

## **MONITORING THE FRESH FRUITS AND VEGETABLES SUPPLY CHAIN IN TURKEY**

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### **INTRODUCTION**

Agricultural supply chains are formed by individuals and institutions responsible for carrying out activities such as production, processing, distribution and marketing of agricultural products to the end consumers [Ahumada and Villalobos 2009]. Agricultural supply chains have a highly sophisticated structure which required certain specifications and performance standards [Dolan and Humphrey 2000]. This requires are mainly sourced from product features, consumer expectations and multi-intermediated structure of supply chain. Providing of the consistency and reliability of supply can be harder and more costly than other supply chains because of the characteristic features of the agricultural supply chain [Zuurbier 1999].

Agricultural products may be subject to dual discrimination, including perishable and non-perishable. Perishable products supply chains or, in other words, fresh supply chains have more complicated processes and difficult governance than other groups. The short shelf life of perishable agricultural products, the prominence in terms of general public health and additional logistical requirements are the main reasons for this situation [Ahumada and Villalobos 2009].

Due to the above-mentioned characteristic features of fresh supply chains, it is inevitable that some inefficiencies and losses occur in these systems. However, it is necessary to review the inefficiencies and losses with a critical point of view considering the economic, social and environmental effects and to make necessary arrangements [Alexander et al. 2017].

In this paper, we focus on the losses and price differences between farmers and final consumers caused by inefficiency observed throughout the fresh fruits and vegetables supply chain of Turkey. We aimed to draw attention to the fact that these losses and price differences are far above the acceptable level and this situation adversely affects the interests of the producers and consumers, which are the weakest rings of the supply chain. We review the related literature and used secondary data. In order to control product losses and price differences and to bring them to more reasonable levels, firstly planned production should be started in agricultural production. Producers and producers’ unions should be supported to strengthen their dominance over the supply chain. Finally, the transition from a multi-intermediated supply chain structure to a non-intermediated supply chain model should be in a gradual way and focus on the development of value-added processes and activities rather than reducing the number of intermediaries.

**FRESH FRUITS AND VEGETABLES SUPPLY CHAIN STRUCTURE OF TURKEY**

It is possible to say that fresh fruits and vegetables sector has a very large and complex supply chain structure in Turkey. Farmers in Turkey usually consist of small-scale family businesses which operating with limited resources. However, the dominance of the fresh fruits and vegetables supply chain is at large retailers with high bargaining power. This structure of the supply chain increases the producers and consumers price difference and leads to very huge amount of losses.

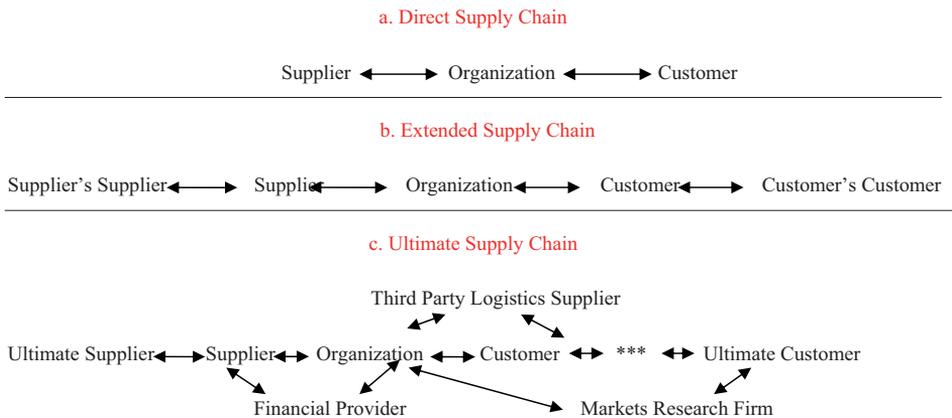


FIG. 1. Types of channel relationships  
Source: Mentzer et al. 2001.

