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ORIGINAL PAPER

PROFITABILITY OF SUGAR BEET CROP IN CAMPAIGN 2019/2020

Zbigniew Krzysiak
Faculty of Production Engineering
University of Life Sciences in Lublin
ORCID: https://orcid.org/0000-0002-4950-7481
e-mail: zbigniew.krzysiak@wp.pl

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K e y w o r d s: sugar beet, sugar beets crop, cost and profitability of sugar beet production.

A b s t r a c t

The work presents a complex analysis and cost accounting of beet sugar cultivation in the 2019/2020 campaign for individual farms of the Lublin region. About 119 farms were analyzed. On the basis of this analysis, the criteria for the model farm were defined, which were adapted for the calculation of sugar beet production costs.

The economic results obtained by the producers are mainly affected by indirect costs accounting for 60.48% of the revenue from the total production. Within this group of costs, the major components are sowing service, harvest and soil liming operations reaching 39.26%.

Sugar beet production in the analyzed campaign was profitable, with the profitability index 1.21 and unit production cost of 15.07 PLN/dt. Sugar beet growing is considered to be one out of profit-making activities, in agricultural production, yet it is characterized by the high production cost that gobbled up 82.48% of total revenue in the analyzed campaign of 2019/20.

DOCHODOWOŚĆ PRODUKCJI BURAKÓW CUKROWYCH W KAMPANII 2019/2020

Zbigniew Krzysiak
Wydział Inżynierii Produkcji
Uniwersytet Przyrodniczy w Lublinie

Kody JEL: Q5, R4.

S ł o w a k l u c z o w e: burak cukrowy, uprawa buraków cukrowych, koszty, opłacalność, dochodowość produkcji.

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A b s t r a k t

W pracy przedstawiono kompleksową analizę i kalkulację kosztów uprawy buraków cukrowych w kampanii 2019/2020 dla gospodarstw indywidualnych regionu lubelskiego. Przeanalizowano 119 gospodarstw. Na podstawie tej analizy określono kryteria dla gospodarstwa modelowego, które przyjęto do kalkulacji kosztów produkcji buraków cukrowych. Większość danych zawartych w pracy to własne obserwacje autora lub uzyskane bezpośrednio od plantatorów.

Na wynik finansowy uzyskiwany przez plantatorów w głównym stopniu mają wpływ koszty pośrednie pochłaniające 60,74% przychodu z produkcji. Wśród tej grupy kosztów największy udział mają koszty usług zasiewu, zbioru buraków cukrowych i wapnowania gleby wynoszące 18,80%. Koszty bezpośrednie natomiast w tej kampanii stanowiły 39,26% osiągniętego przychodu.

W rozważanej kampanii produkcja buraków cukrowych była opłacalna, ponieważ wartość wskaźnika opłacalności produkcji wyniosła 1,21, a wartość kosztu jednostkowej produkcji wyniosła 15,07 zł/dt. Uprawa buraków cukrowych jest jedną z dochodowych działalności w produkcji rolnej, ale charakteryzuje się wysokimi kosztami produkcji wynoszącymi 82,48% całkowitych przychodów z produkcji w analizowanej kampanii 2019/2020.

Introduction

The development of the sugar industry based on sugar beet sugar crop requires sustainable cultivation for the needs of sugar producers (Burell *et al*., 2014; Bogetoft *et al*., 2007). Ensuring that their values are essential for the produced white sugar on the world market. In Europe, sugar beet is the main raw material for sugar production. In the world, sugar beets are also used for energy purposes.

The EU sugar sector is currently one of the most deregulated in the world and stands out as an international competitive sugar production for sugar factories and sugar yields per hectare of configuration to the highest in the world (Gawryszczak, 2020a). The sugar industry in the EU was able to achieve such a significant increase in productivity only thanks to advanced innovations and significant investments. For example, over the past 28 years, the sugar industry's performance (measured by sugar production per factory) has grown by 4.7% annually, which is noteworthy growth rate compared to other agricultural industries. The beet sugar sector comes first in terms of sustainable environmental protection. Diabetes covered by a higher level for sugar beet than for other crops, including sugar cane, to obtain very efficient in terms of arable land area (Chudoba, 2004). The situation is different, for example, for the cultivation of wheat, which is economically competitive with sugar beet.

