


Evaluation of Economic Efficiencies of Veterinary Practices in Kars Province with Data Envelopment Analysis

Kars İlindeki Veteriner Hekim Muayenehanelerinin Ekonomik Etkinliklerinin Veri Zarflama Analizi ile İncelenmesi

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ABSTRACT

This study was performed to determine the economic activity and profitability of veterinary practices operating in Kars province by using Data Envelopment Analysis (DEA). In this study, the 2023 data of 53.6% of veterinary practices operating in Kars province were obtained through a face-to-face survey. In the DEA applied to determine the economic efficiency of practices, input-oriented constant returns to scale (CCR) technique were used. According to the study findings, 6.7% of the veterinarians participating in the survey were female, 93.3% were male, and 46.6% were aged between 25 and 29 years. It was observed that all the veterinarians participating in the research had been practicing their professional activities since the date of graduation, and the majority (73.3%) had 3-12 years of experience (graduate date 2011-2020). It was determined that 10% of the veterinarians participating in the survey received postgraduate education (master's degree with thesis and PhD). It was found that 30% of veterinarians opened a practice after working in a practice. According to the DEA results for economic efficiency, it was determined that 90% of the practices were active. As a result, when veterinary practices were evaluated in terms of efficiency, it was understood that rent, maintenance-repair, general administrative costs, and other costs must be reduced in order to make economically ineffective veterinary practices to effective.

Keywords: Kars, practice, economic efficiency, data envelopment, veterinarian

ÖZ

Bu çalışma ile Kars ilinde faaliyet gösteren veteriner hekim muayenehanelerinin ekonomik etkinlik ve karlılık durumlarının Veri Zarflama Analizi (VZA) kullanılarak belirlenmesi amaçlanmıştır. Çalışmada, Kars ilinde faaliyet gösteren veteriner hekim muayenehanelerinin %53,6'sının 2023 yılına ait verileri yüz yüze uygulanan anket ile elde edilmiştir. Muayenehanelerin ekonomik açıdan etkinliklerinin tespiti için uygulanan VZA'da girdi yönlü ölçeğe göre sabit getiri tekniği (CCR) kullanılmıştır. Çalışma bulgularına göre, ankete katılan veteriner hekimlerin %6,7'si kadın, %93,3'ü ise erkek olup, %46,6'sının 25-29 yaş aralığında olduğu tespit edilmiştir. Araştırmaya katılan veteriner hekimlerin mezuniyet tarihinden itibaren tamamının meslek faaliyetlerini icra ettiği görülmüş ve çoğunluğunun (%73,3) 3-12 yıllık (mezuniyet tarihi 2011-2020) tecrübeye sahip olduğu saptanmıştır. Ankete katılan veteriner hekimlerin %10'unun lisansüstü eğitimi (tezli yüksek lisans ve doktora) aldığı tespit edilmiştir. Veteriner hekimlerin %30'unun daha önce bir muayenehanede çalıştıktan sonra muayenehane açtığı görülmüştür. Ekonomik etkinlik için yapılan VZA sonuçlarına göre muayenehanelerin %90'nın aktif olduğu tespit edilmiştir. Sonuç olarak işletmeler etkinlik yönünden değerlendirildiğinde, ekonomik yönden etkin olmayan işletmelerin etkin olabilmesi için kira, bakım-onarım, genel idare giderleri ve diğer giderlerin azaltılması gerektiği anlaşılmaktadır.

Anahtar Kelimeler: Kars, muayenehane, ekonomik etkinlik, veri zarflama, veteriner hekim

INTRODUCTION

Veterinary medicine, all around the world, is considered one of the deep-rooted professions with an important past.¹ The foundation of the veterinary profession began with the opening of a school providing veterinary education in France in 1762 and has continued until today.² In Türkiye, academic veterinary education began in 1842, 80 years after the first veterinary school established in the world, by a Prussian military veterinarian named Godlewsky, by giving veterinary medicine courses to cavalry schools in Istanbul.^{3,4} Today, there are 32 veterinary faculties operating academically in Türkiye.⁵ Individuals who receive a 5-year undergraduate education from these faculties and are successful receive the title of veterinarian. Veterinarians, who graduate from veterinary faculties, are employed in many different fields and units in the public and private sectors. Veterinarians can work in ministries, municipalities, and universities in the public sector. In addition, they can work as clinicians in the field of horses, cattle-sheep, poultry, and animals in the private sector as well as in veterinary practices operating in these fields and the pharmaceutical production and marketing sector and others.⁶ Veterinarians work in different sectors such as improving animal production (increasing productivity, breeding animals, protecting genetic resources, etc.), preventing and treating animal diseases, protecting public health (zoonotic diseases, etc.), and providing food services at all stages from production to consumption of animals and animal products as a professional group responsible and authorized for safety.^{7,8} It is extremely important for sustainability that veterinarians, especially those who own private practices, undertake such important tasks and can run an economically profitable veterinary practice. A profitable veterinary practice is possible if veterinarians fulfill their entrepreneurship, management, and physician missions in the best possible way. Many studies reported that practices managed by veterinarians trained in veterinary practice management and administration were better in terms of both veterinary service quality and profitability.^{9,10} It is regarded as necessary to analyze the economic situation of veterinary practices at certain time intervals to evaluate service quality and profitability. Data envelopment analysis is used in the economic evaluation of practices, as in the current study.

