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Viability of the open-pit cultivation of bell peppers in Meoqui, Chihuahua

Viabilidad del cultivo de chile morrón (*Capsicum annuum L*) a campo abierto en Meoqui, Chihuahua

Pacheco-Meléndez, Brenda Marina [a], Macías-López, María Guadalupe *[b], Ortega-Montes, Fabiola Iveth [c] and Pérez, Jerónima Antonieta [d]

[a] Universidad Autónoma de Chihuahua • KXQ-9734-2024 • 0009-0007-3431-4445 • 1155982
[b] Universidad Autónoma de Chihuahua • KVA-7187-2024 • 0000-0002-4823-7651 • 214110
[c] Universidad Autónoma de Chihuahua • KUC-6886-2024 • 0000-0002-2071-7901 • 343986
[d] Universidad Autónoma de Chihuahua • KVA-7626-2024 • 0000-0002-8290-1739 • 213229

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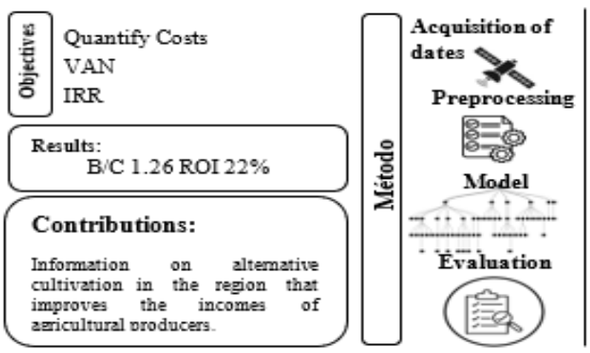
* ✉ [gmacias@uach.mx]

Abstract

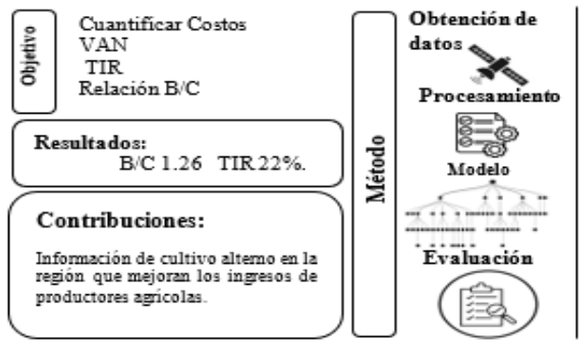
Chili bell pepper (Capsicum annuum L.) has its origin in South and Central America, domesticated in Mexico (Mendoza, 2010), and is part of the small genus of tropical herbs. In Mexico, there is a lack of sufficient economic information about the production costs of the chile bell pepper crop; however, it is considered an economic alternative due to the low input costs it requires. The objective of this study was to determine the economic viability of this crop in a plot established in the municipality of Meoqui Chihuahua, Mexico, where the costs of cultural activities and necessary inputs were collected from land preparation, establishment of the plantation until harvest, and the financial indicators net present value (NPV), internal rate of return (IRR) and the benefit-cost ratio (B/C) were considered. A B/C ratio of 1.26 was obtained, an IRR of 22%, higher than the discount rate (12%), which indicates viability.



Costs, Economic indicators, Harvest

Resumen

El chile morrón (*Capsicum annuum L.*) tiene su origen en América del sur y América central, domesticado en México (Mendoza, 2010), forma parte del reducido género de hierbas tropicales. En México se carece de suficiente información económica acerca de los costos de producción del cultivo chile morrón, sin embargo, se considera una alternativa económica debido a los bajos costos de insumos que este requiere. El objetivo de este estudio fue determinar la viabilidad económica de este cultivo en una parcela establecida en el municipio de Meoqui Chihuahua México, en donde se recabaron costos de las actividades culturales e insumos necesarios desde la preparación del terreno, establecimiento de la plantación hasta la cosecha y se consideraron los indicadores financieros valor actual neto (VAN), tasa interna de retorno (TIR) y la relación beneficio costo (B/C). Se obtuvo una relación de B/C 1.26, una TIR del 22%, mayor que la tasa de actualización (12%), lo que indica viabilidad.



Costos, Indicadores económicos, Cosecha

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Introduction

The chilli pepper (Capsicum annuum L.), also known as pepper, has its origin in South America. Researchers Walsh and Hoot (2001) after a study of molecular analysis of both wild and domesticated species concluded that the genus capsicum originated in the arid regions of the Andean mountains; in particular, what is now Peru and Bolivia.

