCO for products essential for their livelihood. Finally, and perhaps most critically, the 1250 employees of TADCO have a very important stake in the future success of TADCO operations.

Fruit Consumption

Fruits are very important food for humans at all growth levels. General consumption of fruits has steadily increased due to the change in consumption patterns. Per capita consumption of fruit in the Kingdom of Saudi Arabia has increased from 104.8 kg / year during the period (1974-1976) to 155.6 kg/year for the period (1983-1986) then decreased to 132.8 kg/year for the period (1987-1989) (Saudi Arabia Food Balance Sheets, 1974-1989). Fruits imported from different countries and some fresh fruits are produced and consumed domestically. However, recent production of fresh fruits has increased as a result of using most advanced irrigation and production technologies (figure 1) in addition to the free land given by the government to enhance the development projects. Fruit's maturity is very important during product collection, specifically if the fruit is going to be stored for long period. For example, some pear varieties such as Bartlett if collected at early stage, has its value reduced because it does not come to a satisfied maturity at the normal temperature (21^{o} C.), and if it is collected at a ripen stage, it can not bear the storage temperature and accordingly loses its value. Fruits are sold in the open market. Until recently, fruit markets were seasonal which caused large price fluctuations. However, with improved marketing services and better storage and refrigeration facilities in addition to the off season fruit imports decrease price fluctuation and year-around domestic demand is met.

In conclusion, the agricultural growth rate improved because of facilities and services provided to the sector. As a result of these services and incentives, private investors such as agribusiness firms were attracted to invest in the agricultural sector.

Traditional farms were labor intensive, commercial farms such as TADCO were capital intensive in the production process.

CHAPTER 3

THE INSTITUTIONAL APPROACH

Fruit Market in Saudi Arabia

Overview

Policy goals of the Saudi Arabia government are to encourage and promote the private sector for the purpose of increasing domestic food production and thus decreasing reliance on imports. In addition, the government tries to keep consumer prices relatively low by subsidizing and controlling prices for both domestic and imported food commodities.

Pure competition and imperfect competition, from the impact of government intervention, characterize market structure. Under perfect competition, there are many sellers and buyers of the commodity relative to the market size, all commodities sold in the market are entirely homogenous, there are no artificial restrictions, and resources are free to seek the location of highest return. It is easy to enter and exit from any factor market and producers and consumers have perfect knowledge about prices and sources of supply.

Directly or indirect government intervention in market structure depends on current economic or political objectives. Government intervenes through different means and options. It may reduce food prices to improve nutritional status and urban income distribution in the short run. Also, it may increase farm level prices to protect domestic producers from foreign competition. Moreover, the government may lower consumer prices and raise farm prices at the same time.

Fruit Production and Marketing

Fruit production has succeeded in Saudi Arabia in different regions because of the different climatic conditions. For a profitable fruit product, it has to meet the market needs. The producer is responsible for choosing fruit kinds and varieties that consumers prefer at that market and to protect his products from diseases and insects. The producer has to collect the fruit products at a suitable maturity level and to prepare it for the market taking into account timing of production, harvesting and marketing. Building a relationship between the producer and the consumer is important marketing strategy so that product quality and timing meet market needs.

The producer is supposed to know for whom he is producing from the purchasing power point of view. If his fruit product is going to a market where the purchasing power is weak and quality does not matter, he might not bear more production and marketing costs to enhance product quality. However, if the producer is planning to export his product, process, store, or sell in a competitive market, it is vital for him to introduce new varieties and to maintain a competitive quality. The producer could increase his profit using fertilizers, plant protection from diseases and insects, and choosing the best time for product collection and other marketing services such as grading, packing, and shipping.

The fruit-marketing season can be extended by growing early, medium and late fruit varieties and by growing in different times. There are some fruit varieties that can be stored better than other varieties, so that storage can extend the marketing season. It is vital for the fruit producers to pay great attention to the fruit maturity during harvesting. Manual fruit collection is the most dominant in Saudi Arabia, so it is very important to have skilled and well-trained labor that should harvest at the best maturity level. After

harvest, fruits need to be graded carefully, specifically if collected at different maturity levels. Incorrect storage and shipping and handling at the farm level affect the quality of products arriving at the market. There is no doubt that package design has a vital role in reducing the rejected quantity. The package must be clean of dust, sand, and sharp edges. The product should be carried from the field to the marketing packages carefully.

Fruit Marketing

After the successful fruit production which meets the consumers need, the product has to be shipped to the consumer in good condition. Table 2 shows the share of TADCO products that go to each market by type of fruit. It also shows the percentage of total quantity that goes to each market. Unfortunately, bad shipping and handling result in large losses. Some producers, to reduce shipping costs, use over packed boxes or very large packages. As a result, the fruits get injured and accordingly rejected. Modern technology can be used to improve the storage; shipping and handling services. Good packing, storage and shipping are considered very important for fruit because of its quick perishablity. Fruits are packed in plastic baskets or small boxes, so the product can be handled easily. Packages are supposed to meet the product requirements and market needs (Figure 4). In the developed countries such as America and Europe, fruit is packed in expensive boxes and cartons. Each fruit may be wrapped in paper that does not prevent air circulation and is attractive to customers. Apricots, for example, are packed in a plastic tray with holes that fit each piece of fruit separately. The plastic tray is then put in larger boxes. The main purpose of such services is to maintain quality in the period between harvest and consumption. Consequently, the demand will be extended because of reaching the markets easily and the extended period between product collection and consumption.

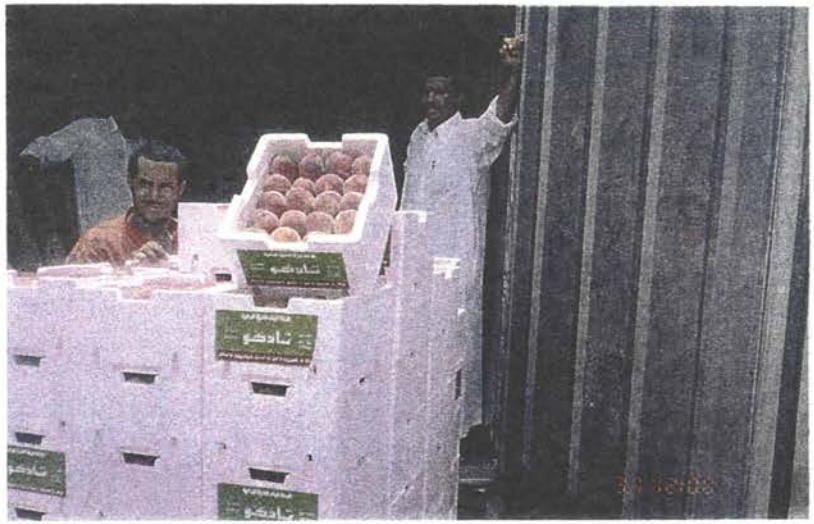

Figure (4)
Fruit Packing and Packages Used for Good Quality.

Shipping is a very important and costly marketing service. If the product is going to be shipped to a short distance, it must be protected against physical damage and high or low temperature. However, long distance shipping requires even more attention to insure air circulation between the rows in the trucks to avoid the damage caused by the inconsistent and temperatures. It is important to use refrigerated trucks to maintain the relevant temperature, particularly in Saudi Arabia.

Storage helps in marketing the fruit in controlling the prices and alleviating price fluctuations. However, lack of this important marketing service may result in large losses because of product damage and also price instability. Some fruits such as apples and pears could be stored for two to eight months according to the varieties and the storage conditions. In addition, temperature and humidity differ from one kind of fruit to another (Table 5). Any deviation from the ideal conditions may result in a large loss. The fruit should be in good condition when brought to storage without any scratches, injury, or damage. It must be neither very green nor over ripe. Storage temperature should be maintained constant at the required level without any fluctuations, and it must be checked often.

Cooling is required for removing the field heat, which averages 30-35° C. in Saudi Arabia. Cooling quickly before storage or refrigerated shipments is critical to delaying the maturation process. Cooling requires technical skills not only in building and providing the facility but also in the daily administration and supervision.

Fruit Marketing Channels

Fruits go through different marketing channels before reaching the ultimate consumers (Figure 5). The brokers/commissioners are the most market institutions who

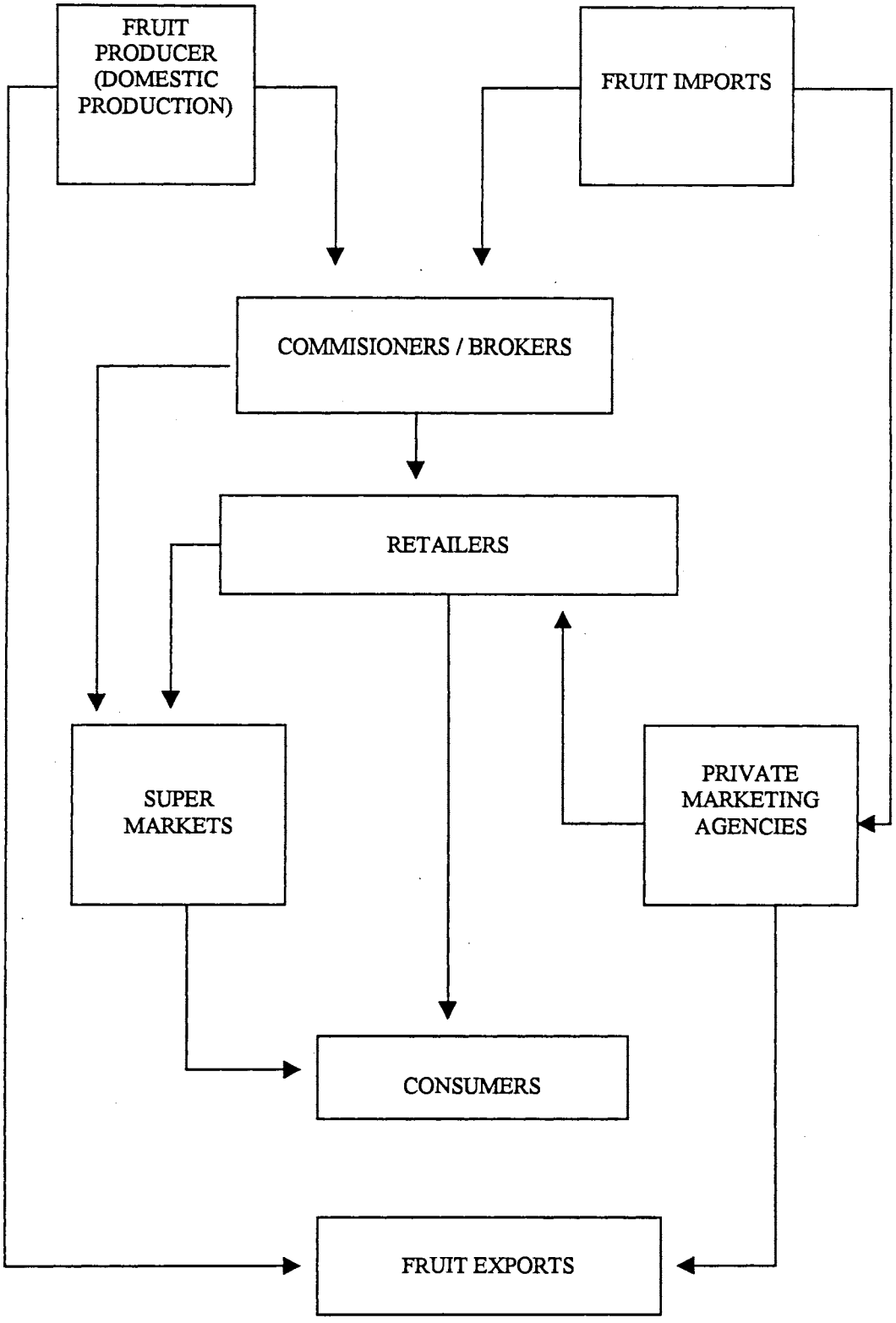

FIGURE (5)
FRUIT MARKETING CHANNELES IN SAUDI ARABIA

deal with the fruit producers. Shipping and import agencies also play a very important role in product distribution. They perform shipping, wholesaling and commission services as well. Fruit marketing requires flexibility in selling policies and decision making.

Sometimes the markets in which the producers sell their products are located in the villages and the cities, specifically in the streets and in the open public areas. It is better for them to arrange with the government to have their own market place to sell their products wholesale if their sale to the ultimate consumers is not enough. The advantage of the producer's market is that the product is sold directly to the ultimate consumers, so the producers get 100% of the consumer's price. However, there are high costs such as time and product damage resulting from consumers examining the fruits. In addition, the consumer may select the good quality leaving the lower quality as rejected. Moreover, the producer is trying to sell a small quantity and may have to wait for a long time in the market while he could benefit from doing something else.

Some fruit is sold at auction in Saudi Arabia. In the auctions, instead of the negotiation between the buyer and the seller, the commodity to be sold to the highest bid. In most auctions the commodity is sold on behalf of the producer. The fruit auctions in Saudi Arabia are conducted more frequently for lower quality fruit while the most dominant selling method for higher quality fruit is direct negotiation. The advantage of auctions is that a large quantity is sold in a short time if the auction is conducted in one spot in the market. In addition, the seller makes sure that he gets the market price for his commodity, and it saves time and reduces risk.

The most popular sale method, in both developed and developing countries, is the commission sale, where the commissioner sells the commodity, deducts his share which is

5 per cent approximately, and pays the producer the remittance. The wholesalers do not want to take risk taking into consideration the perishable nature of fruits. If the producer takes the risk and pays commission on his products, he may get a fair price.

Finally, retailing is the closest channel to the ultimate consumer. There are three main categories of retailers in the fruit market in Saudi Arabia. Retailers at the large terminal markets, street retailers, and the supermarkets, which have special administration. Street retailers, who do not have fixed locations from which they sell their products, but contribute by distributing the product. Retailers, who have small shops for selling fruits, are considered as an active unit in the product distribution if they have large quantities and quick distribution. Finally, supermarkets are spread all over the country. Some supermarkets do packing in small and priced packages, so the consumer can help himself in choosing what he prefers based on his budget and preference. They insure that fruit is clean and ready for consumption, and save consumers' time. It is costly to do so, but it reduces the need for labor whose wage might be high.

Pricing Policies

The free markets reflect the balance between demand and supply of fruits. For most kinds of fruit, the planted area for commercial production does not change quickly so in domestic quantity supplied is primarily due to fluctuations in yields. Early in the fruit season the commercial quantity is small, and then increases gradually until it reaches the peak, and then it decreases gradually until the end of the season. Usually, the early quantity is sold at high prices because it is new, even though quality may be better later in the season. The consumers in the early period are people who can afford to pay the high prices and have a strong preference for fruit. After that, more consumers enter the market

in the middle of the season as fruit prices decline. Consequently, the seasonality plays a very vital role in price determination. The fruit quality also plays a very important role in price determination when consumers' incomes reach a reasonable level where they are willing to pay more for higher quality and attractive marketing services. Mostly, there are big differences in the quality characteristics of fruit that arrives at the market in terms of color, size and package. As a result, grading also allows consumers to get what they want. Generally, higher fruit quality is accompanied by higher costs, so the producers are expecting to sell higher quality product at a higher price.