Data envelopment analysis, which dates back to Farrell's work in 1957, was first developed by Charnes, Cooper and Rhodes¹¹ as a method to evaluate the comparative efficiency of organizational units.¹²⁻¹⁵ Data envelopment analysis is a non-parametric linear programming method that uses multiple inputs to obtain multiple outputs. In this respect, it differs from other single-output parametric

methods. In DEA, efficiency scores vary between 0 and 1. It is suggested that the effectiveness of the decision-making units (DMU) whose value is closest to 1 is more effective than the others. Veterinary practices with an efficiency score of 1 are considered fully efficient.¹⁶ In the literature review, no study evaluating the economic efficiency of veterinary practices using DEA was found.

The objective of this study was to evaluate the economic efficiency of veterinary practices operating in Kars province with DEA by considering income and cost variables.

MATERIALS AND METHODS

This study was approved by the Kafkas University Non-Interventional Clinical Research Ethics Committee (Approval date and number: 29.09.2023 and 8/123).

Study Design

In this study, data obtained from 30 veterinary practices out of a total of 56 veterinary practices operating in all districts (8 districts) of Kars province, who agreed to participate in the survey, were used. One-year data on veterinary practices were obtained from face-to-face surveys (general information about the practice and the veterinarian who owns the practice, information about the costs and income of the practice). The study results were examined in the following three parts.

Descriptive information about veterinary practices:

Survey questions were asked to veterinarians who own practice, including general information about them and their practices. At the end of the survey, the answers given to the questions were presented as percentages.

Cost, income and profitability of practices:

Survey questions were asked to veterinarians to obtain 10 input and five output data for their practices.

The economic analysis method for determining total cost, income and profit situations was presented below.

Total cost (TRY) = invoice (communication, electricity, water) cost + medical equipment cost + maintenance-repair (practice, vehicle) cost + medicine and food supplement cost + rent cost + employee cost + artificial insemination (sperm, straws, etc.) cost + accessory (collar, etc.) cost + depreciation cost + general administrative cost (transportation + communication + health insurance) cost

Total income (TRY) = Examination fee (veterinarian + travel fee) + medicine and food supplement (food, premix) fee + artificial insemination fee + accessory fee (leash, etc.) + additional income (expertise, consultancy, etc.)

Profit (TRY) = total income - total cost

Statistical Analysis:

In the created DEA economic efficiency model, invoice (communication, electricity, water), medical equipment, maintenance-repair (practice, vehicle), medicine and food supplements, rent, employee, artificial insemination

(semen, straws, etc.), accessories (collar, etc.), depreciation, general administration (transportation + communication + health insurance) costs were taken into account as 10 input variables of veterinary practices.

Economic efficiency scores were calculated by DEA analysis (Table 1).

Table 1. Income and cost items

Costs Items	Income Items
1. Invoice (communication, electricity, water)	1. Examination fee (veterinarian + travel fee)
2. Medical equipment	2. Medicine and food supplement (food, premix) fee
3. Maintenance-repair (practice, vehicle)	3. Artificial insemination fee
4. Medicine and food supplement	4. Accessory fee (leash, etc.)
5. Rent	5. Additional income (expertise, consultancy, etc.)
6. Employee	
7. Artificial insemination (sperm, straws, etc.)	
8. Accessory (collar, etc.)	
9. Depreciation	
10. General administrative (transportation + communication + health insurance)	

The obtained data were analyzed by applying the input-oriented CCR technique. In DEA, it was assumed that each unit on the problem to be analyzed has "m" inputs, "s" outputs and "n" decision-making units. The i th input amount of the j th decision-making unit was $X_{ij} \geq 0$ and the Y_{ij} parameter indicated the i th output amount used by the j th decision-making unit. The mathematical expression of the CCR technique of the input-oriented fractional DEA model, where $Y_{ij} \geq 0$, was as follows:

$$Enb h_k = \frac{\sum_{r=1}^s u_{rk} Y_{rk}}{\sum_{i=1}^m v_{ik} X_{ik}} \quad [1.1]$$

$$= \frac{\sum_{r=1}^s u_{rk} Y_{rj}}{\sum_{i=1}^m v_{ik} X_{ij}} \leq 1 \quad ; j = 1, 2, \dots, n \quad [1.2]$$

$$u_{rk} \geq 0; \quad r = 1, 2, \dots, s, \quad v_{ik} \geq 0; \quad i = 1, 2, \dots, m \quad [1.3]$$