The genus Capsicum has been part of the human diet and Native Americans used various chilli species as early as 5,200 BC (Nadeem et al., 2011). Prior to the arrival of the Spanish in the Americas, the pepper was not known in Europe, Asia and Africa. However, there is evidence that Christopher Columbus, on his return from his second voyage to the New World, brought some samples of bell peppers as a gift to the King and Queen of Spain, which led to its distribution and knowledge of it to the rest of the world (Bosland and Votava, 2012). In fact, Christopher Columbus is also credited with having christened this chilli pepper, although an inappropriate term, as it is as hot as black pepper. In Mexico, chilli production in 2020 was 2,818,443 tonnes, which were harvested on 157,911 ha, giving a national average yield of 17.8 tonnes ha-1 (Bastida Cañada, 2023).

Regarding bell peppers, Mexico is considered the world's main fresh pepper exporter, with a world share of 29%. In the period January-November 2021, the value of fresh pepper exports totalled 1,366 million dollars (SADER, 2022).

According to the same source, this amount represents an increase of 5.4% compared to the same time in the previous year. Around 50% of the production of bell peppers is carried out under protected agriculture, i.e. under greenhouses, shade netting or macro tunnel, which makes it available on the market all year round.

In the open-air production modality, the state of Sinaloa is the main producer. It is important to mention that, apart from the names of chili pepper or pepper, in some regions it is identified as sweet pepper, brown pepper, sweet pepper or paprika.

The state of Chihuahua, located in northern Mexico, has traditionally been the main producer of the various types of chilli; for example, in 2020, 675,131 tonnes were produced, representing 24% of national production (Bastida Cañada, 2023). In particular, bell peppers are grown in three production systems: open field, shade house and greenhouse. Higher yields are obtained with the shade net system; however, the construction of a greenhouse means a significant investment and this must be carefully analysed (Huerta et al., 2009).

In this State, there are few producers dedicated to the production of bell peppers, hence the need to investigate the economic impact that would be generated, as well as to investigate the technical management, in order to analyse how to achieve greater profitability. Therefore, the objective was to analyse the economic profitability of pepper cultivation under an open field system. It is hoped that this information will be useful for agricultural producers in the south-central region of the state of Chihuahua, who are interested in the production of this crop.

Materials and methods

The study was carried out in a farm located in the town of Las Puentes, in the municipality of Meoqui, Chihuahua State, Mexico (Figure 1).

Box 1

Figure 1
Location of the agricultural property under study
Source: Own elaboration

The project was supported by a cooperating producer who has been involved in the production of bell peppers in the region. It started with the transplanting of the plants to the field, which was in April 2023, and then a flow chart was used to describe the technical and financial management of the whole production process.

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The termination of the study was with the harvesting actions and the study was completed until June 2023.

Economic and financial analysis

For the calculation of the total cost of cultivation (TCC), the fixed costs (FC) and variable costs (VC) that were incurred in the entire crop production process were taken into account. Figure 2 shows this relationship. That is, the costs incurred for land preparation, seedling production and transplanting to the field, number of irrigations, fertilization, weed control, pest and disease control, harvesting and, finally, packing were computed.

Box 2

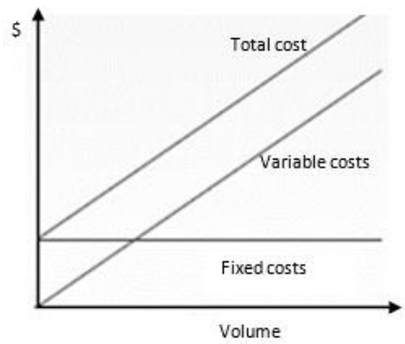

Figure 2
Graph showing the total cost concept
Source: Ramírez, 2008

In the particular case of land preparation, the necessary expenses were considered, such as soil preparation, subsoiling, harrowing, fallowing, levelling, furrowing and bed formation. The purpose of all these activities was to provide the plant with a suitable environment for root development, improving aeration and soil structure. It is important to mention that the mulch was installed in the field and the expenses incurred for the establishment of the tape were noted, as the irrigation was done using the technique known as drip irrigation. In the particular case of harvesting and packing activities, cardboard boxes were purchased, and to complement these expenses, transport and freight costs were also taken into account.

