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Water Rates Based on Customers' Income

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Abstract: The provision of potable water and treatment services in Mexico is under the responsibility of municipal-level governments in keeping with the Mexican Constitution. This legal particularity, however, is at the heart of many unmet challenges in the water-service sector, especially in the areas of financial, technical and quality management because it gives municipalities autonomy over these matters, making it difficult to establish a standardized and efficient national protocol. One of the most overlooked yet vital challenges herein, lies with payment and collections deficiencies which cause water utilities to operate unsustainably and accrue debt. This investigation has the objective of creating a restructured water-rate system for utilities on the basis of certain economic factors such as customer salary, type of home, an adequate customer classification and the types of public services contracted so as to create a new water rate that will allow water utilities to operate in a financially balanced way while still being affordable to the customer. A case study was carried out in the Mexican town of Erongarícuaro, Michoacán to propose different payment alternatives on the basis of the analysis of key economic indexes.

Key words: affordable rates, earnings per capita, water rate, water bill payment

1. Introduction

As is the case in many cities at the global level, Mexico faces the major challenge of providing adequate and quality water provision since it has become a limited resource. Although there are many issues here, technical and administrative, this paper seeks to address overlooked financial insufficiencies in the sector. Currently in Mexico, as is stipulated in the Fourth Article, sixth paragraph of the Political Constitution of the United Mexican States concerning water rights: The State will guarantee this right and the law will define the grounds, supports and modalities for the access as well as the equitable and sustainable use of water resources, with roles allotted to the Federation, the Federal entities, municipalities and the participation of the citizenry for the attainment of such ends.

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Several significant deficiencies exist within this system, however, which keep water utilities from meeting service demands adequately. Among the factors that lie at the core of this problem are; insufficient funds, a high turnover in administrative personnel, as well as deficiencies in management planning in the short, mid and long-term. Moreover, there are issues with organizational, technical, and commercial management; the legal and regulatory framework for the improvement of inadequate potable water and treatment services, the water rates and structures that don't reflect the operational costs of water utilities, the politicization of decisions and annual work programs. Additionally, there is a low or absent disposition of people to pay for services which cause utilities to become indebted and rigidity is found in the authorization of tariffs.

From the environmental and operative perspective, scarcity and the inadequate use of water, as well as an increase in service demand, physical losses and over-exploitation call for stricter measures in the

design and enforcement of public policies that impact and discourage the inefficient use of water through educational campaigns and water culture, especially in the area of payment which requires adjustable rates that change in accordance to the volume consumed and customers' economic level and classification.

Both previously mentioned components are effective, and essential for promoting conscious and responsible use of water and avoiding waste. Failure to deal with this issue will provoke a constant deterioration in sources of supply and a depletion of aquifers which could result in low domestic water availability and potential crises.

To address the overlooked and culturally uncomfortable, yet vital aspect of money and collections in this sector, this investigation carried out a case-study analysis of field-gathered and government-provided socioeconomic information for the town of Erongarícuaro, Michoacán so as to identify key opportunity areas and strategies for moving forward towards higher quality standards and a more professional dialogue between water utilities and their customers.

The study weighed the factors of the socio-economic situation of the population and identified the affordability of water rates based on per capita earnings in the municipality, it further considers the type of housing, public services being contracted aside from water and the water habits of the town inhabitants.

This data, with the aid of the ARCGIS software's map-making system, was used to create a classification system based on housing types according to socioeconomic status using data provided by Geo-Statistical Population Analysis GSPA published by the National Institute of Geography and Statistics (INEGI).

To complement this study, official INEGI graphs were used for: the economically active population, the public services contracted (in addition to water), ability to make payment, and a real analysis of the water utility's financial situation so as to identify what inadequacies are present, be they from the population's economy or from the management of finances on behalf of the water utility.

The study was created starting with a general and commercial diagnostic of the municipality [1], specifically its physical geography, demography, social infrastructure, economy, politics, social participation, availability of water sources and their potential contamination along with the degree of satisfaction on behalf of customers for the water service they receive. Using this data, environmental and socioeconomic feasibility scenarios were created for the development of potable water, sewerage and treatment services in the short and mid-term.

The diagnostic of the commercial area was performed with information gathered from the field that was analysed jointly in collaboration with the water utility to guarantee the veracity of the information, it was supported with measurements and fieldwork done expressly by the Mexican Institute of Water Technology.

Also, sample surveys were carried out for different residential zones to identify core issues residing in the municipality, particularly, the quality, quantity and continuity of the water services they received, the satisfaction rating in complaints dealings, the rates they are willing to pay for a better service, the estimated collections level based on the total amount people in the user log versus revenue, the customer perception of the overall institutional image, social participation, and communication channels with public.

The town of Erongarícuaro is found in the north of the state of Michoacán, Mexico (Fig. 1), along the 19°35' northern latitudinal and the 101°43' western longitudinal coordinates. It has an elevation of 2,080 meters above sea level and its distance from the state capital is 75 km.

In Michoacán, the main economic sectors are distributed in percentages in the following way (Fig. 2), 11.05% belong to the first sector (fishing, mining, agriculture, livestock), 23% belong to the secondary

sector (mining industries, art crafts and construction) and 65% pertain to the third sector (transport and logistics services, tourism and the hotel industry) [2].

According to the population and housing census, Table 1, the municipality has 883 homes, a population growth average of 1% annually, the birth rate is 2.18%, the mortality rate is 0.65%. The male to female ratio is 92.8 men for every 100 women. The total number of inhabitants is 2,573 made up of 1280 men and 1293 women.

For the economic study, data was used from the Basic Geo-Statistical Area (BGSA) from the INEGI to analyze the goods and services had by the town residents, as well as the type of material used in the construction of their homes and the status of the economically active population. For more explicit

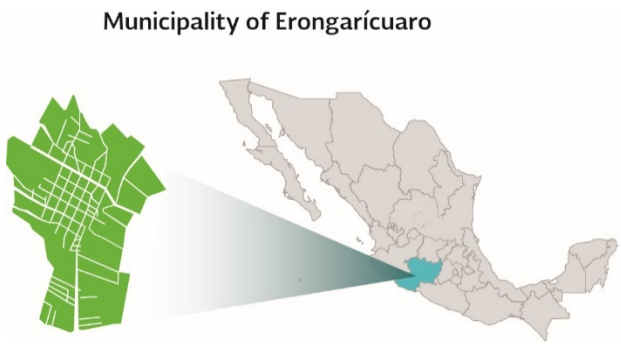

Fig. 1 Geographic location of Erongarícuaro, Michoacán, Mexico.