The world cropping area for wheat exceeds that of any other crop, and high grain yields in intensive wheat cropping systems are essential for global food security (Voss-Fels *et al*., 2019, p. 706). In addition, sugar beet cultivation, thanks to the large amount of ingredients, contributes to the significant assimilation of carbon dioxide, which is responsible for reducing air and the effect of global warming. Important efficiency is also the effect of carbon binding in the soil by leaving beet leaves in the soil with the currently used root harvesting technology (Chudoba, 2004; Gawryszczak, 2020a, p. 3).

Such technology contributes to the protection of soil and climate. For this purpose, restrictions in the use of plant protection products were also implemented and the Integrated Pest Management (IPM) system was introduced.

Since January 1, 2014, Poland and other European Union countries have been obligated to apply the principles of IPM. Integrated pest management (IPM), a worldwide agricultural strategy, contains methods to control or manage agricultural pests and diseases in a more efficient way, and consequently, to obtain better quality raw materials for food production. The engagement and practice of farmer (Sawińska *et al*., 2020; Świątek *et al*., 2022, p. 283).

The sugar campaign 2019/2020 in Poland began on August 30, 2019 at the Gostyń sugar factory, owned by Pfeifer & Langen Polska S.A. The end took place on January 14, 2020, and was carried out by the sugar factory in Cerekiew, belonging to Südzucker Polska S.A. In this campaign in Poland, all four producers worked 17 sugar factories, and the average duration of the campaign almost 109 days, which is the result less than last year by 8 days and less than 19 years ago. In the 2019/2020 campaign it amounted to 2,065,250.71 tons (Chudoba, 2004). On average, yields in this campaign amounted to 58.52 tons per hectare. This result is smaller com-pared to recent years, when the yields reached the result of up to 68 tons per hectare. Sugar producers have signed contracts for the cultivation and supply of sugar beet with 30,643 growers, from whom they purchased 13,834,291.23 tons of beet. Despite the smaller purchase of sugar beet, in 2019 the cultivation area was slightly higher than a year ago and amounted to 240,793.88 ha. Particularly noteworthy is the growing average plantation area from year to year, which this year amounted to 8.44 ha, in the previous year it was 7.75 ha in the campaign (Gawryszczak, 2020b, p. 14).

In Krajowa Spółka Cukrowa S.A. (KSC) the sugar campaign 2019/2020 began on September 10, 2019 at Sugar Factory Werbkowice. The campaign lasted the longest at the Kluczewo Sugar Factory (110 profitability of sugar beet crop in campaign of 2019/2020 including transport costs days). The average campaign time was 99 days. Seven KSC S.A Branches participated in the next 18 campaigns: Sugar Factory Dobrzelin, Sugar Factory Kluczewo, Sugar Factory Krasnystaw, Sugar Factory Kruszwica, Sugar Factory Malbork, Sugar Factory Nakło and Sugar Factory Werbkowice. The average sugar beet yield at KSC was 57 t/ha, the highest average yield was obtained at Malbork Sugar Plant – 74 t/ha. The average polarization (sugar content of beets) was 16.7% (Gawryszczak, 2020b, p. 14).

During this campaign, KSC S.A. purchased almost 5.8 million tons of sugar beet and produced over 860 thousand tons of sugar. In 2019, sugar beets, contracted by KSC S.A. were cultivated on the area of over 100 thousand ha, by 15,000 growers (Gawryszczak, 2020b, p. 12). In October 2019 KSC S.A. has opened a sugar terminal in the Sea Port of Gdansk. Thanks to this investment, KSC increases the possibilities of gaining new sales markets. Due to the decrease in sugar consumption in the European Union, markets outside the Community

are of great importance. During the campaign in 2019, 60,000 were sent from the Terminal tons of sugar, among others to the Middle East and Africa. KSC S.A. plans to ship sugar via a terminal of 300,000 tons per year (Gawryszczak, 2020b, p. 13).