Figure 1 shows supply chain models with general outlines that may apply to each sector. In Figure 1, “a” direct supply chain shows the shortest, direct to the customer from supplier without intermediary. On the other hand, “b” and “c” have at least one internadi-

ary, “c” has a rather complex structure than “b”. It is possible to create the supply chain in the fresh fruit and vegetable sector as shown in Figure 2 by referencing to Figure 1. In general, the structure of agricultural supply chain management follows a bidirectional path towards the final consumer from the farmer, as shown in Figure 2.

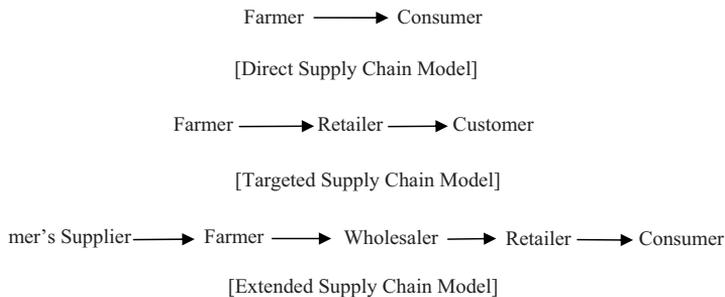


FIG. 2. Illustration of fresh fruits and vegetables supply chain  
Source: the authors.

It is possible that it can be examined the structure of fresh fruits and vegetables supply chain of Turkey in three models: Direct supply chain (farmer–customer), targeted supply chain (farmer–retailer/cooperatives–customer) and extended supply chain (farmer’s supplier–farmer–wholesaler–retailer–customer).

### **DIRECT SUPPLY CHAIN MODEL (FARMER–CUSTOMER)**

In fresh fruits and vegetables sector the shortest supply chain form is direct supply chain model. In this model farmers sell their products to the end consumers directly. There isn’t any intermediary person or institution which involved between the farmer and the end consumer. This supply chain structure is more suitable for local products generally. In this supply chain the products are presented directly to the customers after the harvest by the farmers. In the sales made to individual consumers at low volumes and handling activities such as product sorting, classification and standardization is quite limited. In Turkey due to the limited resources of local farmers certain products such as tomatoes, peppers, peaches, cherries, lettuce and beans, which have short shelf life and high degree of perishability are being evaluated in this way. Advantages of this supply chain is favourable price, freshness, and direct marketing communication between farmer and consumer. Also, farmer can determine price independently and get from higher revenue but on the other hand certain problems can appear in practically. First of all, farmer’s limited resources are not sufficient for handling, warehousing and domestic distribution activities. Inadequate resources of farmers can lead to certain marketing and financial problems and it may not be possible for the farmers to sell the product after the harvest in a short time. At the same time, the fact that a large number of farmers involved in the markets simultaneously with the same fruits and vegetables variety can lead to price fluctuations and most of the farmers can not eliminate adverse affects of this problem.

### **TARGETED SUPPLY CHAIN MODEL (FARMER–RETAILER/COOPERATIVES–CUSTOMER)**

This supply chain structure is usually seen as contracted production in Turkey. The contracted production model is a product and marketing form where the company guarantees the purchase of the production that the farmer produces within the determined conditions [Yılmaz et al. 2013]. The farmer makes an agreement with the retailer firm before production about the production methods, quality standards, price and the other factors which related to production. In other words, production and marketing activities are entirely driven by the retailers in this supply chain structure. The greatest advantage of this structure is eliminating the problem of product marketing and evaluation problems. After the harvest product is classified and packaged in the way that it is pre-ordered and sold to the retailer company. Transportation, storage, distribution and marketing functions are performed by the retailer firm. Products that do not meet the necessary conditions as well as products that meet the standardization conditions are also bought by the retailer firm at relatively low prices. This gives the farmer the opportunity to evaluate the entire product it produces. However, the quality and quantity requirements desired by strong retail companies can only be fulfilled by certain producers.

