Analysis of investment cost of apple cold storage facilities

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Abstract

The objective of this study is to make a comparison of normal and controlled atmosphere cold storage facilities in terms of investment costs and profitability in Isparta province, Turkey. The main material of the study consists of primary data gathered from the cold storage in Isparta province. The data covers 2011 storage period. The cold storages are analyzed in groups of normal atmosphere (51 facilities) and controlled atmosphere (8 facilities). According to the results of the study it has been determined that, the average capacity per facility in normal atmosphere cold storages is 4 978.43 tons and in controlled atmosphere cold storages 7 125 tons. The capacity utilization rate is found to be 86.72% in normal atmosphere storages and 96.49% in controlled atmosphere storages. In both types of storages, it has been determined that almost all of the stored products are apples. The net present worth of the investment is found to be $ 166 047.59 in normal atmosphere storages and $ 2 423 434.00 in controlled atmosphere storages. Internal rate of return is determined to be 6.63% in normal atmosphere cold storages and 12.36% in controlled atmosphere cold storages. When a comparison is made in terms of benefit-cost ratio it has been calculated to be 1.03 and 1.39 respectively for normal and controlled cold storages. According to the economical assessment criteria, it has been determined that controlled atmosphere cold storages are more advantageous than normal atmosphere cold storages.

Keywords: Cold storage. Net present worth. Internal rate of return. Benefit-cost ratio.

1. Introduction

Due to its climatic and geographic specialties, Turkey has an important potential in terms of many product's production. One of the products with high potential is apple. Since it can be cultivated in many regions of Turkey, apple interests a large mass of producers. It is

also an important product, which needs work force in storage, sales, packaging and processing phases thereby contributes to employment. According to 2011 data, Turkey, which is regarded as the homeland of apples, is in the 4th place with 2 680 075 tons of production after China, USA and India in world (FAO, 2014). One of the most important regions in Turkey in terms of apple production is Isparta. According to 2012 data, Isparta has the first place in Turkey with 634 795 tons of apple production and meets 21.97% of Turkey's apple production (TSI, 2014). Until it reaches to the consumer, 30% to 40% of losses occur in fruits and vegetables produced in our country (MD, 2001). These losses cover all the losses within different phases of the marketing chain. This loss of product also means the loss of inputs in the production process, hence loss of sources creating cost. Especially storing fruits under proper conditions will make a great contribution in terms of reducing these losses. Storage is defined as; being kept in an environment with low heat and high humidity which will preserve the quality and minimize quality loss of products, which will be marketed later on (Ozcan and Erturk, 1994). Through storage, many benefits can be provided to both the producers and the consumers. Surplus not consumed in harvesting season will be utilized; finding fruits and vegetables in all seasons on the market will be guaranteed; in harvest season sales of products with low prices due to surplus will be prevented and producers will be ensured to have a higher income and consumers will be able to find fruits with affordable prices throughout the year (Ekmekyapar, 1993). Storage services also have positive contributions to industrial businesses based on agriculture. They are; a more even distribution of production and marketing activities and work force and economical long term operating possibility for the industry which utilizes the product (Okuroglu et al., 1998).

Some of the apples produced in Isparta, where the study is carried out, are put upon the market right after harvesting and the rest is stored and offered to the consumers in different periods of time. There are 87 cold storages In Isparta with 346 568 tons of capacity, which are almost completely used for apple storage. The existing cold storage capacity in Isparta satisfies 56.80% of apple production. The cold storage capacity in our country is around 1.2 million tons (MFAL, 2004). 28.8% of cold storage capacity of Turkey is in Isparta region. With these parameters, it can be stated that Isparta is one the important cities in Turkey in terms of cold storage.

The aim of the study is comparison of normal and controlled atmosphere cold storages in terms of investment costs and profitability in Isparta region, which ranks first in terms of apple production and cold storage capacity. With this aim, normal and controlled atmosphere

storages are compared in terms of net present worth, internal rate of return and benefit-cost ratio and the type of storage with higher profitability is determined. The fact that, no studies are conducted in Turkey comparing different storage types in terms of investment costs and profitability until now increases the importance of this study. It is hoped that the results of the study will provide important information to institutions providing grant or credit support as well as to entrepreneurs considering investment.

