Taro (*Colacasia esculenta* (L.) SCHOTT) value chain in Veracruz, Mexico

Salgado-Molina, Abel[1]; **Álvarez-Ávila, María del C.**[1*]; **Asiain-Hoyos, Alberto**[1]; **Platas-Rosado, Diego E.**[1]; **Figueroa-Rodríguez, Katia A.**[2]; **Ducrocq, Charles**[3]

[1] Colegio de Postgraduados-Campus Veracruz, Km. 88.5 Carretera Federal Xalapa-Veracruz, vía Paso de Ovejas entre Paso San Juan y Puente Jula, Tepetates, Veracruz, México, C.P. 91690.
[2] Colegio de Postgraduados-Campus Córdoba, Carretera Federal Córdoba-Veracruz km 348, Manuel León, Amatlán de los Reyes, Veracruz, México, C. P. 94946.
[3] Escuela Doctoral en Ciencias Jurídicas, Políticas, Económicas y de Gestión - ED 262, Universidad de París, 10 avenida Pierre Larousse 92240 Malakoff, Francia.
* Correspondence: malvareza@colpos.mx

ABSTRACT

Objective: To identify and analyze the links of the taro (*Colocasia esculenta*) value chain in Actopan, Veracruz, Mexico, focusing on its deficiencies and opportunity areas, and to simulate the yields generated by this crop.
Design/Methodology/Approach: The research was carried out in the town of Santa Rosa, in Actopan, Veracruz, Mexico, with local producers and manufacturers, using both an exploratory and a random descriptive method and a qualitative and quantitative approach. Direct observation, interviews with key informants, and reflection and analysis workshops were carried out to find out which are the links of the value chain and how they operate within the taro agroecosystem in the study region.
Results: The links between inputs supply, production, harvest and post-harvest, collection and distribution, transformation-packing-crating, and commercialization were determined. The main limitation was the area cultivated by half of the producers (0.5 to 3.0 hectares) who obtain an average annual yield of 50 t ha^{-1}. The cost of agricultural inputs is high, the market prices for the product are low, and pest organisms impact the production. Regional middlemen (both retailers and wholesalers) are in charge of commercialization and most of the agreements are informal. The main market for taro and its destination is international (90% for the American market). The best organized packing plant has a 126 to 169% monthly yield.
Study Limitations/Implications: Performance simulations must be carried out in medium and small packing plants to obtain an overall comparison.
Findings/Conclusions: The production and commercialization of taro in the study area generate economic income and local employment throughout the year. Taro also has lower production costs than other crops, as well as a high return on investment. Overall, it benefits the economic agents of the value chain. However, the lack of organization of the participants does not allow them to use economies of scale or to access preferential markets. Consequently, the economic benefits are not distributed equally among all the links.

Keywords: Taro, value chains, performance.

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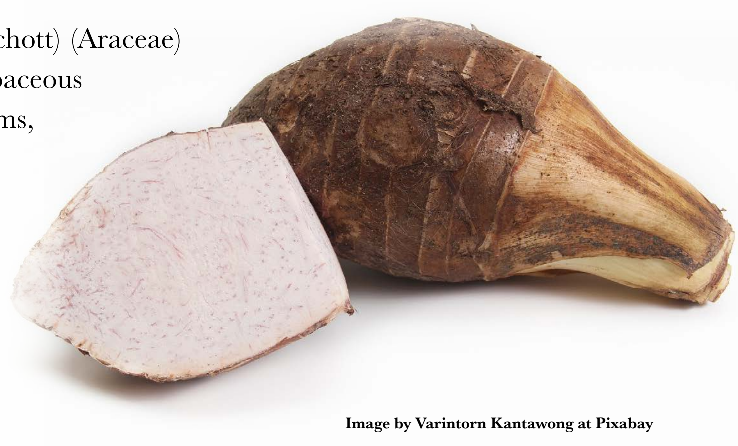
INTRODUCTION