In 2019, the general weather conditions were unfavourable, and in spring there were pests in the form of gray shark, which were most common in beet cultivation in the east of the country. Although the beginning of the season promised to be good, because early spring enabled the field work to start quickly. In the first half of March there was warming, which allowed to start sowing. The sowing period was characterized by very low rainfall. In many cases, it was only the May rains that allowed seeds to germinate. In some parts of the country there was heavy rainfall causing periodic flooding and flooding. At the end of June, the first water shortages in soil occurred, which intensified depending on and region in July and August, significantly reducing crop yields. Higher rainfall occurred in August, but it was stormy and at high temperatures soil water reserves did not increase (Gawryszczak, 2020b, p. 14). During the buying campaign, the weather conditions favoured the harvest of dry beet roots and the warm autumn favoured the acquisition, cleaning, loading and transport of sugar beets were not hindered.

In the modern world, calculating the benefits of cultivating various plants, including sugar beet, is done by many researchers (Augustyńska-Grzymek, 2017; Jansen & Stibbe, 2007; Jarmołowicz & Kuźmar, 2017; Maung & Gustafson, 2011). Researchers, apart from the classic methods of agricultural economics, are also trying to apply new methods based on the case theory with the use of computer analysis (Xiao *et al.*, 2021).

The cost calculation of sugar beet production presented is complex with a special concern to grower`s labour input and farm overhead expense. It often happens that similar calculations exclude other costs of factors of production, e.g. the interest on capital, while the present cost calculation includes that. The calculation was made for the 2019/2020 sugar campaign, the first after the sugar quota elimination. This calculation, just like other presented by the author, provides a detailed analysis of sugar beet production costs and its profitability for individual farms in the Lublin region (Gawryszczak, 2020b, p. 14; Krzysiak, 2006, p. 363; 2010, p. 128; 2020, p. 49). Currently, about 3,485 growers deliver sugar beets to the KSC S.A. branch – Krasnystaw Sugar Factory.

As can be seen from the above description, the main purpose of the work is to show the value of income and costs incurred during sugar beet cultivation. However, the presented research and analyses are aimed at understanding the changing production conditions or profitability of sugar beet cultivation by growers. Moreover, the partial goal of the presented work was to show the producers' reactions to market changes on the way to the implementation of sustainable sugar beet cultivation without incurring unnecessary expenditure.

Methodological assumptions for calculating sugar beet cultivation costs

The analysis of cost estimates was based on chosen individual sugar beet farms owning special machinery and reporting contracting out services occasionally. Around 119 farms were examined and finally, a model farm was chosen for further analysis as the one reflecting above mentioned criterias. Most data found in the paper are the present author`s observations or obtained directly from sugar beet contract holders or from Krasnystaw Sugar Factory, a branch of KSC S.A. The premise was to assume real costs instead of estimated costs wherever possible.

Each category of costs and revenue calculation was defined according to a scheme below (Burell *et al*., 2014):

– production value,
– direct costs,
– direct surplus,
– indirect costs,
– income,
– total costs,
– production costs 1 dt.

Owner/operator labour costs

The cost of owner/operator labour was estimated according to a wage parity rate per hour. A parity rate was calculated on the basis of average annual net earnings in the national economy (after GUS (Central Statistical Office)) assuming that nominal working time of a full-time employee in individual farming is 2,200 hours annually, the rate assumed for the year 2019 – 18.58 PLN (Augustyńska-Grzymek, 2017; Lorencowicz & Cupiał, 2013).

Tractor and farm machinery labour costs

The tractor labour cost was estimated on the basis of calculation of exploitation costs of farm machinery according to the literature (Litwinow, 2020; Lizbetin & Stopkova, 2021) and the data supplied by the Agricultural Advisory Centre in Końskowola. It is a complex calculation including the costs of depreciation, fuel, oil and lubricants, repairs, housing, insurance, technical inspection and interest payments. The 48.5 kW tractor operation time was assumed to be 400 h per year (300 mth/year) and thus the cost of hourly work rate of tractor is 94.29 PLN.

The costs of particular agricultural practices include total cost of tractor operation with implements. A number of hours spent performing particular farm operations was determined based on the literature data available (Augustyńska-Grzymek, 2017; Jarmołowicz & Kuźmar, 2017; Litwinow, 2020; Lorencowicz & Cupiał, 2013), and the present author`s experience.

It was assumed that a model farm owns the used farm machinery (in 50%) – plough, disc and spike-tooth harrow, sprayer, agricultural trailer and new equipment – farm tractor, soil tillage unit and fertilizer spreader.