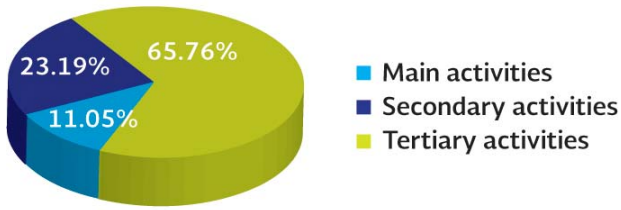

Fig. 2 Economic activities for the state of Mich., Mex [2].

Table 1 Population indicators [3].

Indicator	Result
Total of homes	883
Population growth (average)	1.01%
Birth rate	2.18%
Mortality rate	0.65%
Male to female ratio	92.8 men for every 100 women

visualization of this information, ArcGis map-making software was used to be able to classify the residential areas according to their socioeconomic characteristics.

The goods owned by the population show the purchasing power of each home and includes material goods such as, radio, television, refrigerator, washing machine, automobile, computer, land line and cellular telephony, and internet.

Upon performing a survey, it was discovered that the majority of homes are within the 41 to 60% range of ownership of these items, meaning that more than half of the population has the purchasing power to afford them (Table 2).

The main problem in this town, as is the case in many other towns, is a nascent water culture in regards to payment for potable water, sewerage and treatment services which has resulted in as much as 45% of people failing to make payment for water services.

This results in financial imbalances that create a strain for water utilities and keep them from reaching self-sustainability, what's worse is that it forces them to seek financing from external credit agencies which generate high interest rates and perpetual debt. Additionally, money shortages impair proper operations in the water utility, causing quality and supply problems. These causes drove this investigation's impetus to identify and determine customers' payment possibilities, as well as the financial situation of their water utility so as to understand which deficiencies it has that are impeding better collections practices and ultimately reveal if the problem resides in the economy of the population or in the handling of finances in the water utility.

To define the key factor for this analysis, which was the social status of customers, it was necessary to

Table 2 Socioeconomic indicators [3].

Indicator	Result
Homes with some goods	41-60%
Homes with public services	61-80%
Homes that don't have dirt floors	61-80%
Economically active population	41-60 %

examine the type of home they lived in (irrespective of the residential area or geographical location within the town), public services contracted in addition to water (such as cell phone plans, cable, television), quantity and types of vehicles owned, just to name a few elements.

2. Material and Methods

The socioeconomic analysis conducted on the town of Erongarícuaro, Michoacán, Mexico was carried out with two principal factors in mind, the first is the social cost, which can be calculated by measuring the deteriorative health impacts along with their collateral economic repercussions. The second factor is the earnings versus expenditures analysis to examine operational costs. These factors cannot be quantified easily but they can bear tangible economic benefits such as increases in production and higher collection rates for the provision of services, not to mention the generation of major and minor employment opportunities etc. [4]. This study is grounded in field data and officially gathered demographic, social and economic information from the National Statistics and Geographic Information Institute [3], which also provided the study's Basic Geo-Statistical Area indicators (BGSAs) that classify geo-statistical areas into two types: urban BGSAs and rural BGSAs. These data sets were joined together to create a map of urban BGSAs that corresponds to municipal statistics. All information was graphed using the ArcGIS map-making software in order to employ its multiple applications function that allows for joint analysis of all of the study's demographic and municipal indicators within a Graphic Information System (GIS) using data and metadata to identify housing types according to the study's classification [5].

Upon graphing the data sets and determining the socioeconomic status types of the town's inhabitants, a correlation was made between customer classification and the type of water rate that is actually being paid for.

Following that, another analysis was carried out to identify and corroborate if the customer classification corresponds to the type of contract and use that each water intake has in order to finally determine if they have the economic wherewithal to cover this payment based on monthly earnings (calculated in multiples of minimum wage salaries) or not, which would imply the requirement of a subsidy and a specially assigned tariff should there be a verifiable inability to pay. To complement the socio-economical demographic classification, a final analysis of the water utility's finances was conducted which implied a study of the whole to understand each one of its parts. That is to say, a diagnostic of the utility's technical and administrative circumstances was carried out which included the principal properties and roles of the organization. This required data from different sources and derived from a specific context which generated information that could be a key factor in transformative decision-making [6].

To visually represent the results from the socio-economic study carried out in the town of it on Erongarícuaro Michoacán, a CANVAS model was created to analyse and define the payment potential of customers for the water service they receive. CANVAS is a business model, grounded in administrative innovation with the objective of creating and generating new and applicable competitive advantage benefits for customers and water utilities alike.

This model is made up of nine essential elements that all organizations require in their business activities and examines each one of them until finding a sustainable model that adheres to a value proposal, resulting in a successful business [7].

The nine elements that make up the Canvas model, Fig. 3, and which were applied in the financial study are: (1) Client segment (2) Value proposal (3) Service channels (4) Customer relations (5) Earnings (6) Key Resources (7) Key activities (8) Key alliances and (9) Cost structure. To achieve an adequate interpretation of

this model, here is the meaning and description for each one of the nine aforementioned elements:

