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Technical, economic and marketing assessment to determine the losses of Strawberry Fruits during harvesting in the West Nubaria region

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ABSTRACT

Reducing Food losses and waste is a key global challenge to ensure sufficient food for the future and to use available natural resources more efficiently,The strawberry is one of the vegetable crops with a great economic and social return, as it contributes to increasing income of the state, farms and employment, as it absorbs a large part of the labor from production to harvest, and provides the hard currency resulting from the export operations abroad, The research problem is the high rates a loss of the strawberry, as previous estimates indicate that loss of the strawberry reaches 35% of the production, starting from the production to consumer, which negatively affects the economic and marketing efficiency, Research aims to estimate loss of the strawberry and identify the main factors responsible for it in the harvest stage and measure its impact on the income of the product. This study is based on the primary data collected from different farmers' questionnaires to determine the percentage of losses at the farm level in the Nubaria region, The result revealed the average percentage of PHL for physical and mechanical damage in strawberry 50.91% of the cumulative post-harvest losses at farm level are unsuitable for exportation specifications nevertheless, it is used for local marketing and processing purposes. The percentage of strawberry rejected (discarded) which are invalid for marketing and processing (insect damage, rotten and deformed fruits) is 2.90 %,9.50% and 0.67%while quality characteristics, were TSS 8.1 %, fruits diameter 29.37mm and color 96.16%. The most important results were the indicators of return above costs and the return on the invested pound indicated 2.03 and 1.03 for each of them, respectively, and value-added per ton About 6,832 pounds, the loss of harvest operations about 6.9% per fed., with a loss ranging between 11.3 thousand pounds if selling to the local market and 31.6 thousand if selling to the exporter. The marketing efficiency also ranged between 44.7% for the third category(greater than 10 fed) to 53% for the first category(less than 5 fed), which indicates the high marketing efficiency in the first category compared to the other categories, And results of the econometric estimate showed that the most important factors affecting on loss during harvest operations are number of years of experience, cultivated area per feddan, quantities destined for export per tons, and the quantities destined for the local market per tons, finally should include the different actors from the farmers and applied good agricultural practice to reduce losses at the farm level, Therefore, it requires raising the awareness of those in the agricultural sector and stakeholders from farmers and suppliers about the importance of reducing losses.

Keywords: Strawberry, Quality, Postharvest, Losses, Marketing and Production Cost and Benefit, Marketing Efficiency, Regression Model.

1. Introduction

Strawberry is one of the most popular vegetable in Egypt, it occupies an important position among the untraditional vegetable crops due to its multifarious use in local fresh consumption, food

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processing, and exportation. Strawberry is a high-value crop, rich in bioactive compounds with known health benefits such as lower the level of cholesterol, and blood pressure, reducing inflammation and decreasing oxidative stress. An important characteristic of strawberry fruit includes aroma, taste and flavor (Giampieri *et al.,* 2012). Also, include vitamins, especially vitamin C and E, and other bioactive compounds such as β-carotene and phenolic compounds (Manganaris *et al.,* 2014). However, as is the case with all soft fruit, strawberry shelf life is very limited, leading to substantial waste in the supply chain (Nunes *et al.,* 1998) Strawberries are considered one of the most non-climacteric perishable fruits, with a very limited shelf life (Ayub *et al.,* 2017). Major storage issues are rapid metabolic activity, sensitivity to fungal decay and grey mold disease (Hernandez-Munoz *et al.,* 2006). Postharvest losses (25-40%) of strawberries are more than pre-harvest due to inappropriate management practices, poor handling techniques, low-quality packaging, poor transportation system and complex marketing channels (Aday and Caner, 2014). and its one of the vegetable crops has economic and social return, it contributes to increasing the income of the country, farms and employment, as it absorbs a large part of the labor from production to harvest, which contributes to the operation process and reducing the severity of the unemployment problem, As well as its contribution to the provision of foreign exchange resulting from exporting abroad, as 347.7 thousand tons are exported, equivalent to about 160.3 million dollars during 2019, also its effective impact in improving farmers' incomes due to the high income it generates as a result of investment in its cultivation. The area of strawberries is about 31.6 thousand Fadden, with a production amount of 539.4 thousand tons, with average productivity of 17 tons per Fadden, Inspitaf, the strawberry crop is characterized as a perishable crop, which increases losses rates during the production, harvesting and marketing stages. The yield achieved from this crop can be increased by improving productivity and reducing loss rates, by applying good agricultural practices, which in turn contribute to improving the quality of the produced fruits. Reducing waste rates during the production and marketing stages benefits both the state and the producer alike, Therefore, a need for studies to determine the losses percentage of strawberries and Find solutions to reduce losses on the farm level and the marketing system.

Research problem

The problem of research is that loss rates of vegetable crops in general and strawberry crop, in particular, is still high, as previous estimates indicate that strawberry crop losses to 35% from production, starting from production to consumer, which negatively affects the economic and marketing efficiency, Hence, the research problem is to answer the following questions: **what are the harvesting losses of strawberry? What are their causes?, How do these losses affect farmer's income?, and how do these losses affect the marketing efficiency of strawberry farmers?**

The aim of research

Research aims mainly to estimate the strawberry crop losses and identify the main factors responsible for it in the harvest stage and measure its impact on the income of the producer through several sub-objectives represented in:

1. Estimating the technical and economic losses of the strawberry crop at the harvest stage.
2. Estimating some indicators of the economic and marketing efficiency of the strawberry crop.
3. Determining the most important factors affecting the marketing loss of the crop during the harvest stage.

