ISSN 2359-6562 (ONLINE) 2359-6562 (CD-ROM)

SWEET POTATO PRODUCTION COSTS AND LEVEL OF SOCIAL REPRODUCTION IN FAMILY FARMING

JOSÉ BONIFÁCIO MARTINS FILHO [1], RAIMUNDO NONATO TAVORA COSTA [2]

[1] Postgraduate Program in Agricultural Engineering, São Paulo State University Júlio de Mesquita Filho, Faculty of Agricultural Sciences of Botucatu, R. Nícola Zaponi, 1427, Vale do Sol, 18606-12, Botucatu - SP – Brazil, boni.martins@outlook.com.
[2] Postgraduate Program in Agricultural Engineering, Federal University of Ceará, Department of Agricultural Engineering, Center for Agricultural Sciences, Department of Agricultural Engineering. DENA - Block 804 - Postal Box, 12168, Pici, 60451970 - Fortaleza, CE – Brazil, rntcosta@ufc.br.

ABSTRACT: Recording and controlling production costs are not activities commonly carried out by family farmers. However, it is essential to understand the composition of costs to improve agricultural management and to ensure good financial results. The objective of this work was to identify the production costs of sweet potatoes and simulate the added value and farmer's income for a family production unit that wishes to implement an irrigation system. The ABC costing method was used, and the average cost, average fixed cost and average variable cost of sweet potatoes were determined. The socioeconomic analysis was based on the determination of added value and producer income depending on the useful agricultural surface. To produce 1.0 kg of sweet potatoes in the period analyzed, a total expense of R$0.47 was needed. The main cost of sweet potato production in family farms is labor (R$ 6,215.00 per hectare). This agricultural activity allows the maintenance of the activity by family farmers who have small properties, ensuring the level of social reproduction under the conditions studied.

Keywords: Added value, Farmer income, Agricultural management.

SWEET POTATO PRODUCTION COSTS AND LEVEL OF SOCIAL REPRODUCTION IN FAMILY FARMING

ABSTRACT: The registration and control of production costs is not an activity commonly performed by family farmers. However, it is essential to understand the composition of costs to improve agricultural management and to ensure good financial results. The objective of this work was to identify the production costs of sweet potatoes and to simulate the added value and income of a farmer for a family production unit that wants to implement an irrigation system. The ABC costing method was used, and the average cost, the average fixed cost and the average variable cost of sweet potatoes were determined. The socioeconomic analysis was based on the determination of the added value and income of the producer as a function of the useful agricultural area. To produce 1.0 kg of sweet potato in the analyzed period, a total expense of R$ 0.47 was needed. The main cost of the production of sweet potatoes in family farms was labor (R$ 6,215.00 per hectare). This agricultural activity allows the maintenance of the activity by family farmers who have small properties, ensuring the level of social reproduction under the conditions studied.

Keywords: Added value, Farmer income, Agricultural management.

1. INTRODUCTION

The family agricultural production unit is legally defined as the union of individuals composed of a family who exploit a set of production factors to produce food for themselves or for sale and is characterized by having up to four area fiscal modules. The management of property is strictly the responsibility of the family, using family labor, predominantly for the economic activities of the establishment, and at least half of the family income comes from the activity carried out on the property (B razil, 2017).

Recebido em 14/02/2022 e aprovado para publicação em 03/10/2023
DOI: http://dx.doi.org/10.17224/EnergAgric.2023v38n4p16-24

In Brazil, 3.9 million establishments are classified as family farmer property and occupy an area of 80.9 million hectares. In the Northeast Region, the states of Pernambuco and Ceará have the highest proportions of area occupied by family farming in the country. Family production units in Ceará cover an area of approximately 3.3 million hectares (IBGE, 2017).

Temporary crops, such as vegetables and legumes, are the main foods produced by family farming. According to Faulin and Azevedo (2003), this is explained by the possibility of obtaining good economic results without requiring large areas of land and not requiring much technical knowledge from farmers.

The economic results of family farming establishments (added value) can be maximized with rural credit. Rural credit is an agricultural policy instrument created in the 1960s; however, family farming was only covered in 1995 with the creation of the National Program for Strengthening Family Agriculture (PRONAF) (Bianchini, 2015). For Gomes *et al* . (2021) A PRONAF is essential for undercapitalized family farmers who need financial resources to invest in their property.