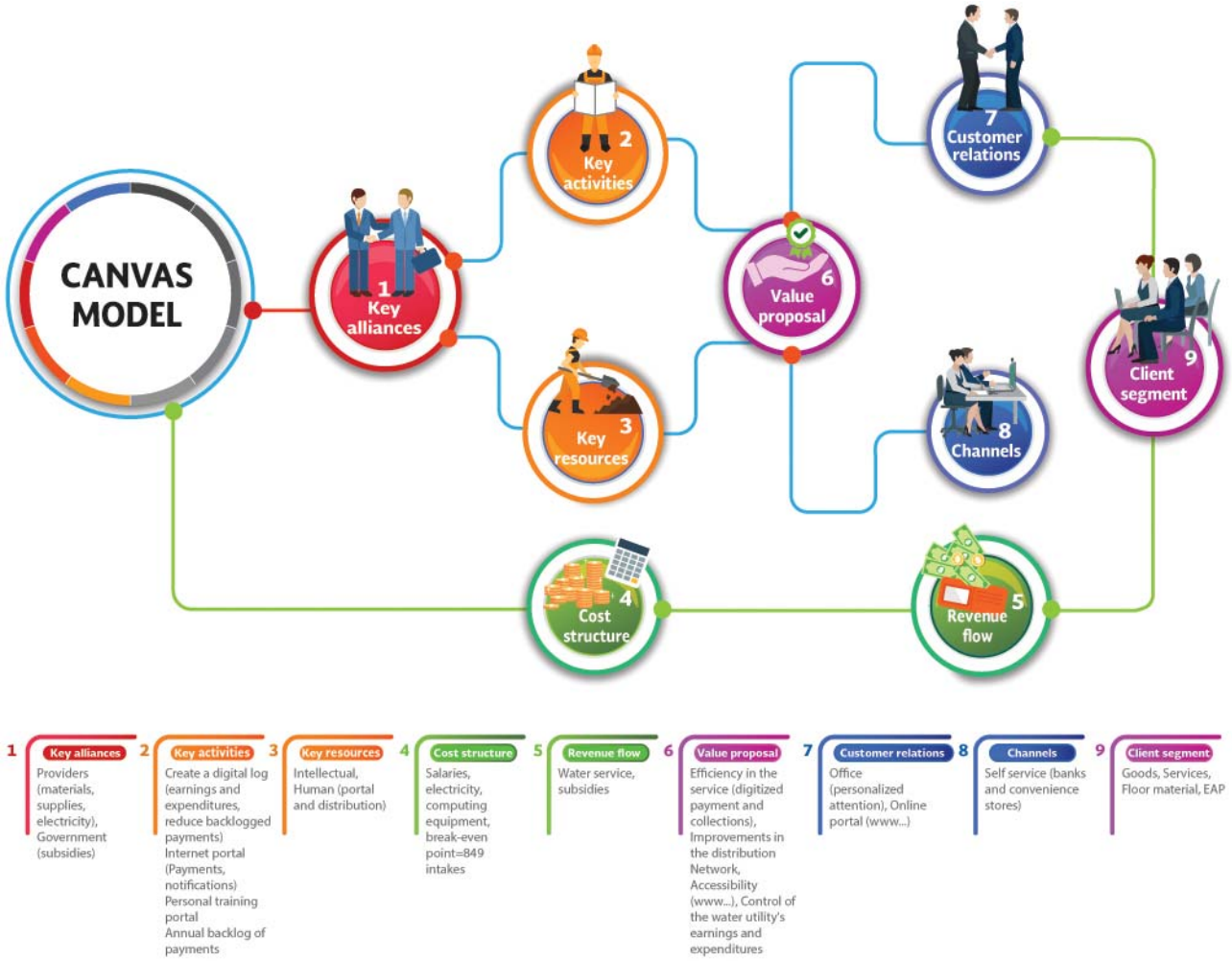

Fig. 3 CANVAS model [8].

(1) Client Segment: This element places the population into an economic segment based on monthly earnings and was key for evaluating the affordability of water rates. To achieve this segmentation, the belongings of the population were analyzed along with the totality of other types of services contracted in each home such as telephony, cable television which in turn, helped to identify the economically active population. Additional factors considered were vehicle ownership (number owned and type) as well the type of floor found in the home (tile, cement or dirt).

The results of the analysis showed that the majority of the population from 61% to 80% had high enough earnings to pay for water services, moreover, the 2010 INEGI recommendation on the matter is that up to of 6.2% total earnings can be destined in each home for basic household goods and services without generating a strain on family finances. This means that customers within the economically active classification have the financial stability and the wherewithal to pay for their monthly water service, see Fig. 4, revealing a major issue taking place in this town and in many other towns across the republic: a nascent and undeveloped water culture in regards to payment for potable water sewerage and treatment services. This nascence has resulted in as little as 55% of people paying for water services.

The amount backlogged, past-due payments for water service is significant and is not due to the

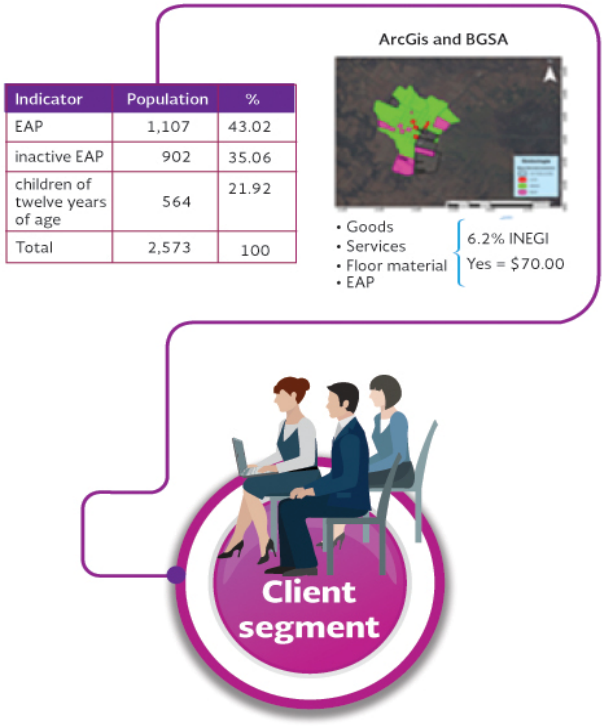

Fig. 4 Client segment.

economic limitations of customers, 87.34% of the population is economically active (Table 3), and can pay for the established water rate which is less than 70 Mexican pesos per month (3.5 USD or € 3.2). This rate represents less than one day of a minimum wage salary, which is currently $80.34 Mexican pesos (4.0 USD or € 3.6) which, based on the town's income level and the INEGI's 6.2% recommendation, which could actually ascend up to $149.00 Mexican pesos per month (7.45 USD or 6.8 EUR). Monthly minimum wage earnings add up to $2,410.00 Mexican pesos (roughly 120.50 USD o € 110.20). The United Nations Development Program (UNDP) offers an alternative percentage and counter-reference for this measure and suggests that the percentage not exceed 3% of monthly earnings, both scenarios can be applied in Erongarícuaro without affecting family economy (Table 3).