CCR (constant returns to scale) data envelopment model can be obtained by converting the above model to the following model.

$$Enb h_k = \sum_{k=1}^s u_{rk} Y_{rk}; \quad k=1, 2, \dots, n \quad [2.1]$$

$$\sum_{i=1}^m v_{ik} X_{ik}, \quad u_{rk} \geq 0; \quad r = 1, 2, \dots, s \quad v_{ik} \geq 0; \quad i = 1, 2, \dots, m \quad [3.1]$$

$$\sum_{r=1}^s u_{rk} Y_{rj} - \sum_{i=1}^m v_{ik} X_{ij} \leq 0 \quad ; j = 1, 2, \dots, n \quad [4.1]$$

The model is represented as follows. In the model;

Enb : Maximization

urk": Weight assigned to the r th output by decision unit k ,

vik": Weight assigned to the i th input by decision unit k ,

Yrk": Output produced by decision unit k for the r th output,

Xik": i th input used by decision unit k ,

Yrj": r th output produced by j th DMU,

Xij": i th input used by j th DMU,

The problem here is processed n times to determine the effectiveness of all DMU scores, and weighted inputs and outputs are selected to optimize the efficiency score of each decision-making unit. The efficiency value of each DMU is in the range of 0-1. If the efficiency value of the DMU is 1, the relevant decision-making unit is considered effective, and these also constitute the efficiency limit. If the efficiency value of the DMU is less than 1, the relevant decision-making unit is ineffective^{12, 17}.

The analysis was applied to a total of 30 veterinary practices. Inputs were coded for the 1st Practice as "I1 {I}," for the 2nd Practice as "I2 {I}" and for the 30th Practice as "I30 {I}," and the outputs were coded for the 1st Practice as "O1 {O}," for the 2nd Practice as "O2 {O}" and for the 30th Practice as "O30 {O}." MS Excel¹⁸ and EMS (Efficiency Measurement System) version 1.3.0¹⁹ were used for DEA in the study, and IBM SPSS 25.0²⁰ package program was used for the independent sample t test.

Table 2. Some general information about veterinary practices

General Information About Practices	%
1. Gender of veterinarians	100
Male	93.3
Female	6.7
2. Age of the veterinary practice owner veterinarian	100
25-29	46.6
30-34	13.3
35-39	33.4
40 and above	6.7
3. University graduation year	100
2001-2010	16.6
2011-2020	73.3
2021-2023	10.1
4. Status of continuing postgraduate education after undergraduate graduation	100
Yes	10.0
No	90.0
5. Have you attended any training courses and seminars organized within the scope of professional education?	100
Yes	93.3
No	6.7
6. Have you ever worked at a veterinary practices before	100
Yes	30
No	70

RESULTS

Table 2 presents general information about veterinary practices.

In this study, 6.7% of the veterinarians participating in the survey were female, 93.3% were male, and 46.6% were aged between 25 and 29 years. It was found that all the veterinarians participating in this study had been practicing their professional activities since the date of graduation, and the majority (73.3%) had 3-12 years of experience (graduation date 2011-2020). It was determined that 10% of the veterinarians participating in the survey had postgraduate education (master's degree with thesis/PhD degree). It was determined that veterinarians were interested in seminars and courses, and almost all of them (93.3%) participated in such training activities. It is observed that 30% of veterinarians opened a practice after gaining experience in a practice.

Data regarding the establishment and operation period of veterinary practices are given in Table 3.

The majority of veterinarians (76.7%) answered no to the question "Have you ever had concerns about your competence when opening a practice?". The ideal of opening a practice (38.7%), desire to work independently

(38.7%), 12.9% considering the opportunities to work in the public sector as limited, and willingness to earn a high income (9.7%) were among the reasons for opening a practice among the veterinarians surveyed in the present study. It was determined that 86.7% of the veterinarians participating in the survey met their financing needs from equity capital in the establishment of their practices, while 13.3% used loans. Knowing the environment (42.4%), knowing the animal population in the region (39.4%), the number of practices and their proximity to each other (9.1%), capital status (3.0%), and other factors (6.1%) were found to be effective in the selection of the location of the practice by veterinarians. Veterinarians stated that when determining the fee schedule in their practices, 73.3% considered their costs, 23.3% considered the fees of other practices, and 3.4% considered the minimum wage tariff determined by the chamber of veterinarians. When the veterinarians in charge of the practices were asked about the number of employees other than themselves; 15 of them (50%) said they had no other employee other than themselves, 6 of them (20%) worked with only 1 auxiliary staff, 5 of them (16.6%) employed 1 veterinary technician, 2 of them (6.7%) had 1 veterinarian and 1 assistant, and 2 of them (6.7%) stated that they worked with 2 veterinary technicians. It was seen that almost all the veterinarians in the current study examine and treat cattle, sheep, pets, poultry and exotic animals. It was determined that 96.7%