Contractual production constitutes an important alternative to the capital and resource constraints of the producer. However, because important decisions about the production process are made by capital owners, the producer loses his independence in the production process and is alienated to the production process [Teoman and Tartıcı 2012]. The major disadvantage of contracted production for producers is that their influence and dominance over important decisions on the production process, such as input, quality, price and production decisions [Bor 2011]. In addition to this production standards, deferred payment system can also cause an interruption in continuity of product supply. On the other hand, consumer prices are not sufficiently reduced in this model due to the high logistics costs (such as transportation, storage, packaging and repackaging activities) and profit margins of retail firms. As a result of the deficiencies observed in practice and the non-generalization of the model throughout the country, contract production model is far from meeting the expectations [Yılmaz et al. 2013].

In order to better manage the contracted production process, cooperatives should be encouraged to increase bargaining power of small producers. The support of the producers' associations in the legal ground and the asymmetric power relations in the contractual production process have to be improved in favor of the producer [Teoman and Tartıcı 2012].

### **EXTENDED SUPPLY CHAIN MODEL (FARMER'S SUPPLIER-FARMER-TRADERS-WHOLESALE-RETAILER-CUSTOMER)**

In the fresh fruit and vegetable sector, a significant part of seed, fertilizer, pesticide, energy, and agricultural machinery and vehicles are supplied through imports. This situation leads to the addition of another intermediary (farmer's supplier) in the chain and naturally leads to an increase in costs. Another factor of high costs is the distance between production and consumption centers. Fruits and vegetables are brought to wholesaler,

which in production area by the farmers and then transport to wholesaler in consumption area by traders or packers. Then extended numbers of intermediary person or firm is involved in the supply chain at various stages such as handling, transport, storage, packaging, distribution etc. This long, complex and time-consuming structure of the supply chain not only reduces the quality of the product but also increases the losses and costs. It is possible to say that the main causes of product losses and associated cost increases are generally inadequate storage, transport and marketing conditions. On the other hand, this supply chain model also leads to a number of problems in terms of traceability, informality and food safety.

### **LOSSES IN FRESH FRUITS AND VEGETABLES SUPPLY CHAIN PROCESSES**

The most effective factors on the success of the supply chain are the concepts of speed and food safety due to the perishability of fruits and vegetables. Fresh fruits and vegetables are included in the supply chain considering numerous criteria such as product type, perishability degrees, marketing channels, processing techniques and distance between production and consumption center. In spite of the direct form of supply chain is being most targeted model, multi-intermediated supply chain model is often observed in practice because farmers are more interested with production than marketing [Kara et al. 2007]. Traders, wholesalers, processing firms and retailers take place between farmer and the end-consumer in this supply chain model. Intermediaries are more powerful than farmers especially in price negotiations and this is the main factor that increases consumer prices while reduce the farmer's revenues [Pezikoğlu et al. 2004].

Another disadvantage of the long and complicated supply chain structure is product losses that achieve fairly high rates occurring throughout the supply chain. Product losses can occur at different stages throughout the supply chain, including production, post-harvest (handling and storage activities), processing, packaging, distribution and consumption [Gustavsson et al. 2011]. The product losses observed at different stages throughout the fresh fruit and vegetable supply chain for Turkey are given in Figure 3.

Average product losses in fresh fruits and vegetables are between 10 and 30% and this range can vary in terms of the species and variety. According to Figure 3 fresh fruits and vegetables are lost throughout the supply chain at the rate of 4–12% in harvest, 2–8% in transportation, 5–15% in handling, 3–10% in storage and 1–5% in consumption stages. It is estimated that the production loss is about 25 billion TRY while the annual fruit and vegetable production value is 100 billion TRY. These losses adversely affect all the stakeholders that are involved in the supply chain and the country's economy, but the negative impacts are more on the consumer and farmer side. The loss ratios from farmer to the end consumer (not including consumption losses) by product groups are given in Table 1.

Product losses occur at a high level of about 22% in some products such as green onion, garlic and plum when at the rate of 5% in citrus products. The part of the product losses from farmer to the last consumer corresponds to approximately 9.5% of the annual average production. At the same time the total loss production rate is calculated as 8.5%. This rate is further increased by the inclusion of 1–5% loss rates in the consumption phase.