Taro (*Colacasia esculenta* (L.) Schott) (Araceae) is a tropical and subtropical, herbaceous perennial plant. It lacks aerial stems, but it has large leaves that come from a primary underground corm —its commercial product. It is classified as a



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non-traditional exotic product and its global consumption has experienced a significant boom, taking advantage of the interest shown by growing consumer sectors. Its importance as a nutritious and highly digestible food comes from the microgranular structure of its starch, as well as from its minerals and vitamins (magnesium, iron, phosphorus, potassium, sodium, copper, and manganese; and vitamin C, vitamin E, and vitamin B6). It is grown in humid and tropical regions of southeastern Mexico, Central, and South America. Its easy cultivation makes it highly viable for its commercialization as fresh and processed products, providing it with great potential in the domestic and foreign markets. Taro develops well in humid areas and only its underground fraction —a modified stem known in the field of botany as corm— can produce more than 50 t ha^{-1}. One fifth of the total biomass stored in it constitutes dry matter; 80% of it is made up of high digestive quality starches (Olguín-Palacios, 2018).

In Mexico, the main producing states are Oaxaca, Tabasco, Nayarit, Sinaloa, and mainly Veracruz. The last state accounts for 84.80% of the national total (577 ha). In Veracruz, the main producing municipalities are Paso de Ovejas, La Antigua, Puente Nacional, Úrsulo Galván, and Actopan. In this last municipality, the average annual growth rate of taro has been higher than other crops in the same period, including sugarcane (*Saccharum* spp.), chayote (*Sechium edule*), and manila mango (*Mangifera indica*) (Lezama, 2020).

Currently, value chain analysis is one of the main tools that companies have available to carry out their strategic planning and to generate competitive advantage —a topic of vital importance nowadays, given the number of competitors whom they have to face, mainly as a consequence of globalization, e-business, and the opening of markets, among other factors (Zamora, 2016).

A value chain (Porter, 1985) is a basic business tool to analyze the sources of competitive advantage, because it is a systematic way to examine all the activities that are carried out, as well as their interactions. Consequently, the processes can be divided in their strategically relevant activities, in order to understand the cost behavior, as well as the current and potential sources of differentiation. A value chain is surrounded by economic agents; the agent can also be a participant in all the activities carried out in the said chain (Riemann, 2013). Jan van Roekel (1995), mentioned that "In the future, agri-food producers, processors, logistics service providers, and distributors will no longer compete as individual entities; rather, they will collaborate in a strategic "Value Chain", competing against other value chains in the market."

In this scenario, the proper management of sustainable agri-food value chains plays an important role, since they provided a clearer reflection of the complex reality of agriculture and the relationships that develop between the various participants (Sayers, 2003). In this sense, a value chain must be evaluated based on its profitability (as a relative measure of profits). It is determined by the comparison of the net profits of the company through its sales (profitability or net profit margin on sales) with the investment made (economic or business profitability) and the funds contributed by its owners (financial or owner profitability) (Morillo, 2001). More specifically, financial profitability indicates the company's ability to obtain profits from the investment made by shareholders, including the undistributed profits of which they have been deprived (Urias, 1991). Consequently, the promotion of the economic and social development of the producing region requires a clear identification of the members of the taro value chain in the study region and their functions, as well as an economic measurement of their production process.

MATERIALS AND METHODS

Location of the study area

The research was carried out in the town of Santa Rosa Actopan, Veracruz, Mexico (19° 23' and 19° 44' N and 96° 20' and 96° 48' W) with local producers and manufacturers.

Data collection and analysis

The research was exploratory and descriptive, using a qualitative and quantitative approach; it had the participation of key actors. To determine the links of the value chain and how they operate within the taro agroecosystem in the study region during 2018, 2020, and 2021, the following research instruments were used: direct observation, interviews and questionnaires answered by key informants, and reflection and analysis workshops.