2. Materials and Methods

The main material of the study constitutes of original data gathered from 59 cold storages in Isparta through survey method. The data are gathered in July-August 2011 period. Various research results on the subject along with existing statistical data are also used.

The numbers and addresses of cold storages are ascertained from registries of Control Branch Office of Isparta Food, Agriculture and Livestock Provincial Directorate. According to these registries, it has been identified that, there are 87 cold storages with 346 568 tons of capacity within the research area (MFAL, 2010). Almost all of these facilities are used for apple storage. Interviewing with all of the 62 cold storages in Egirdir, Gelendost, Merkez, Senirkent and Uluborlu districts of Isparta is aimed, where cold storages are intensively located. However, with 2 of the cold storages not giving information and 1 newly established cold storage within the research region, the data could only be gathered from 59 of the facilities. The facilities are analyzed in two groups; normal and controlled atmosphere facilities. Accordingly, it has been determined that there are 51 normal atmosphere and 8 controlled atmosphere cold storages within the research region. Cold storages with a certain number of controlled rooms besides normal atmosphere rooms are considered to be controlled atmosphere storages. The investment costs and revenues of cold storages are included within the survey forms prepared for the facilities.

Normal cold storages, which are also known as normal atmosphere storages, are those where only the heat and relative humidity can be controlled without interfering the air composition. Gas tightness in these storages is not important since heat and humidity are controlled. Good heat insulation is enough in normal atmosphere storages. As the name implies, in controlled atmosphere storages the ratio of gasses in the environment is controlled besides heat and relative humidity. These gasses are carbon dioxide and oxygen which have an impact on the breathing rate of the product. The main principle in these storages is to

decrease the oxygen ratio and increase the carbon dioxide ratio in the environment and decrease the breathing rate. Thus, the products can be stored longer with a higher quality. The gas compound in the storages changes according to type and variety of the product.

Facilities are grouped according to the storage types (normal and controlled atmosphere) and compared in terms of profitability indicators of the investment. MS Excel and SPSS programs are used for the analyses of the data gathered from facilities through surveys. Tables are constituted according to the results and these tables are interpreted by using absolute and relative distributions and arithmetic and weighted average methods. The main indicators used for comparison are net present worth, internal rate of return and benefit-cost ratios. The discount rate used in financial analysis is determined according to the real capital market interest rates in our country or the opportunity cost of capital. However, this calculation is relatively difficult and it is also not possible to express a rate everyone will agree upon. This rate is accepted to be around 10-14% in underdeveloped countries, 6-9% in mid-level developed countries and 3-5% in developed countries (Yurdakul, 1999). Therefore the discount factor is considered to be 6% in financial analyses.

2.1. Net present worth (NPW)

This is simply the present worth of the incremental net benefit or incremental cash flow stream. Net present worth may be interpreted as the present worth of the income stream generated by an investment. To calculate the net present worth requires determination of the appropriate discount rate. The formal selection criterion for the net present worth measure of project worth is to accept all independent projects with a zero or greater net present worth when discounted at the opportunity cost of capital (Gittinger, 1982).

Net present worth: $\sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t}$ (1)

Bt= benefit in each year

Ct=cost in each year

t= 1, 2, ..., n (time)

n= number of years

i= discount rate

2.2. Internal rate of return (IRR)

Another way of using the incremental net benefit stream or incremental cash flow for measuring the worth of a Project is to find the discount rate that makes the net present worth of the incremental net benefit stream or incremental cash flow equal zero. The discount rate is called the internal rate of return. It is the maximum interest that a Project could pay for the resources used if the Project is to recover its investment and operating costs and still break even. The internal rate of return is a very useful measure of Project worth. It is measure the World Bank uses for practically all its economics and financial analyses of projects and the measure used by most other international financing agencies (Gittinger, 1982).