2. Methodology and data sources

In achieving its goals, the research depends on both the descriptive and quantitative analysis method by estimating some technical, economic and marketing indicators, firstly technical Methodology, Strawberry (Fragaria×ananassa) cv. 'Festival' fruits were harvested at the commercial ripeness stage (97% surface showing red color) from the private farms in South Tahrir region On March in 2021 summer season, To determine the percentage of losses at the farm level in six sites (Sien EL-baharia and El-kibilia villages) were selected and followed the methodology series of interviews with different farmer's face-to-face questionnaire (survey)and random samples were collected and evaluated for different defects at harvest and calculated as a percentage (%) of the total sample. The average sample size was 14 Kg, 5 replicates (EU) were randomly taken from the site and examined immediately,

and each sample was examined visually to study the percentage of physical and mechanical damage (without stalk, over ripe, without calyx, undersize, bruising, fingerprint, misshapen, sun scald, green shoulder, green tip and neck splitting), marketable and unmarketable and decayed of strawberry fruits. (Insect damage, rotten and deformed fruits).

Secondly, economic Methodology, which is the return over costs indicator (CBR) and the return on the invested pound indicator, in addition to the distribution of a consumer pound, estimates margins and marketing efficiency, as well as using a regression model. A multi-factor to determine the most important factors affecting crop loss during harvest, based on both secondary data issued by official agencies and primary data collected through a stratified random sample according to the proportional distribution method, which was collected from the farmers of the study community of 70 farmers distributed over According to holding categories during the agricultural season 2020/2021, using a survey form designed to achieve the research objectives.

2.1. Materials and methods for the CSAM studies

Commodity Systems Assessment Methodology (CSAM) was used to measure postharvest losses. This is the methodology developed by World Food Logistics Organization (WFLO), LaGra *et al.,* (2016). CSAM is a systematic process of using surveys, interviews and observations to collect data on the key aspects of the value chain including postharvest handling. It considers the entire commodity system, from planning and production to processing and marketing, but we will focus more on the postharvest aspects trying to determine the relative costs of any potential or observed changes in handling, containers, or value addition practices to reduce loss and maintain product quality, which will be increasing the net return of the farmer and improving the strawberry yield. Data related to the value chain of strawberry crops in Nubaria region were collected through questionnaires and interviews with small farmers, and some questions related to costs, yield, loss percentage and the factors causing their occurrence at the farm level were asked.

2.2. Tools used to measure losses

1- Digital thermometer for measuring the temperature of strawberry fruits
2- Digital refractometer to measure total soluble solids (Brix).
3- Digital caliper to measure the average strawberry diameter.
4- Digital scale to measure the weight.

2.3. Sampling method

Tables in Appendix No 1, 2 and 3 data show that Egypt's strawberry production averaged about 491.5 thousand tons during the average period (2018-2020) with an average area of about 29.8 thousand Fadden. Each of the Nubaria region, Ismailia, Beheira, Qalyubia and Sharqia governorates came with an average production of 178.9, 131.2, 77.1, 63.7 and 35.3 thousand tons, representing approximately 36.4%, 26.6%, 15.6%, 12.9% and 7.19% of Egypt's average strawberry production, Nubaria region largest strawberry production area, with an average area of about 11.6 thousand is the Fad. and about 178.9 thousand tons, has been selected as the Nubaria region, representing about 38.9% tons. 36.4% of the area of strawberry production in Egypt respectively, the South Tahrir region was selected as it represents about 54.9% of the area of strawberry in the Nubaria region of about 15 thousand Fad. during the 20/2021 season, in South Tahrir region, Nubarua region, Egypt. On March in 2021summer season As to as villages of Sein El Bahariya and Sein El Qibliya were selected as the largest strawberry producing villages, where 70 farmers were selected distributed according to the tenure categories, 33 farmers for the first category (5 Fadden or less) with an average area of about 4.7 Fadden , 20 farms for the second category (greater than 5 to 10 or less) with an average area of about 8.5 Fadden , 17 farms for the third category (10 Fadden and more) with an average area of about 15.6 Fadden.

3. Results and Discussion

3.1. Postharvest losses for strawberry fruits at the farm level.

The measurements of the percent of physical and mechanical damage in strawberry fruits (without stalk, over ripe, without calyx, undersize, bruising, fingerprint, misshapen, sun scald, green

shoulder, green tip and neck splitting fruits) are shown in Table (1). Mechanical damage including bruising, without calyx and stalk, and fingerprint leads to a high respiration rate and increases the loss of weight and accelerates the decayed during the stages of product marketing (Almenar *et al*., 2006). On the other hand, physical damage (neck splitting, sun scald, green tip, green shoulder, misshapen and over ripe) leads to a decrease in the quality of fruits and shelf life. (Aday and Caner, 2014). Data in Table (1) show that the average cumulative postharvest losses at the farm level were 50.91% in the 2021 season.