In this sense, taking out a loan with financial agents requires planning and production management so that farmers can meet their commitments. In addition, administration can help make better decisions and obtain optimal results in projects, regardless of the size or economic sector in which they operate (Assis Neto; Robles Júnior, 2021).

In agriculture, due to its particularities, which are mainly related to fluctuations in input markets and seasonality of production, management assumes significant importance in guaranteeing remuneration to rural producers and the continuity of food production.

Cost management is a crucial part of agricultural administration. Decision-making when supported by data and information ensures rational choices and adequate use of production factors (Conab, 2010). However, recording and controlling production costs is not an activity commonly carried out by family farmers.

In this context, this study aimed to identify the costs of sweet potato production and calculate the added value and farmer's income for a family production unit that wishes to implement an irrigation system for sweet potato cultivation.

2 MATERIALS AND METHODS

To analyze production costs, expenses recorded during a sweet potato production cycle from September to December 2020 on family farmer property in the municipality of Guaraciaba do Norte-CE were considered. The data obtained were estimated for one hectare, considering the real costs and marketing price arising from the commercial production of sweet potatoes.

The socioeconomic analysis was carried out based on simulations of asset acquisition for irrigation infrastructure without financing and with financing by family farmers.

2.1 Production costs

The survey and monitoring of production costs were carried out on the property during the crop cycle. The costing method adopted was activity-based costing or activity-based costing (ABC) to identify costs according to each activity performed in the crop production process (Bornia, 2002).

Costs were classified into fixed and variable costs. The fixed costs (CFs) were composed of the depreciation values of the irrigation system items.

The variable costs included the inputs (fertilizers, growth regulators and propagation material), contracted services and operations and labor required during the crop cycle.

The total cost (CT) is the sum of the total fixed cost (CFT) and total variable cost (CVT), according to the following equation:

$$\mathrm{CT} = \mathrm{CFT} + \mathrm{CVT} \quad (1)$$

The average total cost (CMe) is given by the ratio of the total cost to the quantity produced (Q). Therefore, the average fixed cost (CFMe) and average variable cost (CVMe) are obtained by dividing the fixed and variable

costs, respectively, by the quantity produced (Q), according to the following equations:

$$CMe = \frac{CT}{Q} \quad (2)$$

$$CFMe = \frac{CF}{Q} \quad (3)$$

$$CVMe = \frac{CV}{Q} \quad (4)$$

The selling price of sweet potatoes was R$25.00 per 25 kg box, according to values provided by the Tianguá-CE Supply Center (Ceasa, 2020). After harvesting, commercial productivity was 34.85 t ha $^{-1}$ in the study area.

2.2 Socioeconomic analysis

Social analysis consists of expressing the potential of an activity to generate jobs and determine the added value of rural property (Silva Neto; Dezen; Santos, 2009). The value-added indicator aims to analyze the capacity of the production unit to generate wealth for society and can be obtained according to equation 5:

$$VA = VBP – (CF+ CV + D) \quad (5)$$

Being:
VA: added value (R$);
VBP: gross production value (R$)
CF: fixed costs associated with the production system (R$)
CV: variable costs associated with the production system, except the cost of labor (R$);
D: depreciation of equipment and facilities (R$).

The gross value of production (VBP) is determined by the product of crop productivity (kg ha $^{-1}$) and the product's sales price (R$ kg $^{-1}$), which is associated with the area established with the crop (ha). For the present study, the amount paid to the producer was considered in accordance with the values practiced at the Tianguá-CE Supply Center in December 2020.

The depreciation (D) of fixed assets (wells, motor-pump sets and irrigation systems) represents the wear or loss of usability (useful life) of the tangible elements classifiable there, resulting from wear due to the action of nature or normal obsolescence (caused by technological developments). Depreciation was calculated according to equation 6:

$$D = \frac{C-R}{n} \quad (6)$$

Being:
D: annual depreciation quota, (R$);
n: expected useful life (years);
C: initial value of the good (R$);
A: residual value (R$).