Internal rate of return: $\sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} = 0$ (2)

Bt= benefit in each year

Ct=cost in each year

t= 1, 2, ..., n (time)

n= number of years

i= discount rate

Except by lucky accident, one cannot simply choose that discount rate which will make the incremental net benefit stream equal to zero. Unhappily, there is no Formula for finding the internal rate of return. We are forced to resort to a systematic procedure of trial and error to find that discount rate which will make the present worth of the incremental net benefit stream equal zero. The most difficult aspect of the trial and error is making initial estimate. If the estimate is too far from the final result, then several trials will have to be made to find two rates close enough together to permit accurate interpolation (interpolation is the process of finding a desired value between two other values) (Gittinger, 1982).

$$\text{IRR} = \text{LDR} + \text{DDR}\left[\frac{\text{Present worth of incremental net benefit stream at the lower discount rate}}{\text{sum of the present worths of the incremental net benefit streams at the two discount rates,signs ignored}}\right] \quad (3)$$

IRR= Internal rate of return

LDR = Lower discount rate

DDR = Difference between discount rates

2.3. Benefit – cost ratio

A third discounted measure of Project worth is the benefit- cost ratio. This is the ratio obtained when the present worth of the benefit stream is divided by the present worth of the cost stream. The formal selection criterion for the benefit- cost ratio measure of Project worth is to accept all independent projects with a benefit- cost ratio of 1 or greater when the cost and benefit streams are discounted at the opportunity cost of capital (Gittinger, 1982).

Benefit- cost ratio: $$\frac{\sum_{t=1}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+i)^t}} \quad (4)$$

Bt= benefit in each year

Ct=cost in each year

t= 1, 2, ..., n (time)

n= number of years

i= discount rate

3. Results and Discussion

The capacity and capacity utilization rates of cold storages are given in Table 1. It has been determined that, in normal atmosphere cold storages, average storage capacity per facility is 4 978.43 tons. The stored apple quantity in normal atmosphere cold storages is 4 207.84 tons and the capacity utilization ratio is calculated to be 85.52%. In controlled atmosphere cold storages on the other hand, average capacity per facility is 7 125 tons, stored apple quantity is 6 875 tons and the capacity utilization ratio is determined to be 96.49%. According to these results it can be said that, average capacity and the capacity utilization rates are higher in controlled atmosphere storages according to normal atmosphere storages.

Table 1: Capacity utilization rate of cold storage facilities

	Storage type	
	Normal atmosphere	Controlled atmosphere
Capacity (ton)	4 978.43	7 125.00
Stored apple quantity (ton)	4 207.84	6 875.00
Capacity utilization rate (%)	84.52	96.49

Bingol (1980) has expressed that in 41 cold storages analysed in Aegean and Marmara region, 36 worked in full capacity and the remaining 5 had idle capacity. Islam et al., (2008) have determined in their study done in Bangladesh that, according to 5 years data of cold storages storing potato, the capacity utilization ratios changed between 74.42% and 101.64%. As for the study conducted by Terzioglu (1990) in İzmir province, 2 of the cold storages out of 11 had idle capacity and the remaining 9 worked full capacity.

3.1. Investment costs

3.1.1. Fixed investment costs

Fixed investment costs include expenses made for all the monetary and non-monetary capital factors predicted in the implementation plan of the investment throughout the establishment period of the facility (Sariaslan, 1990). The fixed investment costs in analysed are given in Table 2. Fixed investment costs are determined to be $ 2 582 057.55 in normal atmosphere cold storages and $ 3 188 577.79 in controlled atmosphere cold storages.

Etute and project costs include all costs made for all economic and technical research and examination needed in marketing, technical and financial analyses phases after the feasibility etute decision is made as a result of pre-feasibility studies for the investment proposal (Sariaslan, 1990). In both types of storages etute and project costs are calculated to be $ 5 988.02. The percentage of etute and project costs within investment costs is calculated to be 0.35% in normal atmosphere cold storages and 0.28% in controlled atmosphere cold storages (Table 2).