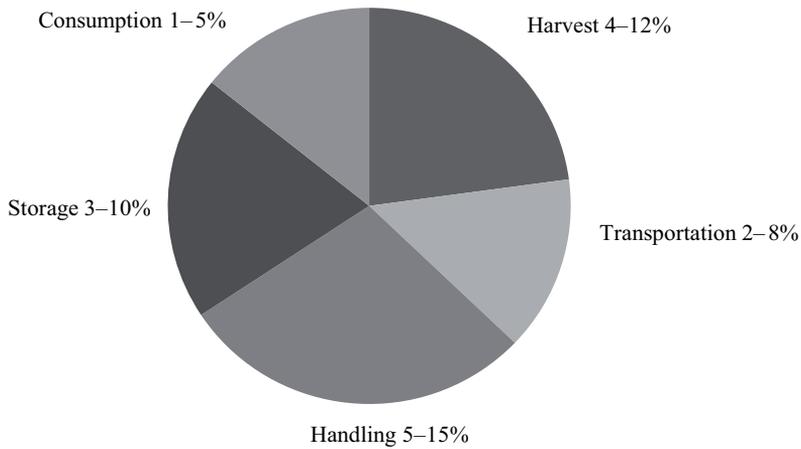


Fig. 3. Losses in Turkey fresh fruits and vegetables supply chain

TABLE 1. Product losses from farmer to consumer in fresh fruits and vegetables supply chain

Fresh fruits and vegetables	Total production values [thous. t]	Losses in 2016–2017 period [thous. t]	Loss production rate [%]
Scallion	134.5	30.4	22.6
Garlic	109.2	23.37	21.4
Plum	297.6	63.69	21.4
Banana	305.9	53.53	17.5
Mulberry	71.7	11.11	15.5
Lettuce	478.4	59.32	12.4
Watermelon	3 928.90	487.18	12.4
Melon	1 854.40	229.95	12.4
Pear	472.3	58.09	12.3
Sour Cherry	192.5	23.68	12.3
Cabbage	715	87.23	12.2
Tomato	12 600.00	1 537.20	12.2
Green Bean	638.5	75.98	11.9
Pumpkin	351.6	41.84	11.9
Spinach	211	24.9	11.8
Cherry	599.7	68.97	11.5
Cucumber	1 811.70	206.53	11.4
Apple	2 925.80	321.84	11

cont. tab. 1

Fresh fruits and vegetables	Total production values [thous. t]	Losses in 2016–2017 period [thous. t]	Loss production rate [%]
Peach	674.1	74.15	11
Pepper	2 457.80	267.9	10.9
Orange	1 850.00	186.85	10.1
Strawberry	415.2	41.1	9.9
Carrot	554.7	52.14	9.4
Onion	2 120.60	186.61	8.8
Grape	4 000.00	328	8.2
Pomegranate	465.2	31.17	6.7
Apricot	730	41.61	5.7
Grapefruit	253.1	12.15	4.8
Potato	4 750.00	223.25	4.7
Lemon	850.6	39.98	4.7
Mandarin	1 337.00	60.17	4.5
Fig	305.5	10.08	3.3
Radish	199.3	3.79	1.9
Total Production	110 728.90	9 411.96	8.5

Source: WWW 1.

It is possible to divide harvest losses of fresh fruits and vegetables into two groups as losses on the farm due to the excessive decrease in product prices and losses from harvest to sale [Gunders 2012]. The increase observed in post-harvest loss rates negatively affects the bargaining power in price negotiations and income level of farmers [Shukla and Jharkharia 2013].

Product losses from harvest to sale are due to the wrong harvest time and harvesting techniques. The lack of proper care during harvest and using of unsuitable containers cause damage to the product and shorten the shelf life. Due to the unplanned production structure, producers present their products to the markets at the same time and this cause to distort the balance of supply and demand. While the demand for the product is unchanged, the supply of the product is above the markets volume causes the producer income to fall below the costs. To reduce product losses due to the price fluctuations, producers should be directed to product types with different harvest time. In this way, it is possible to ensure the maintaining of supply and eliminating the adverse effects of price fluctuations [Yulafçı and Cinemre 2007].