The economic analysis of the production system was carried out based on determining the rural producer's income (Equation 7).

$$RA = VA – (J + S + I) \quad (7)$$

Being:
RA: producer income (R$);
VA: added value (R$);
J: interest paid to banks or other financial agents (R$);
S: Salaries paid to workers (casual or permanent) (R$)
I: Taxes (R$).

The cost of electrical energy consumption for the irrigation system was estimated based on Equation 8:

$$EC = 0.7457x\ Pot\ xTf\ x\ PkWh \quad (8)$$

Being:
CE: cost of electrical energy during the crop cycle (R$);
0.7457: conversion factor from hp to kW;
Pot: engine power (hp);
Tf: system operating time (h);
PkWh: price per kWh (R$).

For this study, two possible scenarios for sweet potato production were considered, without financing and with financing from PRONAF Mais Alimentos, in accordance with the 20-21 Harvest Plan, whose line has a rate of 2.75% per year and a period of payment for ten years. In the financing scenario, the capital of

the simulated loan is intended to cover the initial fixed costs of implementing a drip irrigation system for sweet potato cultivation on one hectare.

From the determination of the added value and farmer's income obtained for each established scenario, linear models were developed that describe the added value of sweet potato production as a function of the useful agricultural surface per unit of work (SAU/UT) and the farmer's income as a function of useful agricultural area per family work unit (SAU/UTF). One work unit corresponds to an adult working eight hours a day.

Considering the farmer's income models, the minimum usable agricultural surface was identified for the farmer to continue agricultural activities, guaranteeing a minimum income represented by the level of social reproduction (NRS). An NRS value of R$1,100.00, equivalent to the monthly minimum wage (in 2020), was considered.

3 RESULTS AND DISCUSSION

The production costs of a sweet potato cultivation cycle on one hectare are shown in Table 1. Variable costs constitute more than 60% of the total production costs. Among the variable costs, labor (R$6,215.00) is the largest, followed by services/operations (R$5,991.00) and inputs (R$3,805.32).

Table 1. The sweet potato production costs for one cycle (3 months) on one hectare.

Activity-Based Costing					
Cost	Discrimination	und	qty	value unit (R$)	Total (R$)
Variable	A- Inputs				
	Ammonium sulfate	kg	300	1.68	504.00
	Simple superphosphate	kg	834	2.42	2,018.28
	Potassium chloride	kg	259	2.56	663.04
	Reg. Cres . Stimulate	L	two	290	580.00
	Sweet potato branches	kg	80	0.50	40.00
				subtotal A	3,805.32
	B- Labor				
	Labor in soil preparation	daily	40	40	1,600.00
	Planting labor	daily	16	40	640.00
	Weeding labor	daily	30	40	1,200.00
	Harvest labor	daily	30	40	1,200.00
	Washing labor	daily	45	35	1,575.00
				subtotal B	6,215.00
	C- Services/Operations				
	Plowing and harrowing	H/T	4	60	240.00
	Electricity	kw	500	0.35	175.00
	Logistics costs	R$/cx	1394	4	5,576.00
				subtotal C	5,991.00
Fixed	D- Depreciations				
	pit	R$			90.00
	irrigation system	R$			198.8
	motor pump set	R$			180.00
				subtotal D	468.80
Total cost	(A+B+C+D)				16,480.12
VBP	Gross Production Value for the period				34,850.00
	Net result for the period				18,369.88

To produce 1.0 kg of sweet potatoes in the period analyzed, a total expense of R$0.47 was needed. The average variable cost corresponds to 98% of the average cost, requiring R$0.46 to produce 1.0 kg of sweet potatoes or R$11.50 to produce a 25 kg box. The fixed cost represents 2% of the average cost, requiring R$0.01 to produce 1.0 kg of sweet potatoes or R$0.34 to produce a 25 kg box (Table 2).

Table 2. Average cost, average fixed cost and average variable cost in reais per kilo and in reais per box

Cost	R$/kg	R$/Box 25 kg
CM	0.47	11.82
CFM	0.01	0.34
CVM	0.46	11.49

The average cost represented 47% of the total VBP for the period, the average fixed cost corresponded to 1%, and the average variable cost represented 46% of the VBP. The net result for the period was R$ 18,369.88.

