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LISIANTHUS (*Eustoma grandiflorum*) PRODUCTION AS A STRATEGY TO REDUCE POVERTY LEVELS IN RURAL COMMUNITIES IN MEXICO

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Abstract: A study was conducted to produce the Lisianthus flower in order to compare the income obtained from its sale, considering costs and prices in 2024. Under rustic greenhouse conditions in San Lorenzo Jilotepequillo, Oaxaca, two planting beds were implemented with 672 plants, which were fertilized at transplanting with a dose of 110-40-40 (N, P O_{25} and K_2 O per hectare) and during four months fungicides and an insecticide were applied sequentially every 15 days, in addition to irrigation and weed control. Considering the production costs, the average cost per piece was 13.38 pesos per flower, which results in a profit of 11.61 pesos per unit. Under this consideration, the economic benefit is 7,808 pesos, which divided in the four months required to be able to market the flower, is equivalent to 1,952 pesos per month. Based on the above, with the economic benefits obtained, it is only enough to cover the food needs of one person considering the 1,800.55 pesos as the Extreme Poverty Line by Income in the food basket. Another scenario corresponds to planting the entire greenhouse with the flower, however, transporting and marketing 6,666 plants that would cover the greenhouse is a risk that must be considered in order not to have a negative impact, which is why government support is required for this purpose.

Keywords: flowers, costs, poverty line, *commercialization, marketing*

INTRODUCTION

Poverty is defined as the lack of economic income to meet needs, whether food, goods or services, coupled with lack of housing, social security, education and health, among others (Jefferson, 2018). The problem of poverty is not new, it is present in all countries and in all of them strategies have been applied to remedy it, in medieval times in England the "Poor Law" was integrated where the

population was categorized into children, sick people and people without disabilities, the latter with the obligation to work and subject to the maxim "who does not work, do not eat" (Rodgers, 2006). In the pre-modern period, poverty was synonymous with hunger, with the emergence of the market economy, where the use of money to exchange it for goods dominates, the type of poverty we recognize today emerged (Jefferson. 2018). The incidence or poverty rate is defined as the number of people living in poverty over the size of the population (Jefferson, 2018) and in Mexico it is the National Council for the Evaluation of Social Development Policy (CONEVAL) that is responsible for indicating it. The percentages of the country's population in poverty for the years 2016, 2018 and 2020 were 43.2, 41.9 and 43.9, respectively (CONEVAL, 2020). In the year 2020 in the state of Oaxaca, 61.7 of its population was in poverty and of this, 20.6% in extreme poverty (CONEVAL, 2020a), a situation that is considered serious, considering that 51% of the population lives in rural areas. The difference between these categories for the country's criteria is that the situation is poverty when there is one deprivation and income is insufficient to acquire the necessary goods and services, while poverty is extreme when income is insufficient and there are three or more deprivations. On the one hand, there is the method of Unsatisfied Basic Needs, which consists of comparing the situation of each household in terms of a group of specific needs with a series of norms that express for each one of them the minimum level below which the need is considered unsatisfied, among others, the availability of water, drainage, electricity, housing, furniture and household items. This method has the limitation that the more items of needs considered, the greater the incidence of poverty (Boltvinik, 1992). The other method considers a "Poverty Line", defined as the monetary cost for a given person, in a given place and time and of a reference welfare level (Revallion, 1998), reflects the cost of covering basic needs, including food in a family of four elements during a month (Damman, 2008) and consists of comparing the income of a given person, in a given place and time and of a reference welfare level (Revallion, 1998), 2008) and consists of comparing *per capita* income or consumption by assigning them a value, so that households with incomes lower than that assigned to the line are considered poor and the same characteristic is attributed to the households that live in them (Boltvinik, 1992). The Extreme Poverty Line (food basket) reflects the estimated cost to cover food needs (Damman, 2008), considering the energy needed for maintenance and work, corresponding to 1,600 calories only for the maintenance of an adult male (Hardin, 1969). Chopra *et al*. (2010) indicate that poverty is not only a question of income to acquire food, but of many other factors that affect human welfare, such as services.

In poverty studies, income is used as a measure of well-being, however, consumption of goods is more important, as some people do not report their income truthfully, but it is better to consider nutrition more broadly and take into account the annual cost of a basic diet that allows adults to be productive workers and children to grow at normal rates (Jefferson, 2018). In 1992 the World Bank proposed a Poverty Line of 370 dollars per year (Boltvinik, 1994), however, based on a study in 75 countries for the year 2005 it was proposed to be 1.25 dollars per person (Ravallion *et al*., 2007) and for the year 2015 it was indicated to be 1.90 dollars (Farreira *et al*., 2015).