Table 3. Data regarding the establishment and operation period of veterinary practices

Data regarding the establishment and operation period of veterinary practices	%
1. Did you have any concerns about your competence when opening the practices	100
Yes	23.3
No	76.7
2. The reason for choosing the profession of clinical veterinarian	100
Professional idealism	38.7
Desire for independent work	38.7
Professional idealism Desire for independent work Limited opportunities for working in the public sector	12.9
High income potential	9.7
3. Did you use credit during establishment?	100
Yes	13.3
No	86.7
4. The factors influencing the choice of establishment location	100
Animal population in the region	39.4
Number of practices and their proximity	9.1
Familiarity with the environment	42.4
Capital situation	3.0
Other	6.1
5. What do you consider when determining fees for vaccination, examination, treatment, etc. at your practices?	100
By looking at the fees of other practices	23.3
Based on costs	73.3
By referring to the minimum fee schedule of the Veterinary Health Organization (VHO)	3.3
6. Number of employees	100
Only oneself	50.0
Himself + 1 Assistant Staff (secretary, etc.)	20.0
Himself + 1 Veterinarian + 1 Veterinary Technician	6.7
Himself + 1 Veterinary Technician	16.6
Himself + 2 Veterinary Technicians	6.7
7. What practices do you implement to increase the number of patients and ensure customer loyalty?	100
Establishing good relationships with animals owners	20.0
Improving service quality	70.0
Developing patient registration and tracking system	3.3
Providing services by visiting homes	6.7

of the patient profiles that came to these veterinarians' practices or where the veterinarian treated the patient on-site were cattle, 90% were sheep, 80% were pets, 80% were poultry and 23.3% were exotic animals (Table 3).

Problems encountered establishment and operation period of veterinary practices are given in Table 4.

Insufficiency of credit and financing opportunities (36.7%), lack/expensiveness of devices and equipment (30%), problems in promotion and public relations (20%) and

bureaucratic procedures encountered during the establishment phase (10%) were among the problems veterinarians encountered when establishing a practice. It was determined that the most important problems experienced by veterinarians during the operation period were that the animal owner found the fee tariff high for the service and bargained with it, at a rate of 63.3%, and that the fees were reduced due to competition between practices, at a rate of 36.7%. In this study, it was observed that 73.3% of veterinarians could not collect the full fee they requested for the provided health services (Table 4).

Table 4. Problems encountered establishment and operation period of veterinary practices

Problems encountered establishment and operation period of veterinary practices	%
1. The most significant challenge encountered when establishing a veterinary practice?	100
Competitive pressure among practices leading to downward pressure on fees	36.7
Animals owners finding service fees high and bargaining for lower rates	10.0
Low-income levels of animals owners	20.0
In some cases, abandonment of stray animals at the practices and failure to pay for treatment	30.0
Other	3.3
2. The most significant problem experienced during the operation period of the practices?	100
The reduction of fees due to competition among veterinary practices	36.7
Animals owners finding the service fees high	63.3
3. Are you able to collect the fee you request for the service provided in full?	100
Yes	26.7
No	73.3

Table 5. Annual average cost of veterinary practices

Cost Items	Number of Vet. practices	Average Costs (TRY)	Share of Total Costs (%)	S _x
1. Invoice	30	24,292	1.8	2,455.3
2. Medical equipment	30	47,533	3.5	6,256.4
3. Maintenance-repair	30	35,140	2.6	2,698.5
4. Medicine and food supplement	30	856,400	62.4	107,265.7
5. Rent	30	40,740	3.0	4,283.1
6. Employee	30	104,400	7.6	24,694.4
7. Artificial insemination	30	29,680	2.2	6,146.7
8. Accessory	30	3,400	0.2	2,119.5
9. Depreciation	30	24,452	1.8	3,592.6
10. General administrative	30	206,282	15.0	19,301.3
Total	30	1,372,319	100	140,182.1

S_x: Standart Error

The annual average cost items (TRY) of veterinary practices operating in Kars are given in Table 5 and Figure 1.

Proportional distribution of total annual costs of veterinary practices sorted from largest to smallest as medicine and food supplement costs (62.4%), general administrative costs (transportation + communication + social security) (15.0%), employee, ousts (7.6%), medical equipment costs (syringe, gloves, boots, overalls, apron) (3.5%), rent costs (3.0%), maintenance-repair costs (2.6%), artificial insemination cost (2.2%), depreciation costs (1.8%), invoice costs (electricity, natural gas, water) (1.8%) and accessory costs (collar, etc.) (0.2%) (Table 5; Figure 1).