Sales Policy

Accurate information must be available about the present and the anticipated marketing channels for sales policy in any marketing agency. A small seller should know the consumers needs and preferences in his area and the supply conditions in the wholesale markets from which he buys his commodities. Large supermarkets which sell all over the country need to know the same information from all over the country including the supply sources, domestic markets, competition etc. Finally, importers and exporters should be aware of the world markets conditions.

The Governmental Marketing Services

Government intervention can be helpful in activating fruit markets in many ways by providing some services such as credit availability, price information, marketing research, consultant and training services, and organizing the marketing process for the public interest. It is rare that the individuals can provide such services and the investments accompanying it for building public markets provided by the government. Infrastructure improvement also is one of the government responsibilities in the development process.

Such service is important in shipping perishable fruits to the markets at the right time. Public investment has been targeted for the establishment of the wholesale markets and the packing, storage and processing facilities. Producers, wholesalers, processors, and retailers need credit to run their businesses. The main source of credit is the commercial banks that hesitate to support those involved in the fruit business because of its perishable nature and the fluctuations in prices.

Sales Promotion

Among the main factors of marketing is the use of advertising and sales promotion to let the people know about the product. The newspapers, radio, and television can be used for this purpose. In addition, giving price incentive to the retailers is another way of sales promotion. Choosing the right time for the promotion is very important in the fruit business. Many firms promote at the beginning of a season, so the consumer knows when products are available.

Marketing Education and Training

The government can support such programs through the schools and the educational system by educating the students about the values of fruits. The government can also provide financial contributions or by participate in funding, sponsoring, and/or organizing exhibitions and the commercial markets. One of the government responsibilities is to provide the education and establish the learning facilities for the needs of both producers and merchants in the field of agricultural marketing. It is the responsibility of the education and extension systems to carry out this task. Marketing extension is considered to be an important factor in the marketing process. It should provide the consultant services for production strategies, marketing services, packing and grading,

shipping, handling, and storage. It also makes the price information available so that negotiations are easier, insures credit availability, and helps producers and consumers understand the balance between fruit demand and supply.

In summary, seasonality, varieties, packing and grading play a vital role in fruit price determination. It is not only the fruit itself that matters, but the product characteristics also are important to both producers, who must take the product quality attributes into account during the production phase and the pricing decision, and consumers who would like to satisfy their needs.

The Market Channel

The main purpose of this chapter is to describe the various middlemen, related agencies and business structures and market conduct in the marketing process for fruit starting from the farm level to the ultimate consumer (Figure 5). Fruit marketing begins in the marketing services group at the farm level where the fruit receiving includes placing the fruit from trailers or refrigerated trucks from the field on pallets while still in the field boxes. Figure 6 and 7 show on farm fruit marketing services. The fruit is weighed on the forklift, and tagged so that it can be identified with the Orchard-Vineyard Irrigation System (OVIS) and block (variety) from which the fruit was harvested.

Detailed yield records are kept and reported to the production department. The fruit is then put in the pre-cooler until the packing, which is done at night, begins.

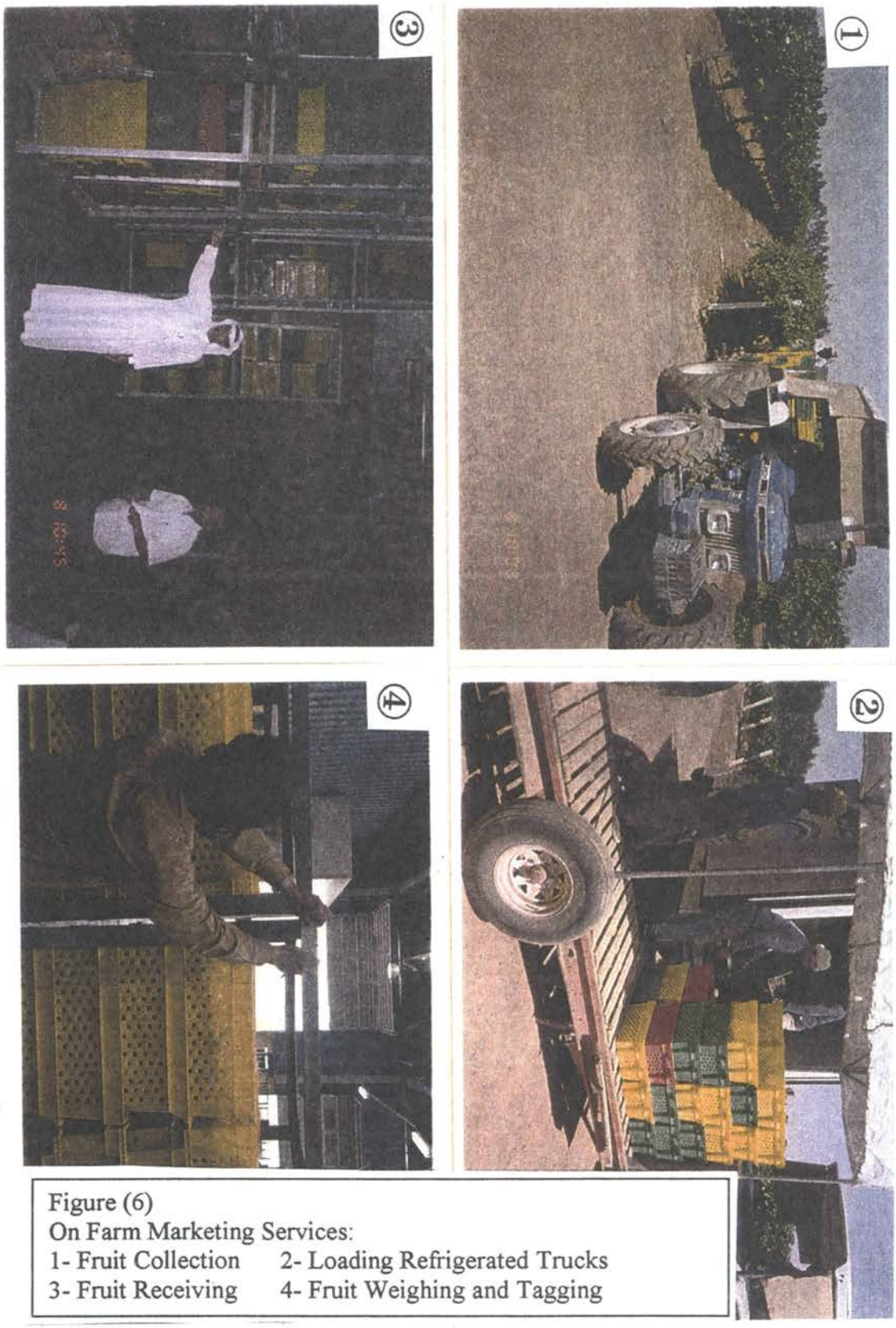

Figure (6)
On Farm Marketing Services:
1- Fruit Collection 2- Loading Refrigerated Trucks
3- Fruit Receiving 4- Fruit Weighing and Tagging

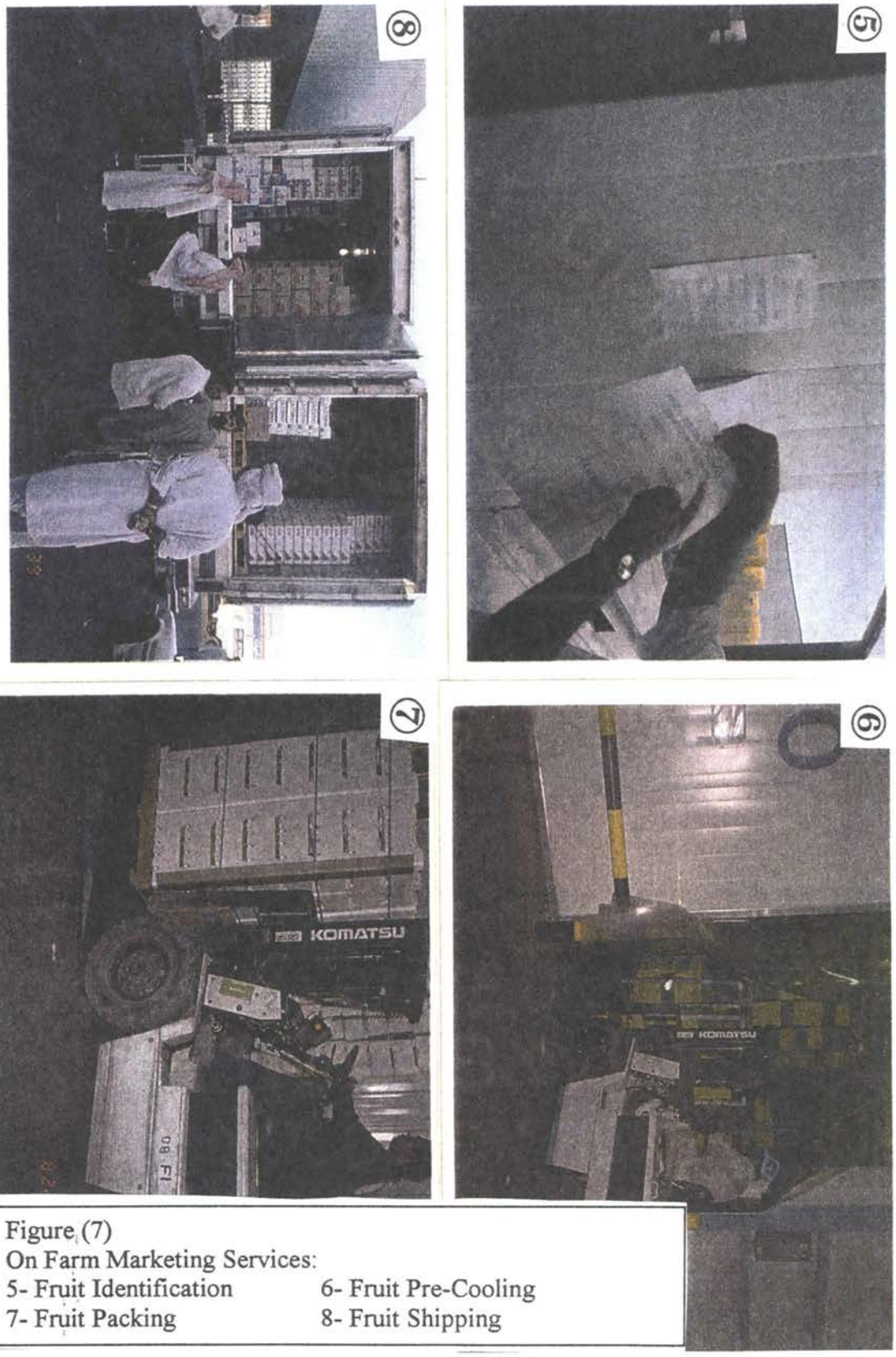

Figure (7)
On Farm Marketing Services:
5- Fruit Identification 6- Fruit Pre-Cooling
7- Fruit Packing 8- Fruit Shipping

Packers then remove fruit from the field boxes (Figure 8), visually determine whether the fruit should be rejected, and visually size the fruit, and determine in which type of package it should be. Table 4 and Figure 9 show different types of fruit packages used by TADCO. Two sizes are place packed, blossom end up in cardboard single layer boxes with a plastic liner. The lower grade acceptable fruit are put in styrofoam boxes. The containers hold approximately 4 kilograms of fruit. The boxes are hand placed and stacked on wooden pallets, cardboard corners are put in place, three bands are applied, and the pallets are then loaded into a truck or returned to the cooler. The packing equipment consists of tables for the workers that will hold field and packed boxes. Field boxes are washed prior to being returned to the field for harvest.

Future plans are for packing services to move into new facilities currently under construction. Some modifications to the packing line are planned which may include grading lines, more automated packing, and a cooled packing area.

There are three main and large markets in Jeddah, Dammam, and Riyadh in which there are sales commissioners (brokers), who act only as representatives of their clients. The quantities of some types of fruits, which are produced by TADCO, shipped to the three main markets and to other markets as well are presented in Table 2. The commissioners do not own the products they handle. Commissioners receive their incomes in the form of fees and commissions. They have good market knowledge and act on behalf of the seller, in this case the producer, of goods who feels that either he does not have the knowledge or opportunity to bargain effectively for himself.

Figure (8)
Fruit Manual Packing and Package determination.