Handling activities are another factor that influence losses rates and service quality. Fresh fruits and vegetables products are presented to the markets after a number of handling activities such as washing, sorting, weighing and packaging. Packaging is the most

important handling activity in the prevention of product losses. Right packaging provides a protection against the mechanical and physical environment damage and ensure to hygiene and quality requirements [Kader and Rolle 2004]. For this reason, standardization and availability of suitable packaging materials is an important factor in the performance of the fresh fruit and vegetable supply chain [Union of Agricultural Chambers of Turkey 2008]. Development and commercialization of natural packaging materials will significantly reduce post harvest losses by up to 30% [Öz and Süfer 2012].

Reduction of quality and quantity losses of fresh fruits and vegetables during the storage and transportation is closely related to ensuring adequate ambient temperature and humidity conditions. For most fresh fruits and vegetables, the optimum temperature is around 0°C, and every 10°C increase above optimum temperature leads to two or three times increase in perishability level of the product. As well as the optimum temperature values are exceeded, temperature conditions below this value also lead to deterioration of the product. Especially in tropical products, because of the freezing threshold is low these products must be kept between 5°C and 13°C during the transportation and storage phases [Kader 2002].

## **PRICE DIFFERENCES BETWEEN FARMERS AND CONSUMERS**

Providing of the consistency and reliability of supply can be harder and more costly than other supply chains because of the characteristic features of the agricultural supply chain [Zuurbier 1999]. According to Alemdar [2008], asymmetric power relation between farmer and holders is the factor that separates agricultural supply chain from the other supply chains. The asymmetric power relation occurs mostly in distribution phase but in fact it is a situation that continue throughout the supply chain from production to the consumption.

Major retailers have a strong position in the fresh fruits and vegetables supply chain, especially in the distribution and marketing phase. A large part of the supply chain activities are under the control of these companies, depending on this strong position [Zuurbier 1999].

Asymmetric power relations between farmer and retailers also can lead to exclude small farmers from the markets or force to operate with very small profit margins. This situation is observed in both developed and developing countries in inverse proportion to the state development level [Brown and Sander 2007]. Especially in economies such as Turkey where small and fragmented production structure is observed, it is becoming difficult for small producers to comply with markets conditions. The asymmetric power relation spread inevitably along the chain and cause to welfare loss of the farmer and the end consumer, which constitute the weakest rings of the chain.

It is possible that we can show the farmer and consumer price differences as the most concrete indicator of the asymmetric power relation. Farmer and consumer price differences reach huge sizes of 300% in some product groups. This situation will be better understood when Table 2 which shows the average prices for certain agricultural products for Turkey with the year 2015, and Table 3 which shows the farmer-markets price differences are examined.

TABLE 2. Average prices for certain agricultural products in Turkey

Products	Farmer			Markets		
	30.12.2015	30.12.2016	change [%]	30.12.2015	30.12.2016	change [%]
	farmer price [TYR/kg]	farmer price [TYR/kg]		markets price [TYR/kg]	markets price [TYR/kg]	
Tomato	1.87	1.47	-21.39	3.91	3.34	-14.51
Cucumber	1.29	2.5	93.91	3.2	4.19	30.74
Onion	0.69	0.33	-52.73	1.94	1.18	-39.23
Eggplant	1.83	3.58	95.36	3.83	6.02	57.43
Apple	0.96	0.67	-30.39	3.24	2.7	-16.52
Pumpkin	1.69	2.62	54.72	3.86	5.47	41.5
Spinach	1.41	1.12	-20.69	3.3	2.93	-11.11
Carrot	0.54	0.72	32.41	1.79	2.04	13.88
Potato	0.44	0.6	36.74	1.71	1.73	1.34
Pepper	2.02	2.91	43.81	4.08	5.14	25.82

Source: WWW 1.