Annual average incomes of veterinary practices are given Table 6.

When looking at the average annual income of veterinary practices, the highest income was received from the sale of medicines and food supplements (66.1%), followed by examination (veterinary and transportation) (27.3%),

artificial insemination (4.8%), additional (expertise, consultancy, etc.) (1.5%), and accessory incomes (0.3%) (Table 6).

The economic efficiency scores of the practices are given in Table 7.

According to the DEA results, the efficiency score of 27 practices (Practices 1-9, 11-13, 15-30), which are among the decision-making units, was 1, whereas the efficiency score of the other three ineffective practices (Practices 7, 10, and 14) was 0.

Practice 9 (by Practice 10), Practice 11 (by Practice 7), Practice 19 (by Practice 14), Practice 20 (by Practice 10), Practice 23 (by Practice 14), Practice 27 (by Practice 7), Practice 28 (by Practice 14), were referenced once, and Practice 5 (by Practices 10 and 14), Practice 18 (by Practices 7 and 14) and Practice 25 (by Practices 7 and 14) were referenced twice (Table 7).

Cost Items (%)

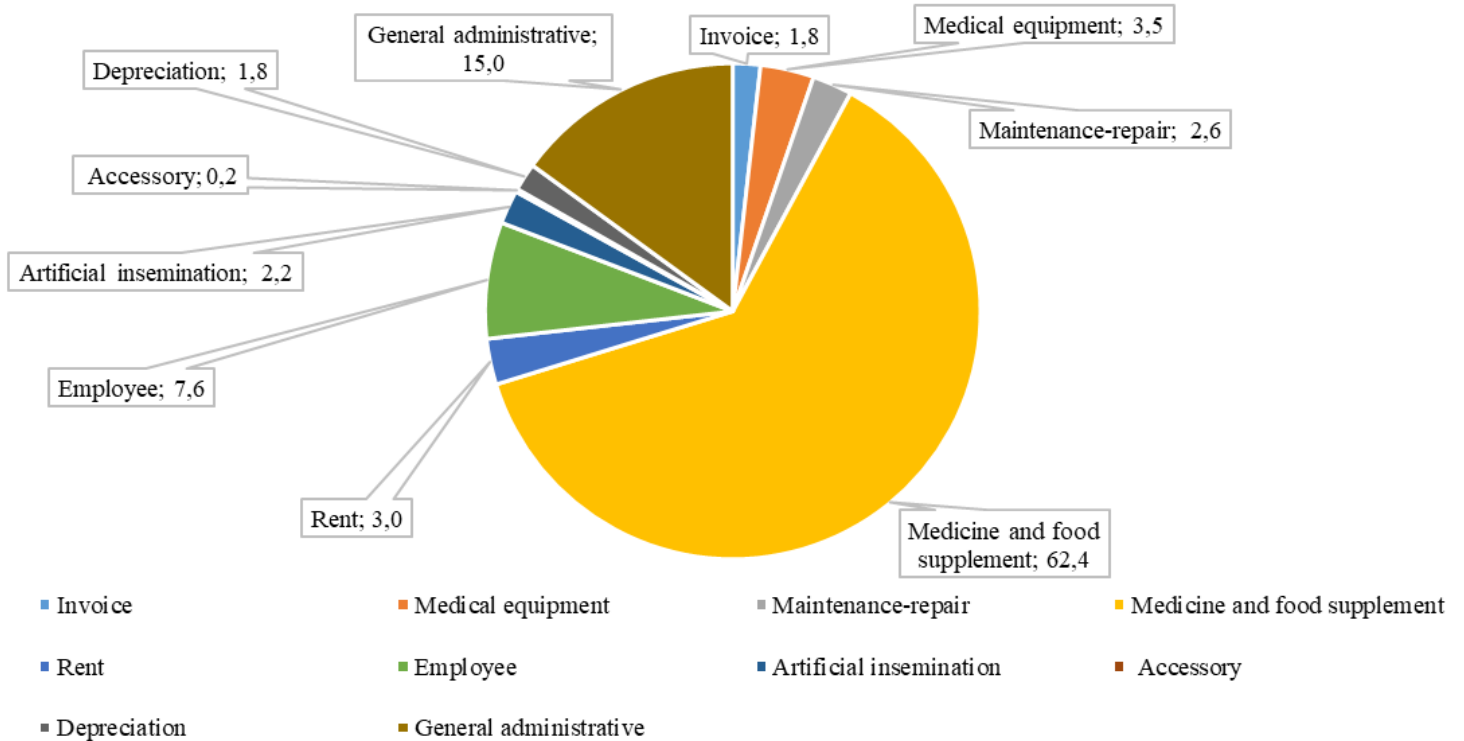


Figure 1. Proportional distribution of annual average cost items of veterinary practices (%)

Table 6. Annual average incomes of veterinary practices

Income Items	Number of Vet Practices	Average Annual Income	Share of Total Revenue (%)	$S_{\bar{x}}$
Examination	30	577,600	27.3	52,045.8
Medicine and food supplement	30	1,398,800	66.1	171,038.2
Artificial insemination	30	102,520	4.8	16,637.8
Accessory	30	31,200	1.5	14,799.1
Additional income	30	6,080	0.3	3,199.3
Total	30	2,108,920	100	204,668.9

$S_{\bar{x}}$: Standart Error

The CCR input efficiency score of the practices and the residual values of the variables (input elements that need to be reduced) are given in Table 8.