Table 3 The UNDP's 3% and INEGI's 6.2% calculation in Mexican pesos and their USD equivalent according to monthly earnings for the payment of basic services in Erongarícuaro, Michoacán.

Minimum wage mulitple	EAP	EAP (%)	Monthly earnings (average)	3% monthly (in Mexican pesos)	3% monthly (in US dollars)	6.2% monthly (in Mexican pesos)	6.2% monthly (in US dollars)
*Unemployed population	140	12.66%	$0.00	$0.00 MX	0.00 USD	$0.00 MX	0.00 USD
Less than 1 minimum wage earned	186	16.76%	$1,110 MX 60.00 USD	$33.00 MX	1.75 USD	$69.00 MX	3.65 USD
1-2 minimum wages earned	360	32.50%	$3,331 MX 175.00 USD	$100 MX	5.25 USD	$206.00 MX	10.85 USD
2-5 minimum wages earned	332	29.99%	$7,771 MX 409 USD	$233 MX	12.25 USD	$482.00 MX	25.40 USD
5-10 minimum wages earned	63	5.70%	$16,653 MX 876.50 USD	$500 MX	26.30 USD	$1,032.00 MX	54.30 USD
More than 10 minimum wages earned	26	2.39%	$23,314 MX 1,227.05 USD	$699 MX	442.00 USD	$1,445.00 MX	76.05 USD
Total	1,107	100.00%	$52,180.00 MX 2,746.30 USD	$1,565 MX	487.55 USD	$3,774.00 MX	170.25 USD

Source: Author's with data from the INEGI 2010, UNPD 2016 and 2016 official salary minimum.

Author's note: *People that were interviewed during the week of the survey that did not have employment or were looking for work.

(2) Value proposal: Once the socio-economic study of the population had established that they had the wherewithal to pay their water bill, four short-term actions were set forth that offered a competitive advantage to those who paid their services on time. The completion of these four actions will result in a value proposal for the process, Fig. 5, and are as follows:

a) Service efficiency: In conjunction with the water utility, it was proposed and agreed upon that it would conduct its administrative functions in a more orderly, dynamic and efficient manner through the practice and operation of a digital collection system complete with billing printouts. In other words, the monthly delivery of water bills to customers.

Fig. 5 Value proposal.

b) Improvements in the distribution network: To have a better hydraulic infrastructure for the supply of water so as to guarantee that the customer receives it in every domestic intake in technically good and healthy conditions.

c) Accessibility: Calls for the design and launch of a web page that will permit the population to directly and easily access relevant information concerning services offered, water provision, updates and changes which could include equipment failures, service delays etc.

d) Revenue and expenditure control for the water utility: Involves presenting a monthly, bimonthly, or semestral report of all the financial transactions that are automatically registered with the use of accounting software, this allows for a stricter control of finances and greater transparency.

(3) Service channels: Communication with customers is fundamental at all times as part of a quality service offering because it ameliorates understanding on both parts. This interaction is the medium through which customers and the water utility can come closer together so that the needs of both sides are understood and met. In other words, it is necessary and beneficial to give customers easily accessible and friendly communication to aid service channels (Fig. 6), so that users might be informed and have options that permit timely service payment. This can impulse the development of a payment culture, reduce and eventually the eliminate backlogged, past-due payments and allow convenient measures to be taken and communicated immediately with clarity and objectivity. Generating and delivering a monthly bill opens up extended customer service options such as the

Fig. 6 Service channels.

ability to make payment in convenience stores or in water-utility installed ATMs that are assigned for said purpose in strategic points of the town to create greater convenience.

(4) Customer relations: This is one of the most important and strategic activities that takes place between the customer and the service provider, which is why a very close relationship must be kept with constant communication and understanding so that adequate solutions can be arrived at for any problems that could arise. The majority of customers don't know or even find out about all of the actions that have to take place so that they can have enough, high-quality water which further underscores need for this element. A good relationship contributes to the fulfilment of element number two (Value proposal) of the CANVAS model, because it is through this means that a direct link is created between the water utility's administrative offices and personalized, efficient customer service, Fig. 7, given the utility's information, in general, is available in digital form or through the internet portal when it is uploaded and placed at the disposition of the customer. Having an excellent relationship with clients favours harmonious dealings and solidarity between both parts so that the water system may function well. This results in having customers that are satisfied with the service they receive, as well as with the cost that they have to pay for the service.

(5) Inflows: The source of earnings for the water utility comes from two sources (Fig. 8). First is the amount that is collected from the customers for the

provision of water service, which as already stated, is low. The ever-increasing backlog of past-due payments is the reason why activities to increase collections efficiency must be implemented, such as the ones indicated in element number two of this model (Value proposal). The other source of income for water utilities is from government subsidies that they might receive from the municipal or state level. It must be said, however, that the use of subsidies has encouraged low operative, financial and administrative efficiency. Actions like the ones mentioned in element 2 (Value Proposal) are recommended in order to improve the earnings from collections while diminishing or eliminating revenue from subsidies.

Fig. 7 Customer relations.

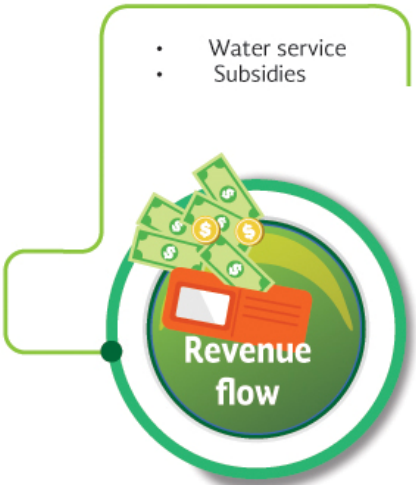

Fig. 8 Revenue flow.

(6) Key resources: To arrive at an adequate correlation and compliance of element 2 of this model (Value proposal), it is necessary to rely on the intellectual resources of the day based on current information and communication technologies (Fig. 9), that adhere to the needs, characteristics and informational infrastructure that are available in the offices of the water utility. Specialized personnel are also required to create and run an internet page with all the applications that are needed to have a user-friendly experience so that customers can access the information that is useful for them.