The first approach consisted of a meeting with the manager of the largest packing plant in the area, as well as with a group of producers. The objectives of the research work were explained to both the businessman and the producers and they were asked their opinions about the taro value chain. Their answers laid the foundations for the development and arrangement of the data collection instruments, specifically semi-structured interviews and questionnaires that covered the following topics: information about the members of the links (name, age, sex, etc.), knowledge of value chains, participation in the value chain (link to which they belong), types of interaction with the different links, and contribution to the value chain.

Subsequently, field visits were carried out in the area to learn about the operation of the value chain. The producers and the workers answered guiding questions with their point of view and opinion. In addition, periodic semi-structured interviews were conducted with the manager of the packing plant and with some producers who work with him. Consequently, the resulting data were used to identify the components and the function of each link of the taro value chain in the study area.

The data was subjected to a three-stage analysis. In the first stage, the framework data was subjected to a qualitative analysis, considering the stages of separation of units according to functional and process criteria, as well as the identification and classification of units. The value chain model proposed by Michael Porter (1985) was taken as a basis to identify which stages add value for clients and interested parties of the taro agroecosystems. In the second stage, a cost and component analysis of the taro production process was carried out using the Vensim software. And in the third stage, the same software was used to develop a predictive model to project the profitability generated by the productive process of the taro value chain.

RESULTS AND DISCUSSION

The state of Veracruz has mostly extensive and monoculture production systems (INIFAP, 2019) and, for the most part, taro is grown under this modality. Taro is grown in

679 ha of the Mexican territory (SIAP, 2018), out of which 577 ha (84.80 %) are located in the Veracruz.

Identification of the participants of the value chain

Six links of the taro value chain were identified in the Actopan municipality (Figure 1): inputs supply; production, harvest, and post-harvest; collection and distribution; transformation; packing and crating; and commercialization.

Agricultural input suppliers are the first link in the value chain. These are considered relevant participants or agents of the chains and are represented by agrochemical stores that supply agricultural inputs to producers in various parts of the Actopan municipality. These stores advice the producers during the initial stage of planting and development of the crop, regarding the use, dosage, and application of fertilizers. However, not all producers receive this service, since it depends on their type and their economic capacity. Regarding the value chain approach, there is no special link between the first and other links and the input purchase and production activities lack any kind of organization. All the respondents indicated that they did not belong to any organization, which limits their lobbying power, hindering their access to government financial support and preferential wholesale prices, and limiting their preferential access to the markets, among other advantages that they would obtain if they belonged to a group of that kind.

The production includes the producers as main participants. Most of them (57.1%) have a small productive unit ranging from 0.5 to 3.0 ha; producers with plots between 4.0 and 6.0 ha account for 14.3%, while those with plots of 7.0 to 9.0 ha are 21.4% of the total; finally, producers with more than 10 ha and whose average yields reach 50 t ha^{-1} account for 7.1%. Most of the producers (75%) grow a local or native variety identified as coconut taro and obtain a 75.0% profitability. The rest of the producers (25%) indicates that they produce it to increase the profitability of the planted area. This result matches the findings of a study carried out by Arce (2018), in which most of the producers explained that the production of taro enhances their income. The main problems or limitations that producers have faced are high prices of agricultural inputs (32%), low market prices for the corm (28.5%), pest and disease control (25%), high production costs (14.2%), and commercialization problems (3.5%). To calculate the total production sowing costs, the following elements were added: labor costs of sowing per month, total water costs per hectare and per month, and total land treatment costs per year and per month, as well as the total and monthly number of hectares (Figure 2).

The next link is divided into harvest and post-harvest activities. The harvest is carried out 9 to 12 months after planting. In order to keep the corm fresh during the

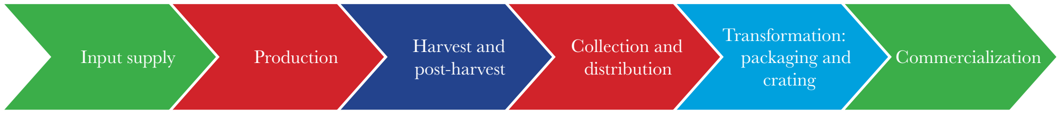

Figure 1. Taro value chain in the municipality of Actopan, Veracruz.