According to the input-oriented CCR efficiency analysis, considering the Practice 7, it was required that the annual invoicing cost by 1,624.5 TRY, the medical equipment cost by 4,774.3 TRY, the maintenance-repair cost by 3,006.6 TRY, the artificial insemination cost by 4,856.7 TRY, the depreciation cost by 8,688.8 TRY, and the general administrative costs by 16,189.2 TRY should be reduced in order to be effective.

In order to be effective, Practice 10 must reduce its annual invoice cost by 21,366.7 TRY, its medical equipment cost by 14,094.1 TRY, its maintenance-repair cost by 13,904.5 TRY, its rent cost by 9,732.7 TRY, its depreciation cost by 7,927.8 TRY and its general administrative costs by 68,080.8 TRY. It was determined that in order to be effective, Practice 14 should reduce its annual invoice costs by 23,312.3 TRY, its maintenance-repair costs by 15,500.2 TRY, its rent costs by 19,047.7 TRY, its employee costs by 53,696.8 TRY and its general administrative costs by 26,149.5 TRY (Table 8).

Table 7. Economic efficiency scores of veterinary practices

Decision unit (Vet Practices No)	Efficiency Score	Benchmarks (Reference set)	Number of References Shown by Another Decision Unit	Efficiency Status
Veterinary Practice 1	1	Veterinary Practice 1 (1.00)	0	Effective
Veterinary Practice 2	1	Veterinary Practice 2 (1.00)	0	Effective
Veterinary Practice 3	1	Veterinary Practice 3 (1.00)	0	Effective
Veterinary Practice 4	1	Veterinary Practice 4 (1.00)	0	Effective
Veterinary Practice 5	1	Veterinary Practice 5 (1.00)	2	Effective
Veterinary Practice 6	1	Veterinary Practice 6 (1.00)	0	Effective
Veterinary Practice 7	0.96	Veterinary Practice 11 (0.02); Veterinary Practice 18 (0.16); Veterinary Practice 25 (0.65); Veterinary Practice 27 (0.02)	0	Ineffective
Veterinary Practice 8	1	Veterinary Practice 8 (1.00)	0	Effective
Veterinary Practice 9	1	Veterinary Practice 9 (1.00)	1	Effective
Veterinary Practice 10	0.95	Veterinary Practice 5 (0.27); Veterinary Practice 9 (0.08); Veterinary Practice 20 (0.38)	0	Ineffective
Veterinary Practice 11	1	Veterinary Practice 11 (1.00)	1	Effective
Veterinary Practice 12	1	Veterinary Practice 12 (1.00)	0	Effective
Veterinary Practice 13	1	Veterinary Practice 13 (1.00)	0	Effective
Veterinary Practice 14	0.93	Veterinary Practice 5 (0.14); Veterinary Practice 18 (0.32); Veterinary Practice 19 (0.44); Veterinary Practice 23 (0.09); Veterinary Practice 25 (0.07); Veterinary Practice 28 (0.06)	0	Ineffective
Veterinary Practice 15	1	Veterinary Practice 15 (1.00)	0	Effective
Veterinary Practice 16	1	Veterinary Practice 16 (1.00)	0	Effective
Veterinary Practice 17	1	Veterinary Practice 17 (1.00)	0	Effective
Veterinary Practice 18	1	Veterinary Practice 18 (1.00)	2	Effective
Veterinary Practice 19	1	Veterinary Practice 19 (1.00)	1	Effective
Veterinary Practice 20	1	Veterinary Practice 20 (1.00)	1	Effective
Veterinary Practice 21	1	Veterinary Practice 21 (1.00)	0	Effective
Veterinary Practice 22	1	Veterinary Practice 22 (1.00)	0	Effective
Veterinary practice 23	1	Veterinary practice 23 (1.00)	1	Effective
Veterinary Practice 24	1	Veterinary Practice 24 (1.00)	0	Effective
Veterinary Practice 25	1	Veterinary Practice 25 (1.00)	2	Effective
Veterinary Practice 26	1	Veterinary Practice 26 (1.00)	0	Effective
Veterinary Practice 27	1	Veterinary Practice 27 (1.00)	1	Effective
Veterinary Practice 28	1	Veterinary Practice 28 (1.00)	1	Effective
Veterinary Practice 29	1	Veterinary Practice 29 (1.00)	0	Effective
Veterinary Practice 30	1	Veterinary Practice 30 (1.00)	0	Effective