The other assumptions

Characteristics of data for calculating costs of sugar beet cultivation:

– sugar beet farming area – 2-10 ha,

– medium intensive cultivation on soils of good wheat complex and very good rye complex, pH – 6-6.5,

– sugar beet tops left in the field serve as fertilizers,

– the farm owns most of farm machinery for agricultural production,

– sugar beet selling price for sugar producer – 114.49 PLN/tonne (for 16% standard polarization),

– price of wet beet pulp (1,900 PLN/dt) was that applicable in the Krasnystaw Sugar Factory in 2019/2020 campaign,

– price of plant protection products and fertilizers applicable in the 2019/2020 campaign,

– sugar beet cultivation in the farm without manure use,

– the farm contracts services – liming, sugar beet sowing and harvest.

The calculation also estimates the quantity and value of by-products obtained in sugar beet growing (pulp) as well as some other factors involved in the production process. These are partial costs like, using a car, mobile, consumption of electricity and water (included into overhead costs). The calculation accepted that raw material will be transported from the plantation by the sugar producer (from field to factory).

Cost calculation

The analysis of sugar beet production considering all the assumptions aforementioned is presented in Table 1.

Table 1

Calculation costs of 1 ha sugar beet production in 2019/2020 season

Content	U. m.	Unit price	Quantity	Value PLN	Share in percent [%]
1	2	3	4	5	6
Production – sugar beet roots	dt	11.45	500	5,725.00	–
Refund of lump sum tax VAT	%	7.00	5,725.00	400.75	–
By-product – beet pulp	dt	2.05	250.00	512.50	–
Area direct payment	ha	973.16	1.00	973.16	–
Sugar payment per 1 ha form 2015	ha	1,524.16	1.00	1,524.16	–
Total revenue from production				9,135.57	–
DIRECT COSTS					
Seeds					
Cultivar – Jampol Rh, Cr (KHBc)	Jdn.	577.80	1.25	722.25	9.58
Plant protection products					
Herbicides					
Pyramin Turbo 520 S.C.	I	82.00	5.00	410.00	5.44
Betanal maxxPro 209 OD	I	141.00	2.50	352.50	4.68
Targa Super 0.5 EC	I	95.00	1.50	142.50	1.89
Fungicidal products					
Optan 183 SE	I	210.00	0.70	147.00	1.95
Duet Ultra 497 S.C.	I	107.00	1.00	107.00	1.42
Total plant protection products expenses				1,052.00	13.96
Fertilizer needs					
N-ammonium nitrate	dt	121.00	3.53	427.13	5.67
P – 46% granular triple superphosphate	dt	156.00	1.96	305.76	4.06
K – 60% potassium salt	dt	153.00	2.83	432.99	5.75
Cao – dolomitic lime (every 4th year)	dt	1.84	40.00	18.36	0.24
Total fertilizer expenses				1,184.24	15.72
Total direct costs				2,958.49	39.26
Direct surplus				6,177.08	–
INDIRECT COSTS					
Complex service cost (transportation from field)	dt	0.30	500.00	150.00	1.99
Production levy	dt	0.00	500.00	0.00	0.00
Services					
Seed sowing		329.00	1.50	493.50	6.55
Beet root harvest (Holmer harvester)		850.00	1.00	850.00	11.28
Liming operation (every 4th year)		293.24	1.00	73.31	0.97
Total services costs				1,416.81	18.80

cont. Table 1

1	2	3	4	5	6
Cultivation and protection					
Disking operation	hour	104.20	2.00	208.40	2.77
Harrowing (2 × 0.7 h)	hour	98.87	1.40	138.42	1.84
Deep plowing	hour	152.29	2.50	380.73	5.05
PK fertilizers application (2 × 0.7 h)	hour	107.39	1.40	150.35	2.00
Pre-sowing tillage (soil tillage unit 2 × 0.7 h)	hour	119.09	1.40	166.73	2.21
N top dressing (2 × 0.7 h)	hour	107.39	1.40	150.35	2.00
Sprays (5 × 0.5 h)	hour	112.02	2.50	280.05	3.72
Collection of beetroots from harvester	hour	113.51	2.00	227.02	3.01
Total cultivation and protection costs				1,702.03	22.59
Farm overhead expenses					
Property tax				135.00	1.79
Liability insurance				15.00	0.20
Building structure depreciation				102.53	1.36
Other overheads				163.56	2.17
Total overhead costs				416.09	5.52
Owner/operator labour cost	hour	18.58	40.00	891.84	11.84
Total indirect costs				4,576.77	60.74
Agricultural income				1,600.31	–

Source: own study.