For Mexico, under the CONEVAL criteria for a family of four in the year 2020 the Income Poverty Line was 13,133.30 pesos, while for the World Bank it was 4,845.18 pesos

(CONEVAL, 2020b) and under a simplistic approach, any person who does not reach those amounts is simply poor. For August 2024, the CONEVAL (2024) indicates that the Income Poverty Line, which considers the food and non-food basket for the rural zone for one person per month is 3,296.89 pesos, while the Extreme Income Poverty Line that considers only the food basket is 1,800.55 pesos, with the premise that the rural zone are the towns with a population of less than 2,500 inhabitants.

Although poverty levels have been reduced in the country for both categories, it should not go unnoticed that in Mexico a quarter of the population lives in rural areas, however, two thirds of them live in extreme poverty. Just as people fall into poverty or extreme poverty, however, because of their extended duration there are also the chronically poor (Hulme and Shepherd, 2003), who are those who have been in poverty for more than five years and who can inherit this characteristic, so that from birth an infant is born with the category of poor. These chronic poverty rates are higher in rural areas than in urban areas, but considering the absolute number of people, urban areas in many countries have a higher number of chronic poor, however, the rural chronic poor tend on average to live in worse conditions than the urban chronic poor (Vakis *et al.,* 2015). Due to climatic misfortunes in agricultural production, such as droughts or frosts, unforeseen events in the health of family members, as well as loss of employment, can cause the family to fall into the category of transient poor or those who over time temporarily fall into poverty (Vakis *et al.,* 2015). Rural poverty is marked by its connection to agriculture and land and the households most susceptible to falling into the poverty trap are those whose income depends largely on agricultural activities linked to markets and who have low educational levels among their members (Trivelli *et al*., 2020). The rural poor are more dependent on agriculture than the non-poor.

Thus, poverty in rural areas tends to be largely explained by low access to natural assets (particularly land), non-agricultural employment opportunities, health and education (Mwabu *et al., 2005*), since rural areas are characterized by the absence of industrial or semi-industrial production spaces, lack of quality services, as well as market-imposed commercialization conditions (Horbath, 2012). Compared to urban areas, rural areas also present high levels of inequality, considering that the Gini index for income or consumption is higher than 40% (Trivelli *et al*., 2020), therefore, living in poverty depends on where in the world they are (Jefferson, 2018). One of the alternatives to solve poverty can be migration to take advantage of the opportunities offered by national urban areas or abroad (Fay and Ruggeri, 2005)**,** however, this can lead to the displacement of local workers (Jefferson, 2018) and when migration is at the international level of indigenous people, it leads to the gradual loss of their traditions, due to transnational cultural hybridization (Horbath, 2012).

One way to help a country become less impoverished are social programs that provide money to the poor (Jefferson. 2018), however, aid must also address all aspects of the community's situation to lift its inhabitants out of poverty. Remittances sent by migrants to their families are also important, in Mexico in the month of November 2023 remittance income from abroad was 4,908 million dollars in 12.7 million transactions, with an average remittance of 386 dollars (Banco de Mexico, 2024) and for some Latin American countries these cover 20% of households and constitute 25% of income (Trivelli *et al*., 2020). In rural areas, one of the strategies to mitigate

the effects of poverty is livestock farming, which in some countries is the third most important source of household income, with the advantage of being a piggy bank, which can be accumulated through reproduction, as well as obtaining by-products, such as draught power, plant nutrients and milk, among others (Ashley and Nanyeenya, 2005). However, it should be emphasized that support institutions are required to protect the ecosystems that sustain the means of production and ensure that participation in the market contributes to poverty alleviation for all participants in the production chain (Daming *et al*., 2010), since common goods can be overexploited (Chopra *et al*., 2010) and ecosystems can be severely affected by users seeking to take advantage of them (Hardin, 1969). In Mexico there are 59 indigenous groups (Horbath, 2012) representing 9.6% of the population and of these 78.7% are in poverty (CONEVAL, 2018). Because they are indigenous, they are associated with poverty, suffering labor discrimination in urban labor markets, mainly in the metropolitan areas of the country (Horbath, 2012). Just as there are differences in poverty in rural communities with urban communities, comparing indigenous communities with non-indigenous communities presents a similar situation, since in those the poverty levels are higher and have risen over time.

In Mexico, an analysis by Damman (2008), when relating the indigenous population in poverty to the non-indigenous population, obtained coefficients of 1.8 and 3.7 for 1992 for poverty and extreme poverty, respectively, while for 2002 these values were 1.9 and 4.6, respectively, so that the households most susceptible to falling into poverty are those that are predominantly indigenous (Trivelli *et al*., 2020).