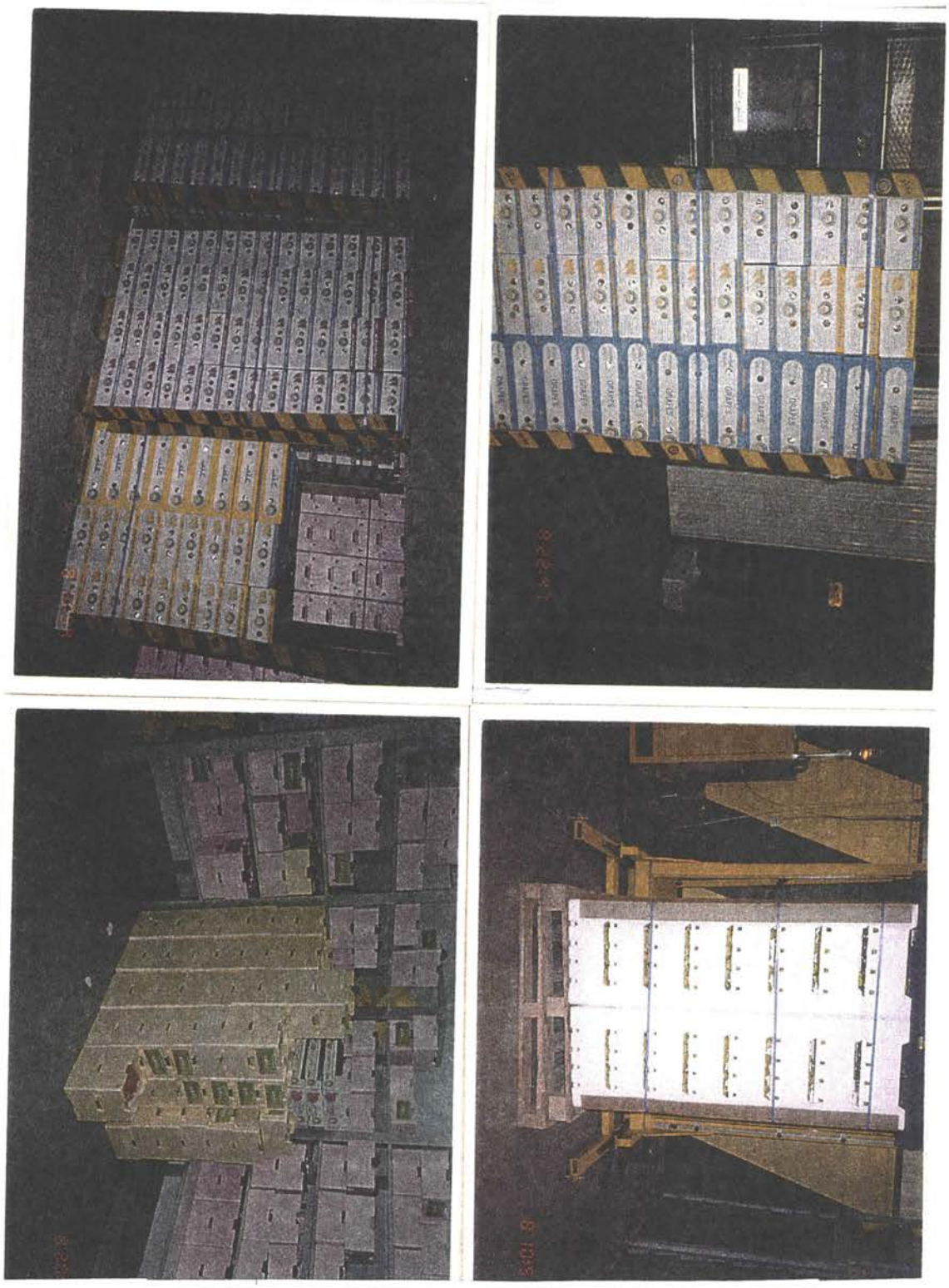

Figure (9)
Different Fruit Packages and Pallets Designed Used by TADCO

Fruit commissioners are granted broad powers by those who consign fruit products to them, in this case the General Manager of the agribusiness firms or the marketing manager. They take over the physical handling of the product in the market place, arrange for the terms of sale, collect the money, deduct their fees, and remit the balance to the producing firms. They can perform the fruit marketing functions more efficiently than their clients. Some commissioners do storage, transportation, and retailing. There are few true auctions used to sell produce in any of these three markets. Almost all sales are negotiations between Brokers / commissioners and their customers. There are some auctions of fruits and vegetables from small farmers. Bids were rare and every lot was not sold. In Jeddah, Dammam, and Riyadh auctions are seldom used. Auctions are sometimes used to establish an initial price level or to dispose of poor quality product (Figure 10).

In some small markets such as the Tabuk market, direct retail and wholesale sales to customers are emphasized. Because of their proximity to fruit supply locations, some sales centers owned by the agribusiness firms can order product from cold storage as needed to meet market conditions. There would appear to be little or no need for external brokers in such markets. An overview of each of the three main markets will be presented below:

Jeddah Market

The Jeddah market is a complex maze of brokers, retailers, and buyers' representatives. Jeddah is one of the primary import locations in the KSA. Fruit arrives in the Jeddah market in refrigerated trucks from different domestic and import suppliers. Transportation time differs from one supply center to another. Temperature maintenance

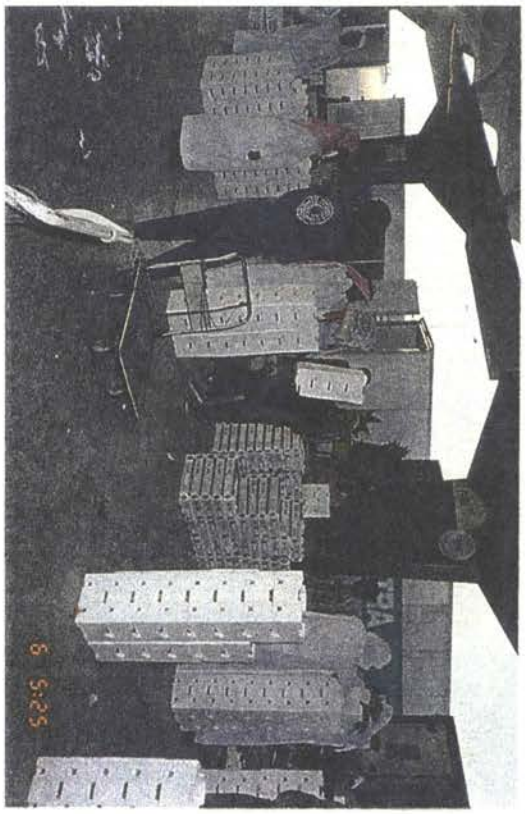

Figure (10)
Fruit Auctions and Sale Negotiations in Dammam Market, Saudi Arabia

in the trucks used in the transportation is a concern. While the financial losses are insured, the disappointment that can be created in brokers and buyers awaiting arrival (Table 3) is perhaps a greater concern. It was estimated that as many as 5 percent of the trucks have some temperature problem (usually getting overheated). Most of the fruit producers do not own trucks and hired transportation services are used. Table 3 shows the destinations, the costs of transportation, the travel time and the distance between the supply centers (in this study Tabuk) and the demand centers, specifically the three main fruit markets: Jeddah, Dammam and Riyadh. The share of TADCO's product, 1996 season that went to Jeddah market is presented in Table 2. It shows that 32, 27, 35 and 22 percent of apples, grapes, peaches and pears respectively went to Jeddah market. Brokers in the Jeddah market negotiate sales with buyers as the fruit is arriving or after it has arrived. These are generally not open auctions. Open auctions are held for generally lower quality product that is in some way out of condition for the market. There are opportunities to pull fruit from the market by using the brokers' cold storage facilities to hold it for a later sale. Some brokers have cold storage facilities and some also provide space for retailers that are also their customers. They charge a fee of 5 percent of the value of the transaction. Most of the trade is done on short-term credit. Consumers get credit from retailers, retailers receive credit from brokers, and brokers sometimes delay paying suppliers. Some of the large brokers also owns trucks, which are sometimes used to transport producers' products. In addition, the brokers provide retailers in the market with space for their retail operations without charging for the retail space. Because the brokers own trucks and cold storage facilities, producers sometimes receive use of the trucks and storage facilities for short-term storage without charge.

The brokers are familiar with the high level of credit losses in the market. It is difficult, however to get a firm estimate on the amount of the losses from bad debt. Some brokers suggest that it is 25 percent while others suggest that it is perhaps 1 to 2 percent of sales. All transactions are initially oral deals and the invoicing and billing procedures follow. There is little evidence of paper or invoices on the platforms where the transactions are negotiated. Brokers suggest that their buyers would not purchase from them if a signature is required. Large retail buyers also pay at the end of the month. Apparently, producers do not always get paid immediately for the product they deliver. Because of the environment, there are great many opportunities for losses due to poor memory, disagreements between parties, and also fraud. The people doing retailing and wholesaling do not have clear title to the product except for the oral contracts that are used. Oral contracting is common throughout the world but there is usually a FAX and hard copy of the transactions that follows the oral agreement reached via a telephone call. The brokers are in some sense bonded in that a cash balance of a certain amount must be maintained in order to assure producers of payment.

In terms of tactical activities, the sales and marketing staff of some large agribusiness firms have no control of pricing or product quality and have not apparently applied for or received marketing promotion or advertising budget from the producers headquarters. The emphasis is on communicating market needs to the marketing manager who must allocate shipments to markets and on developing personal relationships with brokers and buyers in the market. The emphasis on public relations activities are due to limited budgets and control over market situations.

There are some concerns about the quality of some fruit products. These concerns center around the current pre-cooling capacity at some supply centers and time required for pre-cooling and different maturities of fruit in the same pallets and sometimes in the same boxes. It is suggested that fruit needs to be harvested when it is hard and immediately pre-cooled to zero centigrade to delay the ripening process. Brix testing (sugar content) is needed prior to shipping products.

Prices in the Jeddah market can be incredibly volatile. Overnight, peach prices moved from SR 20 to SR 26-28. This creates a difficult allocation decision for the agribusiness firm's marketing manager who must make allocation decisions and have at least 12 hours to supply the market.

Brokers who are familiar about the market situation have some comments such as:

1. Fruit quality is comparable to other domestic and import competitors;
2. Frequently, some fruit products are not sufficiently ripe;
3. There is ample opportunity for corruption which has caused large retailers to use agents rather than their own buyers;
4. There are frequent delivery problems with truck arrivals difficult to predict; and
5. Personal relationships with firms and customers are critical to doing business in this market.

Opportunities for direct sales may be limited unless producers are interested in dealing with oral contracts, credit sales, and business in a chaotic market. The direct sales would have to be accomplished with large retail customers outside the central market and producers would compete with brokers, importers and other suppliers that do little business in the market.

Dammam Market

Some producers produce is primarily handled by their commissioners in the Dammam market with roles similar to those in Jeddah. In addition, fruit can be exported from this market to neighboring countries such as Bahrain, Kuwait, Qatar, and the United Arab Emirates. Reports sent to producers include a FAX detailing sales to buyers, a second report on prices competitors receive, and an overall market summary. Each week a more comprehensive summary report is written and sent by FAX to some agribusiness firms by their sales representatives in the market.

Table 2 shows that 14, 23, 25 and 22 of TADCO's apples, grapes, peaches and pears respectively went to Dammam market in the 1996 season. The market is much more organized than Jeddah because of the existence of public officials that control the timing of "auctions", locations of imported and domestic produce, and clearly separate the wholesaling and retailing functions. In addition, they will sometimes remove spoiled produce from the market. They do not become involved in reporting prices or mediating disputes that sometimes occur among participants. The commissions are from 4 to 5 percent. The word "auction" is used to describe the brokers negotiations with potential buyers. Few true open auctions are held.

Some fruit retailers charge SR 2 above the wholesale market that same morning. A good retailer at the market will sell between 100 and 150 boxes per day. The rent of the facilities is SR 4,500 per year.

Because of the long distance between the fruit supply centers (Table 3), it is difficult to get transportation to the Dammam market. Some competitors in the Dammam market have their own sales offices and facilities. In addition, cold storage space and the

ability to hold produce for a week or more could greatly enhance revenues at the Dammam market. If the Dammam market becomes an active export location for other Gulf States, the availability of cold storage facilities would greatly enhance their ability to serve the export markets as well.

The commissioners in the Dammam market indicated that 10-15 percent of the sales are cash and the others are credit. The commissioners are bonded, they have their own trucks and cold storage facility. Specific comments from the commissioners about fruit included:

1. Packing needs to improve so that there is more size homogeneity;
2. Grading is inconsistent and it is sometimes difficult to distinguish between top grade and lower grades;
3. Maturity in each box varies considerably creating potential storage problems;
4. Transportation has improved because of the improved palletization (although transportation costs increased per unit); and
5. Cartons are much preferred to styrofoam cartons (perhaps because it is a higher income area).

Riyadh Market

The market in Riyadh is in open facilities while a new market is being constructed. More than 90 percent of sales in the market are negotiated transactions between the commissioner and retail clients in the market. Table 2 shows that 24, 19, 13 and 17 percent of apples, grape, peaches and pears respectively went to Riyadh market in the 1996 season indicating that Riyadh has the lowest share of TADCO's products among the three main markets. Some producers' sales representatives do some selling of produce

directly to customers to provide competition in the market for the lone commissioner. There are some comments about inconsistent sizing, green color in the fruit and a preference for alternative plastic packaging.

In addition, there are some problems with the pallets and boxes used by some domestic producers (Figure 9). The boxes used are not as sturdy as some others in the market and the interlocking of the cartons is inconsistent. Some of the pallets have tilted while other pallets of similar products from other suppliers had six or seven bands holding stabilizing the pallet in place.

There are very large, large and medium sized supermarkets in Riyadh revealing that California peaches are being sold for SR 37 per kg. While in the same store domestic producers peaches (not Florida King) are being featured for SR 8.5 per kg., a nearly fifty percent price break from the price previously charged for domestic producers peaches for whom Florida King peaches are in the back room. It appears that the market is trying to move the lower quality domestic product prior to putting the Florida King product on the shelf. Apricots, domestically produced, in the same store are sold for SR 13 while California product is sold at SR 39.5 per kg. Clearly, there is a market for high-valued products in Saudi Arabia and domestic products are not comparable in consistency and quality to the higher end international standard set by the California products.

Fruit Imports and Exports

Saudi Arabia imports and exports of fruit products are playing an increasingly important role in this industry, specifically, through the two important ports in Jeddah (West Coast) and Dammam (East Coast). Jeddah is considered an important import point for fruits from different sources in the world. Dammam, on the other hand, is an important

export point for domestic fruits to the neighboring countries in the Gulf States. Saudi Arabia exports wide varieties of fruits, including fresh grapes, peaches, apples, and pears as well as almonds and apricots. Kuwait, Bahrain and United Arab Emirates (U.A.E.) are the major buyers.

Saudi Arabia is also a large importer of fruits from different sources all over the world. The U.S., Chile, European countries, Asian countries and some African countries export fruits to Saudi Arabia. However, The U.S. and Chile are the major sources of these products as explained later in Chapter 5. Fruit imports compete directly with Saudi fruits grown in Tabuk, Hayel, Qasim, Jouf and Najran. Fruit imports do not bear a tariff and have good qualities. Moreover, production costs are somewhat lower than in Saudi Arabia, and domestic producers feel these imports depress fruit prices. They have requested the government to put tariffs on imports, which have also higher transportation costs, to protect the domestic production. Clearly, transportation costs and tariffs have a significant impact on the competitive effects of these imports.

Summary

The institutional approach discussed emphasizes the answer of who operates the marketing process. The fruit market in Saudi Arabia was described showing that the brokers/commissioners play a vital role in distributing the import and domestically produced fruits. In addition, government agencies provide the facilities at a reasonable rent and supervise the market without any intervention in prices. Clearly there is a competition between imports and domestic fruits in favor of consumers. This might encourage domestic fruit producers to enhance and improve their marketing services to be qualified to compete with imports. It was found that the fruit commissioners and retailers are

familiar about the importance of fruit quality characteristics and its reflection in fruit prices. Producers should get feedback from their commissioners and from those who are involved in the market for future planning and assessments.