TABLE 3. Annual price difference between farmer and markets for certain agricultural products for 2015–2016

Products	Farmer	Markets	Price difference [%] 30.12.2015	Farmer	Markets	Price Difference [%] 30.12.2015
	30.12.2015	30.12.2015		30.12.2016	30.12.2016	
	farmer price [TYR/kg]	markets price [TYR/kg]		farmer price [TYR/kg]	markets price [TYR/kg]	
Tomato	1.87	3.91	109.09	1.47	3.34	127.21
Cucumber	1.29	3.2	148.06	2.5	4.19	67.60
Onion	0.69	1.94	181.16	0.33	1.18	257.58
Eggplant	1.83	3.83	109.29	3.58	6.02	68.16
Apple	0.96	3.24	237.50	0.67	2.7	302.99
Pumpkin	1.69	3.86	128.40	2.62	5.47	108.78
Spinach	1.41	3.3	134.04	1.12	2.93	161.61
Carrot	0.54	1.79	231.48	0.72	2.04	183.33
Potato	0.44	1.71	288.64	0.6	1.73	188.33
Pepper	2.02	4.08	101.98	2.91	5.14	76.63

Source: WWW 1.

According to Table 2, the average rate of decline in farmer price of tomato is around 21%, while the rate of price decline is close to 15% in the markets. Likewise, declines in farmer prices of around 30% in apple and 53% in the dry onion are observed to be around 17% and 40% in markets respectively. So, it can be concluded that the decline in farmer prices is reflected in consumer prices at a lower rate. That is, consumer prices are not cheap enough despite the drop in producer prices.

According to Table 3, the annual increase in farmer prices is reflected at higher rates in markets prices generally. The 109% increase in farmer price of tomato is reflected in the markets price as 127% and these rates can increase from 181 to 258% in onion and 303 to 237% in apple respectively. There can be many reasons for this. According to Alemdar [2008], the main reason of this is the fact that an effective price mechanism has not developed in agricultural sector and the legal regulations and inspections which protect the producer and consumer are remain at a limited level especially in underdeveloped and emerging economies.

## **DISCUSSION**

The long and complex structure of the fresh vegetables and fruits supply chain leads to a loss of 30–60% of the products throughout the value chain from producer to the end consumer. The high level of sensitivity to the time and temperature values of the products leads to the loss of quality in addition to the loss of quantities. All these losses and inefficiencies increase the price difference between producers and final consumers. In other words, the current structure of the supply chain leads to welfare loss of producers and final consumers, which are the weakest rings in the chain, and the price difference is in favour of other intermediary persons or institutions on the chain.

The failure to develop a permanent solution to product valuation and marketing problems strengthens the position of the intermediaries in the supply chain and carries the asymmetric power relationship to a more advanced level. When the economic and social impacts of product quality and quantity losses are considered, it is clear that the supply chain needs a radical change and restructuring process. However, it is very difficult to realize this change in the short run, and disabling a significant portion of the chain's intermediaries may lead to damage to a certain segment of society. However, it is quite difficult to be performed this change in the short run, and disabling a significant part of the intermediaries in the chain may lead to damage to a certain part of the society. Re-employment of these intermediaries in different sectors of the economy will be difficult and time-consuming. Therefore, in the restructuring process of the supply chain, it would be more appropriate to set up value-added processes and activities rather than to leave the intermediaries completely out of the system and direct them to these areas.

Another important problem that needs to be addressed in the restructuring process is the small scale and fragmented structure of the existing production. Existing resources and capacities of farmers are not sufficient for the product presented directly to the distribution channels. It is not possible to carry out product storage, distribution and marketing activities in an effective and efficient way, at least in the short term. For this reason, it may be considered that the public sector can be considered to participate in the system

as an intermediary and regulatory entity for a certain period of time. However, this situation is a temporary alternative and the principal thing what needs to be done is solving the resource shortage and capacity problems permanently by supporting the producers and producers unions. It is not a realistic approach to completely disable the intermediaries in the current system, and this approach can also lead to more serious problems in the product distribution and supply process.