Profitability of sugar beet production

Production profitability was determined on the basis of the production profitability index defined below:

$$W = P : K,$$

where:

W – profitability index,
P – value of production PLN,
K – production cost PLN.

The index value greater than 1 indicates profitability of production, whereas less than one – unprofitable. An index calculated in this way can also determine the profit percentage generated from the production. The values of production profitability index and unit production cost are shown in Table 2.

The profitability index is greater than one so the sugar beet production in the 2018/2019 campaign was profitable, yet at a low profit level.

Table 2

Values of production profitability index and unit production cost

Type of production	Profitability index (*W*)*	Unit production cost (1 dt in PLN)
Sugar beet	1.21	15.07

* The values calculated include the values of by-product beet pulp and area payment (SAP + greening + redistribution) and sugar payment.

Source: own study.

Results

The Figure 1 shows indirect costs in sugar beet production.

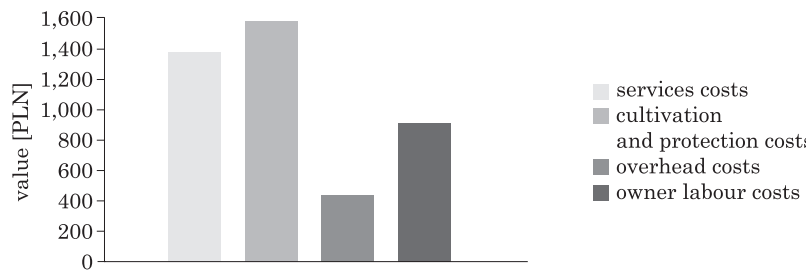

Fig. 1. Indirect costs

Source: own study.

As the analysis demonstrates, the indirect costs had the highest share in sugar beet cultivation (Tab. 1) with the highest effect of the costs of sowing and harvesting services, as well as liming operation – 18.80% followed by the costs of plant cultivation and protection – 22.59%, overhead expenses – 5.52% and owner/operator labour – 11.84.

The direct costs also had strong influence (39.26%), the costs of fertilizers – 15.74%, seeds – 9.58%, plant protection products – 13.96%. The Figure 2 shows direct costs in sugar beet production. The Figure 3 shows the breakdown of revenue from sugar beet production.

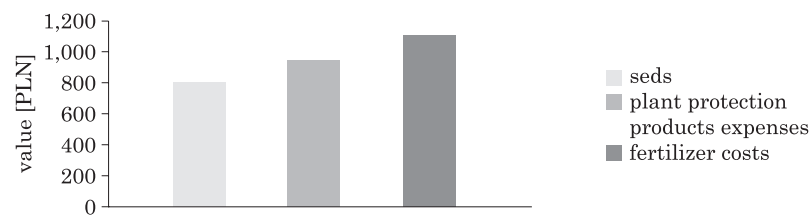

Fig. 2. Direct costs

Source: own study.

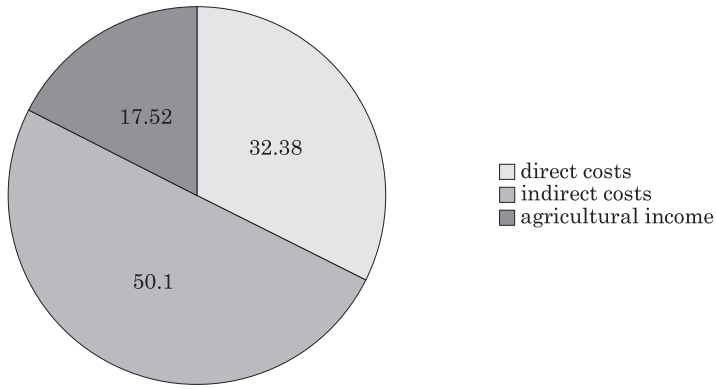

Fig. 3. The breakdown revenue from sugar beet production
Source: own study.