CHAPTER 4

HEDONIC PRICING IN THE FRUIT MARKET

The Idea and Historical Background

Fruit producers in Saudi Arabia do not know what the fruit consumers want. They are unfamiliar about the importance of product characteristics on fruit prices. The main purpose of this chapter is to estimate the effect of seasonality, variety, and package on fruit prices. Production or consumption of heterogeneous goods can be analyzed by disaggregating them into more basic units ("the characteristics"), that better measure the dimension of what is bought and sold. The underlying principle theme of hedonic price analysis is that consumer goods are valued based on its characteristics. Lancaster (1966) introduced the concept of heterogeneous goods having a bundle of characteristics that have value to consumers. This chapter provides a model of product differentiation based on the hedonic hypothesis that goods are valued for their utility-bearing attributes or characteristics. Hedonic prices can be defined as the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them (Rosen, 1974). In his paper, Rosen showed that estimated hedonic price functions identify neither demand nor supply functions and can not be used to identify the structure of consumer preferences and producer technologies that interact to generate the hedonic prices. Hedonic price functions are a regression of the observed price of a product against its quality attributes (Lucas, 1975). The analysis of his paper has been restricted to the competitive markets, no consideration having been given to the monopoly structure. The estimated parameters from the hedonic prices are the shadow prices or implicit prices of the characteristics of a

commodity (Ladd and Martin, 1976). They applied the product characteristic approach to production input. They argued that the price of a purchased input equals the sum of the money values of the input characteristics to the purchaser, and the demand for an input is affected by the inputs characteristics. In another paper, Ladd and Suvannunt (1976) apply the approach to consumer goods. Based on a study carried out in 1929 by Waugh for fresh vegetables, Ladd and Suvannunt derived that for each product consumed, the price paid by the consumer equals the sum of the marginal monetary values of the product's characteristics. They added that consumer demand functions for goods are affected by characteristics of the goods. They concluded that, for the first claim, the marginal implicit prices are a practical mean to evaluate grading schemes for consumer products. For the second claim, if the relation of consumer's purchases to product characteristics is known, a product can be designed to maximize profit by determining how much of each characteristic to put in the product. Wilson (1984) estimated implicit (or hedonic) prices for selected quality factors of the malting barley and concluded that a change may be evolving in the price determination process. In another study, Ethridge and Davis (1982) developed a model of hedonic prices for cotton lint. The main focus of the study was impact of quality attributes on price rather than a price index. They used primary data and concluded that producer prices were sensitive to variations in some characteristics such as fiber length, micronaire, and trash content. Brorsen, Grant, and Rister (1984) developed a framework to analyze quality differentials for rough rice prices observed in bid/acceptance markets and the probability of whether or not producers will accept bids based on those differentials. Their result indicates grades are useful but inadequate in explaining observed quality differentials in rice prices. By modifying and extending other Input Characteristics

Model (ICM), Melton, Colette, and Willham (1994) developed an ICM to estimate economic values for genetically determined input characteristics. They found that the extended ICM is more flexible than prior ICMs. It allows economic values to be imputed for a wide range of genetic characteristics. Moreover, they suggested that additional modifications of the extended ICM method of analysis is recommended for further enhancement and broadening it applicability. A retail-level hedonic model for analyzing the value of milk components in aggregate dairy product commodities was developed and applied by Lenz, Mittelhammer, and Shi (1994). The finding showed that a hedonic approach applied at the retail level can be used to value milk components.

Once the characteristics in the bundle (the heterogeneous good) have been identified and measured, the hedonic function is interpreted as a function that disaggregates the price of the good into the implicit prices and the quantities of the characteristics. Also, it provides estimates of prices for the characteristics (the hedonic values).

Product Characteristics

Fruit varieties, grades, packages, and compatibility are considered characteristics of fruits. An overview will be given for each one of the selected four kinds of fruits, apples, grapes, peaches, and pears to make the product characteristics picture clear.

First, there are several thousands varieties of apples, but less than a dozen constitute most of the apple production such as Red Delicious, Golden Delicious etc. Unlike many other commodities, grade continues to be a major factor in apple sales. There are different kinds of containers used for packing apples such as: carton, tray or cell, 3lb

bags (Table 4). With regard to apple compatibility, ice is never in contact with the fruit. Apples produce ethylene, so it can not be stored with other ethylene sensitive fruit.

There is a standard USDA recommended storage temperature for some kinds of fruits (Table 5). Apples should be transported at the same temperature as maintained in the storage facility. Elevation of temperature will accelerate the dormant ripening process, and lower temperatures may result in chilling injury. To achieve year around availability a good percentage are placed in controlled atmosphere storage facilities which require constant monitoring of both temperature and gases with oxygen regulated at between two per cent and three percent and CO_2 at one percent to two percent. Since apples produce ethylene, which enhances ripening, it is also necessary to remove the ethylene from the storage facilities. Controlled storage techniques not only greatly arrest the ripening process, but also control both pathogens and insects. It is extremely important to remember that the atmosphere in these facilities will not support human life.

In transporting apples, it should always be remembered that apples produce ethylene and should not be shipped with ethylene sensitive products. Apples also readily absorb odors, and care must be used in selecting compatible products for mixed loads.

Ice contact is not recommended for grapes. Table 5 shows the USDA recommended storage temperature and the approximate freezing point for grapes.

Different types of packages are used for peaches such as peach cartons, boxes, and plastic baskets (Table 4). In the U.S., 22 lb. lug or carton, 18 lb. box, ½ bushel crate and ¾ bushel crate.

The recommended storage temperature for peaches is at 32^{O} to 34^{O} F. (0 to 1.5^{O} C.) (Table 5), and the approximate freezing point is 30.4^{O} F. (-0.9^{O} C.). Ice contact is not

recommended for peaches, which are also ethylene producers. Since peaches are transported at near freezing temperatures, freezing injury is sometimes encountered. Symptoms of freezing injury are a water soaked, translucent appearance of the skin and/or flesh. If freezing injury is severe, the tissues will turn brown and become soft and mushy. As temperatures elevate, large quantities of juice will be given up from the injured tissue making the surrounding fruit sticky and prone to infection by diseased organisms.

Pears are harvested in their mature state while they are still hard and green. Unless they are to be promptly marketed, the pears should be promptly cooled at 32^{O} F. (table 5) and maintained at that temperature throughout storage.

The recommended storage is 32^{O} to 34^{O} F. (0 to 1.5^{O} C.) and the approximate freezing point is 30.4^{O} F. (-0.9^{O} C.). Pears which have been held at below freezing temperatures for only a short period of time will most often not reflect damage to the fruit after thawing, provided the fruit has not been handled in its frozen condition. Pears, which are held well below the freezing point, however, will develop a glassy, water soaked appearance after thawing along with the flesh being dry and pithy. Ammonia injury is sometimes seen at receiving points. Refrigeration equipment using ammonia gas may allow some escaping ammonia to come in contact with fruit. Exposure to ammonia will result in reddish brown rings around the lenticels and will turn black when the fruit is moved into area free from ammonia fumes. For most varieties of pears, it is necessary to raise the temperature between 60^{O} to 70^{O} F. after removal from cold storage to initiate the ripening process. Many varieties of pears will not ripen satisfactorily at temperature above 70^{O} F.

Theory of Hedonic Prices

Lancaster (1966) proposed that all goods possess objective characteristics relevant to the choices which people make among different collections of goods, and individuals differ in their reactions to different characteristics content of various goods collections. He emphasized that it is the "characteristics" in which consumers are interested. It is assumed that the characteristics-people relationship is of the same kind as the goods-people relationship assumed in the traditional demand theory. Lancaster provided a fully integrated theory of consumer choice and demand, in which the characteristics of goods are taken explicitly into account. He argued that the demand for a new good could be predicted from observed behavior with respect to existing goods, provided the new good possesses the same characteristics as those existing.

Following Lancaster, it is assumed that all characteristics are quantitative and objectively measurable so that the assertion that b_{ij} is the quantity of the ith characteristics possessed by a unit amount of the jth good has empirical meaning. If z_i and x_j are quantities of the ith characteristic and jth good, respectively, then the assumptions of the model are:

(1) $z_i = b_{ij} x_j$

(2) $z_i = b_{ij} x_j + b_{ik} x_k$

In a system of r characteristics and n goods, the collection of characteristics possessed by some collection $(x_1, \ldots, x_n)$ of the n goods is given by:

(3) $z_i = \sum b_{ij} x_j$ for $i = 1, \ldots, r$

In matrix terms:

(4) $z = Bx$

where $z = [\ b_{ij}\ ]$ the matrix of coefficients relating goods and characteristics.

Equation (4) implies that a unique characteristics vector (z) associated with a given goods vector (x). It is assumed that $z \geq 0$ if $x \geq 0$.

According to Lancaster, what distinguishes the consumer choice in the characteristic model from that in the traditional model of consumer is that the objective function u(z) of the optimizing problem in the characteristics approach is a function of characteristics, while in the regular budget constraint is a constraint on goods.

$Px \leq k$

Where P is the vector of prices facing the consumer and k is his income. The utility function has the form u(z), while z, x are linked through the goods-characteristics relationship: $z = Bx$. The optimization problem can be written as:

Max u(z)

S.T. $z = Bx$

$x \geq 0$

$Px \leq k$ (budget constraints)

Under the assumption that $B \geq 0$, no need to add that $z \geq 0$. By substituting (4) in the utility function

Max $u(Bx) = v(x)$

S.T. $Px \leq k$, $x \geq 0$

Suppose that the number of characteristics is less than the number of goods ($n > r$). Then the partial derivative of v with respect to the goods (x_j) and the partial derivatives of u with respect to the characteristics (z_j) are related by:

(5) $\partial v/\partial x_j = \sum b_{ij}\ \partial u/\partial z_i$ $j = 1, \ldots, n$

Since they are only r derivatives $\partial u/\partial z_i$, it follows that n – r of the derivatives $\partial v/\partial x_j$ can be expressed in terms of the remaining r. Thus not all the first order conditions of the traditional solution

(6) $\partial v/\partial x_j = \lambda_j P_j$

can necessarily be satisfied. Solving for P_j, the hedonic price equation can be obtained.

Empirical Model

Following Lancaster who introduced the concept of heterogeneous goods having a bundle of characteristics that have value to consumers. In another article, Lancaster proposed that all goods possess objective characteristics relevant to the choices which people make among different collections of goods. He emphasized that it is the characteristics in which consumers are interested (1966). According to Lucas (1975), Hedonic price functions are regression equation of the form:

(1) $P_i = P(V_{i1}, \ldots, V_{ij}; u_i)$

where P_i is the observed price of product i; V_{ij} is the amount of some "intrinsic quality" (or "characteristics") j per unit of product i; and u_i is a disturbance term.

Consumer's, according to Lancaster arguments, fruit characteristics such as variety, grade (package), and seasonality will be used in estimating fruit prices. The hedonic fruit model for the four different products is written as:

$$(2)\ P_{ijkvl} = \beta_0 + \delta_1 SIN12_{ikvl} + \delta_2 SIN6_{ikvl} + \delta_3 COS12_{ikvl} + \delta_4 COS6_{ikvl} + \sum_{k=1}^{\mu} \alpha_k MKT_{ijvl} + \sum_{v=1}^{m} \gamma_v VRT_{ijkl} + \sum_{l=1}^{n} \lambda_1 PKG_{ijkv} + \beta_1 QTY_{ijkvl} + \in_{ijkvl}$$

Where P_{ijkvl} is the price of fruit i with specific variety v and package l sold in Saudi Riyal (SR) per kg in market k at time period j; SIN12, SIN6, COS12, and COS6 are seasonality

variables representing the transaction time in which the fruit is sold during the season; MKT is the fruit markets (Jeddah, Dammam, Riyadh and other markets). VRT is the variety of a specific product such as Florida King peaches for example; PKG is package of fruits. Using the package criterion used in packing the fruit such as labeled carton and Styrofoam boxes. QTY is the quantity of fruit i per kg with specific variety v and package l sold in market k at time period j; u is number of markets in which the fruit is sold, three main fruit markets are discussed in the study in addition to the base market; m is the number of varieties for each product; n is number of packages used for each product; and ϵ is the error term.

Data

Daily fruit sales data for one season were obtained from TADCO, a Saudi agribusiness firm. It includes the quantity and price of fruits (in this study apples, grapes, peaches and pears) sold in different markets in SR per kg for different grades (package), variety, and time.

Estimation and Procedures

Seasonality, markets, varieties, and packages were estimated for each one of the four products. For seasonality, the sine and the cosine functions wit 12 and 6 month periodicity are used to estimate the effect of seasonality on fruit prices. The sine and cosine functions that used in the estimation are:

(1) Sin12 = Sin(day/365 * 2 * 3.14)

(2) Sin6 = Sin(day/182.5 * 2 * 3.14)

(3) Cosin12 = Sin((day/365 * 2 * 3.14) + (3.14/2))

(4) Cosin6 = Sin((day/182.5 * 2 * 3.14) + (3.14/2))

Where day represent the transaction date in the daily fruit sales data used in the study. Specification test are conducted to make sure that the hypothesis testing and test statistics are valid. First, GF, which prints Goodness-of Fit statistics testing for normality of residuals, and LM, which gives the Jarque-Bera [1980] Lagrangian Multiplier test for normality of the OLS residuals, options (White, p: 9 and 223) with ordinary least squares (OLS) were used to get the coefficients of skewness and kurtosis for the normality test. The null hypothesis of normality was not rejected. Second, the conditional variance test to test for change in variance and static hetroskedasticity was conducted. The null hypothesis of hetroskedasticity was rejected indicating that hetroskedasticity might be a problem. maximum likelihood estimator (MLE) with the option model, which specifies the form of hetroskedasticity, and stdlin option, which is the standard deviation is linear function of exogenous variables, were used to estimate the final model (White, 1980). Significance tests are conducted for all variables involved. The SHAZAM computer software program is used for analyzing the data.

Results

The use of different fruit varieties, packages, seasonality and markets to explain observed price differentials is investigated in this section. Summary statistics of all variables involved in the hedonic equations for the four products are presented in Tables 6, 8, 10, and 12 in which the means and the bases used in the study are presented. The result of equation (2) with four different products, apples, grapes, peaches and pears, each with four main different variables, seasonality, markets, varieties, and packages, are presented in tables 7, 9, 11, and 13. The data sample of 298, 620, 700 and 219 observations of apples, grapes, peaches and pears are used. These observations contain different dates in

the season, markets, varieties and packages for each product. The R^2 for the models are 0.51, 0.72, 0.76 and 0.78. Generally, the null hypothesis that seasonality, markets, varieties, and packages do not affect fruit prices is rejected in each equation. Wald chi-square statistics of the unrestricted model used in this study is presented in Tables 7, 9, 11, and 13, and it is significant in each equation at 5 percent significant level. The estimated coefficients with the t-ratios from all four models indicate that characteristics have a significant impact on the prices of fruits. Seasonality variables, which are represented by the SIN12, SIN6, COS12 and COS6, indicate a significant impact on the prices of all different products in the study. Three main markets were included in each model in addition to the base, which was the rest of the fruit markets in Saudi Arabia mostly the Tabuk market. The result shows that markets are a significant factor on the prices of fruits. The estimated coefficients as well as the t-ratios results from the four models indicate that both quality characteristics, represented by different varieties and different packages, have a very significant impact on prices of all products.