With the information provided, a profitability analysis was weighted, for which the financial variables of Net Present Value (NPV), the Internal Rate of Return (IRR) and the Benefit-Cost Ratio (B/C) were considered.

The NPV calculation analyses the investment of a project based on the future income and expenditure to be made (Montes, 2023). Consequently, it is possible to know how much would be gained or lost by making a given investment, in this particular case, with the planting of bell peppers (Le, 2021). The IRR is an indicator of the profitability of projects or investments; therefore, the higher the IRR, the higher the profitability (Magni, 2011), thus helping to make a good decision on the investment to be made. With regard to the B/C ratio, this parameter represents the relationship between costs and benefits over a given period, and is calculated using the simplest formula (Ortega et al., 2023).

$$\text{Cost Benefit} = \left(\frac{\text{Benefit neto}}{\text{Neto cost}}\right) \times 100 \qquad (1)$$

Results and discussion

Table 1 shows the main variable costs, which were: seedling production and labour for transplanting $65,535.00, fertilizer $14,789.00, and trampling and boxes $100,000.00. As recommended by BTC Bank (2023), variable costs are considered to be those that increase or decrease according to production. In terms of fixed costs, administrative payments of $89,992.80 and water usage of $121,086.00 can be observed for this activity; fixed costs are those that do not change with the level of production.

It can be seen that seedling production and labour are the largest proportion of expenses in this activity. Accordingly, BTC Bank mentions that some elements of the cost of agricultural production, such as soil, sunlight, heat and rainfall are natural inputs, therefore, they do not require financial management.

With a cost in the first year of $414,858.56, the amount of 20 tons of product was obtained. To determine the selling price per ton, the price of the competition was analyzed to enter the market with a selling price of $30,000.00 per ton, obtaining an income in the first year of $600,000.00. According to Martínez S. (2022) the formula to determine the selling price of a product is: Selling price = Cost price + (cost price + margin), in the simplest form.

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Box 3

Table 1

Five-year projected variable and fixed costs

Concept/month	Year 1	Year 2	Year 3	Year 4	Year 5
Variable costs					
Land preparation	4,000.00	4,480.00	5,017.60	5,619.71	6,294.08
Labour, webbing and padding	2,400.00	2,688.00	3,010.56	3,371.83	3,776.45
Prod.plant and labour transplant	65,985.00	73,903.20	82,771.58	92,704.17	103,828.67
Manpower irrigation	13,625.00	15,260.00	17,091.20	19,142.14	21,439.20
Fertiliser	14,789.00	16,563.68	18,551.32	20,777.48	23,270.78
Agrochemicals	2,389.00	2,675.68	2,996.76	3,356.37	3,759.14
Pizca	60,000.00	67,200.00	75,264.00	84,295.68	94,411.16
Boxes	40,000.00	44,800.00	50,176.00	56,197.12	62,940.77
Transport	7,000.00	7,840.00	8,780.80	9,834.50	11,014.64
Fuel	20,591.76	23,062.77	25,830.30	28,929.94	32,401.53
Subtotal	**230,779.76**	**258,473.33**	**289,490.13**	**324,228.95**	**363,136.42**
Fixed costs					
Administrator	53,992.80	60,471.94	67,728.57	75,856.00	84,958.72
Water	121,086.00	135,616.32	151,890.28	170,117.11	190,531.17
Capataz	36,000.00	40,320.00	45,158.40	50,577.41	56,646.70
Subtotal	**184,078.80**	**206,168.26**	**230,908.45**	**258,617.46**	**289,651.56**
Total cost	**414,858.56**	**464,641.59**	**520,398.58**	**582,846.41**	**652,787.98**

Source: Own elaboration

For the profitability analysis, the initial investment, income, costs and the discount rate were used to determine the 5-year projection (*Montes, et al. 2023*). A NPV greater than 1, IRR greater than the evaluation rate, and a benefit-cost ratio greater than 1 were obtained, which means that each invested peso recovers a surplus of 0.26 pesos.