In rural areas, the economic resources generated by agricultural activity are generally insufficient, which is why non-agricultural alternatives can make up for the economic deficit. Haggblade *et al.* (2010) indicate that non-farm alternatives represent between 35% and 50% of income in rural households in the developing world and are not based on production, but on the transformation of raw products, such as milling, packaging, transport and marketing. Bathla and Gautam (2021) indicate that adding value to agricultural products is a strategy to solve the impact of poverty; however, it must be accompanied by strategies that facilitate their commercialization, such as products considered healthier, non-traditional and organic.

Priyadarshan and Mohan Jain (2022) indicate that there are crops that are produced more for commercialization than for self-consumption, including cocoa, coffee, rubber, coconut and spices, among others, which are generally perishable.

Flowers are a high-value product, with a short shelf life, which requires technique for its production and quality for its commercialization. In Mexico, flowers are grown in all states, but the State of Mexico, Morelos and Puebla are the main ones, both in open-air and greenhouse production. In the case of cut flower production, an analysis by Tejeda-Sartorius *et al.* (2015) indicates that there are more than five thousand hectares in the State of Mexico where flowers are produced, with a tendency to continue growing as they consider this activity profitable. In a representative sample with producers, they mentioned pests and diseases, as well as the improvement of their infrastructure as a priority. The economic importance of the production of 44 types of flowers in that state, considers a production value of 6,550 million pesos per year (Secretaría del Campo, 2020).

On the other hand, there are other types of producers, for whom the main problem is marketing, since they lack resources and are not integrated to a marketing company, they cannot grow and have the risk of wasting the product and therefore, have lower prices.

Such is the case of small flower producers in San Lorenzo Jilotepequillo, Santa María Ecatepec, Oaxaca, who had the support of the National Indigenous Institute to build rustic greenhouses of 10 X 20 m, in which they produce flowers that are periodically sold in bulk, In these greenhouses, they produce flowers that they sell periodically in bulk, in tianguis or in the streets, reaching better prices on symbolic dates, for example, Mother's Day, the Day of Love and Friendship, Day of the Dead, as well as in festivities, such as weddings, school closings and mourning ceremonies, among others. The flowers they produce are roses, chrysanthemums, lylis, astromelias, dahlias, daisies and cempazuchitl, being the lylis the ones they sell most easily. The quantities they sell are those that they can carry in their arms and that can be transported by public service within two hours of the site where they are produced. The Lisianthus flower (*Eustoma grandiflorum* (Raf.) Shinn.) they have tried to produce, however, they have had problems with pests (thrips, white fly, aphids), as well as diseases (Fusarium, Pythium). This type of flower is not commonly found in the market, but it is appreciated and easily marketed because of its rarity, varied colors, many flower buds, good shelf life, and with management, several cuttings can be made. Based on the above, a proposal was integrated to complement a technology to produce this flower, considering the infrastructure conditions of a producer.

MATERIALS AND METHODS

In 2018, the study was conducted in San Lorenzo Jilotepequillo, belonging to the municipality of Santa María Ecatepec, Oax. in the Sierra Sur Region, located between 1,700 and 2,400 meters above sea level, updating costs and prices to the year 2024. The dominant climate is temperate sub-humid C(w), whose characteristics indicate that the average temperature for the coldest month is between -3 and 18º C, precipitation in the wettest month of the summer half of the year is greater than ten times that of the driest month and precipitation in the driest month is less than 40 mm (García, 2004), with annual rainfall of 800 to 1,200 mm. Characteristic of the locality is the rugged terrain, with natural vegetation of pine-oak forest, which is disturbed by the planting of small plots of corn, agave and the cultivation of flowers. In the case of Lisianthus, it was agreed with a cooperating producer to complement the production technology of this crop and to consider its profitability. For this last point, the opportunity costs of the inputs used and the activities carried out in the field to obtain a marketable quality product were recorded. Namely, the activities were:

Three months prior to planting, the vegetative material was ordered, which were four colors of flower cv. Mariachi, for "cutting" in "Plántulas de Tetela" based in Cuernavaca, Mor. derived from seeds of the company Sakata Seed. Inside the greenhouse, the planting bed is implemented forming a ridge, thus reducing the risk of rotting due to waterlogging, promoting greater rooting, reaching a greater aerial part and therefore, purchasing preferences. To implement the two planting beds of 1.20 X 12.0 m, 12 packages of topsoil were considered at a cost of 50 pesos each, in addition to one day's work (300 pesos) for manual transport from the purchase site to the greenhouse. The 28 m^2 comprising the two

planting beds that make up the "experimental plot" is considered an average size in this type of farms in the locality.