The analysis of revenue from sugar beet production shows that 82.48% are production costs and only 17.52% are agricultural income (Tab. 1, Fig. 3).

The profitability of sugar beet production in the analysed campaign decreased by PLN 147.09 in relation to the campaign of 2019/2020 This is mainly due to an increase in indirect costs by 0.63%. The analysis shows that income reduction was not compensated by an increase of PLN 1.47 for sugar beets or a 0.63% reduction in direct costs. All this is due to an increase by 2.09% in total costs compared to the previous campaign (Krzysiak, 2010, p. 127). Despite this, the financial result from sugar beet cultivation was beneficial for growers. It should be assumed that for a positive financial result from sugar beet cultivation, a sugar surcharge will be paid to hectares of sugar beet, amounting to PLN 1,524.16 and a direct payment per hectare (SAPS) of 471.64 PLN. The existence of these subsidies means that the cultivation of sugar beet is profitable, also in the third year after the abolition of production quotas.

It is still one of the most profitable traditional agricultural crops in the Lublin region, despite the varied income in particular years (Jansen & Stibbe, 2007; Lee *et al*., 2015; Krzysiak, 2020, p. 343).

Discussion

In the analysed Lublin region represented by sugar beet growers supplying to the KSC S.A. branch – Krasnystaw Sugar Factory campaign for 2019/2020 ended with a good result. The conditions of plant emergence immediately after sowing were good, and during their further growth there were also favourable sugar beet growing conditions. The harvest of sugar beet roots in the first half of the procurement campaign was very good, only in the second half of the campaign there were temporary difficulties related to weather conditions.

1030000 tonnes of sugar beet were purchased. This year the buying campaign in Kransystaw Sugar Factory – KSC S.A. branch began on 17th September 2019 and lasted until 20th December 2020. Due to favourable weather conditions in the spring and not much rainfall in autumn, the average value of polarization was 17.56%.

The average yield from 1-hectare was 54.46 dt, while the average contamination of the raw material was 8.88%.

Some growers had surplus of the raw material.

The surplus price was set at 40 PLN/dt. In the KSC S.A. branch – Krasnystaw Sugar Factory sugar beets cultivated 3,485 farmers, covering 18,421 ha.

The development of beet production in both Lublin region and in Poland as a whole is dependent on the common agricultural policy in the European Union.

The report on the development of European agriculture for 2019-2030 prepared by the European Commission shows that sugar production in this period in the EU will reach 18.5 million tons, while at the same time the possibilities of export outside the EU will increase to 2.2 million tons per year by 2030, while imports will reach 1.3 million tons (Gawryszczak, 2020a, p. 3). Considering these facts, it can be concluded that the cultivation of sugar beet will develop and its profitability will depend on the price of sugar (Jansen & Stibbe, 2007; Lee *et al*., 2015).

The discussed campaign ended with a slight decrease in the profitability of sugar beet cultivation. This happened at almost unchanged prices for the means of production. In 2019, economic conditions may change even more as the price of white sugar has decreased.

Conclusions

1. The cost analysis of sugar beet production indicated profitability at the average income level of 1,600.31 PLN/ha and the profitability index 1.21.

2. It was found that the income from sugar beet production is primarily affected by the indirect costs (60.74%) which are higher than the direct costs by 21.48%. The fertilizer costs which were shown to make up as much as 15.72% of the direct costs determine the production costs to the greatest degree.

3. The main factor influencing the income from sugar beet cultivation was the price for the raw material, which in the considered business year in relation to the previous season increased by only 0.77 PLN/t).

4. Sugar beet growing is characterized by high production costs accounting for 82.48% of revenue from the production.

5. The main factor affecting the income from sugar beet cultivation was the price for the raw material, which in the considered marketing year compared to the previous season increased by only 1.46 PLN.

6. The limitation of the presented analysis of the costs of cultivation and profitability of sugar beet production is its preparation for a model farm with specific criteria.

7. Further research should be carried out taking into account the division of the analysed farms into groups with different criteria, this will allow for a better approximation of the performed analyses of cultivation costs to the actual conditions.

8. A good direction for the development of individual farms is to combine science with practice in the pursuit of cooperation between growers and scientists indicating the economics of sugar beet production.

Translated by: Agata Gniecka-Caban

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