Table 1: Physical and mechanical damage (%) of strawberry fruits in six different locations, Nubaria region, season (2020/2021).

Locations / Type defected	1	2	3	4	5	6	Average
Sun scald	0.1	0.5	0.3	0.0	0.0	0.5	0.23
Neck splitting	1.0	1.02	1.01	1.04	1.06	1.0	1.02
Green tip	1.1	1.60	0.05	0.07	1.2	1.3	0.89
Green shoulder	1.07	1.8	1.2	0.5	1.3	1.7	1.26
Misshapen	1.1	1.07	1.51	1.0	1.2	2.0	1.31
Finger print	5.5	4.9	4.5	5.2	5.5	4.7	5.05
Bruising	8.0	6.0	8.0	8.8	6.9	8.5	7.70
Under size	8.0	9.0	8.0	10.0	9.0	10.0	9.00
Without calyx	4.0	5.0	2.0	5.0	3.0	3.00	3.67
Over ripe	11.0	10.0	13.0	7.0	10.0	14.0	10.83
Without stalk	10.0	11.0	8.0	10.0	9.0	9.0	9.50
Total Losses%							50.91

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

It is worthy to mention that the cumulative postharvest losses at the farm level are unsuitable for exportation specifications. Nevertheless, it is used for local marketing and processing purposes.

The measurements of the percent of rejected fruits in six different localities on the farm level in Behira Governorate are summarized in Table (2). & Figure (1). The percentage of strawberry rejected fruits which are invalid for marketing and processing (insect damage ware 2.90%, rotten% 9.50% and deformed fruits 0.67% 2021 season. The total rejected and unsuitable fruits for marketing were 13.07%.

Table 2: Percentage of rejected strawberry fruits in six different localities on the farm level, Nubaria region, Egypt in season (2020/2021)

Locations	1	2	3	4	5	6	Average
Insect damage	3.0	2.9	2.8	3.1	3	2.6	2.90
Rotten	10.0	9.9	9.0	8.9	9.5	9.7	9.50
Deformed fruits	0.6	0.5	0.8	0.7	0.5	0.9	0.67
Total Rejected fruits							13.7

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

There were major reasons for high postharvest losses for strawberry fruits in Nubaria region, Egypt such as Lack of identification of the optimal stage of harvest, Lack of appropriate harvesting containers, Excessive field heat and lack of storage facilities on the farm, Lack of good agricultural practices (pest control - pesticides - irrigation - fertilization), Unreliable transplant source and Weather fluctuations.

The economic impact of crop losses Table (3) the data show that the estimates of technical losses had a negative impact on the labor resource, as the loss in the labor resource was estimated at about 48 working days, valued at about 5778 pounds per feddan, while the loss in the water resource was about 552 m^3 per feddan, The economic loss of the land resource was also estimated at about 3 carats, equivalent to about 3079 pounds during the season per feddan. The loss in the plastic used was also estimated at about 15 kg, estimated at about 557 pounds per feddan. The increase in production costs

per acre as a result of this loss was estimated at about 14,561 pounds, and the sum of these factors was estimated at about 3.5 tons per feddan, with a loss estimated at about 35537 pounds per feddan during the season.

Table 3: Value of the realized loss in pounds for loss of an feddan of the strawberry crop in the field study community for the season (2020/2021)

Item	Amount of waste (per feddan)	Loss of value (pounds per feddan)
A work day (pound/feddan)	48	5778
Seedlings (thousand/feddan) (pound/feddan)	5200	2133
Plastic (kg/feddan) (pound/feddan)	15	557
Water m^3	522	
Land per feddan (pound/feddan)	0.125	3079
Costs per feddan (pound/feddan)	14561	
Productivity (Ton (pound/feddan)	3.5	35537

Source: collected and calculated from the technical estimates of crop losses in Table No. 2 in the research.

Field and fruit temperature and some quality characteristics (TSS, fruit diameter and color) in six locations in Beheira governorate, Egypt are presented in Table (4). Measurements show that the average percentage for all selected locations the field temperature is 24.4 0C, fruits temperature 19.35 0C, TSS 8.1 %, fruits diameter 29.37mm and color 96.16%.

Table 4: Field and fruit temperature and some quality characteristics of festival strawberry fruits (tss, fruit diameter and color) in six locations in Nubaria region, Egypt.