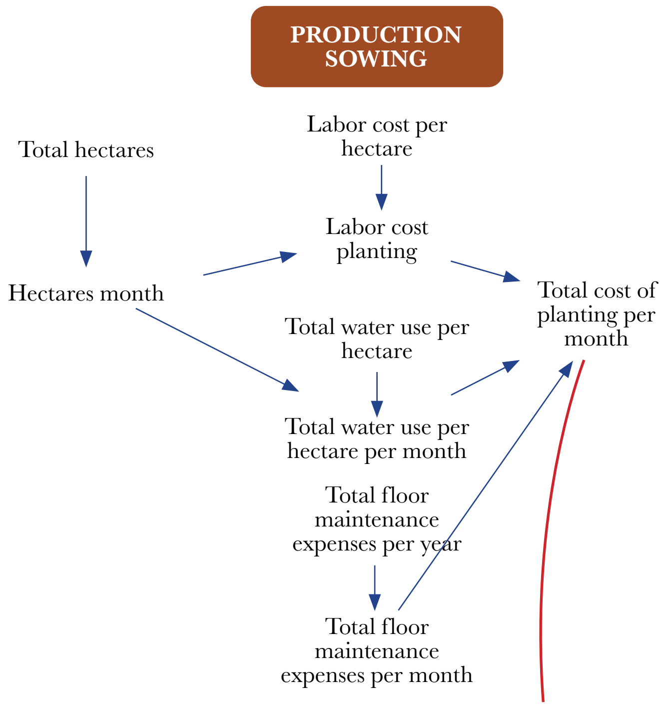

Figure 2. Elements of the production link.

transportation from the plantation to the packing facilities, it must include part of the stem where leaf growth begins (Zelendon, 2010). The intermediaries hire personnel to visit the production unit to schedule the purchase with the producers; the said personnel are aware of the quality standards of the exported produce, the main destination of this crop. Once the corms have arrived at the various packing plants, a process of selection, washing, drying, and packing in 18-kg net sacks (arpillas) begins. The total labor per crop and the daily labor payment were used to calculate the total expenses per crop (harvest) (Figure 3).

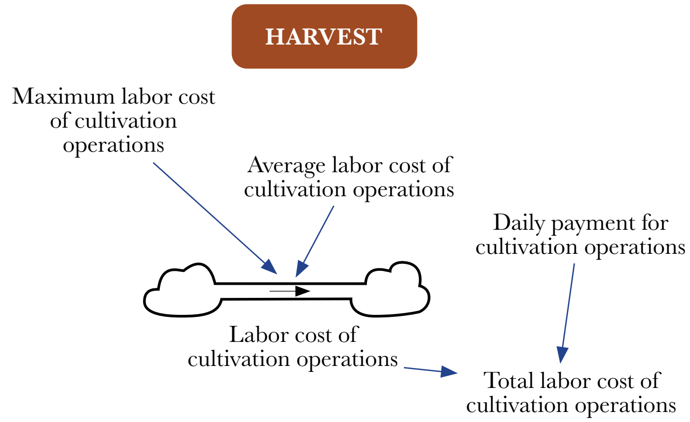

Figure 3. Elements of the harvest and post-harvest link.

The activities of the collection and distribution link (Figure 4) are carried out by regional rural collectors, retailers, and wholesalers. The wholesalers are the dominant force in the region: they go directly to the production unit where the harvest is carried out. This type of negotiation means that the producers avoid the inconvenience of transporting the product. The product is paid according to the regional price (López *et al.*, 2018).