One day's work was considered for mixing the soil with bush soil to raise the 30 cm of the two beds and form them with wood. Of these, the stakes cost 200 pesos, while the stakes cost 50 pesos. Metam Sodium fumigant was applied to the two planting beds, using three liters of product dissolved in 30 liters of water and covered for one month with plastic, at a cost of one third of a day's labor for the activity.

The cost of each seedling was 4.40 pesos, Libre A Bordo in Izucar de Matamoros, Pue. where the vegetative material was collected. From there it was transported to San Lorenzo Jilotepequillo, Oax. for which $ 1,500 pesos were spent on fuel.

Prior to planting, the seedlings were submerged in a 1% solution of the fungicides Thiabendazole, Carbendazim, as well as Metalaxyl-M plus Chlorothalonil, plus a growth promoter with Auxins and Cytokinins, to prepare a total amount of 15 liters. Then the transplanting was done, for which a frame with a grid system was placed on the ground, with delimitation of rows and rows of 20 X 15 cm, proceeding to make perforations in the central part with a "coa". To prevent damage by fungi and soil bacteria, the fumigant 2-thiocyanomethylthio-benzothiazole was applied to this hole at a dose of 1.5 mL per liter of water for a total of 10 liters, and this activity was assigned the cost of one third of a day's work.

In the two planting beds, 672 seedlings were transplanted under a scheme of 24 plots, each with four columns for seven rows of plants. Subsequently, the seedlings were placed on the perforations, the root ball was completely covered so that there were no spaces without plant-soil contact, assigning to this process the equivalent value of one day's work.

For fertilization, the dose of fertilizer 110-40-40, kg of N, P O_{25} and K_2 O per hectare, respectively, was applied, applying it all to one side of the seedling at the time of transplanting, for which Calcium Nitrate (15.5% N, 26.5% CaO), Triple Calcium Superphosphate (46% P O_{25}) and Potassium Chloride (60% K_2 O) were used. This source of Nitrogen was preferred based on the results of nutrient extraction in this flower by Castillo-Gonzalez *et al.* (2017) where Calcium ranked fourth in importance. This activity was assigned the cost of one third of a day for the preparation, dosage and application.

After transplanting, two irrigations per week were applied, at a cost of one third of a day's work, while the same amount was assigned for monthly weed control.

Pest control, mainly whitefly and thrips, as well as the complex of pests that were present in the greenhouse in other crops, such as red spider mites and aphids, are a central part of the control of pests, while diseases in these plants include root rots, as well as gray mold and ashy mildew in the vegetative parts. To control the above, a daily monitoring scheme was followed and a "preventive" control every 15 days, alternating seven fungicides with an insecticide.

Pesticide applications to the foliage were made fortnightly, from February to June, eight applications were made, alternating the fungicides Thiabendazole, Metalaxyl-M plus Chlorothalonil, Benomyl, Carbendazim, Mancozeb, Iprodione, Propamocarb plus Fosetil, all of these with the insecticide Imidacropid, Propamocarb plus Fosetil, all of these with the insecticide Imidacropid, assigning the cost of one third of a day's work to each application, since other crops in the greenhouse, the "streets" and the structure were also sprayed.

Four months after transplanting, the flowers were cut over a period of 15 days as they matured, and were marketed locally,

without packaging or supports, estimating an average price of 25 pesos per piece, this price being associated with the law of supply and demand, since it is a perishable product. The efficiency of management was shown by the fact that during the cultivation cycle, of the 672 transplanted plants, only one flower was lost due to root rot, a situation that had not been achieved before.

For the economic analysis, working capital is considered to correspond to the manual physical effort of a person, assigning an economic value to his or her activity, as well as to the inputs applied, considering only net quantities of products used and the fraction of a day's work performed.

No financial costs were considered in the intangible assets, since the growers alternate several species of flowers and Lisianthus would be one more. Since the greenhouse is a "means" of production for several crops, no value was assigned as initial fixed asset investment, neither to the land inside the greenhouse, nor to the water, which is collected from runoff and stored in a cistern, nor to the utensils and tools to conduct the water, eliminate weeds and cut the flowers, since these were already in place. The investment schedule was associated with production costs and did not consider sales costs (Baca, 2010), since in addition to direct sales by the producers, sometimes people come to the community to buy the flowers for their own use or for resale.

The price of the product is associated with the number of flower buds produced by each plant, finding up to 17 buds, with an average of 8, with a potential retail price of 5.0 pesos per large flower bud.

