© by PSP Volume 29 – No. 05/2020 pages 3614-3621 Fresenius Environmental Bulletin

PROBABILITY OF MAKING PROFITS IN GREENHOUSE PRODUCTION: ANTALYA - TURKEY CASE

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ABSTRACT

Greenhouse production is vital for Mediterranean countries in four season fresh fruits and vegetables supplies. However, with high investment and varying variable costs and high labour demand, greenhouse production provides fluctuating profits to producers. Accordingly, it was aimed to undermine factors affecting probability to make above average profits for 281 greenhouse operators surveyed in Antalya, Turkey in 2015. The farm level profit was detected as $10.184,63, while it was $2.639,77 per 0,1 hectares on average departing from primary data retrieved from greenhouse farmers in 2015. Accordingly, 82 greenhouse farms were making loss and 86 farms ended up with a below average profit. Following the logistic estimation of above average profit making situation, it was understood that the most important profit rising factor was ownership of the farmland. This is related with reduction of variable costs like rent or subcontractor commissions. Besides, western Antalya towns appeared as more profitable, keeping in mind the risk of lands' overuse in the long-term. However, the findings also indicated that corporatization of the sector is essential for reducing real tax payments and assuring limited responsibility of the farmers.

KEYWORDS:
Greenhouse production, profitability, logistic regression, Antalya

INTRODUCTION

Profit generation is the main objective of any sort of economic activity. Yet, profitability of an enterprise can be determined in various ways considering fixed and variable costs. Profitability of agriculture differs from other sectors with respect to time evaluation. It is well known that people involved in agriculture have to maintain their activities irrespective of their short-term profits or losses due to conditions specific to the sector.

Profitability in all terms is the ability to cover costs of productive activities and it is induced by many factors. Short term effects on agricultural profitability are more visible than other sectors as producer response to variations in consumer preferences is faster, especially for annual crops. Besides, the proximity of market structure to perfect competition is closer than other sectors especially when government intervention is minimised [1, 2, 3].

In accordance, it was intended within this study to measure factors affecting profitability of greenhouse operators in Antalya province of Turkey, where greenhouse vegetable production is a main and prominent agricultural activity [4]. Prior to proceeding, it is important to provide brief information on greenhouse production in Turkey and Antalya. The Mediterranean province of Antalya has abundant natural resources and ecological advantages to maintain four-season agricultural production. Antalya had a 1,55 % share in total agricultural lands occupied in Turkey by 2018, while its share in greenhouse production was 36,69 %. Besides, 3,57 million tonnes of vegetables were produced in plastic and glasshouses with a value of 9.5 billion TRY. This figure corresponded to 6.8% of Turkey's overall agricultural production and 64 % of national greenhouse production in 2018 [5]. When compared with 2010 data, it was understood that the share had reduced from 68 %. However, 2,82 million tonnes was the sum of the amount produced in Antalya then, signing to a 75 % rise from 2010 to 2018. These figures emphasize the dominance of the province in greenhouse production in Turkey [5, 6].

A field survey was conducted in the Centre, Kumluca and Serik towns of Antalya in 2015 in order to determine profit level of greenhouse operators. As a result of this survey, gross profit levels of 281 greenhouse operators were calculated. Gross profit for the study referred to the difference between the overall revenue retrieved for a particular farm activity and its variable costs involving seed, labour including family labour, irrigation and energy use. In opposition to fixed costs, depreciation of physical capital was included in variable costs for short term gross profit calculation [7].

After profit levels were calculated, it was intended to measure determinants of probability of an enterprise to receive above average gross profits. The factors affecting probability were considered as socio-demographic features of the farm operator and structural characteristics of the greenhouse farm. In

addition to these, the impact of taxation, which is important for government revenue generation, was considered as another effective factor [8].

Accordingly, the probability of a greenhouse operator to end up with an above average profit level was analysed with binary logistic regression. The average profit level of the focused sample was considered as a benchmark for the study. The main objective was to measure effectiveness of personal features of the operator and structural and economic characteristics of the greenhouse farm on probability to receive considerable level of profits.