Melo *et al* . (2009) reported that sweet potato production is an economic activity that allows workers to be employed in rural areas, ensuring satisfactory financial results and a return on capital invested in the municipality of Itabaiana-SE.

3.1 Socioeconomic analysis

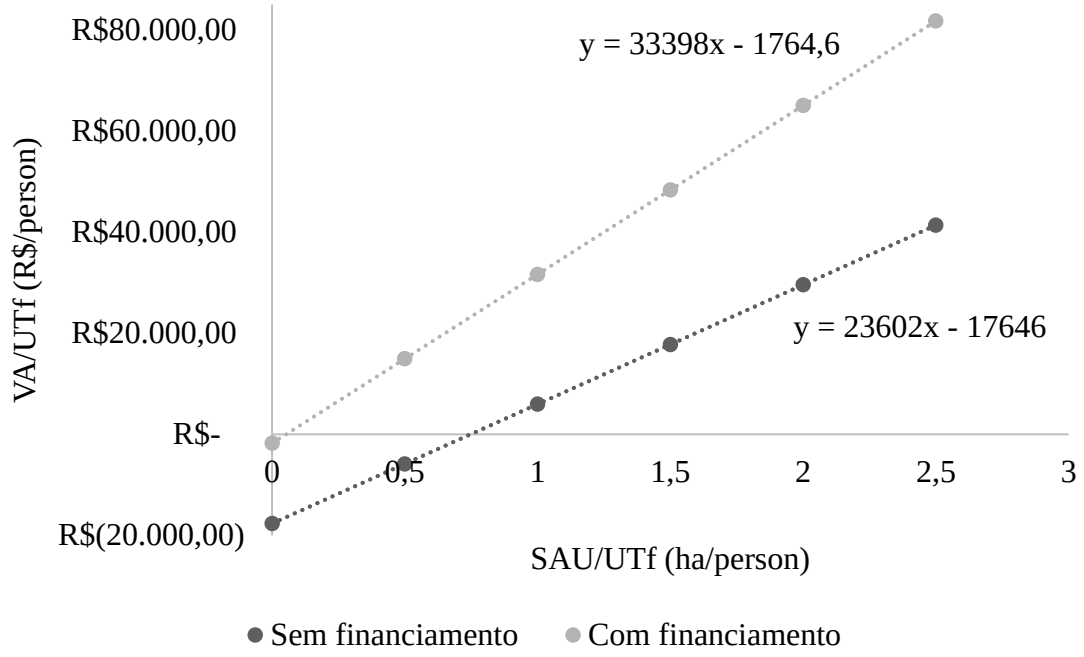
Table 3 presents the sweet potato production costs considering the need for initial investment in a water storage reservoir for irrigation, motor-pump sets and irrigation systems. Therefore, fixed costs correspond to the value of acquiring basic infrastructure for implementing an irrigation system in a family production unit.

Table 3. Variable costs, cost of purchasing an irrigation system (fixed cost), gross production value and added value of production.

Costs	**Discrimination**	**Price R$)**
Variables	Inputs	3,805.32
	Labor	6,215.00
	Services/operations	5,991.00
	total variable costs	16,011.32
Fixed	Reservoir	8,000.00
	Irrigation system	4,489.00
	Motor pump set	5,157.00
	total fixed cost	17,646.00
	financing installment	1,764.60
	annual depreciation	1,452.15
VBP	Gross Production Value	34,850.00
VAcf	VA = VBP – (CF+CV+D) with financing	31,633.25
Vasf	VA = VBP – (CF+CV+D) without financing	5,955.53

The added value models in relation to the useful agricultural surface are represented in Figure 1. The social contributions of the two scenarios (with and without financing) to the area needs and fixed production costs are observed.

Figure 1. The added value depends on the useful agricultural area for the sweet potato production unit.



The scenario with financing presents a greater marginal contribution per unit of area (33,398) compared to the scenario without financing (23,602); therefore, it is a more intensive scenario and generates greater added value per unit of useful agricultural surface. The linear coefficients correspond to fixed production costs that do not vary in the short term in both cases.

Furthermore, financing plays a fundamental role in the agricultural activities of undercapitalized producers. Gomes *et al* . (2021), studying the added value of properties with organic and conventional systems in the municipality of Guaraciaba do Norte-CE, found that farmers are unable to meet the initial expenses related to the investments necessary for production with just one hectare without access to rural credit.