Table 2: Total investment costs of cold storage facilities

	Normal atmosphere		Controlled Atmosphere	
	$	%	$	%
Etute and project cost	5 988.02	0.35	5 988.02	0.28
Land cost and arrangement	58 450.56	2.26	57 101.43	1.79
Construction	1 485 798.99	57.54	1 690 494.01	52.97
Storage	1 422 390.51	55.09	1 646 706.59	51.60
Administrative office	44 088.29	1.71	38 922.16	1.22
Weighbridge	4 197.49	0.16	0.00	0.00
Power distribution unit	7 972.29	0.31	1 497.01	0.05
Watch box	4 156.40	0.16	748.50	0.02
Well	2 994.01	0.12	2 619.76	0.08
Equipment	942 442.76	36.50	1 322 574.85	41.44
Cooling system	859 340.14	33.28	1 220 059.88	38.23
Office supplies	6 880.36	0.27	823.35	0.03
Thermostat	174.95	0.01	202.10	0.01
Hygrometer	524.83	0.02	606.29	0.02
Humidiometer	528.35	0.02	0.00	0.00
Psychrometer	35.22	0.00	0.00	0.00
Truck weighbridge	16 038.51	0.62	24 550.90	0.77
Pallet jack	1 881.53	0.07	5 389.22	0.17
Battery powered forklift	8 688.50	0.34	4 491.02	0.14
Scale	1 808.15	0.07	59.88	0.00
Generator	1 866.86	0.07	149.70	0.00
Forklift	44 675.35	1.73	66 242.51	2.08
Truck	352.24	0.01	19 461.08	0.61
Pickup truck	10 825.41	0.42	-	-
Unforeseeable cost (3%)	75 205.56	2.91	92 958.40	2.91
A.Fixed investment cost	2 582 057.55	100.00	3 188 577.79	100.00
Fixed Labour	12 827.02	31.61	15 919.05	33.60
Seasonal labour	2 111.54	5.20	1 729.04	3.65
Electricity	17 441.59	42.98	18 525.45	39.10
Fuel	876.19	2.16	289.11	0.61
Water	395.98	0.98	410.74	0.87
Insurance	1 867.15	4.60	3 424.40	7.23
Cleaning	698.60	1.72	243.26	0.51
Maintenance	1 536.05	3.78	2 526.20	5.33
Stationery	750.97	1.85	984.28	2.08
Indirect costs	121.81	0.30	617.51	1.30
Transport	1 215.22	2.99	2 189.37	4.62
Communication	743.31	1.83	518.34	1.09
B. Working capital	40 585.43	100.00	47 376.76	100.00
Total investment cost (A+B)	2 619 648.96		3 235 954.55	

Land costs and arrangement costs are the value of the land needed, according to the qualification of the operation that will be carried out. Even if the land is own property, the value needs to be among project costs (Yurdakul, 1999). Costs about arrangement of land and about subjects such as excavation, levelling, etc. need to be also included on this cost item (Rehber and Erkus, 2007). In normal atmosphere cold storages, land costs and arrangement costs are calculated to be in average $ 58 450.46 and in controlled atmosphere cold storages $ 57 101.43. The percentage of land costs and arrangement costs within investment costs is

calculated to be 2.26% in normal atmosphere cold storages and 1.79% in controlled atmosphere cold storages (Table 2).

Construction jobs include the storage building, administrative office, weighbridge, power distribution unit, watch box and well of the facility. In normal atmosphere cold storages, average construction costs are calculated to be $ 14 822 390.51. The biggest share within the investment costs in normal atmosphere storages is construction costs with 57.54%. In controlled atmosphere cold storages, average construction costs are calculated to be $ 1 690 474.01. The biggest share within the investment costs in controlled atmosphere storages is construction costs with 52.97%. Due to higher machinery and equipment costs in controlled atmosphere cold storage, the construction costs that are higher compared to normal atmosphere cold storages, have a proportionally lower percentage. In both storage types, an important part of construction costs consists of storage building construction (Table 2). Construction jobs are very important in both preparation and implementation phases of an investment project. Also the quantitative magnitude within fixed investment costs enhances its importance. Factors such as the area of activity of the facility, production methods, the qualification and quality of the produced goods, magnitude of the investment and technology affect the sum of these costs (Ozpeynirci, 2001).