MATERIALS AND METHODS

Material. The research was based on a field survey conducted in three towns (Centre, Serik and Kumluca) of Antalya that are popular for four-season plastic/glasshouse vegetable production. The sample for the survey was determined with random sampling [9]. Even though stratified sampling is preferred more in survey and scale based studies, random sample was selected for the study as all analytical processes were based on per 0,1 hectares or 0,247 acres. So, enterprise level variation was considered irrespective of the scale. Therefore, 281 operators were surveyed with 95 % confidence interval and the sample was distributed among the selected towns respecting number of greenhouse operators in these towns. Accordingly, 43 producers from the Centre, 183 producers from Kumluca and 55 producers from Serik towns of Antalya were surveyed randomly.

Methodology. The objective of the study was to measure indicators of probability to make profits for the concerned farms. The estimated probability is considered to range between 0 and 1. However, the detected probability was referred as 'making profits above average' or 'making profits below average' for the sample. Within this study, multivariate binomial logistic regression was used, which was developed to estimate dependent variables that do not have normal distribution characteristics [10]. Conversion of dependent variable referring to a choice or existence or inexistence of a situation takes place in binary choice models. The model was developed to overcome non-normality of error terms invalidating the OLS estimation assumptions [11, 12]. Therefore, the situational variable was estimated against quantitative and qualitative features involving information about greenhouse farmer, greenhouse structure and economic characteristics of the enterprise.

Within this study, the dependent variable was a dichotomous variable having values of '1 for the greenhouse farm having profit above the average profit level of the sample' and '0 for the greenhouse farm having profit below the average profit level of the sample'. Yet, the average profit level calculated for 0,1 hectares was 7.190,73 TL ($2.639,77) ($/TL exchange rate from the Central Bank of Turkey for 2015 was 1 $ = 2,7240 T.L. This rate was used hereafter.) for the sample. Therefore, the onset of the estimated equation is as following:

$$log[Pr(Y = 1 \mid x)] = ln\left[\frac{Pr(Y = 1 \mid x)}{1 - Pr(Y = 1 \mid x)}\right] = \sum \beta_i x_i + \sum \propto_i D_i + u_i$$

Here, in addition to the dependent variable (Y_i) explained above, X_i refers to the quantitative independent variables and D_i refers to the categorical variables involving information about the i^{th} greenhouse and greenhouse farmer. The proposed independent variables are as following:

TABLE 1
Description of independent variables

Abbreviation	Independent Variable	Feature
IT_{1i}	Income tax accrued to the greenhouse farm	Continuous – Quantitative – TL
PT_{2i}	Property tax accrued to the greenhouse farm	Continuous – Quantitative – TL
E_{3i}	Education level of the greenhouse farmer	Binary – (1: Secondary and above; 0: Below secondary)
A_{4i}	Age of the greenhouse farmer	Continuous – Quantitative
OS_{5i}	Ownership situation of greenhouse farm	Binary – (1: Owner; 0: Renter - subcontractor)
GG_{6i}	Structure of the greenhouse	Binary – (1: Glasshouse; 0: Greenhouse)
ID_{7i}	Classified income tax accrued to the greenhouse farm	Binary – (1 – paid tax above average of the sample; 0 – paid tax below average of the sample)
PD_{8i}	Classified property tax accrued to the greenhouse farm	Binary – (1 – paid tax above average of the sample; 0 – paid tax below average of the sample)
K_{9i}	Greenhouse takes place in Kumluca town	Binary – (1: In Kumluca; 0: In Serik or the Centre)
S_{10i}	Greenhouse takes place in Serik town	Binary – (1: In Serik; 0: In Kumluca or the Centre)
$T1_{11i}$	Declaration form of income tax – 1	Binary – (1: Enterprise; 0: Stoppage or Balance Sheet based)
$T2_{12i}$	Declaration form of income tax – 2	Binary – (1: Stoppage; 0: Enterprise or Balance Sheet based)

With continuous variables referring to income and property taxes born, binary variables respecting the average taxes paid were also included in independent variable list. It is important to note average tax levels born by these 281 greenhouse farmers. 1.067,65 TL ($391,94) was the average income tax, while average property tax was 214,68 TL ($77,71). Accordingly, dummy variables were classified due to the concerned averages.