Apples:

The data show that the season for apples starts on late May until mid of August. The estimated coefficients for Seasonality, sine and cosine functions with 6 and 12 month periodicity suggest that apple prices follow a seasonal pattern.

The Wald Chi-square test statistics for the market variables is significant indicating that different markets have impact on fruit prices. Table 2 shows the share of TADCO' s apples that go to each of these markets. 32 percent of TADCO's apples went to Jeddah market in 1996 season.

The Wald test statistics for apple varieties, Anna and Dorset are significant suggesting these varieties have an impact on apple prices.

The results suggested that apple packages are significant indicating that premiums and discounts are associated with different packages used for apples. Apple carton receives a premium when compared to other packages.

Grapes:

The data show that grape has a longer season which starts on late June until mid of October. The estimated coefficients for seasonality, sine and cosine functions with 6 and 12-month periodicity suggest that grape prices follow a seasonal pattern.

The Wald Chi-square test statistics for all three main markets is significant suggesting that different markets have impact on grape prices. The share of TADCO' s grapes that go to each of these markets is shown in table 5. Jeddah market has the largest share of TADCO's grape (0.26) when compared to Dammam and Riyadh, the result shows that the price received by fruit producers differ from one market to another.

The Wald Chi-square test statistics for grape varieties are positive and significant suggesting that varieties have an impact on grape prices. The result, also, helps in ranking the varieties according to their price level.

The Wald Chi-square test statistics for packages used by TADCO is significant indicating that grape packages have great impact on fruit prices. The result shows that there are premiums and discounts associated with grape packages. Grape carton (6.17) and Poly Tray (9.16) have premium when compared to other packages.

Peaches:

The data show that the season for peaches starts in late April until late July. The estimated coefficients for Seasonality, sine and cosine functions with 6 and 12 month periodicity suggest that peach price follows a seasonal pattern. The Wald Chi-square test statistics for seasonality is significant.

The Wald Chi-square test statistics for the three main markets are significant. The result shows that the fruit prices received by the producer differ from one market to another. 35, 25, and 13 of TADCO's peaches went to Jeddah, Dammam, and Riyadh markets, respectively, in 1996 season.

The null hypothesis that peach varieties, grown by TADCO, have no impact on fruit prices was rejected at 5 percent level indicating that there are premiums and discounts associated with peach varieties.

The results suggested that most peach packages, used by TADCO, such as: Poly-Boxes (2.19), Fruit Carton (15.15), and Peaches Carton (20.08) have premium when compared to the base packages. The result confirms that fruit buyers prefer the attractive packages to the regular one.

Pears:

The data show that the season for pears produced by TADCO starts in early June until late November. The estimated coefficients for Seasonality, sine and cosine functions with 6 and 12 month periodicity suggest that pear prices follow a seasonal pattern. The Wald Chi-square test statistics is significant indicating that seasonality affects fruit prices.

The Wald Chi-square test statistics for all three main markets are significant, and the fruit prices received by the producer differ from one market to another. This result

should be compared with the share of TADCO' s pears that go to each of these markets (Table 2) and also to the transportation costs for evaluation and future marketing plans.

The Wald Chi-square test statistics presented in Table 13, for pear varieties such as: Ercolin, Blanqul, and Mp. More Time, is significant suggesting that there are premiums and discounts associated wit different pears varieties. The results indicate that the fruit buyers prefer some varieties to others.

The null hypothesis that the pear packages have do not affect fruit prices is rejected at 5 percent significant level indicating that packages have an impact on pear prices.

Tables 7, 9, 11, and 13 include the Wald Chi-squares statistics for seasonality, market, variety and package. All hypothesis that seasonality, market, variety, and package do not affect selling prices are rejected.

In conclusion, the results suggest that fruit quality characteristic attributes have significant impact on producer prices. Both premium and discounts are associated with seasonality, market, variety, and package, which are significant in all of the equations and all of the hypothesis. The results support the argument in this study that the quality characteristics have a significant impact on the prices paid by the fruit buyers.

Interpretation

In general, it appears that the hedonic prices models provide an excellent explanation of how quality differentials represented by the fruit varieties and packages in addition to the seasonality are reflected in prices paid by fruit buyers. The fruit producers should know the premiums and the discounts associated with some of these factors in order to make profit maximization decisions.

Many factors other than the characteristics attributes producer fruit prices. However, the range of prices implied by the variation in explanatory variables in this study has a substantial affect on producer prices above those from formal market fluctuations. Producers have substantial influence on the values associated with varieties and packages through the selection of the one that has a significant impact on prices. It is emphasized here that the measured price impacts occurred at the point of first sale of fruit as a fresh product in the market.

CHAPTER 5

IMPORT DEMAND FOR FRUIT IN SAUDI ARABIA

Fruit producers in Saudi Arabia have successfully planned for fruit production without evaluation of competition from imported fruits. Specifically, domestic fruit producers do not know the value of their products relative to imports. In consideration for competition, it is important to know the nature of the fruit import market. Moreover, it is important to the decision-makers in both public and private sectors to anticipate the future of fruit imports.

Import Demand Systems

Many models have been proposed as alternative for estimating demand equations using the consumer theory. The Rotterdam model and the translog model have been proposed, estimated, and used to test the homogeneity and symmetry restrictions of demand theory (Deaton and Muellbauer, 1980). Deaton and Muellbauer introduce a new system of demand equations which they call the Almost Ideal Demand System (AIDS), in which the budget shares of the various commodities are linearly related to the logarithm of real total expenditure and the logarithm of relative prices. It can be used to test the restriction of homogeneity and symmetry through linear restrictions on fixed parameters. AIDS has an advantage that it posses all the desirable properties simultaneously. Dynamic AIDS models were estimated for meat aggregates and for disaggregated meat products (Eales and Unnevehr, 1988). Two questions were addressed in this paper. First, do consumers allocate expenditures among meats by animal origin or by product type? Second, does disaggregation of meat into products in a meat demand model give insight into the causes of structural changes? Two meat demand systems were estimated with the

AIDS to answer these questions. The results showed that consumers choose among meat products rather than meat aggregates suggesting that test for structural change in the meat aggregates may be biased. Hayes et al. (1990) estimated a model of the Japanese meat demand system using Linear Approximate (LA) AIDS. They found that there is evidence of net complimentarity between chicken and dairy beef, and that fish can be treated as separable in the Japanese meat demand system.

The Armington trade model (Alston et al., 1990) distinguishes commodities by country of origin, and import demand is determined in a separable two-step procedure. Alston et al. tested the Armington assumptions of homotheticity and separability with data from the international cotton and wheat markets, and their empirical results rejected the Armington assumptions for cotton and wheat. They added that this result lead to concern that similar conclusion might apply to other trade models. In another paper, Alston and Chalfant (1993) developed a test to prove that while the Linear Approximate (LA) AIDS and the Rotterdam models are thus equally attractive in most respects, including (local) flexibility, compatibility with demand theory, ease of use, familiarity, and plausibility, they lead to different results in some applications. Using an illustrative application to US meat demand, they developed a test of each against the other and found that the AIDS model is rejected while the Rotterdam model is not. They added that this is not to be interpreted as evidence that the Rotterdam model is superior in any general way. Another data sets could yield different conclusions.

Arnade and Pick (1997), who applied seasonal unit root tests to price and quantity data for apples and pears, discussed the demand for fruits. Their result shows that elasticities could be sensitive to standard seasonal variables and seasonal trend variables.

The Model

A Restricted, Source-Differentiated, Almost Ideal Demand System (RSDAIDS) is used in this study. The RSDAIDS model is a more general demand model and does not impose perfect substitutability or the block separability assumptions. The Almost Ideal Demand System (AIDS) model is obtained from a specific parameterization of price independent generalized logarithmic (PIGLOG) cost function (Deaton and Muellbauer, 1980). The PIGLOG cost function is written as:

$$(1)\quad \log[C(p,u)] = (1-u)\log\{a(p)\} + u\log\{b(p)\}$$

where a(p) is a price aggregator function of the type

$$(2)\quad \log a(p) = \alpha_0 + \sum_i\sum_h \log(p_{i_h}) + 1/2\ \sum_i\sum_j\sum_h\sum_k \gamma^*_{i_h j_k}\log(p_{i_h})\log(p_{j_k}),$$

and b(p) is written as

$$(3)\quad \log b(p) = \log a(p) + \beta_0 \prod_i\prod_h p_{i_h}^{\beta_{i_h}}$$

and $\alpha_i, \beta_i, \gamma^*_{ij}$ are parameters. The subscripts i and j are goods (i,j=1,…,N) in this study, apples, grapes, almonds and pears ; and h and k denote sources. For each good, the number of sources is not necessarily the same. Good i may be imported from m different sources while good j may have n import sources. If $i \neq j$, h = 1, …,m and k = 1,…,n. By taking the derivative of equation (1) with respect to the price, a system of demand equations can be written in share form as

$$(4)\quad w_{i_h} = \alpha_{i_h} + \sum_j\sum_k \gamma_{i_h j_k}\log(p_{j_k}) + \beta_{i_h} u\beta_0 \prod_i\prod_h p^{\beta_{i_h}}_{i_h},$$

where $\gamma_{i_h j_k} = 1/2\left(\gamma^*_{i_h j_k}\right)$, w_{i_h} is the share of good i from country h. Next, taking the first derivative of the cost function with respect to u and substituting the result into equation (4) result in the Source Differentiated AIDS (SDAIDS) in budget share form as:

$$(5)\quad w_{i_h} = \alpha_{i_h} + \sum_j \sum_k \gamma_{i_h j_k} \log\left(p_{j_k}\right) + \beta_{i_h} \log\left(E/P^*\right),$$

where

$$(6)\quad \log\left(p^*\right) = \alpha_0 + \sum_i \sum_h \alpha_{i_h} \log\left(p_{i_h}\right) + 1/2 \sum_i \sum_h \sum_j \sum_k \gamma^*_{i_h j_k} \log\left(p_{i_h}\right) \log\left(p_{j_k}\right)$$

Since p* is not linear, the Stone index has been used extensively as a linear approximation for the price index (p*) (Andayani and Tilley, 1996). The Stone index is defined as

$$(7)\quad \log\left(p^*\right) = \sum_i \sum_h w_{ij} \log\left(p_{ih}\right).$$

The Tornquist index is used because it retains some features of the stone index which is the log linear analogue of the passch price index and also it retains some features of the log linear analogue of the Laspeyres price index (Moschini, 1995). The Tornquist index P^T, viewed as a discrete approximation to the Divisia index, is:

$$(8)\quad \log\left(p_t^T\right) = 1/2 \sum_i \sum_h \left(w_{iht} + w^o_{i\,h}\right) \log\left(p_{iht} / p^o_{i\,h}\right),$$

Where the zero subscript denotes base period values. Mean values can be used for the base.

Using the SDAIDS model in equation (5), the import demand of different fruit products from different sources can be estimated if a sufficient number of observations are available. However, SDAIDS model contains all product prices of different fruits from different sources in each equation to be estimated. For example, to estimate four products such as apples, grapes, peaches and pears each of which has four sources, there will be 18

parameters (4 times four prices + intercept + expediter) to be estimated in each equation. Yang and Koo (1994) assumed that

$\gamma_{ihjk} = \gamma_{ihj} \forall k \in j \neq i$

This means that the cross-price effects are not source differentiated between products while the cross-price effects are source differentiated within a product. Using Yang and Koo's assumption, the SDAIDS (equation 5) model becomes the Restricted SDAIDS (RSDAIDS) model:

$$(9) \quad w_{i_h} = \alpha_{i_h} + \sum_k \gamma_{ihk} \log(p_{ik}) + \sum_{j \neq i} \gamma_{ihj} \log(p_j) + \beta_{i_h} \log(E/P^T),$$

$$where \log(p_j) = \sum_k ((w_{jk} + w_j^o) * \log(p_{jk} / p_j^o)),$$

γ_{ihk} are the cross price coefficients of good i from different source h, γ_{ihj} is cross price coefficient between good i and good j where $i \neq j$, w_j^0 and p_j^0 denotes mean values. For four products, each of which has four sources, each equation of the RSDAIDS model has a price coefficient for each source, three coefficients for the other three products, an intercept, and an expenditure coefficient or nine total coefficient (compared to eighteen in the SDAIDS model). In addition, the Marshallian price elasticities can be calculated using the RSDAIDS coefficients. Assuming $\delta \log P^* / \delta \log P_j = w_j$ (Chalfant, 1978).

The general demand restrictions:

Adding - up : $\sum_i \sum_h \alpha_{i_h} = 1; \ \sum_h \gamma_{i_h k} = 0; \ \sum_i \sum_h \gamma_{i_h j} = 0; \ \sum_i \sum_h \beta_{i_h} = 0$

Homogeneity : $\gamma_{i_h j_k} = \gamma_{j_k i_h}$;

and Symmery : $\sum \gamma_{i_{ik}} + \sum_{j \neq i} \gamma_{i_k j} = 0$

for import behavior also can be imposed or tested in the RSDAIDS model. Symmetry is applied only within each good.

Data

Quarterly data from 1991 through 1996 are used for this study. The import quantity and value of fruits in Saudi Riyal (SR) were obtained from the Department of Census and Statistics Studies (Division of Foreign Trade) in Riyadh Saudi Arabia. The import price used is the unit value of imports. Exchange rate and per capita income are obtained from the Ministry of Commerce in Saudi Arabia and the International Monetary Fund (IMF) respectively.

Estimation Procedures

The sample data available for this study are only 22 observation, so the RSDAIDS will be used to avoid degrees-of-freedom problems. This model has two equations for each of the fruits and there are 7 parameters in each equation. In each of the equations, there is one source differentiated own-price coefficient, one source differentiated cross-price coefficient, four non-source-differentiated cross-price coefficients (one for each of other fruits), an expenditure coefficient, and an intercept. The equation of other fruit was dropped because the adding-up condition across goods creates a singularity problem. The estimation procedures will be as follows:

1. A non-source differentiated (aggregate) AIDS assuming perfect substitutability will be estimated.

2. The RSDAIDS model represented by equation (9) will be estimated using Seemingly Unrelated Regression (SUR) with homogeneity and symmetry restrictions imposed using the SHAZAM computer program.
3. Equation (9) will be tested for symmetry and homogeneity. Although symmetry conditions among goods are not applicable because of block substitutability, symmetry is applied within each good. Homogeneity and symmetry tests will be conducted using Likelihood Ratio (LR) tests.
4. Following Hayes et al. (1990), block separability among goods and product aggregations are tested. Assuming that the cost function in equation (1) is quasi separable, Hayes et al. (1990), following Deaton and Muellbauer (1980), derived tests for block separability among goods and product aggregation. The following constraints on the RSDAIDS model represented by equation (9) will be tested:

   Block separability:

$$(10)\quad \gamma_{i_h j} = w_{i_h} w_{j_k} \quad \gamma_{ij} \forall j \neq i$$

   Product Aggregation:

$$(11)\quad \begin{bmatrix} \alpha_{i_h} = \alpha_i, \forall h \in i, \\ \gamma_{i_h j_k} = \gamma_{ij}, \forall h,k \in i,j, \\ \beta_{i_h} = \beta_i, \forall h \in i \end{bmatrix}$$

   Where γ_{ij} is the cross price parameter between group i and j. The γ_{ij} are estimated from a non-source differentiated (aggregate), four goods, AIDS model assuming perfect substitutability.