Machinery and equipment costs are those that are made for the machinery and equipment needed for the facility, which is in the production plan appropriate for the determined technology and capacity (Rehber and Erkus, 2007). Machinery and equipment costs consist of cooling system, office supplies, thermostat, hygrometer, humidiometer, psychrometer, truck weighbridge, pallet jack, battery powered forklift, scale, generator and forklift. The machinery and equipment cost of the analysed normal atmosphere cold storages is calculated to be $ 942 442.76. Machinery and equipment costs take the biggest share of the investment costs after construction costs with 36.5%. It has been identified that, because of the use of newer technology in controlled atmosphere cold storages; it is 1.4 times higher than normal atmosphere cold storages. Machinery and equipment costs in controlled atmosphere cold storages are calculated to be $ 1 322 574.85. The share of the machinery and equipment costs within fixed investment costs is calculated to be 41.44% (Table 2).

The truck and pickup truck costs used in the cold storages form this cost item. In normal atmosphere cold storages average truck cost is calculated to be $ 352.24 and pickup cost is calculated to be $ 10 825.41. As for the controlled atmosphere storages, truck cost is calculated to be $ 19 461.08. The transportation vehicles' share in fixed investment is

determined to be 0.43% in normal atmosphere and 0.61% in controlled atmosphere cold storages (Table 2).

A certain percentage of cost indicated in the project is calculated to be unforeseeable cost. The aim of this is to reserve an amount for the costs which might be overlooked or the costs which were unpredictable throughout the project preparation phase, and be protected from the negative surprises. The percentage used for unforeseeable costs depends on the investment. If the investment is an investment made many times in many places previously, the overlooked costs will not be too much, or even none. Therefore a small percentage would be sufficient. If the investment on the other hand is intended for a new production, or if it has not been implemented within the last years, the percentage will need to be a little higher. In practice, 2-5% of the investment costs are taken to be unforeseeable costs (Yurdakul, 1999). In this study, unforeseeable costs are calculated to be 3% of the total investment. The unforeseeable costs are calculated to be $ 75 205.56 in normal atmosphere and $ 92 958.40 in controlled atmosphere cold storages (Table 2). Islam et al., (2008) has determined that in cold storages which were storing potatoes in Bangladesh, investment costs consist of 20.72% land costs, 46.44% construction costs and 32.84% machinery and equipment costs (Table 2).

3.1.2. Working capital

The capital necessary to purchase goods and services that are used for the production activities of an enterprise and that are turned over during the production cycle (Gittinger, 1982). The working capitals are given in Table 2. Working capital is determined to be $ 40 585.43 in normal atmosphere cold storages and $ 47 376.76 in controlled atmosphere cold storages (Table 2). Operating costs is the value of the inputs needed for production. These inputs can be grouped as crates, maintenance and renovation, energy, labour, depreciation and overhead. The annual operating costs for normal and controlled atmosphere cold storages are given in Table 3. The average annual operating cost is calculated to be $ 245 117.90 in normal atmosphere cold storages and 304 814.62 in controlled atmosphere cold storages.