Here, it is also essential to differentiate between the tax declaration forms of the agricultural enterprises classified under binary independent variables T1 and T2. Income taxes accrue on enterprises or producers are classified as real income tax or stoppage based income tax. Real income tax payers are also classified due to financial books they keep. While some of the producers keep their records due to agricultural enterprise accounts, some others pay taxes due to balance sheet records [13]. Taxpayers keeping agricultural enterprise books are responsible to declare their annual net income and 76 % of surveyed farms were taxed with respect to enterprise book declaration. Yet, stoppage based payers are responsible from their declarations and they are not responsible of book keeping due to their scale. 22 % of surveyed farms were taxed based on stoppages. Accordingly, large-scale farms were very limited in number that only 2 % of farms or 6 farms were taxed based on balance sheets.

In addition, checking the list of 12 independent variables, a suspect of correlation between variables can easily appear. Yet, it is also important to mention that this is a general list and exact variables inferred were determined within the analysis due to their relationships and detected correlations.

RESULTS

Profitability and Costs of Greenhouse Farms. Covered farming, covered with glass or plastic fiberglass, maintained in Antalya and relevant Mediterranean provinces, is vital both for domestic consumption and agricultural exports in Turkey. Greenhouses can control or regulate the environmental conditions for efficient plant growing [14]. 82 % of total greenhouse lands of Turkey takes place in three provinces of the Mediterranean region and Antalya ranked the first with 40 % by 2006 [15]. By 2017, the amount of land utilised for greenhouse production was 64 million hectares, of which 39 % was in Antalya [16]. Besides, Antalya is prominent in plastic/glasshouse vegetable production and the most significant products, which are important for agricultural exports as well, are different varieties of tomato and fresh pepper.

Greenhouse farming takes place in all districts of Antalya [17]. Yet, three towns were selected for the survey. The central town and the most significant producer towns of Kumluca from the west and Serik from the east of Antalya were selected. There was a multi-crop production scheme. However, 150 farms seemed to focus on tomato and 113 farms on fresh pepper production. Most of the farms (244) were composed of plastic houses with 76 %, as expected.

It is well known that greenhouse production in Antalya is maintained with a small scale capacity. Average production land was 0,45 hectares for the sample. Most of the farms constituted of pieced houses and the average number of pieces was two. Greenhouse production seemed to have its roots that average age of the plastic/glasshouses was 13,5 and most of the producers had more than 10 years of experience. Property ownership was high that 227 farmers were land owner corresponding to 85 % of the sample. Yet, for remaining renters and subcontractors, monthly rent of the whole enterprise was as $1.750. The average value calculated for owned lands was $36.197,50. These figures were used to compute the variable costs and gross income of the operators.

Considering the production and income figures, it was noted that average amount produced per year was 35 tonnes of various vegetables. The average gross income was $19.997,41, and variable cost was $9.812,78 respectively. Therefore, gross profit per farm had appeared as $10.184,63 on average. The highest farm level gross profit was recorded in Central town with $11.387,66, while the lowest was in Kumluca with $7.911,53 on.

Considering the gross profit levels, it can be noted that 113 of greenhouse farms seemed to produce a profit level above the average. The average gross profit per 0,1 hectares was $2.639,77. Accordingly, while 82 greenhouse farms were making loss, 86 farms ended with a below average profit. A significant inference is that 124 farms making either loss or below average profits were those situated in Kumluca. This can be considered as a result of traditional small scale plastic house farming and it was noted previously that glasshouse production is more profitable in terms of gross profits [18]. Besides, 31 of the farms taxed by stoppage declaration were not profitable.

When the amount of taxes born were considered, it was understood that 101 farms paid less than average income tax, while 262 farms paid below average property tax. The income tax figure referred to small scale subsistence farming once more and low property tax was related with ownership of enterprise and lands. In addition, farmers had a considerable greenhouse production experience with an average of 11 years, contributing to maintenance of the activities. To emphasize once more, significant number of farms had ended up with loss (82 farms) referring to almost 30 % of the farms. Therefore, undermining the reasons behind profitability of the greenhouse farms had been considered as important.

Characteristics of Greenhouse Farmers. Prior to estimating the relationship, farmer characteristics should be considered as they compose dummy variables explaining profitability variation of the farms. Average age of the farmers by the survey time was 42,68. This meant that greenhouse farming is mostly a business for middle aged farmers. Education level of farmers was relatively lower that 63 % of farmers had primary degrees with 8 years. There were only 14 farms operated by Bachelor's graduates. This was considered as an indicator of traditional farming practices and this quote was strengthened with the observed 'family farm' structure.