5. To deflate expenditures, the Tronquist index, which is constructed using the budget share, will be used. An appropriate test will be performed to test for endogeneity that may arise (LaFrance, 1991).

6. Variable $\log(E/P^*)$ will be approximated by the following equation:

$$(12)\quad \log(E/P^*) + \alpha_{i_h} + \sum_j \sum_k f_{i_h j_k} \log(p_{j_k t}) + g_{i_h} \log(PCI) + h_{i_h} \log(ER_t) + i_{i_h} \log(p_o) + V_{i_h}$$

Where t is time, GNP is per capita income, ER is real effective exchange rate for imports, P_0 is the price vector of all other goods, and V_{ih} is the random error term.

Results

To test whether RSDAIDS model is appropriate or not, product aggregation over different import sources and block separability assumptions were tested. Two sources are used in this study: America represented by the United States of America and Chili and the rest of the world, mostly represented by Europe. The results of the estimation of the fruit import demand system are summarized in Tables 14, 15 and 16. The result of the RSDAIDS model, estimated coefficients and t-Ratios for both America (U.S. and Chile) and Rest of the World (ROW) equations are shown in Table 14. Table 15 summarizes the results of the source differentiation and block separability test. The chi-square test statistic for the null hypothesis that apples are separable from all other fruits, which are grapes, almond, pears and other fruits, is 10.63. In addition, the separability tests for grapes, pears and peaches and the joint test for all three equations are 12.5, 19.94, 48.64 and 77.91, respectively. The Wald chi-squares test statistics for the aggregation over sources for apples, grapes, peaches, pears and all imported fruits as a whole are 18.70, 15.16, 44.22, 44.63 and 67.56, respectively and the null hypotheses are rejected. The data support the RSDAIDS model.

Table 15 also shows the auxiliary regression of total expenditures to test for endogeneity. LPApples, LPGrapes, LPAlmonds, LPPears and LPOfruits are price vectors of products in the group. CPI is a proxy of the price vector of all other goods, GNP is per capita income, and ER is the real effective exchange rate for import. All these variables are included in demand equations and tested for significance. A consumer price index for the period of the study is included and used as a proxy for the price of all other goods, and the per capita income is used as a proxy for total expenditure (Table 15).

Homogeneity and Slutsky are tested and are supported by the data. The likelihood ratio tests statistics are 73.99 for homogeneity and 71.88 for Slutsky symmetry.

The result of Marshallian demand elasticities of the RSDAIDS model are in Table 16. The system R^2 of the model is 0.9430. For the apple equation, the expenditure elasticities of both America (U.S. and Chile) and the rest of the world are significant and positive. The expenditure elasticities for America, at 0.8497, indicate that America will maintain its level of exports as the Saudi Arabia apple imports increases. The expenditure elasticity of the rest of the world (1.3506) is positive and significant. The own price elasticities for America are both negative and significant. America apples are more responsive than the rest of the world (-2.6121 and 0.5605). As the price of American apples increases (decreases) by 1 percent, the quantity demanded of these apples decreases (increases) more than the price. The Marshallian cross price relationship between apples from America and from the rest of the world are not significant. Apple imports show a negative or complementary relationship with grapes. Apples and almonds, pears, and other fruits show a positive or substitution relationship.

For the grape equations, the expenditure elasticities of both America and the rest of the world are significant and positive. The American expenditure elasticity is 1.777 and the rest of the world is 1.144. A ten percent increase in fruit import expenditure in Saudi Arabia, would cause quantity of grapes imported from America to increase by 17.77 percent, and from rest of the world will increase by 11.44 percent. The own price elasticities of America is significant and negative, -0.673. As the price of America grapes increases the quantity demanded will decrease less than that percentage change in price. The own price elasticity of the rest of the world is not significant. Grapes and apples indicate a negative or complementary relationship in America while in the rest of the world is positive or substitution relationship. Grapes and almonds, pears, and other fruit in America equation show a positive or substitution relationship. However, grapes and pears and other fruit in the rest of the world equation have complementary relationship while apples and almond have substitution relationship.

For the almond equation, expenditure elasticities of both America and the rest of the world are significant and positive. The America expenditure elasticity is 1.155 and the rest of the world is 1.089. For a ten percent increase in real expenditure in Saudi Arabia, almond import demand from America will increase by 11.55 percent, and from the rest of the world by 10.89 percent. The own price elasticity of the rest of the world is significant while America own price elasticity is not significant. The Marshallian cross price elasticities are not significant. Almonds and grapes and pears have a complementary relationship in America equation while almonds and apples and other fruit have substitution relationship. In the rest of the world equation, almonds and apples and pears

appear to have complementary relation ship while almonds with grapes and other fruit have positive or substitution relationship.

The expenditure elasticity of American pears is significant while in the rest of the world equation is insignificant. Pears, in the America equation, have complementary relationships with apples, grapes and other fruit; and substitution relationship with almonds. In the rest of the world equation, pears have complementary relationship with grapes and other fruit; and substitution relationship with apples and almonds.

Interpretation

For apples, the Marshallian own price elasticities for America and the rest of the world indicate apples imported from America are more price responsive than the rest of the world imports (-2.612 and -0.062). The source differentiated Marshallian cross-price elasticities between apples from America and apples from the rest of the world are negative but significant in the grape equation only. The U.S. and Chile represent America in this study, specifically and significantly in apple imports. The Marshallian cross-price elasticities among apples and other fruits (not source differentiated) are negative for grapes and pears from the rest of the world equation and positive for almonds, pears from America and other fruits.

In the grape equation, the own price Marshallian elasticities of America is negative, -0.673 and inelastic. The own price elasticities of the rest of the world equation is not significant. The cross price elasticities between grapes and apples are both negative suggesting that the substitution does not occur among apples and grapes. However, American grapes were found to have positive and significant substitution relationship with almonds, pears and other fruit imports. This suggest that the American suppliers do not

provide as much competition as do pears, almonds and other fruits that may be marketed at the same time as American grapes are marketed in Saudi Arabia. The U.S. is the largest grape exporter to Saudi Arabia as compared to other American countries. Apples and almonds are found to have significant substitution relationship with grapes in the rest of the world equation.

For almonds, America is significant and highly price elastic than the less elastic rest of the world almond demand. American demand for pears is own price elastic but less own price elastic than the highly elastic rest of the world pears demand.

The Marshallian expenditure elasticities (Table 16) for all four fruits and the two sources are all positive and significant at the one- percent level and the estimates are between 1.62 and 0.90. According to this result, if expenditures on fruit imports in Saudi Arabia continue to grow, then imports of the fruits in these models will grow at a rate slightly above the import expenditure growth rate. Given continued economic growth and development in Saudi Arabia, it is expected the Saudi Arabian fruit import market will continue to grow.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Fruit producers in Saudi Arabia have successfully planned for fruit production without evaluation of the competition or without an adequate marketing plan. They would like to better understand the component of the fruit marketing system in Saudi Arabia, what the fruit buyers want, and the value of their products relative to imports. Neither hedonic fruit pricing or fruit import demand systems have previously been estimated in Saudi Arabia.

Objective one was to analyze the marketing institutions in order to better understand the components of the fruit marketing system. The main purpose of the first part of this study is to study the various middlemen, related agencies and business structures that perform the fruit marketing process in Saudi Arabia starting from the farm level to the ultimate consumer. It is found that commissioners/brokers are the pricing intermediary between fruit producers and retailers. They understand the market and market needs. Commissioners sell to retailers and other small distributors to neighboring small markets. These middlemen suggest that fruit quality characteristics are important in explaining variation in fruit prices. Direct negotiation is the method of price determination and selling while competitive auctions with multiple bidders are conducted primarily for low quality fruit. Most sales are done by credit using invoices and oral contracting. Government agencies provide the market facilities to the wholesalers, commissioners, brokers and retailers at a reasonable rent. It was found that there was not any government intervention in fruit prices but corruption might be a problem in some of the markets where it is difficult to know the real selling price. The commissioners perform their own

business in addition to commission business. Some of them have a transportation system to bring the fruits from the supply centers and some of them are fruit importers. There are other private agencies who participate in the fruit markets domestically and import from abroad.

The second objective of this study was to determine the role of product characteristics in explaining variation in fruit prices. The general hypothesis of the second part of this study is that variation in prices received by producers can be explained by the different fruit quality attributes such as varieties and grading (packages), the efficiency of different fruit markets, and seasonality. The hypotheses were tested using daily data for one season. In general the hypotheses are supported in this study.

A hedonic model of fruit prices for apples, grapes, peaches and pears are estimated. The model should also be useful to participants in the market, specifically the brokers who work for their clients or/and for themselves, to show how quality differentials are reflected in price. Producers should know the premiums and the discounts associated with some of these factors in order to evaluate alternative varieties, markets and packages. The main quality factors in determining fruit prices in this study are varieties and packages. Other factors such as seasonality and market were also important to be known to the producers who can select the early and late fruit varieties and allocate fruit to different markets. The findings support the argument in objective (2) that product characteristics are important in determining the fruit prices. These results are based on one season of daily sales data taken from a Saudi Arabian agribusiness firm (TADCO). To conclude, results indicate that fruit producers' prices were sensitive to seasons, market, fruit variety and package.

The third objective is to determine the nature of the Saudi fruit import market and to estimate some fruit import demand functions together using a source differentiated model. The third part of the study shows that the RSDAIDS model is found to provide an excellent explanation of variation in the fruit import demand in Saudi Arabia from America (U.S. and Chile) and other sources. The RSDAIDS model captures the essential nature of price effects and competition. The data set satisfies both symmetry and homogeneity. Marshallian elasticities for fruits imported from America and rest of the world some exhibit the expected negative sign and are significant. Apples imported from America are much more Marshallian own-price elastic than are imports from the rest of the world. For almonds the reverse is true.

The results indicated competition among fruits as well as competition between sources of the same fruit. Unexpectedly, American apples and grapes have no substitution relationship while both have positive substitution relationship in the rest of the world equation.

Future demand for fruit imports appears to be positive if the development growth continues in Saudi Arabia. It is important for the decision-makers in both the public and private sector to know this fact for future planning. All of the expenditure elasticities are positive, and significant. The markets for American apples were found to be own-price elastic. A one- percent decrease in price would be expected to generate 2.61 percent increases in volume of apples. The results suggest that competition among fruits is as important as competition among sources of the same fruit. If the prices of apples are low, the American grape markets shares will be negatively impacted and the same will happened to the American apples if the prices of grapes are low.

Limitation of the Study

Results of this study, specifically the hedonic model (Chapter 5), are limited by the data that were obtained from TADCO, a Saudi agribusiness firm. Different data and/or different products may have different results. The measured price impacts occurred at the point of the first sale of fruit as a fresh product in the market. In the import demand system, the findings of the study are limited by the accuracy of the quarterly data used in the analysis. This study will need to be updated in order to remain useful.

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Appendix

TABLE 1
TOTAL PRODUCTION OF SOME TYPES OF FRUITS PRODUCED BY TADCO, 1996.

Type	Total Production (kg)	Loss (kg)	Loss Percentage* (%)	Balance (kg)
Apples	592,168.5	31,475	5.32	560,693.5
Grapes	1,589,185.5	41,216.5	2.59	1,549,969
Peaches	1,164,283.5	102,710	8.82	1,040,891
Pears	778,990.5	10,386.5	1.33	768,604
Apricot	407,751	1,598.5	0.39	401,437
Nectarine	382,995.5	11,793.5	3.08	364.894

* Loss is calculated for the period from the production until sale date.
Source: TADCO, a Saudi agribusiness firm, Tabuk, Saudi Arabia.

TABLE 2

SHARE OF TADCO PRODUCTS GOING FOR EACH MARKET BY TYPE OF FRUIT

Product \ Market	Apples (Kg)	Grapes (Kg)	Peaches (Kg)	Pears (Kg)
Jeddah	172018	407424	353741	157763.5
	(0.32)	(0.27)	(0.35)	(0.22)
Dammam	76582.5	355856.5	244990.5	237899.5
	(0.14)	(0.23)	(0.25)	(0.33)
Riyadh	131225	292900	133841.5	124411
	(0.24)	(0.19)	(0.13)	(0.17)
Other Markets	165375	474212	266612	209109
	(0.30)	(0.31)	(0.27)	(0.29)
Total	545200.5	1530392.5	999185	729183
	(1)	(1)	(1)	(1)

Source: TADCO, a Saudi agribusiness firm, Tabuk, Saudi Arabia.

TABLE 3

DESTINATION, DISTANCE, TRANSPORTATION COST, AND TRAVEL TIME BETWEEN THE FRUIT SUPPLY CENTER (TADCO) AND THE FRUIT DOMESTIC DEMAND CENTERS (JEDDAH, DAMMAM AND RIYADH) IN SAUDI ARABIA AND IN THE GULF MARKETS

Destination	Distance (Km)	Cost (SR)	Time (Hour)
Jeddah	1024	2,500	24
Dammam	1729	3,400	40
Riyadh	1537	3,200	32
Kuwait*	2880	4,000	72
U.A.E.*	3960	5,500	72
Bahrain*	1920	4,000	48

* Export markets through Dammam Market.
Source: TADCO, a Saudi Agribusiness firm, Tabuk, Saudi Arabia.

TABLE 4

FRUIT PACKAGES USED BY TADCO FOR SOME TYPES OF FRUITS

PACKING CODE	PACKING TYPE	PACKAGE WEIGHT	PACKING UNIT
P04	4 KG.-POLYBOX	0.084	KG
P07	7 KG.-POLYBOX	0.170	KG
P10	10 KG.-POLYBOX	0.200	KG
FCT	FRUIT CARTON	0.360	KG
GCB	GRAPE CARTON (BIG)	0.370	KG
GCS	GRAPE CARTON (SMALL)	0.280	KG
GBX	GREEN BOX	1.300	KG
RBX	RED BOX	1.570	KG
NBX	NEW BOX	1.530	KG
PTY	POLYTRAY	0.000	KG
ACT	APPLE CARTON	0.820	KG
AB2	ALMOND NETTED BAG2KG	0.000	KG
PHC	PEACHES CARTON	0.360	KG
APS	APRICOT -SML CTN.	0.160	KG
NTC	NECTARINE-CARTON	0.360	KG
APC	APRICOT-CTN BGR SZ	0.360	KG
PLC	PLUMS CARTON	0.360	KG
PLS	PLUMS-SML. CTN	0.160	KG
AEC	APPLE CARTON	0.820	KG
AES	APPLE-SML CARTON	0.360	KG
P2C	PEARS-CTN BGR SZ	0.360	KG
P2S	PEARS-CTN SML SZ	0.160	KG
PRC	PEARS CARTON	0.360	KG
PRS	PLUMS-SML. CTN	0.160	KG
GTY	GRAPE-PLASTIC TRAY	0.240	KG
PHS	PEACHES CTN SMALL	0.160	KG

Source: TADCO, a Saudi agribusiness firm, Tabuk, Saudi Arabia.