Table 3: Operating costs of cold storage facilities

Cost elements	Normal atmosphere		Controlled Atmosphere	
	$/enterprise	%	$/enterprise	%
Crates	1 958.44	0.80	6 586.83	2.16
Maintenance and renovation	6 144.18	2.51	10 104.79	3.32
Energy	69 766.35	28.46	74 101.80	24.31
Labour	53 419.64	21.79	65 405.24	21.46
Seasonal labour	2 111.54	0.86	1 729.04	0.57
Fixed labour	51 308.10	20.93	63 676.20	20.89
Depreciation	77 998.65	31.82	93 616.49	30.71
Building (2%)	29 656.10	12.10	33 757.49	11.07
Cooling system (3.33%)	28 615.99	11.67	40 627.99	13.33
Generator (6.66%)	124.34	0.05	9.97	0.00
Crates for rent (20%)	1 958.44	0.80	6 586.83	2.16
Minor equipment (14%)	176.87	0.07	113.17	0.04
Scale (16.66%)	301.24	0.12	9.98	0.00
Pallet jack (20%)	376.31	0.15	1 077.84	0.35
Forklift (25%)	11 168.84	4.56	5 192.66	1.70
Office supplies (20%)	1 376.07	0.56	164.67	0.05
Pickup truck (20%)	2 165.08	0.88	3 892.22	1.28
Well (6.66%)	199.40	0.08	174.48	0.06
Battery powered forklift (8.33%)	723.75	0.30	374.10	0.12
Truck weighbridge (%6.66)	1 068.17	0.44	1 635.09	0.54
Truck (%25)	88.06	0.04	0.00	0.00
Overhead	35 830.64	14.62	54 999.48	18.04
Transport	4 860.87	1.98	8 757.49	2.87
Water	1 583.89	0.65	1 642.96	0.54
Cleaning	2 794.41	1.14	973.05	0.32
Stationary	3 003.87	1.23	3 937.13	1.29
Communication	2 973.23	1.21	2 073.35	0.68
Heating	2 018.32	0.82	1 609.28	0.53
Insurance	7 468.59	3.05	13 697.60	4.49
Taxes	10 640.19	4.34	19 838.55	6.51
Other	487.26	0.20	2 470.06	0.81
Total operating costs	245 117.90		304 814.62	

It has been determined that, in normal atmosphere cold storages depreciation has the first place with 31.82% within total operating costs. In controlled atmosphere cold storages, depreciation costs are determined to be higher, due to higher fixed investment costs. In controlled atmosphere cold storages, depreciations costs make up 30.71% of the total costs. It has been detected that, building depreciation and cooling system depreciation have the biggest percentage within depreciation costs. The depreciation of the cooling system in normal atmosphere cold storages is 11.67% of total operation costs and 13.33% in controlled atmosphere cold storages. It has been identified that after depreciation, the biggest important cost item is energy. While in normal atmosphere cold storages energy costs make up 28.46% of total operation costs, this value is calculated to be 24.31% in controlled atmosphere cold storages (Table 3). Bingol (1980) has determined that in Marmara and Aegean region in 1978-

1979, in an enterprise with 7500 m^3 capacity, the expenditure was $ 730.93 for cooling system, $ 5 474.45 for electricity, and $ 3 941.61 for labour.

The third important cost item of cold storages is identified to be fixed labour costs. The fixed labour costs within total operating costs are calculated to be 20.89% in controlled atmosphere cold storages and 20.93% in normal atmosphere cold storages. Since the number of fixed workers is higher in controlled atmosphere cold storages, it results with a higher percentage within total operational costs. It has been determined that seasonal labour costs within total operational costs takes up a small percentage in cold storages. Seasonal labour cost is calculated to be 0.86% in normal atmosphere and 0.57% in controlled atmosphere cold storages (Table 3).

In cold storages, water is used to provide 85-95% of humidity. Although water is used in high amounts, it is cost-effective. While some cold storages provide water from mains, others provide their water necessity from the wells of their own (Cosar, 1996). It has been observed that, most cold storages provide water from their own sources and therefore water costs are insignificantly low. It has been determined that, water costs are 0.65% of total operation costs in normal atmosphere and 0.54% in controlled atmosphere cold storages. Crate costs are determined to make up 0.8% of total operation costs in normal atmosphere and 2.16% in controlled atmosphere cold storage. Maintenance and renovation costs make up 2.51% of total operation costs in normal atmosphere and 3.32% in controlled atmosphere cold storage. Transportation costs are determined to make up 1.98% of the total costs in normal atmosphere and 2.87% in controlled atmosphere cold storages (Table 3).

3.2. Investment profitability indicators

3.2.1 Cash flow

In order to evaluate the investment financially and economically, the period of time in years the cash flow table will be prepared for or in other words, the period net flow needs to be calculated for, needs to be known. In principle, cash flow table is prepared for the economic life of the investment. But in most investments this life is too long. Since the net cash flows in the future are discounted by a discount factor when evaluating an investment, and the discount factors are too small after 25th year, it has almost no meaning to discount the values after 25 years. Therefore, for the investments with a life longer than 25 years, net cash

flow is calculated for 25 years, economic and financial evaluations will be made for a period of 25 years (Yurdakul, 1999).