Continuous attention to client needs will also require the right human capital to man the website and to service clients.

(7) Key activities: Certain key actions are necessary for the proper functioning of the model's value proposal (Fig. 10), but require the correct fulfilment of the indications found in the previous point (key resources). The key activities are:

a) Design and creation of an internet portal and its corresponding tools mentioned in element 6 (Key resources) of this model.

b) Training and specialization of personnel in order to efficiently use the portal and the software for the management of earnings and expenditures

c) Creating a digital log with the use of software to manage all the transactions of the water utility that, in turn, generate two benefits. The first benefit is to have

Fig. 9 Key resources.

stricter and more detailed control over earnings and expenditures and the second benefit is being able to find out financial situation of each customer in the most punctual way possible so as to reduce backlogs in payments. This system enables quick identification of customers who owe, how long they're past due, and who is at risk of having service cut off due to lack of payment, all in accordance to the service provider's accounting information. For instance, 47.8% did not pay for water service in 2013, by the year 2014, that amount dropped to 44.33% thanks to improvements in collections practices and by incentivizing payments, in 2015 there was an even better response from customers and that backlog of payments was reduced from 44.33% to 29.43%. In Fig. 10, these backlogged payments from 2013 to 2015 can be seen in thousands of pesos and how they decreased each year from $431,075.50 Mexican pesos ($22,688.00 USD or €20,530.00) to $405,606.00 Mexican pesos (21,348.00 USD or €19,315.00) and eventually down to $297,969.95 pesos (15,683.00 USD o €14,190.00). The decrease in past due payments turned into earnings for the water utility.

(8) Key alliances: This activity is strategic for the whole process because it highlights and represents the role of the allies in the public-private sectors, which in this case is comprised of providers, Fig. 11, given that they are the source of goods, equipment and materials that are required for the operations of the water utility. Furthermore, having a good and healthy relationship with the municipal and state governments is also considered important for the technical-administrative operations to be strengthened since it is through them that subsidies are attained which lend a fundamental support to the water utility to continue its operation and provision of water to all of the population.

(9) Cost structure: Finally, to carry out the eight aforementioned elements it is necessary to define what their costs will be on a continuous basis. This refers basically, to salaries, benefits, energy consumption and computing equipment (Fig. 12), to name a few.

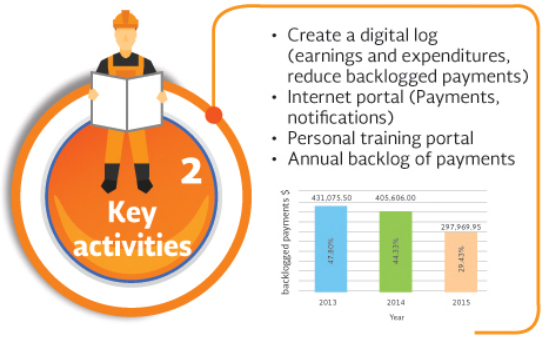

Fig. 10 Key activities.

Fig. 11 Key alliances.

Monthly costs required to operate the hydraulic infrastructure were totalled and with this information it was possible to determine the water utility's break-even point, which in this case was $59,430.00 Mexican pesos each month (3,130 USD or €2,830.00 approximately) which is equivalent to the payment of 849 users, representative of 67% of the $88,480.00 ($4,657.00 USD or €4,213.00) that is potentially collectible each month. That amount represents a customer base of 1,264 at a rate of 70 pesos monthly ($3.68 USD or €3.30) meaning that if 67% collections efficiency is achieved, the water utility can have enough money to have healthy finances, and if it managed to collect 100%, it could achieve self-sustainability and the new inflows could be invested in infrastructure, an established preventive maintenance program and timely rehabilitation of leaks to eliminate physical water losses and improve physical/commercial efficiency.

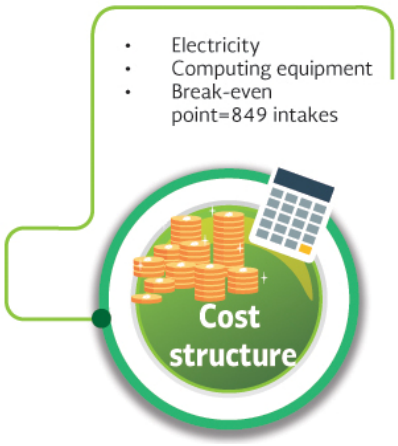

Fig. 12 Cost structure.

For the water utility to operate in a self-sufficient way, it is necessary to determine the break-even point, in other words, to find the number of customers (water intake contracted) that must be collected on irrespective of classification, that is to say, the total earnings minus the total expenditures must be equal to zero. The break-even point indicates the average quantity of production that must be sold to avoid losses [9], above this point, earnings represent a profit.

To determine the break-even point, it is necessary to use the following equation:

$$\boldsymbol{Q = \frac{FC+FS}{P-C-S} = BREAK-EVEN\ POINT} \quad (1)$$

Where:

Q = Quantity (break-even point)

FC = Fixed costs

FS = Fixed spending

P = Price

C = Cost Variable

S = Spending Variable

The break-even Eq. (1) as shown in Table 4 and Fig. 13, reveals that the water utility must collect a on a minimum of 849 customers (water intakes contracted) at the proposed rate of $70.00 pesos monthly (3.68 USD or €3.3) and will generate an upwards of $713,205.25 pesos annually (37,537 USD or €34,000.00) in earnings as shown in yellow on Table 4, which corresponds to a given water volume of 152,830 m^3 delivered, billed and collected.

Table 4 Revenue required to reach break-even point.