Family farms seemed to be managed by male owners, who were directly or indirectly supported by their spouses and family members. Farmers were working within the enterprise with an average of 260 days per year for productive activities. With inclusion of administrative duties, the average number of days that the producers worked in their farms with non-payment had appeared as 262. Besides, 36 producers were also holding out-of-farm jobs and they got paid 3.000 TL ($1.101,32) on average for 139 days. Spouses of the operators were working without payment in 268 out of 281 farms. Only 6 of these women were employed out of the farm as well, in

Mainly, for greenhouse farms situated in Kumluca, there appeared considerable correlation with other indicators. Income and property tax levels were correlated with their categorical reproduces as expected. In addition, tax declaration forms were correlated as well. Therefore, these variables should not be included in the regression simultaneously. Yet, the farm being glasshouse appeared as a variable that might lead multi-collinearity as it was correlated with all forms of tax declaration and property services sector with subsistence wage of the time 1.900 TL ($697,50). In addition, as well as the spouses, remaining family members were working in the greenhouse farms without payment. Therefore, the non-paid labour cost was calculated and included in variable costs of the enterprise as an alternative cost.

Factors Affecting Profitability. Afore mentioned standard equation involved all possible explanatory variables. Yet, the exact variables were determined following relationship analyses and structural tests. A priori, a significant relationship is expected between dependent and independent variables, while inexistence of the relationship is preferred between independent variables.

The correlation between dependent and independent variables were considerably low. Significance correlations with probability to receive above average profits were reached for three variables. These were the farm having situated in Kumluca town, the education level of the farmer and tax declaration forms. As most of the independent variables were dummy variables that do not have normal distribution, this is an expected situation [19]. Yet, the correlation between independent variables was checked as well and presented in Table 3.
and income tax variables. Age and level of education were in negative correlation. All signs were as expected due to the nature of the relationship. Therefore, the explanatories were selected watching these relationships.

The preliminary results for Logit estimation of profitability were indicated in Table 4.

TABLE 2
Correlation of independent variables with the dependent variable

IT_{1i}	:	-0,038 (0,53)	OS_{5i}	:	0,05 (0,40)	K_{9i}	:	-0,22 (0,00)***
PT_{2i}	:	0,04 (0,51)	GG_{6i}	:	0,03 (0,61)	S_{10i}	:	-0,08 (0,21)
E_{3i}	:	-0,109 (0,07)*	ID_{7i}	:	-0,04 (0,51)	$T1_{11i}$	:	-0,14 (0,02)**
A_{4i}	:	0,068 (0,26)	PD_{8i}	:	-0,02 (0,75)	$T2_{12i}$	:	-0,11 (0,06)*

* 90 %; ** 95 %; *** 99 % significance

TABLE 3
Correlation between Independent Variables

PT_{2i} & PD_{8i}	PD_{8i} & $T1_{11i}$	$T1_{11i}$ & $T2_{12i}$	$T2_{12i}$ & GG_{6i}	ID_{7i} & OS_{5i}
0,41 (0,00)***	-0,12 (0,05) **	-0,94 (0,00) ***	0,27 (0,00) ***	-0,11 (0,08)*
T_{2i} & K_{9i}	PD_{8i} & $T2_{12i}$	$T1_{11i}$ & GG_{6i}	$T2_{12i}$ & K_{9i}	ID_{7i} & A_{4i}
-0,14 (0,02) **	0,13 (0,03) **	-0,27 (0,00) ***	-0,38 (0,00) ***	-0,12 (0,06)*
PD_{8i} & K_{9i}	PD_{8i} & GG_{6i}	IT_{1i} & K_{9i}	GG_{6i} & K_{9i}	GG_{6i} & S_{10i}
-0,19 (0,00) ***	0,13 (0,04) **	0,43 (0,00) ***	-0,34 (0,00) ***	0,21 (0,00) ***
PD_{8i} & S_{10i}	PD_{8i} & IT_{1i}	K_{9i} & S_{10i}	E_{3i} & A_{4i}	
0,15 (0,01) **	0,18 (0,01) **	-0,67 (0,00) ***	-0,35 (0,00) ***	
IT_{1i} & ID_{7i}	IT_{1i} & OS_{5i}	E_{3i} & ID_{7i}		
0,53 (0,00) ***	-0,13 (0,03) **	0,18 (0,01) **		