The economic analysis considers the Benefit/Cost ratio (Baca, 2010), as well as the projection of scenarios of Lisianthus production as a means to overcome poverty, based on the Poverty Line proposed by CONEVAL.

RESULTS AND DISCUSSION

Table 1 shows the costs by quantity of product used, while Table 2 shows the costs assigned to the work.

Product	Presentation	Price (pesos)	Quantity used	Cost (pesos)
Calcium Nitrate	25 kg	680	1,430 kg	38.8
Triple Calcium Superphosphate	50 kg	625	175 g	1.8
Potassium Chloride	50 kg	680	134 g	1.6
Thiabendazole	0.5 kg	1360	21 g	**57.1**
Metalaxyl-M plus Chlorothalonil	1.0 L	1060	35 mL	**37.1**
Benomyl	1.0 kg	800	20 gr	**16.0**
Carbendazim	100 g	142	20 g	**28.4**
Mancozeb	500 g	260	30 g	**15.6**
Iprodione	1.0 kg	1600	90 g	**144.0**
Propamocarb plus Fosetyl	1.0 L	1450	15 mL	**21.7**
Imidacropid	200 ml	380	15 mL	**28.5**
Auxins and Cytokinins	1.0 L	490	15 mL	**7.3**
Metam Sodium	20 L	1100	3 L	**165.0**
2-Thiocyanomethyl-thio-Benzothiazole	1.0 L	1500	15 mL	**22.5**
Mountain land				600.0
Wood				250.0
Seedlings				2,956.8
Gasoline (Transportation)				1500.0
Total				5,892.2

Table 1. Costs of products used.

Activity	Cost (pesos)
Hauling of bush land	300
Integrating planting beds	300
Soil disinfection	100
Fumigant application	100
Transplant	300
Pesticide application (8)	800
Irrigation (16)	800
Weed control (4)	400
Total	3,100

Table 2.- Cost of activities carried out.

Based on the costs of products and activities, the total was 8,992.2 pesos, with an average cost of 13.38 pesos per flower, which results in a profit of 11.61 pesos per unit. Under this consideration, the economic benefit is 7,808 pesos, which divided in the four months required to be able to commercialize the flower, is equivalent to 1,952 pesos per month. Based on the above, with the economic benefits obtained, it is only enough to cover the food needs of one person considering the 1,800.55 pesos as the Extreme Poverty Line by Income in the food basket (CONEVAL, 2024).

ALTERNATIVE SCENARIO: EXPANSION OF PRODUCTION AREA TO THE ENTIRE GREENHOUSE

As previously indicated, the size of the greenhouses is 200 m^2 (10 X 20 m), if the cultivation area is extended to the entire greenhouse, potentially 6,666 plants would be produced, which if they could be marketed and obtain the 11.61 pesos profit per flower, would be enough to cover the food needs of a person for 42 months. Evidently, increasing the cultivation area is the most explicit way to obtain a greater production, since the greater the production, the greater the profit, and therefore, potentially, the poor will cease to be poor.

However, Vose (2001) considers contrasting the risk of having a negative impact with an opportunity or positive impact, since it is necessary to consider the scenario, the probability of occurrence and the size of the effect that this would have by wanting to expand the cultivation area, in this case, to commercialize 6,666 plants that would occupy the entire greenhouse, knowing that in the community there are 14 other producers in the same situation and that would compete for the market, in addition to producers from other localities. Van Noordwijk et al. (1994), indicate that one strategy is to diversify activities, in this case, the production of various flowers, especially when faced with production problems, such as pests and diseases or marketing, because it is a perishable product, so it is necessary to make strategic decisions to schedule plantings and not then apply tactical decisions to control negative contingencies. In this regard, Ogurtsov et al. (2008), in addition to diversification, consider other strategies, such as insurance and contract farming, and Burch (1994) indicates that some organizational and governmental support scheme is required to be able to safely change food crops for cash crops.

CONCLUSIONS

The production and commercialization of Lisianthus as a strategy to reduce the effects of poverty, considering the experimental results and based on the Extreme Poverty Line by income in the food basket, the requirements of a person are covered for four months. Based on projections to expand the cultivation area to an entire greenhouse, the requirements would be covered for 42 months, however, the risks, mainly in terms of commercialization, are too high. It is considered that the strategy employed by local flower growers to diversify their crops is in line with their situation. If they want to increase the area, they need government support, mainly for transportation and marketing, since this and other types of flowers are subject to the law of supply and demand, as it is a perishable product that must be sold as soon as possible, which under the rural conditions where it is produced makes this process difficult.

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