Annual Production in m^3	Number of customers	Annual revenue *pesos MX*	Annual revenue *USD*	Annual expenses *MX pesos*	Annual expenses *USD*	Loss vs. profit *MX pesos*	Loss vs. profit *USD*
18,000	100	$ 84,000	4,425	$ 678,411	35,710	-$594,411	- 31,285
36,000	200	$ 168,000	8,845	$ 683,056	35,950	-$515,056	- 27,108
54,000	300	$ 252,000	13,265	$ 687,701	36,195	-$435,701	- 22,932
72,000	400	$ 336,000	17,685	$ 692,346	36,440	-$356,346	- 18,755
90,000	500	$ 420,000	22,105	$ 696,992	36,685	-$276,992	- 14,579
108,000	600	$ 504,000	26,526	$ 701,637	36,930	-$197,637	- 10,402
126,000	700	$ 588,000	30,947	$ 706,282	37,175	-$118,282	- 6,225
144,000	800	$ 672,000	35,370	$ 710,927	37,418	- $ 38,927	- 2,049
152,830	849	$ 713,205	37,537	$ 713,205	37,537	$----------	----------
162,000	900	$ 756,000	39,790	$ 715,572	37,662	$ 40,428	2,128
180,000	1000	$ 840,000	44,210	$ 720,217	37,906	$ 119,783	6,305
198,000	1100	$ 924,000	48,635	$ 724,862	38,150	$ 199,138	10,481
216,000	1200	$ 1,008,000	53,053	$ 729,507	38,395	$ 278,494	14,658
227,520	1264	$ 1,061,760	55,882	$ 732,480	38,552	$ 329,280	17,330
234,000	1300	$ 1,092,000	57,475	$ 734,152	38,640	$ 357,848	18,835

Source: Author's own with information from the Erongarícuaro, Michoacán water utility 2015 y 2016.

The previous information is represented graphically in a comparative way on Fig. 13, which shows that beyond the established break-even point, there can be profits, in other words, if 1,264 water intakes in 2015

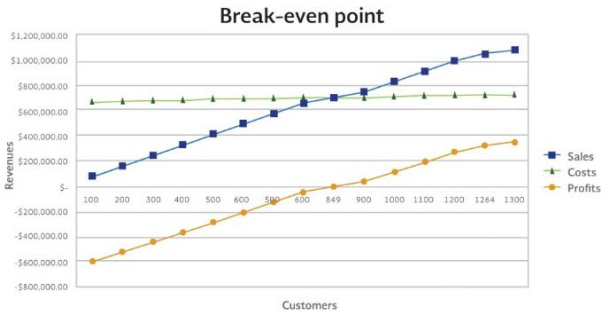

Fig. 13 Break-even/profit point for the year 2015.

had paid 70 pesos monthly during all of the year there would have been inflows of $1,061,760.00 pesos annually (55,882 USD or €50,560) representing a profit of $329,280.25 pesos (17,330 USD or €15,680) in said year, Table 4 shown in green [1]. This demonstrates that it is possible to operate a municipal potable water system in Mexico with quality and self-sustainability.

3. Results and Discussion

To arrive at this study's results, it was necessary to take into consideration, primarily, the production capacity at 100% from the "El Toril" well which was 245,060 cubic meters annually. Additionally, data from Table 4 was taken, Collections break-even point in which it is indicated that the total consumption of the population for the year 2015 was 227,520 m^3, in other words, only around 93% of available volume was consumed, which meant that at the end of the year, the water utility had a surplus of 17,540 m^3 which were not consumed and remained as reserves equivalent to 7% of total annual production. This amount was quantified and warehoused for any given emergency or supply contingency that might befall the town [1].

All the same, once the production costs were determined and it was seen that the well had enough water to supply all of the customer base, an accounting analysis proceeded of the utility's financial statements in order to know the earnings vs. expenses status. During 2013, 2014 and 2015, it was noted that the percentage of earnings that came from the collection of water service fees, was around 71% for 2013; 45% for the year 2014 and 91% during the year 2015. Nonetheless it is attention-grabbing that in the year 2014, the collections percentage hit a striking low, given that 45% of 37.6% of earnings corresponded to the collections of past-due payments and were not new inflows for the provision of services. This situation was corroborated with a survey that was carried out in the municipality to investigate the quality and the image perception of the utility which revealed that customers were unhappy with their water service provider, which is why there was a strong refusal to pay.

On another hand, it was seen that in the year 2013, 14.7% of revenue came from other government agencies, in other words, this percentage represented subsidies and were not customer payments, this indicator led us to detect a lack of trust and support in regards to making payments that was due to a failure to meet the provision demands of the population or the customer service they required, resulting in a reduction in revenue. In a broader context, this represents a vicious cycle in which customers are reluctant to pay on account of poor service which on many occasions stems from a poor payment culture that won't permit water utilities to cover their operational costs or reinvest in necessary equipment and/or infrastructure.

The consequence is a drastic reduction in revenue which causes an economic crisis, impairing the water utility's ability to function normally.

Fortunately, by the third quarter of 2015, a change in the municipal and water utility administration allowed for the recovery of finances and reversed the backlog tendency, allowing for better collections of past-due payments, and an improvement of fundamental activities on the commercial end. These actions have permitted clients and utility finances to coexist in a harmonious environment of well-being today.

The majority of expenses go to cover the payment of salaries and benefits, representing 48.6%, 89.7%, and 58.6% of total spending for the years 2013, 2014, and 2015 respectively. Another one of the main expenses is electricity costs, during the year 2013, 2014 and 2015,

energy spending represented 35.3%, 40.7%, and 26.9% respectively. The analysis of these percentages revealed that in the year 2014 there was an increase in spending for the operations of the water system which caused a net loss of $71,308.16 pesos (3,753 USD or €3,400), because expenditures exceeded revenue by 13.6%. In that same year, a subsidy was received for $147,989 pesos (7,790 USD or €7,050), this government support from the municipality was granted in order for the water service provider to be able to pay its expenses, which had increased by 28.2%. In spite of the subsidies received, however, they were still unable to cover operating costs [1].

As part of the results that came from the socioeconomic and financial analysis, a synthesis and application of the information was brought together using a CANVAS model to create classification profiles and to encourage new ways of creating and capturing a more significant and representative value for the client. The application of this management tool helped to establish a more orderly administration, and more transparency in its handling of material, economic and human resources, which generated significant operational savings for the water utility. Simultaneously, the billing and collections process was improved substantially, public service costs related to equipment operations (electricity, internet, telephony) were controlled and optimized as was the consumption of materials used for rehabilitation and preventive maintenance. Personnel costs improved as well, all of which resulted in significant advances in administrative, operative and financial management. This new administration gave the utility a new operational and organizational efficiency in collections along with a renewed commitment to improve their hydraulic infrastructure, and to cut costs that were unnecessary, wastefulness as reduced as well. Some politically-influenced commitments were cut as well, which were generating imbalanced scenarios and undue contract obligations that should not exist given the negative social impact they cause.