The transition to a planned production structure is very important to control product losses and price differences. It is possible to prevent the supply problems caused by the loss of income due to the surplus of the product of the farmers and the inability of the consumers to reach the product of the desired kind and quality, as the product supply and demand structure is balanced to some extent by switching to the planned production structure. Since the product supply and demand structure will be stabilized considerably by passing to the planned production structure, it will be possible to prevent the supply problems caused by the loss of income due to the surplus of the product of the farmers and the inability of the consumer to reach the product of the desired kind and quality. Although, the contract farming practices applied in Turkey for the last 20 years are an important step in the transition to planned production structure, it is observed that contracted farming practices does not meet the expectations exactly. The asymmetric power relations observed in the multi-intermediated system can also be found in the contractual production model, especially in the contractual relations between small producers and large retail firms. In fact, in this system, besides the price decisions, the domination of farmers on production decisions is also eliminated. Another important problem is that legal regulations do not have the level and competence to protect the small producers against the big retailers.

There are two different situations when contracted production practices are addressed in terms of prevention of product losses and minimization of price differences. Since various processes or activities such as storage, transportation, packaging, cold chain logistics are carried out by retail companies or under the control of these companies, product valuation and marketing problems are being resolved in large scale. However, it is difficult to say that contracted production practices are a significant influence on price differences between farmers and final consumers.

It is observed that price differences are increasing gradually when the producer, wholesaler and markets prices of a specific product are compared. In this case, it is possible to conclude that the reduction in the number of intermediaries, especially in terms of price differences, is not an effective solution, even if the amount of losses is realized at lower levels. As long as intermediaries determine their product costs without a certain inspection and control mechanism and make own pricing decision, the objective of reducing price differences to a reasonable level will not be achieved. As a matter of fact, in the case of fresh vegetables and fruit wholesalers, the profit level of the broker companies can be obtained from the product is limited to 8%, while there is no such legal regulation or limitation for large retail companies. Therefore, the difference between farmer and markets prices is quite high compared to the difference between farmer and wholesaler prices. The difference between the two intermediaries of fresh fruits and vegetables supply chain is clearly too large to be explained for any reason, such as wastage, transportation costs or operating costs.

## CONCLUSION

It is clear that the existing fresh vegetables and fruits supply chain structure needs to be revised and put into a comprehensive transformation process, in order to prevent quality and quantity losses and to control the price differences between farmers and the end consumers. However, in the restructuring process, more emphasis should be placed on adding value-added activities rather than minimising the number of intermediaries. In the change of asymmetric power relations in favour of the farmers, they should be encouraged to become middle and large scale producers, especially by increasing the resources and production possibilities of small producers. Producer and producer unions should be supported, and their dominance in the supply chain should be increased by directing them to distribution and marketing activities as well as production. With the transition of planned production structure, product valuation and supply problems can be controlled significantly. However, contractual production practices, which are one of the most effective means of transition to planned production, need to be re-examined legally in a way that will change asymmetrical power relations in favour of the producer. The restructuring process of the fresh vegetables and fruits supply chain needs to be carried out gradually and taking into account the interests of all stakeholders. In this way, at least in the short term, various negative effects can be avoided such as the damage to certain segments from the restructuring process or the emergence of more important supply problems.

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**Summary.** Turkey's bio-diversity, geographical structure and climatic conditions, makes it possible to produce a wide variety of fruits and vegetables. Although, the high production capacity, half of the vegetables and fruits are lost during the supply chain processes from farmer to the end consumer because of the long and complex structure of the supply chain. At the same time the current supply chain structure leads to huge gaps between producer and consumer prices. The aim of this study is to determine the structure of the fresh fruit and vegetable supply chain in Turkey and develop alternative supply chain forms to prevent the "price differences" and "product losses" from farmer to the final consumer. The study included descriptive analyses with secondary data as well as literature review. In addition, this study emphasizes the asymmetric power relationship in the agricultural supply chain. The asymmetric power relationship is explained by the price differences between the farmer and the final consumer. The research findings suggest that the transition from the existing multi-intermediated supply chain to the non-intermediated model must be done in a gradual way and through strengthening of the farmers.

**Key words:** agricultural supply chain, fresh fruits and vegetables, Turkey, restructuring of agricultural supply chains, food safety and food losses.

**JEL:** Q1, R38

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