TABLE 5

USDA RECOMMENDED FRUIT STORAGE TEMPERATURE AND APPROXIMATE FREEZING POINT .

Commodity	Recommended Storage Temperature	Approximate Freezing Point
Apples	30° to 40° F [1]. (-1.1° to 4.4° C [2].)	30 F. (1.1 C.)
Apricots	32° F. (0° C.)	31.1° F. (-1.1° C.)
Avocados	*CTV 40° F. (4.4° C.)	31.5° F. (-0.3° C.)
	**CIV 55° F. (12.8° C.)	
Bananas	55° to 65° F. (13° to 18° C.)	(Susceptible to Chilling Injury)
Grapefruit	***A&C, 58° to 60° F. (14.4° to 15.6° C.)	30° F. (1.1° C)
	****F&T (Prior to Jan. 1), 60° F. (15.6° C.)	
	F&T (After Jan. 1), 50° F. (10° C.)	
Grapes	32° to 34° F. (0° to 1.5° C.)	28.1° F. (-2.2° C.)
Kiwi	32° F. (0° C.)	29° F. (-1.7° C.)
Lemons	50° to 55° F. (10° to 12.8° C.)	29.4° F. (-1.4° C.)
Lime	48° to 50° F. (8.9° to 10° C.)	29.1° F. (-1.6° C.)
Nectarines	32° to 34° F. (0° to 1.5° C.)	30.4° F. (-0.9° C.)
Oranges	****F&T, 32° to 34° F. (0.0° to 1.1° C.)	Peel 29.7° F. (-1.3° C)
	***C&A, 38° to 48° F. (3.3° to 8.8° C.)	Flesh 30.6° (-0.8° C.)
Peaches	32° to 34° F. (0° to 1.5° C.)	30.4° F. (-0.9° C.)
Pears	32° to 34° F. (0° to 1.5° C.)	30.4° F. (-0.9° C.)
Pineapples	45° to 55° F. (7° to 13° C.)	(Subject to Chilling Injury)
Plums	32° F. (0° C.)	30 .5° F. (-0.8° C.)
Strawberries	32° to 34° F. (0° to 1.5° C.)	30.6° F. (-0.8° C.)
Watermelons	50° to 60° F. (10° to 15.6° C.)	31.3° F. (-0.4° C.)

Source: - The Blue Book (Produce Reporter Co., The Blue Book Services.) Spring 1996.
1 (F)= Fahrenheit
2 (C)= Celsius
* Cold Tolerant Varieties.
** Cold Intolerant Varieties.
*** California and Arizona.
**** Florida and Texas.

TABLE 6
SUMMARY STATISTICS OF ALL VARIABLES INVOLVED IN THE HEDONIC EQUATION FOR APPLES.

VARIABLE NAME	MEAN	ST. DEV[1]	MINIMUM	MAXIMUM
Markets				
Jeddah	0.2013		0.0000	1.0000
Riyadh	0.1443		0.0000	1.0000
Dammam	0.3758		0.0000	1.0000
[2]Other markets	0.2785		0.0000	1.0000
Varieties				
Anna	0.5838		0.0000	1.0000
Dorset	0.3456		0.0000	1.0000
[3]Einsmr	0.0705		0.0000	1.0000
Pakages				
4kg-polybox	0.2718		0.0000	1.0000
Apple carton	0.3289		0.0000	1.0000
7kg-polybox	0.0235		0.0000	1.0000
Apple-small carton	0.3524		0.0000	1.0000
[4]Other package	0.0134		0.0000	1.0000
10kg-polybox	0.0101		0.0000	1.0000
[5]Quantity	1.0894	0.9776	0.1415	4.9620
[6]Unit Price	1.8344	0.4796	1.0000	2.8710

1. Standard Deviation
2. The base market used in the study (Tabuk market and other small fruit markets in Saudi Arabia)
3. The base variety used in the study
4. The base package used in the study
5. Quantity in tons.
6. Unit price SR/kg.

TABLE 7

ESTIMATED COEFFICIENTS FOR THE HEDONIC PRICE EQUATION FOR APPLES (T-RATIOS IN PARENTHESES)

Independent Variables	Dependent Variable: Apple price Mean Equation	Variance Equation	Wald Statistics (Unrestricted)
Intercept	-97.55	-54.47	
	(-4.08)	(-3.21)	
Seasonality			8.80[1]
Sin12	9.95	7.29	
	(3.30)	(3.42)	
Sin6	4.14	-3.60	
	(2.74)	(3.37)	
Cos12	-135.99	-74.50	
	(-4.20)	(-3.26)	
Cos6	-36.46	-19.78	
	(-4.34)	(-3.32)	
Markets			18.24[2]
Jeddah	-0.51	-0.23	
	(-9.68)	(-6.06)	
Dammam	-0.32	-0.19	
	(-6.20)	(-5.06)	
Riyadh	-0.14	-0.11	
	(-1.81)	(-2.12)	
Varieties			3.25[3]
Anna	0.08	0.13	
	(2.70)	(6.31)	
Dorset	0.039	0.11	
	(1.38)	(5.54)	
Packages[5]			10.99[4]
4kg.-polybox	-0.54	-0.02	
	(-4.85)	(-0.26)	
Apple Carton	0.08	0.15	
	(0.72)	(1.77)	
7-kg.-polybox	-0.67	-0.20	
	(-4.19)	(-1.80)	
Apple-Sml. Carton	-0.03	0.18	
	(-0.25)	(1.90)	
10kg.-polybox	-0.61	-0.33	
	(-3.74)	(-2.84)	

TABLE 7 CONTINUED

Quantity	-0.01	-0.02
	(-2.07)	(-4.25)
$R^2 = 0.51$		

[1]The null hypothesis that seasonality does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which seasonality is significant.

H_0 : sin12 = sin6 = cos12 = cos6 = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[2]The null hypothesis that market does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which market is significant.

H_0 : Jeddah = Dammam = Riyadh = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[3]The null hypothesis that variety does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which variety is significant.

H_0 :Anna = Dorset = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[4]The null hypothesis that package does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which package is significant.

H_0 : p04 = aec = p07 = aes = p10 = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[5] Refer to Table 4 for details of fruit packages used by TADCO.

TABLE 8
SUMMARY STATISTICS OF ALL VARIABLES INVOLVED IN THE HEDONIC EQUATION FOR GRAPES.

NAME	MEAN	[1]ST. DEV	MINIMUM	MAXIMUM
Markets				
Jeddah	0.19194		0.00000	1.0000
Dammam	0.29839		0.00000	1.0000
Riyadh	0.15323		0.00000	1.0000
[2]Other Markets	0.35645		0.00000	1.0000
Varieties				
Perlet	0.10161		0.00000	1.0000
Flame	0.17903		0.00000	1.0000
Cardinal	0.16774		0.00000	1.0000
Muscat	0.06612		0.00000	1.0000
Exotic	0.06612		0.00000	1.0000
Thmpson	0.17903		0.00000	1.0000
Bez Al-Anz	0.03709		0.00000	1.0000
Red Globe	0.03871		0.00000	1.0000
Halwani	0.00483		0.00000	1.0000
Danils	0.00322		0.00000	1.0000
Alfalv	0.06935		0.00000	1.0000
Italia	0.04677		0.00000	1.0000
Datter	0.03548		0.00000	1.0000
[3]Vin Hadid	0.00483		0.00000	1.0000
Packages				
Grape Carton	0.61452		0.00000	1.0000
Poly Tray	0.00483		0.00000	1.0000
[4]Other packages	0.03709		0.00000	1.0000
4kg-Poly Box	0.33710		0.00000	1.0000
Grape Tray	0.00645		0.00000	1.0000
[5]**Quantity**	1.9154	1.5885	0.10000	9.2360
[6]**Unit Price**	1.9810	0.86626	0.71400	4.5760

1. Standard Deviation
2. The base market used in the study (Tabuk market and other small fruit markets in Saudi Arabia)
3. The base variety used in the study
4. The base package used in the study
5. Quantity in tons.
6. Unit price SR/k

TABLE 9

ESTIMATED COEFFICIENTS FOR THE HEDONIC PRICE EQUATIONS FOR GRAPE (T-RATIOS IN PARENTHESES)

Dependent Variable: Grape price Independent Variables	Mean Equation	Variance Equation	Wald Statistics (Unrestricted)
Intercept	27.26	6.65	
	(7.18)	(2.48)	
Seasonality			25.59[1]
Sin12	30.45	7.54	
	(7.36)	(2.58)	
Sin6	11.47	2.77	
	(6.55)	(2.25)	
Cos12	21.72	4.61	
	(5.99)	(1.80)	
Cos6	-2.88	-0.89	
	(-12.61)	(-5.51)	
Markets			4.83[2]
Jeddah	-0.31	-0.98	
	(-8.15)	(-3.61)	
Dammam	-0.21	-0.09	
	(-6.72)	(-4.07)	
Riyadh	-0.26	-0.05	
	(-6.55)	(-1.89)	
Varieties			21.69[3]
Perlet	-0.08	-0.25	
	(-0.31)	(-1.45)	
Flame	-0.08	-0.29	
	(-0.34)	(-1.71)	
Cardinal	-0.13	-0.29	
	(-0.55)	(-1.73)	
Muscat	-0.15	-0.27	
	(-0.64)	(-1.56)	
Exotic	-0.15	-0.31	
	(-0.64)	(-1.84)	
Thompson	0.14	-0.15	
	(0.58)	(-0.89)	
Bezanz	-0.38	-0.25	
	(-1.58)	(-1.48)	
Red Globe	0.83	0.15	
	(2.88)	(0.72)	

Table 9 Continued

Halwani	0.03	-0.24	
	(0.08)	(-1.04)	
Denials	0.02	-0.15	
	(0.04)	(-0.40)	
alfalv	-0.35	-0.24	
	(-1.46)	(-1.47)	
Italia	-0.69	-0.31	
	(-2.83)	(-1.82)	
Datter	-0.45	-0.23	
	(-0.46)	(-1.29)	
Packages[5]			34.70[4]
Grape Carton (big)	0.72	-0.02	
	(6.17)	(-0.25)	
PolyTray	3.11	0.27	
	(9.16)	(1.15)	
4kg.-PolyBox	-0.30	-0.34	
	(-2.62)	(0.08)	
Grape-Plastic Tray	0.29	0.02	
	(0.83)	(0.06)	
Quantity	0.02	-0.01	
	(1.72)	(-0.07)	
$R^2 = 0.70$			

[1]The null hypothesis that seasonality does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which seasonality is significant.

H_0 : sin6 = cos12 = cos6 = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[2]The null hypothesis that market does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which market is significant.

H_0 : Jeddah = Dammam = Riyadh = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[3]The null hypothesis that variety does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which variety is significant.

H_0 : = perlet = flame = cardinal = Muscat = exotic = Tohmpson = bezanz = Red globe = Halwani = Danils = alfalv = Italia = Datter 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[4]The null hypothesis that package does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at $\propto$ = 0.05 at which package is significant.

H_0 : p04 = pty = gcb = gty = p10 = 0

H_a : Not H_0

Wald Statistic: $p < \propto$ Reject H_0

[5] Refer to Table 4 for details of fruit packages used by TADCO.

TABLE 10
SUMMARY STATISTICS OF ALL VARIABLES INVOLVED IN THE HEDONIC EQUATION FOR PEACHES.

NAME	MEAN	[1]ST. DEV	MINIMUM	MAXIMUM
Markets				
Jeddah	0.30429		0.00000	1.0000
Dammam	0.27000		0.00000	1.0000
Riyadh	0.12714		0.00000	1.0000
[2]Other Markets	0.29857		0.00000	1.0000
Varieties				
Bonita	0.02000		0.00000	1.0000
Florida Star	0.08428		0.00000	1.0000
L. Variety	0.03142		0.00000	1.0000
N.Variety	0.01000		0.00000	1.0000
Florida Prine	0.15857		0.00000	1.0000
[3]Star Crest	0.01000		0.00000	1.0000
Florida King	0.18714		0.00000	1.0000
Driest Gold	0.07142		0.00000	1.0000
Spring Time	0.00428		0.00000	1.0000
Spring Crest	0.11714		0.00000	1.0000
Florida Gold Star	0.00428		0.00000	1.0000
Florida Goal	0.07285		0.00000	1.0000
20-75	0.01142		0.00000	1.0000
Florida Glow	0.01000		0.00000	1.0000
Tropical Sweet	0.04571		0.00000	1.0000
Florida Grade	0.01285		0.00000	1.0000
Hermicil	0.3428		0.00000	1.0000
Honey Yard	0.00714		0.00000	1.0000
Tropical Snow	0.00142		0.00000	1.0000
Packages				
Fruit Box	0.57000		0.00000	1.0000
Fruit Carton	0.00428		0.00000	1.0000
Peach Carton	0.40429		0.00000	1.0000
[4]Other Package	0.00142		0.00000	1.0000
Poly Small Box	0.00857		0.00000	1.0000
New Box	0.01142		0.00000	1.0000
[5]Unit Price	4.1495	1.3293	1.7200	8.1800
[6]Quantity	1.2421	1.2850	0.16100	8.6640

1. Standard Deviation

2. The base market used in the study (Tabuk market and other small fruit markets in Saudi Arabia)
3. The base variety used in the study
4. The base package used in the study
5. Quantity in tons.
6. Unit price SR/kg.