They deteriorate or delay the proper functioning and financial development of the utility to the detriment of the community, which is supposed to be focused on value proposals such as service efficiency (payment and digitized collections), improvements in the supply network, information accessibility via the internet (transparency) and on financial control of revenue as well as expenditures. Grouping these actions together, a successful business proposal was created for the service provider [7].

The socio-economic study sought to make sure that customers could pay for public services while allowing balanced numbers for the water utility. It was found that in the town of Erongarícuaro, the biggest group of the classification had high percentages (61-80%) of public services present in homes.

To illustrate this with greater clarity, the different percentages are represented in 3 colors on Fig. 14, where it can be seen that in the yellow-colored zone, 41 to 60% of homes have necessary funds to contract basic services, on the same graph, colored in blue are the residential areas in which 61-80% of homes have public services, finally, the areas in pink represent parts where up to 100% of homes have public services, in other words the zones with the best conditions in all of the municipality.

Another fundamental element for the study was identifying the type of material used in the construction of homes, particularly the floors, this is a determining factor when evaluating a family's economic potential to acquire goods and properties, which is why homes using a floor made with any material other than dirt were given a distinction, in accordance to the INEGI classification, "homes that have firm or cement flooring, wooden flooring, mosaics or flooring with other types of material".

Fig. 15 shows the percentages of homes with flooring material other than dirt, for example, the color red represents homes with the lowest incidence of this distinction (21-40%), the color blue represents areas in which 41-60% of homes have floors made with

material other than dirt and the color yellow represents areas in which 61-80% of homes have flooring made of some material other than dirt, finally, the pink color represents areas in which 81-100% of homes use these types of material other than dirt.

Conversely, another point of analysis was for homes with dirt flooring. The percentages of homes with dirt flooring can be seen in Fig. 16. In green are the zones where up to 20% of homes have dirt floors, in yellow are the zones in which 21-40% of homes have this characteristic, and finally in pink is the area with the highest percentage of homes with dirt floors, up to 60% and as such, represents the segment with the lowest salaries.

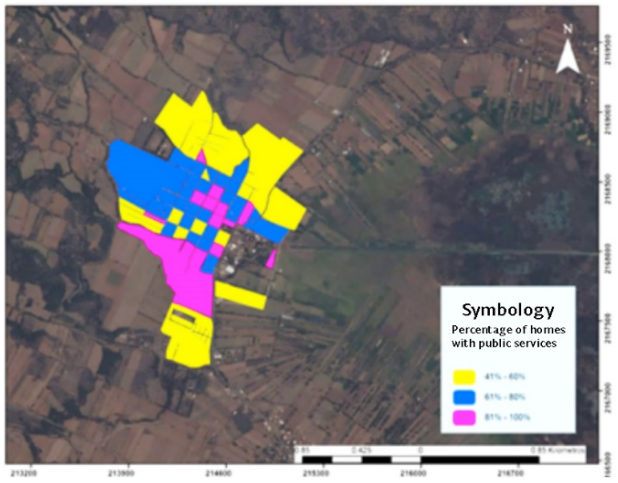

Fig. 14 Homes with public services.

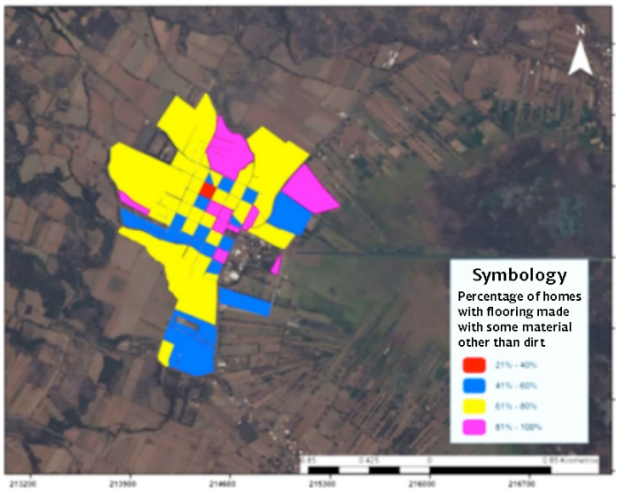

Fig. 15 Homes with flooring made with some material other than dirt.

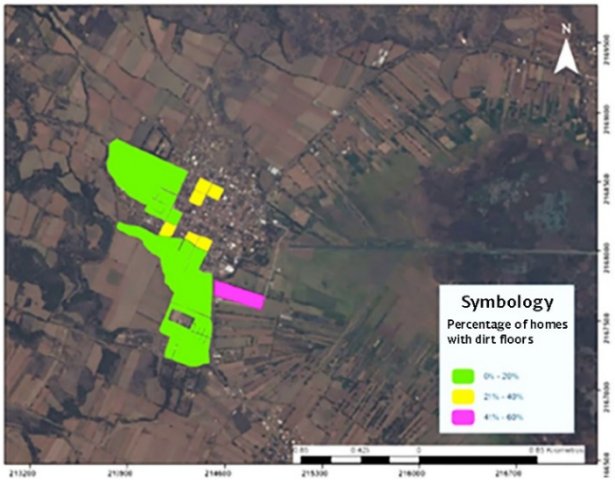

Fig. 16 Homes with dirt floors.

Based on these aforementioned socioeconomic indicators, it was determined that the Economically Active Population (EAP) should be classified into three big groups according to: the types of goods and services found in the home, the surface finish of the home and the type construction it is in terms of material quality and the amount of space in the home as well as the social status of the residential area in which the home is. In this context, the first group corresponds to the color orange with 21-40% of inhabitants being economically active as can be observed in Fig. 17, they can be located on the outskirts of the city as well as to the south and in the center of the town. The color green represents areas in which 41-60% of the population is economically active and can be found in all of the cardinal points, this category occupies the largest area on this geo-statistical map, and also represents the highest number of people in this classification. The third group, which represents areas that have 61 to 80% of economically active residents can be found in pink to the north of the municipality along with a small area in the center, this group represents the lowest percentage of the population but also the most productive and economically well-off in all of the town.