Locations	Field temperature	Fruits temperature	T.S.S Brix	Diameter (mm)	Color (%)
1	23.3 ^{0}C	20 ^{0}C	8.7	28.22	96
2	24.7 ^{0}C	21 ^{0}C	7.8	22.60	95
3	22.3^{0}C	19.3 ^{0}C	8	35.25	97
4	25.4^{0}C	22.3 ^{0}C	7	27.5	97
5	23.8^{0}C	20 ^{0}C	8.6	33.11	95
6	24.9 ^{0}C	21.5 ^{0}C	8.5	29.55	97
Average	24.4	19.35	8.1	29.37	96.16

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2. Economic and marketing Evaluation

3.2.1: Economic Indicators

3.2.1.1. Production costs

Table (5) and annex No. 4 indicates that total production costs of strawberries ranged from a minimum of about 111.02 thousand pounds for Category III to a higher of about 113.4 thousand pounds for Category II and an average of about 112,000 pounds for all categories, For cost items, the cost of labor was first in proportion to the relative importance of the third categories, with ratios representing approximately 37.5%. 36. 01%, 37.8% for categories I, II and III, respectively, averaging about 41.56 thousand pounds, representing 37.1% of total costs rental value, followed by rental value, representing approximately 22.5%, 21.4% and 19.5% for each of those categories respectively, The average rental value of the all categories is estimated at Pound23.68 thousand per Fad. , Next is the cost of the seedling, representing about 14.1%, 15.4% and 14.4% for each of those categories, respectively, with an average of about 16.4 thousand pounds per Fad. , representing about 14.6% of the total costs. and notes that both the cost of labor and the price of seedling represent a large proportion of cost items, which means that any intervention that reduces the cost of those items will contribute to reducing production costs.

3.2.1.2. Productivity

Table (6) shows that the productivity of strawberry Fadden ranged between a minimum of about 22.1 tons for the first category and a maximum of about 30.7 tons for the third category, with an average of about 26.8 tons for the total categories, and the increase in Fad. productivity can be attributed to the third category To their dependence on modern and good agricultural practices in the production process, especially in light of the almost equal production costs for the three categories.

Table 5: Relative importance of strawberry crop fadden costs items from the total production costs of field study sample % for the holding categories season (2020/2021).

/ Categories Cost items	I	II	III	Average categories
Land preparation	2.02	2.14	2.76	2.31
Labor	37.50	36.01	37.82	37.10
Seedling	14.08	15.43	14.41	14.65
Plastic	4.10	3.61	3.71	3.81
Insect and fungi control	3.60	4.01	3.96	3.86
Organic fertilizer (meter)	6.47	7.27	8.02	7.25
Chemical fertilizer	6.47	6.61	7.21	6.76
Irrigation	3.21	3.53	2.59	3.11
Rent	22.53	21.38	19.52	21.15
Total (LE per fadden)	111577	113417	111017	112004

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2.1.3. Prices

Average price of Kg for export from strawberries during the season for the three categories was about 17 pounds, while the price of Kg for manufacturing during the season for three categories was about 7.4 pounds, while the sale price on the farm door for wholesale markets averaged about 6.1 pounds for the three categories during the season, as shown in table 6.

3.2.1.4. Cost per ton product

Table (6) shows that for the first category was approximately LE 5039, while for the second category it was about LE 4094 and for the third category it was about LE 3620 per ton, at an average cost of about LE 4251 per ton for the total categories, and for the third category, it was noted that the productivity of the Fad. of strawberries for the third category could be seen in comparison with the other categories.

3.2.1.5. Value of production inputs

Table (6) reveals that the average value of production inputs for the three categories was about 44.17 pounds thousand per Fadden, ranging from 42.33 thousand pounds for the first category to 45.9 thousand pounds for the second category.

3.2.1.6. Total revenue

Results show that strawberry Fadden of income averaged about 227.5 thousand pounds, ranging from 198.99 thousand pounds for the first category to 244.99 thousand pounds for the second category, an increase of about 23.1% for the first category (Table 6).

3.2.1.7. Net return

Average net return of a Fadden for each of the three production categories was estimated at LE87.4 thousand for the initial category, LE131.57 thousand for the second category and LE127.59 thousand for the third category, with a change rate of -24.3%, 13.88%, and 10.4% of the average net return to the three categories of about LE115.5 thousand per Fadden (Table 6).

Table 6: Average productivity, price, and returns of a fadden of a strawberry crop by field sample for different holding categories (2020/2021)

Item	Categories I	II	III	Average
Average productivity per ton per Fadden	22.1	27.7	30.7	26.8
Average export sale price (LE / kg)	16.9	17.2	17.0	17.0
Average price of manufacturer sale (LE / kg)	7.9	7.5	6.7	7.4
Average price selling local market (LE / kg)	6.0	6.1	6.0	6.1
Cost per ton product (LE)	5039	4094	3620	4251
Value of production inputs (LE)	42331	45900	44298	44176
Total revenue per Fadden (LE)	198997	244995	238610	227534
Net return per Fadden (LE)	87419	131577	127592	115530

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2.2: Economic Efficiency Indicators

3.2.2.1. Costs benefit ratio to total costs (CBRT)

Table (7) show that the CBR for the first category was about 1.78, the second category was about 2.16, and the third category was about 2.15, which means that the second category is more economically efficient than the other categories.

3.2.2.2. Costs benefit ratio to variable costs (CBRV):

Table (7) show that the second category is more economically efficient in using variable production inputs, with the CBR index at about 2.75, which means that each pound spent on variable production inputs will generate about 2.75 pounds in revenue.

3.2.2.3. Return per LE

Table (7) shows that the pound yield invested in strawberry production was about 0.78 pounds for the first category, about 1.16 pounds for the second category, and about 1.15 pounds for the third category, and an average of about 1.03 pounds for the three categories, which confirms that the second category is more economically efficient than the other categories, as each pound invested will give a profit of about 1.16 pounds.