Transformation, packing, and crating are the penultimate link. The seven regional packing plants were the sole participants of this link. Empacadora Santa Rosa is the biggest packing plant in the region. Only 10% of its total production is transformed into fried food which are sold by its subsidiary, Empresa de Frituras Doña Leo. The rest (90%) is packed fresh for its exportation. It is important to emphasize that, following the selection process, the percentage of the corms used to produce fried food (10%) do not comply with the exportation requirements. Other local packing plants follow the same process: they also pack close to 100% of their production for exportation as fresh product. Unlike Empacadora Santa Rosa, low-quality corms (20%) that do not qualify for exportation are sold in the domestic market (20%), which means that they have an 80% loss. Finally, in the last link (commercialization), 90% of taro production is destined for export to the United States by land —five 20-ton shipments per week, along with three weekly shipments by sea. The packing plants are the sole participants in this link. They have their own clients, along with well-defined distribution channels. Figure 5 shows the elements used to calculate the total distribution expenses; the data comes exclusively from Empacadora Santa Rosa.

Empacadora Santa Rosa has total annual expenses of approximately $14,297,396 —calculated adding the monthly expenses of the production process (Table 1)— and a total income of approximately $33,344,230 —the total annual income, which has an approximate 165 % annual return regarding the initial investment (Table 2).

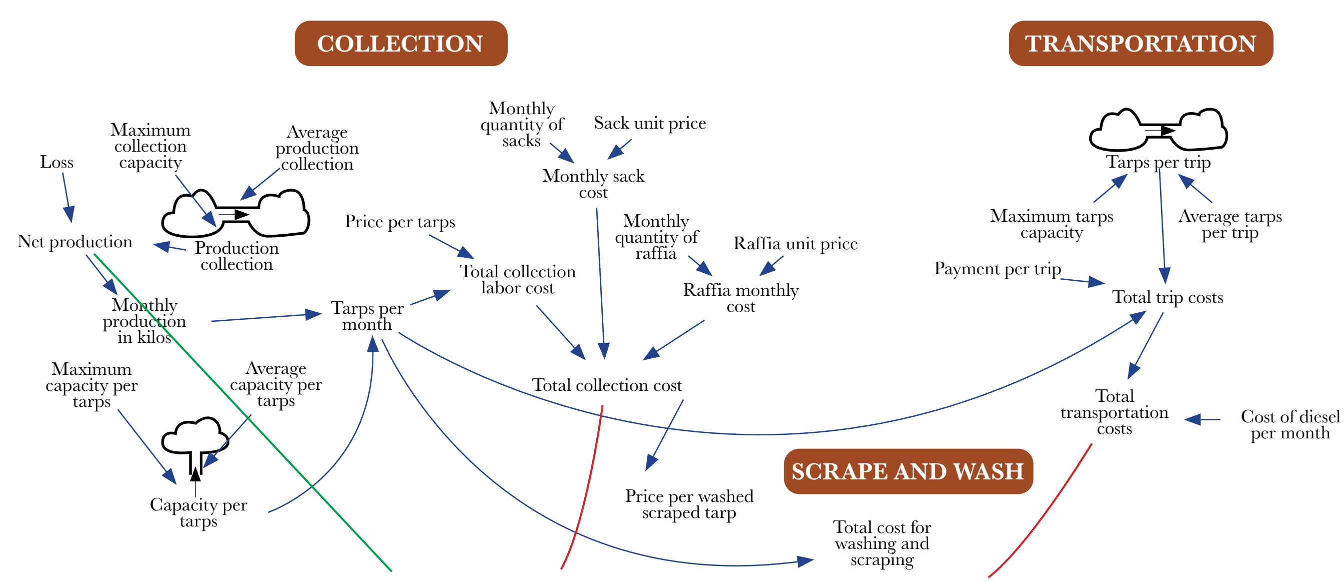

Figure 4. Elements of the transportation and distribution link.