* 90 %; ** 95 %; *** 99 % significance

TABLE 4
Logit estimation findings – 1

Variable	Coefficient	Z-Statistic	Probability
IT_{1i}	$-4{,}56e^{-05}$	-0,365	0,720
ID_{7i}	0,08	0,219	0,83
K_{9i}	-2,88	-5,079	0,00***
S_{10i}	-2,78	-4,726	0,00***
$T1_{11i}$	-0,68	-0,659	0,51
$T2_{12i}$	-1,19	-1,098	0,27
E_{3i}	-0,51	-1,494	0,14
GG_{6i}	-0,26	-0,746	0,46
PT_{2i}	$-1{,}40e^{-06}$	-0,012	0,99
PD_{8i}	-0,487	-0,732	0,46
A_{4i}	0,01	0,612	0,54
OS_{5i}	0,42	1,152	0,25
Constant	2,38	1,838	0,07**
McFadden R^2	0,13	**M.D.V.**	0,402
LR statistic	50,38 (0,00)***		

* 90 %; ** 95 %; *** 99 % significance

Due to the findings, other than the situation indicators and the constant estimate, the factors were insignificant. The effective factors were the greenhouses stance in either Kumluca or Serik towns. Yet, the constant appeared above the mean dependent variable and signed to negative impact of all factors. Due to McFadden pseudo R^2 statistic, which is a valid reproduction of R^2 for binary data [20], variation in the probability to make profits was explained by 13 %. The insufficient explanatory findings leaded us to reconsider the relationships among independent variables and the model was reformed accordingly.

TABLE 5
Logit estimation findings – 2

Variable	Coefficient	Z-Statistic	Probability
IT_{1i}	-0,06	-0,618	0,536
S_{10i}	-0,48	-1,471	0,14
$T1_{11i}$	-0,72	-2,488	0,01***
E_{3i}	-0,58	-2,039	0,04**
OS_{5i}	0,35	1,088	0,27
Constant	0,17	0,429	0,66
McFadden R^2.	0,14	**M.D.V.**	0,402
LR statistic	12,89 (0,02)**		
Hosmer-Lemeshow	33,65 (0,14)		
Andrews	41,77 (0,051)		

* 90 %; ** 95 %; *** 99 % significance

As a result of this estimation, individual parameter estimates did not appear fully significant and the count R^2 had appeared low as well. Yet, with reference to the binary nature of data other goodness of fit measures were checked. However, signs of the estimates fitted to the expectations and joint significance was confirmed with 12,89 at 95 % of confidence interval with Likelihood Ratio statistic. Besides, other relevant goodness of fit measures confirmed this interpretation. The probability value of Hosmer-Lemeshow test, which was above 5 %, indicated that the model had a good fit [21, 22, 23]. Andrews [24, 25] test findings were in the same line, although having a lower significance. In addition, independent variables explained 58 % of the variation, taking the constant as 0,17.

When interpretation of the parameter estimates were considered, it is first essential to compute estimated probabilities via antilog transformation as the primary results indicated log of odds, representing the logarithmic form of the probability [26].

TABLE 6
Expected Probabilities of Logit Estimates

Variable	Expected Probabilities
IT_{1i}	-0,01
S_{10i}	-0,14
$T1_{11i}$	-0,41
E_{3i}	-0,23
OS_{5i}	0,06
Constant	0,01

Accordingly, it can be briefly noted that the probability for a greenhouse farm to make profits was 1 %, when no specific factor was considered. The profit making probability rises by 6 % for farm owners. However, amount of income taxes born negatively affected the profitability. With a 1 TL ($0,37) rise in income taxes born, probability to make profits declined by 1 %.

The negative relationship between rising education level and profitability was significant. If the farmer had a secondary degree at minimum, the probability of ending with more than average profit declined by 23 %. Considering the negative correlation between age and education level of the farmer

and traditional characteristics of greenhouse farming in the region, this is an expected result. Yet, it should be kept in mind that having less profits than average does not mean making loss for all the cases.