3.2.2.4. Value-added

Table (7) shows that the value-added from the use of production inputs for the three categories, the results show that the second category has the greatest value-added from other categories about LE 7188 per ton, with an average value-added for the three categories about LE 6832 per ton.

Table 7: Some indicators of economic efficiency of strawberry crop for category in field sample community (2020/2021)

Item	I	II	III	Average
Costs benefit ratio of total costs (CBRT)	1.78	2.16	2.15	2.03
Costs benefit ratio of variable costs(CBRV)	2.30	2.75	2.67	2.58
Return per LE	0.78	1.16	1.15	1.03
Value - added per ton	7075	7188	6336	6832

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2.3. Marketing Channels and Economic Losses of Marketing Operations and Marketing Efficiency

3.2.3.1. Marketing Channels

Table (8) shows that production is directed towards manufacturing, ranging from 47.8% for the first category to 51.6% for the third category, with an average of about 49.2% for all categories, followed by a sale on the farm gate for the domestic market. (wholesale market) through local traders

ranging from 31.9% for the first category to 34.4% for the third category, with an average of about 32.8% for all categories, Then export-oriented outlets come from 12.8% for the third category to 18.87% for the second category, with an average about 16.8% for all categories, From the above, it is noted that the largest ratio directed at manufacturing comes from the farmers of the third category to ensure marketing and profit by contracting the sale of Strawberry as illustrated in Figure.

Table 8: Relative importance of strawberry marketing and drainage channels for holding categories in study sample society 2020/2021 kg per Fadden

Product channels	Indicator	I	II	III	Average
Household Consumption	**Quantity**	70	63	73	69
	% Equal	0.33	0.23	0.25	0.27
Presents	**Quantity**	229	200	250	226
	% Equal	1.03	0.73	0.84	0.87
Farm gate	**Quantity**	7160	8950	10723	8944
	% Equal	31.92	32.06	34.43	32.80
Export	**Quantity**	4210	5190	3860	4420
	% Equal	18.83	18.87	12.83	16.84
Sell to the manufacturer	**Quantity**	10740	13425	16084	13416
	% Equal	47.87	48.09	51.64	49.20
Total	**Quantity**	22408	27828	30990	27075
	% Equal	100.0	100.0	100.0	100

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2.3.2. Economic Loss of Some Marketing Operations

Table (9) shows that a minimum of about 1.87% of a first category's Fadden, with an average value of about LE 2487, LE 3274, LE 7005 per sale to each From the domestic market or manufacturing or exporting market, respectively, while the upper limit was about 3.01% of a third category, at an average value estimated at LE 5542, LE 6189, LE 15704 per Fadden of sale to each domestic market, manufacturing or export, respectively. In the same context, the loss of sorting per Fadden is estimated to have amounted about 2.54% Fadden total productivity at an average value of about LE 4158, LE 5945, LE 11589 to sale for each domestic market, plant or export respectively, They ranged from 2% of the Fadden productivity of a first category to an average value about LE 2657, LE 3499, LE 7484 per Fadden to sale for each domestic market, manufacturer or export, respectively, to a higher of about 3% of the category III productivity at a value about LE 5520, LE 6164, LE 15640 per Fadden, respectively, to sale for the local market, manufacturer or export, With regard to the loss of the Packing process, the field results show that the total production categories accounted for about 2.1% of the average Fadden productivity, with an average value of about LE 3445, LE 4179 and LE 9601 pounds per Fadden to sale for the local market, or manufacturer or to exports, respectively, It is shown from the above the loss rate of the three marketing operations is high in the third category and low in the first category, which can be attributed to the poor control over the labor of the third category during these marketing operation and the lack of experience of some of them, finale The losses of these operations amounted to about 6.9% of the productivity of the Fadden .