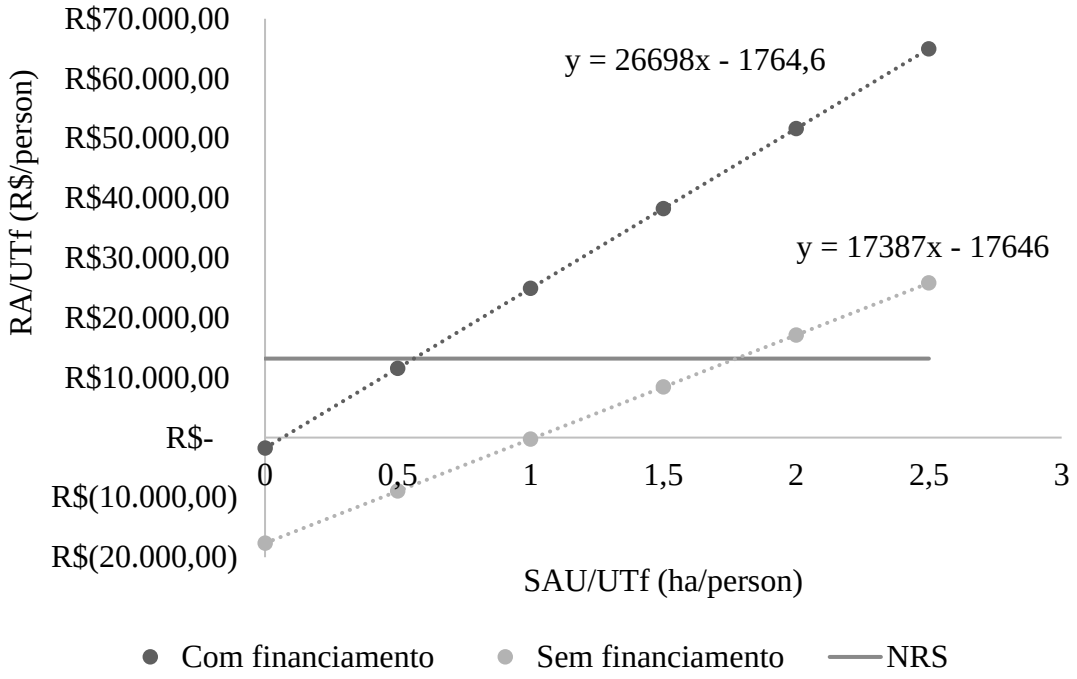
Table 4 presents the components for determining farmer income (RA) for an area of 1.0 ha for conditions with and without financing, obtained by the difference between the aggregate value of production and the interest costs paid to financial agents and wages paid to workers for production. Expenses related to taxes were disregarded due to the classification of family production units in Law 9,393/1996, which grants tax immunity to small rural properties with up to 30 ha (Brasil, 1996).

Table 4. Farmer's income corresponding to 1.0 ha (maximum productivity) for conditions with and without financing

Scenario	VA(R$)	Interest (R$)	Salaries (R$)	AR (R$)
With financing	31,633.25	485.30	6,215.00	24,932.95
No Financing	5,955.53	-	6,215.00	- 259.47

Figure 2 shows the behavior of the farmer's income depending on the useful agricultural surface. The marginal contribution of financed production is greater (26,698) than that of unfinanced production (17,387).

Figure 2. Farmer's income as a function of useful agricultural area



Comparing the two scenarios, it is assumed that nonfinanced production would require more usable agricultural surface than financed production to promote the farmer's continuity in agricultural activity, guaranteeing the social reproduction of his property. To achieve the NRS, it would be necessary to have 0.56 ha with investment financing versus 1.77 ha under unfunded conditions.

Therefore, the greater the fixed costs of the production unit and the lower the marginal contribution are, the greater the amount of useful agricultural surface that is expected for the worker to obtain sufficient income to justify his continuation in agricultural activity.

The dynamics of the need for greater land accumulation to increase farmer income were also observed by Pinto (2021) in the production of organic papaya and by Silva (2017) in the production of cherry tomatoes, both in the municipality of Pentecoste-CE.