TABLE 11

ESTIMATED COEFFICIENTS FOR THE HEDONIC PRICE EQUATIONS FOR PEACHES (T-RATIOS IN PARENTHESES)

Dependent Variable: Peach price

Independent Variables	Mean Equation	Variance Equation	Wald Statistics (Unrestricted)
Intercept	109.83	0.57	
	(9.31)	(0.07)	
Seasonality			24.01[1]
Sin12	-40.93	0.14	
	(-6.31)	(0.03)	
Sin6	-24.34	0.38	
	(-6.96)	(0.15)	
Cos12	145.30	0.30	
	(9.42)	(0.03)	
Cos6	38.53	0.34	
	(11.17)	(0.14)	
Markets			8.34[2]
Jeddah	-0.46	-0.08	
	(-8.13)	(-2.11)	
Dammam	0.61	-0.08	
	(10.41)	(-1.53)	
Riyadh	0.50	-0.06	
	(6.98)	(-1.14)	
Varieties			27.34[3]
Bonita	0.76	-0.32	
	(0.88)	(-0.54)	
Florida Star	-0.54	0.38	
	(-3.82)	(3.86)	
Lvariaty	-0.29	0.39	
	(-1.60)	(3.05)	
Ntvariaty	-0.11	0.47	
	(-0.34)	(2.06)	
Florida Brine	-0.22	0.17	
	(-1.84)	(1.98)	
Florida King	-0.10	0.17	
	(-0.82)	(1.96)	
Driest Gold	-0.97	0.12	
	(-0.78)	(1.41)	

Table 11 Continued

May Crest	0.07	0.12	
	(0.50)	(1.34)	
Spring Time	0.26	1.13	
	(0.31)	(1.91)	
Spring Crest	-0.03	0.30	
	(-0.22)	(2.86)	
Florida Gold Star	-0.60	0.02	
	(-1.92)	(0.09)	
Florida Goal	0.13	0.17	
	(0.84)	(1.58)	
Twnsvnfv	-0.04	0.24	
	(-0.16)	(1.24)	
Florida Glow	0.20	-0.05	
	(1.08)	(-0.36)	
Tropical Sweet	0.05	0.28	
	(0.28)	(2.03)	
Florida Grade	0.16	0.09	
	(0.66)	(0.49)	
Hermicill	-0.22	0.18	
	(-0.81)	(0.97)	
Honey Yard	-0.16	-0.30	
	(-0.45)	(-1.17)	
Tropical Snow	-0.65	-0.74	
	(-2.73)	(-4.40)	
Packages[5]			26.15[4]
Poly-box	0.13	0.26	
	(2.18)	(6.00)	
Fruit Carton	3.62	0.10	
	(3.62)	(0.62)	
Peaches Carton	1.50	0.50	
	(20.08)	(9.42)	
Peaches Small Box	-0.24	0.31	
	(-0.93)	(1.63)	
New Box	1.59	0.28	
	(6.30)	(1.57)	
Quantity	0.03	-0.03	
	(1.95)	(-3.20)	
$R^2 = 0.76$			

[1]The null hypothesis that seasonality does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at $\propto$ = 0.05 at which seasonality is significant.

H_0 : sin12 = sin6 = cos12 = cos6 = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[2]The null hypothesis that market does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which market is significant.

H_0 : Jeddah = Dammam = Riyadh = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[3]The null hypothesis that variety does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which variety is significant.

H_0 : Bonita = flstar = lvarty = ntvrty = flprint = flking = drstgold = maycrest = springtime = springcrest = fgld star = flordgol = twnsvnf = flrdglo = trpcsweet = flgra = hermicil = honyrd = trpcsnow = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[4]The null hypothesis that package does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at α = 0.05 at which package is significant.

H_0 : pof = fct = phc = pos = nbx = 0

H_a : Not H_0

Wald Statistic: $p < \alpha$ Reject H_0

[5] Refer to Table 4 for details of fruit packages used by TADCO.

TABLE 12
SUMMARY STATISTICS OF ALL VARIABLES INVOLVED IN THE HEDONIC EQUATION FOR PEARS.

NAME	MEAN	[1]ST. DEV	MINIMUM	MAXIMUM
Markets				
Jeddah	0.22374		0.00000	1.0000
Riyadh	0.10046		0.00000	1.0000
Dammam	0.36530		0.00000	1.0000
[2]Other Markets	0.31050		0.00000	1.0000
Varieties				
Erocolin	0.67580		0.00000	1.0000
Blanqul	0.27397		0.00000	1.0000
Mp. Moretime	0.04566		0.00000	1.0000
[3]Fanstil	0.00456		0.00000	1.0000
Packages				
Poly Carton	0.53425		0.00000	1.0000
Fruit Carton	0.42922		0.00000	1.0000
Plastic Carton	0.00456		0.00000	1.0000
[4]Other Packing Materials	0.00456		0.00000	1.0000
[5]Quantity	2.6413	1.6468	0.52450	8.7200
[6]Unit Price	3.0361	1.3047	0.58900	7.0080

1. Standard Deviation
2. The base market used in the study (Tabuk market and other small fruit markets in Saudi Arabia)
3. The base variety used in the study
4. The base package used in the study
5. Quantity in tons.
6. Unit price SR/kg.

TABLE 13
ESTIMATED COEFFICIENTS FOR THE HEDONIC PRICE EQUATIONS FOR PEARS (T-RATIOS IN PARENTHESES)

Dependent Variable: Pear price Independent Variables	Mean Equation	Variance Equation	Wald Statistics
Intercept	8.11	0.50	
	(2.29)	(0.20)	
Seasonality			1.47[1]
Sin12	7.8	0.61	
	(1.84)	(0.20)	
Sin6	0.11	-0.17	
	(0.08)	(-0.18)	
Cos12	0.79	-0.24	
	(0.29)	(-0.12)	
Cos6	-1.79	-0.13	
	(-2.23)	-0.22	
Markets			4.64[2]
Jeddah	-0.15	-0.02	
	(-1.35)	(-0.28)	
Dammam	-0.21	-0.29	
	(-2.41)	(-4.79)	
Riyadh	-0.63	-0.30	
	(-7.26)	(-4.91)	
Varieties			2.81[3]
Ercolin	-0.36	0.83	
	(-1.35)	(4.22)	
Blanqul	-0.38	1.10	
	(-2.07)	(8.35)	
Mp. More Time	-1.15	0.74	
	(-5.41)	(4.91)	
Packages[6]			4.33[4]
Poly Fruit Carton	1.09	-0.10	
	(6.11)	(-0.81)	
Fruit Box	0.28	-0.27	
	(1.83)	(-2.47)	
Pears Carton	0.14	-1.23	
	(0.37)	(-4.58)	
Quantity	-0.03	-0.06	
	(-2.63)	(-6.83)	
$R^2 = 0.78$			

[1]The null hypothesis that seasonality does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at $\propto$ = 0.05 at which seasonality is significant.

H_0 : sin12 = sin6 = cos12 = cos6 = 0

H_a : Not H_0

Wald Statistic: $p < \propto$ Reject H_0

[2]The null hypothesis that market does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at $\propto$ = 0.05 at which market is significant.

H_0 : Jeddah = Dammam = Riyadh = 0

H_a : Not H_0

Wald Statistic: $p < \propto$ Reject H_0

[3]The null hypothesis that variety does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at $\propto$ = 0.05 at which variety is significant.

H_0 : eroclin = blnqul = mpmortm = 0

H_a : Not H_0

Wald Statistic: $p < \propto$ Reject H_0

[4]The null hypothesis that package does not affect fruit prices is rejected if the p value calculated, using F and Wald Chi-square statistics, is less than the critical value at $\propto$ = 0.05 at which package is significant.

H_0 : ptc = pof = plc = 0

H_a : Not H_0

Wald Statistic: $p < \propto$ Reject H_0

[5] Refer to table 4 for details of fruit packages used by TADCO.

TABLE 14

RSDAIDS MODEL COEFFICIENT ESTIMATES FOR SAUDI ARABIA FRUIT IMPORT DEMAND, 1991-1996

Equation and Variables*	America equation**	ROW equation**
Apples		
PA_{AMER}	-0.4718 (0.1597)	0.0056 (0.0674)
PA_{ROW}	0.0056 (0.0928)	0.2402 (0.0828)
P_{Grapes}	-0.3140 (0.2351)	-0.2864 (0.1732)
$P_{Almonds}$	0.4849 (0.3676)	0.7039 (0.2417)
P_{Pears}	0.0907 (0.3490)	-0.7660 (0.2671)
P_{Ofruit}	0.2045 (0.1914)	0.1025 (0.1416)
Y	-0.0428 (0.0574)	0.0522 (0.0422)
Grapes		
PG_{AMER}	0.0164 (0.0257)	0.0213 (0.0233)
PG_{ROW}	0.0213 (0.0103)	0.0807 (0.0591)
P_{Apples}	-0.3292 (0.1324)	0.1899 (0.2973)
$P_{Almonds}$	0.0350 (0.1403)	0.5911 (0.3282)
P_{Pears}	0.1661 (0.1453)	-0.7365 (0.3460)
P_{Ofruit}	0.0904 (0.0768)	-0.1466 (0.1744)
Y	0.0351 (0.0257)	0.0187 (0.0583)
Almonds		
PL_{AMER}	0.0318 (0.0138)	-0.0106 (0.0014)
PL_{ROW}	-0.0106 (0.0070)	0.0010 (0.0013)
P_{Apples}	0.0673 (0.0628)	-0.0072 (0.0126)
P_{Grapes}	-0.0786 (0.0508)	0.0077 (0.0126)
P_{Pears}	-0.0457 (0.0754)	-0.0105 (0.0150)
P_{Ofruit}	0.0359 (0.3726)	0.0197 (0.0072)
Y	0.00537 (0.0120)	0.0009 (0.0024)
Pears		
PR_{AMER}	0.0046 (0.0047)	0.0015 (0.0103)
PR_{ROW}	0.0015 (0.0041)	0.0507 (0.0199)
P_{Apples}	-0.0011 (0.0438)	0.2490 (0.1108)
P_{Grapes}	-0.0560 (0.0336)	-0.0755 (0.0875)
$P_{Almonds}$	0.0238 (0.0484)	0.0572 (0.1350)
P_{Ofruit}	0.0272 (0.0264)	-0.2829 (0.0707)
Y	0.0107 (0.0090)	-0.0578 (0.0221)
$R^2 = 0.9430$		

*Note:

PA_{AMER} =Price of apples from America.

PA_{ROW} =Price of apples from the rest of the world

PG_{AMER} =Price of grapes from the rest of the world

PG_{ROW} =Price of grapes from the rest of the world
PL_{AMER} =Price of almonds from the rest of the world
PL_{ROW} =Price of almonds from the rest of the world
PR_{AMER} =Price of pears from the rest of the world
PR_{ROW} =Price of pears from the rest of the world
P_{Apples} =Price of apples (unit value of import for apples is used as a proxy)
P_{Grapes} =Price of grapes (unit value of import for grapes is used as a proxy)
$P_{Almonds}$ =Price of almonds (unit value of import for almonds is used as a proxy)
P_{Pears} =Price of pears (unit value of import for pears is used as a proxy)
P_{Ofruit} =Price of other fruits (unit value of import for other fruits is used as a proxy)
** Standard Errors (SE) are in parentheses following the coefficient estimates

TABLE 15

RESULTS OF BLOCK SEPARABILITY, SOURCE DIFFERENTIATION, AND ENDOGENEITY TESTS FOR THE RSDAIDS model.

Type of Test	Test Results
Block Separability	H_0: Apples are separable from all other fruits. Wald χ^2= 10.63 with 8 degrees of freedom. H_0: Grapes are separable from all other fruits. Wald χ^2= 12.5 with 8 degrees of freedom. H_0: Almonds are separable from all other fruits. Wald χ^2= 19.94 with degrees 8 of freedom. H_0: Pears are separable from all other fruits. Wald χ^2= 48.64 with 8 degrees of freedom. H_0: All of the above Wald χ^2= 77.91 with 52 degrees of freedom
Source Differentiation	H_0: Apples are not source differentiated. Wald χ^2= 18.70 with 6 degrees of freedom. H_0: Grapes are not source differentiated. Wald χ^2= 15.16 with 6 degrees of freedom. H_0: Almonds are not source differentiated. Wald χ^2= 44.22 with 8 degrees of freedom. H_0: Pears are separable from all other fruits. Wald χ^2= 44.63 with 24 degrees of freedom. H_0: All of the above Wald χ^2= 67.56 with 52 degrees of freedom
Auxiliary Regression of Total Expenditures to Test for Endogeneity	$Ln(E/P^T) = 96.12 - 1.15\ LPApple + 0.02LPGrape + 0.52LPAlmond$ (65.82) (1.89) (0.23) (0.76) $- 0.02LPPear + 0.070\ LPOfruit + 0.078CPI - 7.87GNP.$ (0.31) (0.36) (6.75) $R^2 = 0.54$ DW= 1.60

TABLE 16

MARSHALLIAN ELASTICITIES OF SAUDI ARABIA FRUIT IMPORT DEMAND, 1991-1996

Products	America Equation*	ROW Equation*
Apples		
PA_{AMER}	-2.6121 (0.5462)	-0.0622 (0.4462)
PA_{ROW}	0.0421 (0.3143)	0.5605 (0.5366)
Pgrapes	-1.0917 (0.8219)	-1.9453 (1.1610)
$P_{Almonds}$	1.7077 (1.2917)	4.7101 (1.6237)
P_{Pears}	0.3447 (1.2331)	-5.2040 (1.8109)
P_{Ofruit}	0.7355 (0.6680)	0.6466 (0.9425)
Y	0.8497 (0.2012)	1.3506 (0.2836)
Grapes		
PG_{AMER}	-0.6731 (0.2349)	0.1576 (0.1737)
PG_{ROW}	0.3713 (0.2351)	-0.3983 (0.4478)
P_{Apples}	-7.6215 (2.8361)	1.3977 (2.2097)
$P_{Almonds}$	0.7248 (3.1150)	4.5345 (2.5297)
P_{Pears}	3.6396 (3.2206)	-5.6679 (2.6651)
P_{Ofruit}	1.9071 (1.6887)	-1.1440 (1.3331)
Y	1.7766 (0.5692)	1.1436 (0.4484)
Almonds		
PL_{AMER}	0.6586 (0.2092)	-1.1575 (0.1809)
PL_{ROW}	-0.2641 (0.2092)	-0.9340 (0.1329)
P_{Apples}	3.7871 (2.8446)	-2.2273 (2.0001)
P_{Grapes}	-1.9961 (1.5050)	0.5218 (1.0092)
P_{Pears}	-0.5815 (2.3551)	-1.6395 (1.5954)
P_{Ofruit}	1.5476 (1.2362)	1.4993 (0.8317)
Y	1.1553 (0.3480)	1.0885 (0.2323)
Pears		
PR_{AMER}	-0.7808 (0.2828)	0.2126 (0.3073)
PR_{ROW}	-0.4214 (0.3114)	-0.0531 (0.4197)
P_{Apples}	-0.2756 (2.6283)	5.1135 (2.2862)
P_{Grapes}	-3.4095 (2.0155)	-1.6264 (1.8053)
$P_{Almonds}$	1.2836 (2.8994)	1.1808 (2.7863)
P_{Ofruit}	-0.0094 (0.0091)	-5.8372 (1.4594)
Y	1.6242 (0.5410)	-0.2204 (0.4571)
$R^2 = 0.9430$		

* Standard Errors (SE) are in parentheses.

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