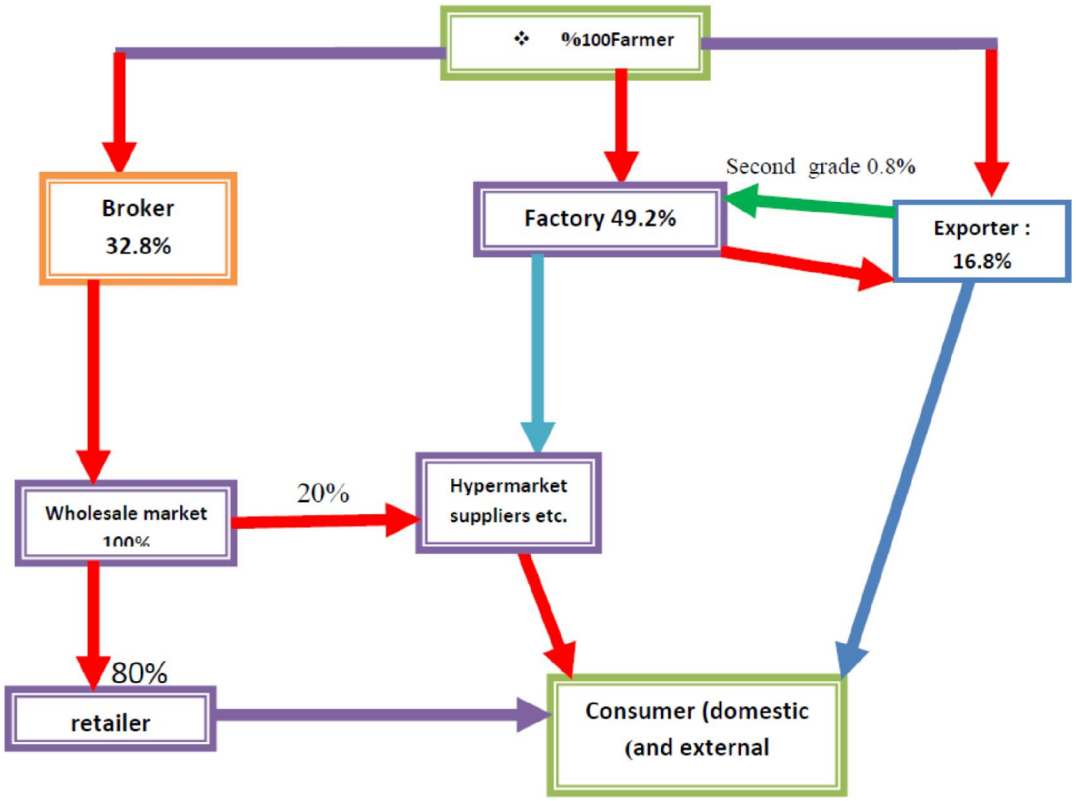

Fig. 2: Nubaria region strawberry marketing channels.

*1.2% of farm production is household consumption and presents

Table 9: Percentage loss per fadden and economic loss for harvesting operation of the strawberry crop for different holding categories season (2020/2021)

Marketing Process Items		Amount of collected per day for worker (kg)	Worker's wage in pound/day	Process loss (kg) of worker/ day	Loss per Fadden kg
Collection	**I**	111	131	2.00	414
	II	118	128	2.30	554
	III	109	127	3.00	924
	Total	113	128	2.40	613
Sorting	**I**	138	148	2.50	443
	II	150	139	3.60	704
	III	163	130	4.70	920
	Total	150	139	3.60	682
Packing	**I**	146	148	2.80	443
	II	166	145	3.70	609
	III	167	147	3.75	705
	Total	160	147	3.30	565
Total		422.9	138	9.3	1859.5

Table 9: continued

Marketing Process Items		% Fadden loss	Value of loss at local price (LE /Fadden)	Value of loss at manufacturing price (LE /Fadden)	Value of loss at export price (LE /Fadden)
Collection	**I**	1.87	2487	3274	7005
	II	2.00	3379	4155	9529
	III	3.01	5542	6189	15704
	Total	2.28	3740	4537	10422
Sorting	**I**	2.00	2657	3499	7484
	II	2.54	4292	5277	12102
	III	3.00	5520	6164	15640
	Total	2.54	4158	5045	11589
Packing	**I**	2.00	2657	3499	7484
	II	2.20	3717	4571	10482
	III	2.30	4232	4726	11991
	Total	2.10	3445	4179	9601
Total		6.9	11343.2	13760.6	31612.1

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2.3.3. Share of the Producer and Local trader from Consumer Pound

Table (10) shows that the farmer's share averaged about 57.6% of the consumer pound for all categories, the wholesaler accounted for about 9.1% of the consumer pound for all categories, while the retailer accounted about 33.2% of the consumer pound, thereby accounting for about 42.3% of the consumer pound, even though the duration of the crop is only a month Harvest from three to four months, indicating a lower share of the producer than that of the local trader.

3.2.3.4. Margins and Marketing Efficiency

Kohls defines marketing efficiency as the maximization of the ratio between both the product of marketing activity represented in consumer satisfaction of goods and services, expressed in the market price paid by the consumer for such satisfaction and the total production elements used in marketing operations, Marketing efficiency is the bulk of the ratio between the output and inputs of marketing activity, and marketing efficiency can be calculated at different mathematical rates and is given an indication of marketing efficiency.

Table 10: Share of producer and local trader from the consumer pound of the strawberry crop for holding categories season (2020/2021)

Item holding categories	Farm price (LE /kg)	Wholesale Price (LE /kg)	Retail price (LE /kg)	Farmer's share%	Wholesaler's Share%	Retailer's % share	Share of local trader %
Category I	6.03	7.01	10.5	57.43	9.34	33.23	42.57
Category II	6.10	7.01	10.5	58.06	8.71	33.23	41.94
Category III	6.03	7.01	10.5	57.43	9.34	33.23	42.57
Average	6.05	7.01	10.5	57.64	9.13	33.23	42.36

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

The following equation was used to estimate the marketing efficiency of strawberries in the sample study:

$$\text{Marketing efficiency} = 100 - \left(\frac{\text{Marketing margins}}{\text{Marketing margins} + \text{Unit Production Cost}} \times 100 \right)$$

Table (11) shows that The results estimated absolute and relative marketing margins indicate that between producer and wholesaler for all categories were about 0.96, 13.68% respectively, Absolute and

relative marketing margins between the wholesaler and retailer were about 3.49 pounds, 33.23%, while the absolute marketing margins between producer and retailer were about 4.45 pounds with relative importance 42.36%, while marketing efficiency, its estimates for all categories 48.9%. It ranged from 44.7% for the third category to 53% for a first category, indicating higher marketing efficiency in the first category than in the other categories, which confirmed the loss estimates for some previous marketing operations.