The cash flow for the economic life of normal atmosphere cold storages is given in Table 4. In normal atmosphere cold storages $ 2 457 972.32 fixed investment is made in starting year and the need for $ 40 858.43 working capital has been determined. In the 1-29 years of the investment, annual operation costs and revenues are calculated to be $ 167 119.25 and $ 355 722.20 respectively. In the final year of the investment, with $ 40 585.43 increasing working capital and $ 119 760.48 scrap value, total revenues are determined to be $ 516 068.11 and net cash flow is determined to be $ 348 948.86. The working capital that won't be used at the end of economic life of the investment is shown as revenue. The values in parenthesis indicate negative values. Operating costs are operating income except depreciation.

Table 4: Net cash flow of normal atmosphere cold storage facilities ($)

	Year 0	Years 1-29	Year 30
1.Revenues			
Sales	-	355 722.20	355 722.20
Working capital	-	-	40 585.43
Scrap value	-	-	119 760.48
Total	-	355 722.20	516 068.11
2. Costs			
Fixed investment	2 417 386.89	-	-
Working capital	40 585.43	-	-
Operating costs	-	167 119.25	167 119.25
Total	2 457 972.32	167 119.25	167 119.25
3. Net cash flow	-2 457 972.32	188 602.96	348 948.86

The cash flow for the economic life of controlled atmosphere cold storages is given in Table 5. In controlled atmosphere cold storage it has been determined that, in starting year $ 3 188 577.79 fixed investment was made and $ 47 376.76 working capital was needed. In the 1-29th years of the investment it has been calculated that annual operating costs were $ 211 198.13 and total revenues were $ 619 850.30.

In the final year of the investment, with $ 47 376.76 increasing working capital and $ 149 700 scrap value, total revenues were calculated to be $ 816 927.66 and net cash flow $ 605 729.53. The working capital that won't be used at the end of the economic life of the investment is shown as revenue. The values in parenthesis indicate negative values. Operating costs are operating income except depreciation.

Table 5: Net cash flow of controlled atmosphere cold storage facilities ($)

	Year 0	Years 1-29	Year 30
1.Revenues			
Sales	-	619 850.30	619 850.30
Working capital	-	-	47 376.76
Scrap value	-	-	149 700.60
Total	-	619 850.30	816 927.66
2. Costs			
Fixed investment	3 188 577.79	-	-
Working capital	47 376.76	-	-
Operating costs	-	211 198.13	211 198.13
Total	3 235 954.55	211 198.13	211 198.13
3. Net cash flow	-3 235 954.55	408 652.17	605729.53

3.2.2 Net present worth

The net present worth of normal atmosphere cold storages with 6% discount rate is calculated to be $ 166 047.59. The net present worth of controlled atmosphere cold storages with 6% discount rate is determined to be $ 2 423 434.00. According to these results, it has been determined that the net present worth of controlled atmosphere cold storages is higher than normal atmosphere cold storages (Table 6 and 7).

Table 61: Net present worth of investment in normal atmosphere cold storage facilities ($)

Year	Total cost	Total revenues	Net cash flow	Discount rate (6%)	Discounted net cash flow
0	2 457 972.32	0.00	-2 457 972.32	1.000	-2 457 972.32
1-29	167 119.25	355 722.20	188 602.96	13.591	2 563 302.80
30	167 119.25	516 068.11	348 948.86	0.174	60 717.10
Total	-	-	-	NPW	166 047.59

Table 7: Net present worth of investment in controlled atmosphere cold storage facilities ($)

Year	Total cost	Total revenues	Net cash flow	Discount rate (6%)	Discounted net cash flow
0	3 235 954.55	0.00	-3 235 954.55	1.000	-3 235 954.55
1-29	211 198.13	619 850.30	408 652.17	13.591	5 553 991.61
30	211 198.13	816 927.66	6 057 29.527	0.174	105 396.94
Total	-	-	-	NPW	2 423 434.00

3.2.3. Benefit- cost ratio

Benefit-cost ratio is achieved through comparing the discounted revenues and costs throughout the life of the investment. If the benefit-cost ratio is equal to or greater than one, the investment can be put into practice (Yurdakul, 1999). It has been determined that, the

benefit-cost ratio of the normal atmosphere cold storages is 1.03 and in the controlled atmosphere cold storages it is 1.39. With reference to the benefit-cost ratio, it can be said that the controlled atmosphere cold storages are more profitable (Table 8 and 9).