Table 8. The input-oriented (CCR) efficiency score of veterinary practices and the residuals of variables

Vet. Practices	Eff. score	Invoice	Med. equipment	Main. repair	Med. and food	Rent	Employee	Art. insemination	Accessory	Depreciation	Gen. administrative
1	1	0	0	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0	0	0
4	1	0	0	0	0	0	0	0	0	0	0
5	1	0	0	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0	0	0	0	0
7	0.6	1,624.5	4,774.3	3,006.6	0	0	0	4,856.7	0	8,688.8	16,189.2
8	1	0	0	0	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	0	0	0
10	0.95	21,366.7	14,049.1	13,904.5	0	9,732.7	0	0	0	7927,8	68080,8
11	1	0	0	0	0	0	0	0	0	0	0
12	1	0	0	0	0	0	0	0	0	0	0
13	1	0	0	0	0	0	0	0	0	0	0
14	0.93	23,312.3	0	1,500.2	0	19,047.7	53,696.8	0	0	0	26,149.5
15	1	0	0	0	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0	0	0	0	0
17	1	0	0	0	0	0	0	0	0	0	0
18	1	0	0	0	0	0	0	0	0	0	0
19	1	0	0	0	0	0	0	0	0	0	0
20	1	0	0	0	0	0	0	0	0	0	0
21	1	0	0	0	0	0	0	0	0	0	0
22	1	0	0	0	0	0	0	0	0	0	0
23	1	0	0	0	0	0	0	0	0	0	0
24	1	0	0	0	0	0	0	0	0	0	0
25	1	0	0	0	0	0	0	0	0	0	0
26	1	0	0	0	0	0	0	0	0	0	0
27	1	0	0	0	0	0	0	0	0	0	0
28	1	0	0	0	0	0	0	0	0	0	0
29	1	0	0	0	0	0	0	0	0	0	0
30	1	0	0	0	0	0	0	0	0	0	0

Economic data for efficient and inefficient practices are given in Table 9.

Table 9. Average economic data for effective and ineffective veterinary practice

Variable	Group	
	Effective	Inefficient
Cost	1,409,253	1,039,920
Income	2,195,778	1,400,000
Profit	786,525	360,080

According to the results of the study, the average costs, income, and profitability of effective practices were higher. It was determined that economically efficient veterinary

practices had an average of 426,445 TRY more profit than inefficient veterinary practices in terms of profitability (Table 9).

DISCUSSION

Although veterinary practices are established as veterinary practices that aim to provide treatment, care, and other services for animal health, they are essentially commercial veterinary practices. Veterinary practices, as a commercial enterprise, must have the necessary competencies in customer relations, service quality methods, patient registration systems, patient tracking, and analysis of inputs and outputs to be economically profitable / effective in terms of sustainability as well as the professional knowledge of veterinarians.²¹

In the present study, 53.6% (30 practices) of 56 practices operating in Kars were included. In other words, more than half of the total practices operating in Kars province were included in this study. In some previous studies, participation rates were reported as 20.8%²² and as 47.1%²³. It was determined that 6.6% of the veterinarians participating in this study were women and 93.4% were men, and almost all of them worked as cattle and sheep physicians. In some studies, although the rate of female veterinarians was higher than that in the present study, it was observed that the rate of female veterinarians, especially in veterinary practices focusing on pet animals, was higher than that of cattle.^{23,24} There were studies in the literature reporting that the rate of female veterinarians was lower than the rate of male veterinarians as in the present study.²⁵⁻²⁷ The high interest of female veterinarians in pet animals²⁸, the fact that female veterinarians do not consider working primarily in cattle as a priority, the majority of the studies conducted in cattle and ovine practices, as in the present study, the fact that high cattle populations in the region where the present study was conducted (Kars province ranks 4th in terms of the presence of cattle in Türkiye), and the conditions for practicing cattle and ovine medicine are more difficult than pet, exotic, and poultry medicine (many problems such as high power requirements of animal restraint, on-site intervention to the patient, time, and climate) may be among the reasons for this situation.²⁹ It was determined that the highest rate of age and experience of the veterinarians participating in the study was in the 25-29 age group with 46.6%, and the majority of them had 3-12 years of experience. There are studies with similar findings in terms of the age²⁷ and experience of veterinarians.^{23,27} Additionally, when the opening years of the practices were evaluated, it was noteworthy that the number of practices opened, especially in the last 5 years was very high. The fact that experience of veterinarian was between 3-12 years, which was also mentioned in previous studies^{19,20} might be explained by the increasing number of veterinary faculties in recent years and limited employment opportunities in the public sector. It was observed that 90% of the veterinarians in this study did not receive a master's degree with a thesis or PhD after their undergraduate education. The rate of veterinarians without postgraduate education found by Aral et al.²³ in Ankara and Erdoğan and Sarıözkan²⁷ in Nevşehir was consistent with the rate found in the present study. The low rate of veterinarians receiving postgraduate education can be attributed to their inability to spare time for education because of working overtime (24/7 working principle). However, according to the findings of both this study and other studies²³, the participation rate of physicians in courses and seminars with short/limited training periods was found to be high.