Table 11: Margins and marketing efficiency of the strawberry crop for holding categories season (2020/2001)

Marketing Margin	Wholesale -Producer		Wholesale -Retail		Retail – Producer		Cost of producing kg in pounds	Marketing Efficiency (%)
Holding categories	Absolute (LE /kg)	Relative (%)	Absolute (LE /kg)	Relative (%)	Absolute (LE /kg)	Relative (%)		
I	0.98	13.99	3.49	33.23	4.47	42.57	5.04	53.0
II	0.91	13.04	3.49	33.23	4.40	41.94	4.09	48.2
III	0.98	13.99	3.49	33.23	4.47	42.57	3.62	44.7
Average	0.96	13.68	3.49	33.23	4.45	42.36	4.25	48.9

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2.4. Econometrical analysis of factors affecting crop losses during harvesting operations

Table (12) shows that Indicate results for estimated of the most important factors affecting strawberry loss during harvesting operations show that relationship between quantity of loss kilograms as a dependent variable and each of the number years of experience, cultivated area per Fadden and quantities directed to export per tons and quantities directed to the local market per tons as independent variables, There was an inverse relationship between number years of experience for farmers and the amount of wastage, as the more years of experience for farmers increased, decrease in the amount of loss, but this relationship was not statistically significant, while the relationship between the cultivated area and the amount of loss was statistically direct and significant, which means that the increase in the cultivated area by Fadden will lead to an increase harvest losses by 43.8 kg, While relationship between the export-oriented quantities and the loss was statistically inverse and significant, which means that an increase in the exported quantities by a ton will lead to a decrease in the amount of loss by 68.1 kg, which can be attributed to the type of packaging used in collection and agricultural practices applied during harvesting operations.

Table 12: Results of a model measuring effect of some variables on the loss of strawberry harvest (collection, sorting and packaging) in the study sample population, season (2020/2021)

Variables	β	T	R^{-2}	F
α	-549.1	-1.606		
Years of Experience	-1.41	-1.519		
Cultivated area	43.83	9.656**	0.85	105.083
Oriented quantities for export	-68.16	-4.205**		
Oriented quantities for the local market	87.69	8.400**		

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

where:
α :Refers to the function segment
B: parameter value
T Refers to the significance of the coefficient:
**significance at level 0.01 *significance at level 0.05

As for the quantities directed to the local market, results of the estimation indicate that there is a direct relationship between them and the quantities of losses are statistically significant, as the increase in the quantities directed to the local market by one ton will lead to an increase in the quantities of losses by

87.6 kg, which can be explained by the weakness of the agricultural practices followed during the harvest for the quantities directed to the local market, including packaging.

3.2.5. Sources of access to inputs, financing and major constraints to production

3.1.5.1. Sources of access to production inputs

Table (13) shows that all farmers get strawberry seedlings from a certified distributor to ensure access to the required items and specifications, while sources of access to pesticides are split between the village trader and the certified distributor. With relative importance of 74.3% and 94.3% respectively, also sources of access to fertilizers split between village traders and certified distributors with forgotten importance of about 32.9% and 84.3% respectively, while all farmers relied on certified distributors to provide plastics to ensure quality and confidence.

Table 13: Sources of access for strawberry farmers to inputs in the field sample population season (2020/2021)

Inputs	Sources	Repetition	Relative importance (%)
Seedling	**Certified distributor (company)**	70	100.0
Pesticide	**The retailer in the village or nearby village**	52	74.3
	Certified distributor (company)	66	94.3
Fertilizer	**The retailer in the village or nearby village**	23	32.9
	Certified distributor (company)	59	84.3
Plastic	**The retailer in the village or nearby village**	5	7.1
	Certified distributor (company)	70	100.0
Total		70	100.0

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2.5.2. Sources of financing

Table (14) shows that 78.6% of farmers depend on in-kind financing from traders to obtain seedlings on a postpaid, 21.4% depend on self-financing for the purchase of seedlings, 64.3% of farmers depend on in-kind financing from traders, while 35.7% rely on self-financing for the acquisition of pesticides, While 21.4% depend on self-financing for fertilizer and feeders, concerning plastics, field results indicate that farmers depend on both self-financing and in-kind equally important for access to plastic, with 50% relative importance, the majority of farmers have previously relied on in-kind financing (term finance) for inputs to production.