The diversity of annual crops typical of family farming combined with the possibility of multiple harvests due to the implementation of irrigation systems are factors that can guarantee higher income values for family farmers.

4 CONCLUSIONS

Recording production costs is essential for planning agricultural activities. Considering the case studied, it was observed that in family farming, the main total cost of sweet potato cultivation is labor, considering the cultivation practices in Guaraciaba do Norte-CE.

Sweet potato production allows family farmers who own small properties to maintain their activity, ensuring the level of social reproduction under the conditions studied.

Detailed studies of property costs and investments are suggested considering all preexisting crops and crops, with the aim of understanding and comparing more advantageous alternatives for family farming.

5 REFERENCES

ASSIS NETO, AG; ROBLES JÚNIOR, A. Application of direct costing on a small rural property. **Costs and @gronegócio** , Recife, v. 17, no. 1, p. 184-216, 2021.

BIANCHINI, V. **Twenty years of PRONAF, 1995 - 2015** : advances and challenges. Brasília: SAF/MDA, 2015.

BORNIA, AC **Management cost analysis** : application in modern companies. Porto Alegre: Bookman, 2002.

BRAZIL . Decree No. 9,064, of May 31, 2017. Provides for the Family Agricultural Production Unit, establishes the National Family Farming Registry and regulates Law No. 11,326, of July 24, 2006, which establishes the guidelines for the formulation of the National Family Farming Policy and rural family enterprises . **Official Gazette of the Union** , Brasília, DF, p. 11, 31 May 2017 . Available at: http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2017/Decreto/D9064.htm. Accessed on: 12 June. 2021.

BRAZIL. Law No. 9,393, of December 19, 1996. Provides for the Rural Land Property Tax - ITR, payment of debt represented by Agrarian Debt Securities and other provisions. **Official Gazette of the Union** , Brasília, DF, p. 27744, 20 Dec. 1996. Available at: http://www.planalto.gov.br/ccivil_03/leis/l9393.htm. Accessed on: 10 June. 2021.

CEASA . **Daily newsletter of 12/24/2020** . Tianguá: National Agricultural Market Information System-SIMA, 2020.

CONAB. **Agricultural Production Costs** : the Conab methodology. Brasília, DF: Conab, 2010. Available at: https://www.conab.gov.br/images/arquivos/informacoes_agricolas/metodologia_custo_producao.pdf. Accessed on: May 29, 2021.

FAULIN, EJ; AZEVEDO, PF Distribution of vegetables in family farming: an analysis of transactions. **Economic Information** , São Paulo, v. 33, no. 11, p. 24-37, 2003.

GOMES, MDA; COSTA, RNT; ROJAS, GG; OLIVEIRA, FTO; NUNES, KG Sustainability of organic and conventional irrigated systems based on family farming . **Irriga** , Botucatu, v. 1, no. 1, p. 14-29, 2021. Special Edition – Northeast

IBGE. **2017 Agricultural Census** : Definitive results. Guaraciaba do Norte: IBGE, 2017. Available at: https://censoagro2017.ibge.gov.br/templates/censo_agro/resultadosagro/pdf/agricultura_familiar.pdf Accessed on: 12 June. 2021.

MELO, AS; COSTA, BC; BRITO, MEB; NETTO, AO A; VIÉGAS, PRA Cost and profitability in sweet potato production in the irrigated perimeters of Itabaiana, Sergipe. **Tropical Agricultural Research** , Goiânia, v. 39, no. 2, p. 119-123, 2009.

PINTO, CS **Technical and economic indicators of the papaya tree to the production factors of water and organic compounds** . 2021. Dissertation (Master's in Agricultural Engineering) – Center for Agricultural Sciences, Federal University of Ceará, Fortaleza, 2021.

SILVA, VB **Response of cherry tomatoes under organic cultivation to water levels and different types of mulch** . 2017. Dissertation (Master's in Agricultural Engineering) – Center for Agricultural Sciences, Federal University of Ceará, Fortaleza, 2017.

SILVA NETO, B; DEZEN, M; SANTOS, PE The concept of social reproduction in the analysis of agricultural production units. **Economic Theory and Evidence** , Passo Fundo, year 15, n. 32, p. 87-108, Jan./Jun. 2009.