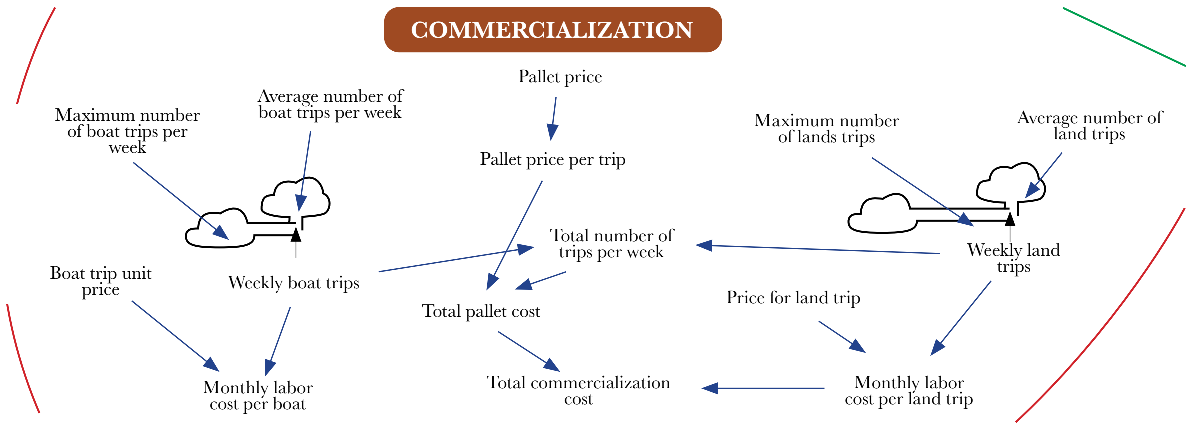

Figure 5. Elements of the commercialization link.

Table 1. Annual expenses for the cultivation and commercialization of taro (*Colocasia esculenta*).

Month	Labor Crop	Harvest	Transp.	Wash. & Scrap.	Packaging	Total Cost
0	181186.3	160917	11922.4	176026	239257	997,642
1	173314.2	160611	12226.3	175679.1	243302.8	993,466.70
2	187087.9	199127.6	14056.9	219331.3	317086.3	1,165,023.40
3	159784.3	181685.2	13417.8	199563.2	373657.6	1,156,441.50
4	182173.9	184746.8	12515.9	203033	314577.4	1,125,380.40
5	184221.6	186570.8	12679.4	205100.3	311926.8	1,128,832.40
6	151263.5	172439.8	13402.6	189085.2	288063.3	1,042,587.70
7	168012.2	198306.1	13381	218400.2	259984.5	1,086,417.30
8	204778.6	199204.1	13926.9	219417.9	363511.8	1,229,172.60
9	181053.2	188410.8	13139.4	207185.6	219901.2	1,038,023.60
10	140510.9	184342.7	13596	202575.1	299256.2	1,068,614.30
11	152196.5	199417.1	12957.9	219659.4	360699	1,173,263.30
12	192343.1	182941.8	12360	200987.3	275565.6	1,092,531.00
TOTAL EXPENSES						$14,297,396

Table 2. Total annual earnings.

Months	Total earnings ($)
1	2,754,200.00
2	2,816,190.00
3	2,763,010.00
4	2,788,030.00
5	2,782,250.00
6	2,787,980.00
7	2,783,710.00
8	2,779,390.00
9	2,762,360.00
10	2,814,400.00
11	2,752,880.00
12	2,759,830.00
Total	33,344,230.00

CONCLUSIONS

Six links were identified within the taro value chain (inputs suppliers, production, harvest and post-harvest, collection and distribution, transformation, packing and crating, and commercialization). All of them have very precise and independent participants, characteristics, and functions. They have scarce interaction and cooperation, unless a single person or company (*e.g.*, packing plants) is involved in more than one link. Otherwise, there are only informal relationships between links and the communication and exchange of information is non-existent. Except for a few participants, there is generally no organization and they do have a specific weight to negotiate with suppliers or customers or to influence the creation of specific government support and development programs. Regardless of the abovementioned problems, the regional packing plant with the best organization has very attractive profitability indexes, which shows that taro is a profitable crop and that, if the other links in this value chain manage to organize themselves, they can obtain better profits and contribute to the socioeconomic development of the region.

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