Table 14: Sources of finance for production inputs for strawberry farmers in the field sample population season (2020/2021)

Inputs	Sources Finance	Repetition	Relative importance%
Seedling	**Self-financed**	15.0	21.4
	In-kind financing (trader or distributor)	55.0	78.6
Pesticide	**Self-financed**	25.0	35.7
	In-kind financing (trader or distributor)	45.0	64.3
Fertilizer	**Self-financed**	15.0	21.4
	In-kind financing (trader or distributor)	55.0	78.6
Plastic	**Self-financed**	35.0	50.0
	In-kind financing (trader or distributor)	35.0	50.0
Total		70	100.0

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

3.2.5.3. Limitations to the expansion of strawberry cultivation

Table (15) shows that all farmers see high prices of fertilizers, pesticides and rental value as one of the most important impediments to the expansion of strawberry farming, while some 92.9% see the

difficulty in obtaining both fertilizer and good pesticides, and 85.7% of farmers also see constraints and problems in obtaining reliable seedlings and transportation and refer 78.6% of farmers that higher seedling prices were an impediment to strawberry expansion. Farmers also reported that access to credit, higher interest rates and higher transport costs were difficulties in the expansion of strawberry cultivation, with a relative importance of 71.4%, 71.4% and 64.3% respectively.

Table 15: Limitations to expanding strawberry production in the field study sample community Season (2020/2021)

Limitations	Repetition	Relative importance%
High prices of fertilizers	70.0	100.0
Rising prices of pesticides	70.0	100.0
High rental value	70.0	100.0
Problems getting fertilizer	65.0	92.9
Problems getting good pesticides	65.0	92.9
Difficulty in obtaining reliable seedlings	60.0	85.7
Transport and communications problems (not equipped)	60.0	85.7
Soaring seedling prices	55.0	78.6
Difficulty in obtaining loans	50.0	71.4
Rising bank interest rates	50.0	71.4
Higher transport and communications costs	45.0	64.3
Total	70	100.0

Source: Compiled and calculated from field compilation data from the survey's Nubaria region season (2020-2021).

Recommendations

1- Awareness campaigns should be increased to follow good agricultural practices in the production and circulation of the strawberry crop, which will reduce the rates of crop loss.
2- When contracting for manufacturing, the farmers of the third holding category must be contracted, due to the desire of that category to contract for the sale of the crop, in order to ensure marketing and profit through the contract.
3- Increasing awareness campaigns to follow up on the application of good agricultural practices in the production and circulation of the strawberry crop, which would reduce fruit loss rates.
4- Planting varieties at the right time, considering climate change.
5- Maintaining the cold chain during strawberry handling.
6- Use the correct harvesting packages and direct packing in the field.
7- It requires raising the awareness of agricultural workers and stakeholders from farmers and suppliers about the importance of reducing losses and increasing income as well as improving their skills and practices and changing their attitudes to be more sustainable users of limited natural resources.

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Appendix

Table 1: Geographical distribution of strawberry area and production in Egypt during the average period (2018-2020)

Governorates	Area in thousand Fadden	%	Production in thousand tons	%
Nubaria	11.63	38.91	178.95	36.40
Ismailia	6.86	22.96	131.20	26.69
Beheira	5.19	17.36	77.13	15.69
Qalyubia	3.37	11.29	63.77	12.97
Sharqia	2.43	8.13	35.35	7.19
Menoufia	0.29	0.97	3.74	0.76
Giza	0.05	0.18	0.46	0.09
Dakahlia	0.04	0.14	0.83	0.17
Damietta	0.01	0.05	0.16	0.03
Asyut	0.00	0.01	0.01	0.00
Total Republic	29.89	100.00	491.59	100.00

Source: Compiled and calculated from Ministry of Agriculture and Land Reclamation data, Economic Affairs Sector website, Agricultural Statistics Bulletin, various issues, International Information Network.

Table 2: Geographical distribution of strawberry production area in the Nubaria region during the season (2020/2021)

Region	Area in Fadden	Relative importance%
Sugar beet	0	0
Al-Nahda and Mariout	1300	8.7
West Nubaria	3451	23.0
Al Bustan	2010	13.4
south of Tahrir	8239	54.9
Total	15000	100

Source: collected and calculated from the data of the Directorate of Agriculture for the new lands in Nubaria, Statistics Department, season 2020/2021, unpublished data.

Table 3: Distribution of Farmers' Sample to Possession Categories in Study Sample Society Season (2020/2021)

Possessive Categories	Number of farmers	Average area in Fadden
5 Fadden or less	33	4.7
Greater than 5 to 10 or less	20	8.5
10 Fadden and more	17	15.6
Total	70	9.6

Source: collected and calculated from the data of the Directorate of Agriculture for the new lands in Nubaria, Statistics Department, season 2020/2021, unpublished data.

Table 4: Total production costs of strawberry crops for possessory category in the sample community (LE per Fadden)

Category / Cost items	I	II	III	Average
Land preparation	2257.1	2425.0	3066.7	2582.9
Labor	41846.7	40842.5	41986.7	41558.6
Seedling	15714.3	17500.0	16000.0	16404.8
plastic	4580.0	4100.0	4120.0	4266.7
Insect and fungi control	4014.3	4550.0	4400.0	4321.4
Organic fertilizer (meter)	7214.3	8250.0	8900.0	8121.4
chemical fertilizer	7222.0	7500.0	8000.0	7574.0
irrigation	3585.7	4000.0	2877.5	3487.7
rent	25142.9	24250.0	21666.7	23686.5
Total	111577.3	113417.5	111017.5	112004.1

Source: Compiled and calculated from field compilation data from the survey's Nobari sample (2020-2021).