The negative impact of tax declaration status of the farm was in conformity with the expectations. For farms, which have enterprise status and taxed based on real income, the probability of making profits declined by 41 %. This is a significant effect of taxation status on the probability. Farm having situated in Serik town of Antalya leaded to 14 % declination. This is also related with the fact that western Antalya is more prominent in greenhouse production.

The most significant probability rising factor for the selected sample was related with the ownership situation of the greenhouse. If the farmer is the owner of the facility, probability of the farm to make above average profits rose by 6 %. A question may arouse related with the property tax load of the farms. Yet, depreciation of the equipment seemed to cover property taxes and owners, in opposition to renters or subcontractors, achieved to manage their costs.

Following this computation, the probability for the i^{th} greenhouse farm of making above average profits was forecasted. Accordingly, it was detected that probability mean was 0,4. Most of the farms have a probability to receive a below average profit. 237 farms might reach 50 % of the average profit level referring to 84 % of the farms. Share of the farms having probability to receive more than average profits was 15 %, while only 3 farms assured complete profitability. Therefore, this is another indicator of traditional maintenance of the greenhouse production in the region.

RESULTS AND DISCUSSION

Greenhouse production opportunities are abundant especially in Mediterranean countries, assuring four season fresh fruits and vegetables supplies. However, after establishment of the farm, it becomes inevitable for the farmer to maintain his/her production activities irrespective of profitability of their activities in the short term. This is mostly related with high investment costs born. And also it is hard to convert greenhouse farms to open fields in the short-term. However, this does not mean continuity of activities with zero or below zero profits all the time. Accordingly, it is essential to evaluate sustainability of the sector with respect to profitability.

The intention was to determine factors affecting profit making situation among green/glasshouse farming in Antalya, Turkey based on survey data. Out of the whole sample of 281, 113 of greenhouse farms seemed to produce a profit level above the average. The average gross profit per farms was \$10.184,63, referring to \$2.639,77 gross profit per 0,1 hectares. Yet, the variation of profits depending on the situation of the farm in three different towns of Antalya, ownership situation or the taxation forms was high among the sample farms. Therefore, these situational factors and farmer characteristics were considered as factors affecting the profitability. Accordingly, the probability of an operator to receive above average profits for its activities was estimated. The gross profits calculated for 0,1 hectares was \$2.639,77. Therefore, the reasons affecting the potential to exceed this calculated average were considered as essential to project future profitability.

Due to the logistic regression estimates, it was understood that farm ownership is the most effective factor in above average profit making potential of the farm. This refers to minimisation of variable costs like rent. If farms are owned, neither rental cost nor the subcontractor commission accrues and the gross profit level of the farm, calculated with deduction of variable costs from the farm income, rises. Or else, this finding can be interpreted with regards to the high level of farmland rents in the region leading to higher variable costs.

Yet, following confirmation of the economic expectations with regards to the profitability of western Antalya, profit-reducing tax levels and taxation form of the farm had appeared as important factors. It was understood that probability to make above average profits declined for real taxpayers. It is well-known that real taxpayers both bear high taxes and they have full responsibility in terms of Turkish tax law. These book-keepers are responsible to declare their all activities and they need to cope with taxes as well as varying operational costs despite their small scale. However, considering the intensity of green/glasshouse production in the region and long-term experiences of operators in farming, this taxation effect suggests development of corporate structures. Or else, professionalization of greenhouse production is expected to produce more profits for the concerned farms.

In addition, one factor should be kept in mind. As mentioned above, western Antalya is a profitable greenhouse centre. However, we know that overuse of lands would lead loss of productivity and profitability in time. So, this confirmation on the stance of the farm should be considered as a short term finding. The dispersion of greenhouse lands with proper use of new technologies and infrastructure investments should be promoted as Mediterranean climate is widespread in Turkey, providing opportunities to new farmers.

ACKNOWLEDGEMENT

The paper is based on the data retrieved within the project entitled ‘Tagem-14/Arge/63 Taxation in Agricultural Markets and Effects of Taxation on

Price Formation: Example From Antalya Greenhouse Production' funded by General Directorate of Agricultural Research and Policies of Ministry of Agriculture and Forestry of Republic of Turkey – TAGEM.

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Received: **19.09.2019**
Accepted: **07.03.2020**

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