Box 4

Table 2

Cash flow

YEAR	REVENUE	COSTS	CASH FLOW	TASA 1/(1+t)^N	REVENUE ACTUALIZ	C EGRESS ACTUALIZ
0		$275,792.00	$275,792.00	1	$ -	
1	$600,000.00	$414,858.56	-$90,650.56	0.893	$535,714.29	$370,409.43
2	$600,000.00	$464,641.59	$44,707.85	0.797	$1,014,030.61	$740,818.86
3	$600,000.00	$520,398.58	$1,165,106.43	0.712	$1,441,098.76	$1,111,228.29
4	$600,000.00	$582,846.41	$2,347,952.84	0.636	$1,822,409.61	$1,481,637.71
5	$600,000.00	$652,787.98	$3,600,740.81	0.567	$2,162,865.72	$1,852,047.14
TOTAL	$3,000,000.00	$2,911,325.11	$7,343,649.37		$6,976,118.99	$5,556,141.43

Source: Own elaboration

Box 5

Table 3

Total

VAN	$1,419,977.56
TIR	22%
B/C	$1.26

Source: Own elaboration

Conclusions and recommendations

From the present study it is concluded that investing in the cultivation of bell peppers in the region is feasible according to the costs and the results of the financial indicators, and it has the opportunity to be easily commercialized in a developing market.

This crop has low water requirements and does not require profound and structural changes to the production system. However, it is recommended that under the conditions of the region, a pruning system and the use of shade netting should be used to obtain higher production and better product quality, as well as to increase the number of harvests with higher production and profitability.

Declarations

Conflict of interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this paper.

Authors' contribution

Pacheco-Meléndez, Brenda Marina: I contributed the project idea and research development.

Macías-López, María Guadalupe: I contributed with the research method.

Ortega-Montes, Fabiola Iveth: I contribute with data analysis and editing.

Pérez, Jerónima Antonieta: I am contributing with data analysis and revision.

Availability of data and materials

Data sets used or analysed during the current study are available from the corresponding author upon reasonable request.

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Abbreviations

B/C	Benefit-Cost Ratio
CF	Fixed Costs
CTC	Total Cost of Cultivation
CV	Variable Costs
TIR	Internal Rate of Return
VAN	Net Present Value

References

Support

Bastida, C.0. (2023). Estadísticas de producción de chile en México. Blog Agricultura.

Bosland, P.W., Votava, E.J. (2013). Peppers: vegetable and spice capsicums.2nd edition. Crop production science in horticultural. Series 22. Wallingford, UK, CABI, 212 248 pág. Peppers: vegetable and spice capsicums 2nd Edition.

Hayes, A., Kelly, R.C., Rathburn, P. (2024). Análisis, cómo se utiliza, cuáles son sus pros y sus contras. Business, business essentials.

Le, S. (2021). The application of NPV in different type of markets. En 3ed International Conference on Economics Management and Cultural Industry (ICEMCI 2021). Atlantis Press, pp 1054-1059.

Magni, C.A. 2011. Average internal rate of return and investment decisions: a new perspective. The Engineering Economist 1-39.

Nadeem, M., Anjum, F.M., Khan, M.R. Saeed, M., Riaz, A. 2011. Potencial antioxidante del pimiento morrón (Capsicum annuun L.): A review. Pakistan Journal of Food Sciences 21 (1-4): 45-51.

Mendoza, J. C. (junio de 2010). Acumulación de biomasa, crecimiento y extracción nutrimental en pimiento morrón.

Montes-Sierra, V. A., Uranga-Valencia, L. P., Palacios Monárrez, A., Ortega-Montes, F. I., & Macías-López; M. G. (2023). Plan de negocios para el establecimiento de una planta procesadora de camote (Ipomoea batatas L.) en Delicias, Chihuahua, México. Agro Productividad.

Ramírez, P.D. (2008). Contabilidad Administrativa. Octava edición. ISBN-13: 978-970-10-6630-0 Conceptos básicos.

Basics

Ortega, M.F., Rubio, A, H., Clemente, S, F., & Uranga, V, l. (2023). Cost-benefit analysis of the best combination of organic and inorganic sources to supply zinc deficiency in pecan (Carya illinoinensis [wangenh] k. Koch).

Background

SADER, 2022. Secretaría de Agricultura y Desarrollo Rural. México, principal exportador mundial de pimientos frescos: Agricultura.

Shou, T. 2022. A literature review on the Net Present Value (NPV) valuation method. Advances in Economics, Business and Management Research 19:826-830.

Walsh, B.M., Hoot, S.B. 2001, Phylogenetic relationships of Capsicum (Solanaceae) using DNA sequences from two noncoding regions: the chloroplast atpB-rbcl spacer region and nuclear waxy introns.

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