Benefit-cost ratio=4 924 416.27/4 758 368.80= 1.03
Benefit-cost ratio=8 566 530.84/6 143 096.81= 1.39

Table 8: Benefit-cost ratio of normal atmosphere cold storage facilities ($)

Year	Total cost	Total revenues	Discount rate (6%)	Discounted cost	Discounted revenues
0	2 457 972.32	0.00	1.000	2 457 972.32	0.00
1-29	167 119.25	355 722.20	13.591	2 271 317.73	4 834 620.42
30	167 119.25	516 068.11	0.174	29 078.75	89 795.85
			Total	4 758 368.80	4 924 416.27

Table 9: Benefit-cost ratio of controlled atmosphere cold storage facilities ($)

Year	Total cost	Total revenues	Discount rate (6%)	Discounted cost	Discounted revenues
0	3 235 954.55	0.00	1.000	3 235 954.55	0.00
1-29	211 198.13	619 850.30	13.591	2 870 393.78	8 424 385.43
30	211 198.13	816 927.66	0.174	36 748.47	142 145.41
			Total	6 143 096.81	8 566 530.84

3.2.4. Internal rate of return

Internal rate of return in normal atmosphere cold storages is calculated to be 6.63%. In controlled atmosphere cold storages internal rate of return is calculated to be 12.36%. It has been determined that, according to the internal rate of return, controlled atmosphere are more profitable (Table 10 and 11).

IRR=6+ [166 047.61/ (166 047.61+ |-261 809.07|)] = 6.63%
IRR=12+ [59 607.74/ (59 607.74+ |-165 150.95|)] = 12.36%

Table 10: Internal rate of return of normal atmosphere cold storage facilities

Year	Net cash flow ($)	Discount rate (6%)	Discounted net cash flow (6%) ($)	Discount rate (7%)	Discounted net cash flow (7%) ($)
0	-2 457 972.3	1.000	-2 457 972.32	1.000	-2 457 972.32
1-29	188 602.96	13.591	2 563 302.83	11.402	2 150 450.95
30	348 948.86	0.174	60 717.10	0.131	45 712.30
		NPW	166 047.61	NPW	-261 809.07

Table 11: Internal rate of return of controlled atmosphere cold storage facilities

Year	Net cash flow ($)	Discount rate (12%)	Discounted net cash flow (12%) ($)	Discount rate (13%)	Discounted net cash flow (13%) ($)
0	-3 235 954.60	1.000	-3 235 954.55	1.000	-3 235 954.55
1-29	408 652.17	8.020	3 277 390.40	7.470	3 052 631.71
30	605 729.53	0.030	18 171.89	0.030	18 171.89
		NPW	59 607.74	NPW	-165 150.95

4. Conclusions

In this study, by using the data gathered from the normal and controlled atmosphere apple storing 59 facilities through surveys in Isparta province, the investment cost and profitability of normal and controlled atmosphere cold storages are analysed comparatively. According to the study results, the apple storage capacity and capacity utilization ratios of the controlled atmosphere storages are higher compared to normal atmosphere storages. It has been determined that the general investment cost per facility is higher in controlled atmosphere storages. While the first place is taken by depreciation with 30.71% within operating costs in controlled atmosphere cold storages, it is followed by energy costs with 24.34% and labour costs with 21.46%. In normal atmosphere cold storages, these values are calculated to be 31.82%, 28.46% and 21.79% respectively. When a comparison is made in terms of economic and monetary evaluation criteria, it has been determined that controlled atmosphere storages are more advantageous. Because, the net present worth, internal rate of return and benefit cost ratios in controlled atmosphere storages are higher than normal atmosphere storages. As a result, to ensure the efficient use of grant and credit support given by various institutions in Isparta province, giving them to high capacity and controlled atmosphere storages will make a contribution to the improvement of the industry.

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