It has been observed that the examination service fee and fees of medicine and materials sale were mostly determined by veterinarians by looking at the sales prices, costs and fees of other practices. Similar findings were also found in the study conducted by Erdoğan and Sarıözkan.²⁷

In order to prevent such unfair competition and practices that may negatively affect patient owners, the necessary authorities need to inspect practices and take the necessary measures in terms of fee schedule application.

It was observed that 42.4% of veterinarians considered the environment when choosing a practice location, 39.4% considered the animal population in the region, 9.1% considered the number of practices and their proximity to each other, 3.0% considered the capital situation, and 6.1% considered other reasons. Previous studies also reported that veterinary practices considered the animal population and household income level in the region when choosing a location for establishment.^{22,23} Possible reasons why veterinarians should pay attention to the animal population and household income levels in the region are the high number of patients (customers) they can treat (increasing their income) and reduced possibility of encountering problems regarding the fee they will charge after the interventions.

It was determined that the veterinarians participating in the survey covered the majority of the establishment costs of their practices from their own capital. In studies conducted in different times and provinces, the high rate of equity capital use by clinicians when establishing their practices supports the findings of the present study.^{22,27} When the costs of the practices participating in the study were examined, the largest share was made up of medicine and food supplement costs. In the studies conducted by Kaygısız and Akdağ²² and Erdoğan and Sarıözkan²⁷, the highest cost items were medicine, serum, and vaccine costs, which were confirmed by the findings of the present study, in which the highest income item of the practices examined in the study was the sale of medicines and food supplements. In the study conducted by Erdoğan and Sarıözkan²⁷ in Nevşehir province, the highest share in total income was obtained from artificial insemination (41.9%). In contrast to other studies, in the present study, the higher pharmaceutical and vaccine incomes than artificial insemination income can be attributed to the fact that the majority of farming enterprises in the region prefer natural insemination to artificial insemination. In addition, the fact that this practice is carried out by public institutions for veterinary practices that prefer artificial insemination suggests that this may cause private veterinary practices to have a low artificial insemination income.

The DEA revealed that 27 of the veterinary practices surveyed in Kars province were economically efficient and 3 veterinary practices were not efficient. High costs involving invoices, maintenance repair, and general administrative costs, which are common to all three, as well as costs of medical supplies (Practice 7, 10), depreciation (Practice 7, 10), rent (Practice 10, 14), artificial insemination (Practice 7), and employee (Practice 14), should be reduced to ensure that the three ineffective veterinary practices are effective. It has been concluded that the majority of veterinary practices operating in Kars

province are economically efficient, and those that are not efficient need to reduce some cost items according to DEA. The DEA used in this study guides veterinarians in determining whether practices are economically efficient or not and which cost items they need to reduce in order to be effective.

One of the most important criteria for determining the commercial performance of veterinary practices and comparing them with other practices is their level of economic activity. Various studies have been conducted on this subject in Europe and the USA. For example, according to the 2018 report of the European Federation of Veterinarians, the average monthly income of veterinarians in Europe was €3,300. The country with the highest income was Switzerland, where the average monthly income was around €6,800. For Türkiye, the average monthly income was reported as approximately € 3,000. According to 2019 reports from the US Bureau of Labor Statistics, the average hourly earnings of a veterinarian were US\$ 45.9, and the monthly income was US\$ 7,900.³⁰ In Kars, the monthly profit of actively working practices was US\$ 2,765, while it was determined as US\$ 1,266 in inactive veterinary practices.

As a conclusion, in recent years, there has been a significant increase in the number of veterinary practices in Kars province, parallel to Türkiye in general. It has been understood that practices encounter several problems both during the establishment phase and the operating period due to this increase. Among the problems experienced, it was observed that a lack of compensation for the service provided, unfair competition between practices, and ethical violations came to the fore. As a solution, it was concluded that it would be beneficial for veterinarians to give up different price practices and open a practice by eliminating their own deficiencies in the field of veterinary practice economics before establishing a practice. In addition, it is thought that the profitability of the clinics will increase by preventing problems and cost increases in the supply of vaccines, medicines and materials (the effect of TL depreciation and increasing exchange rates), general administration and rental expenses, debts and financial management problems. Providing low-interest loan opportunities and more effective work of professional organizations are important for the sustainability of veterinary practices.

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