Based on the results of the different illustrations shown in Figs. 14-17, which represent every economic

factor evaluated, the following classification system was created, comprised of three levels, see Fig. 18:

High: Represents residential blocks in which the majority had an 81 to 100% ownership of goods and services previously mentioned as well as the highest EAP rates, which are shown in red, Fig. 18, this represents the highest percentage of the group.

Medium: Shown in green on Figure 18, this color represents results ranging between 61 and 80%.

Low: The blocks that have homes with less than 60% coverage are shown in pink on Fig. 18.

Another observation that can be made in Fig. 18 is that some areas did not receive a color but rather, were outlined in black, this is because the areas are not used for housing but rather for agriculture or are simply empty lots without construction.

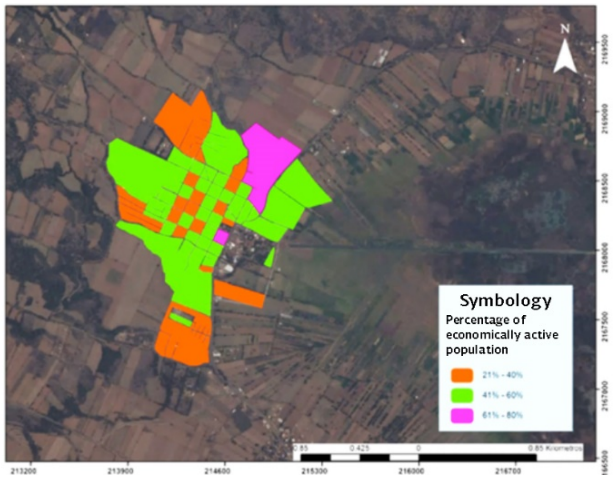

Fig. 17 Percentage of economically active population.

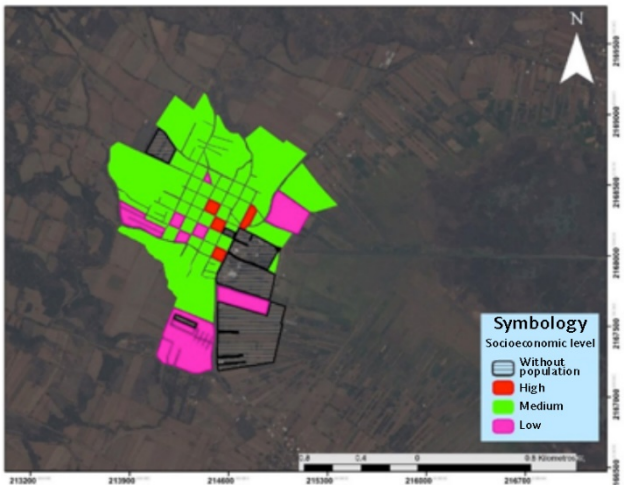

Fig. 18 Socioeconomic levels of Erongarícuaro, Michoacán [3].

Finally, it was found that the level of income of the population was not a determining factor in the backlog of past-due payments, if the INEGI's 6.2% recommendation was applied, 87.34% of the EAP would still be able to afford the payment of their water bill which creates a strong case for studying the finances of the water utility to determine if the problem lies in the poor management of its finances or the result of poor administrative-technical management.

To make sure all of the elements that make up a socio-economic analysis was accounted for, the number of employed people was quantified and with this information, a classification was made based on the number of people in this category and the minimum-wage salary multiples that they receive every month per-capita in Mexican pesos.

For the sake of comparison, these amounts were converted into US dollars and Euros Table 5. To carry out the conversion to US dollars, the exchange rate of 19 Mexican pesos for one US dollar was used and 21 Mexican pesos were used for every Euro (€).

The values of Table 5 are calculated based on the economically active population and correspond to the minimum wage salary system that the Secretary of Labor and Social Welfare establishes with a minimum wage salary being $73.04 pesos daily (3.8 USD or €3.48) and $2,220.42 monthly (116.90 USD or €105.75). It can be observed that the major percentage of earnings is found in the range between 1 and 2 minimum salary wages per month at 32.5% while the lowest percentages were found between the ranges of 5 and 10 minimum salary wages with (5.7%) while 2.39% earn more than 10 minimum wage salaries per month.

As can be witnessed in Table 5, 87.34% of the population is employed and has a monthly salary that permits for the contracting of basic Public Services that are required in the home without affecting the family economy, nonetheless, if you remove the category of people that receive between 2 and 10 salaries minimum wage salaries drops to 70.58%, accounting for 3/4 of the population. This means that in this town, the

population has the wherewithal to deal with and resolve the principal financial needs that would guarantee a dignified life with quality, hygiene, health and social wellbeing. All of that implies that if we take the INEGI indications for the apportionment of the family spending as a reference (Fig. 19), then we can establish a percentage of family earnings that can be destined toward the payment of water service. To demonstrate this, the category of "Articles and services for the home" (green column) in which the INEGI indicates that it is economically feasible to set aside 6.2% of a minimum wage salary or up to 2.3 or more minimum wage salaries for the payment of this type of public service.

Table 5 Earnings for the economically active population in Mexican pesos and them equivalent in USD and Euros.

Minimum Salary multiples	EAP persons	Percentage of EAP	Monthly earnings in pesos MX	Monthly earnings in USD	Monthly earnings in €
Unemployed*	140	12.66%	$ 0.00	$ 0.00	€ 0.00
Less than 1 minimum wage	186	16.76%	$1,110	$ 62.00	€ 55.50
1-2 minimum wages	360	32.50%	$3,331	$ 185.00	€ 166.50
2-5 minimum wages	332	29.99%	$7,771	$ 432.00	€ 388.50
5-10 minimum wages	63	5.70%	$16,653	$ 925.00	€ 832.50
More than 10 minimum wages	26	2.39%	$23,314	$ 1,295.00	€ 1,165.00
Total	**1,107**	**100.00%**	**$52,180**	**$2,899.00**	**€2,608.00**

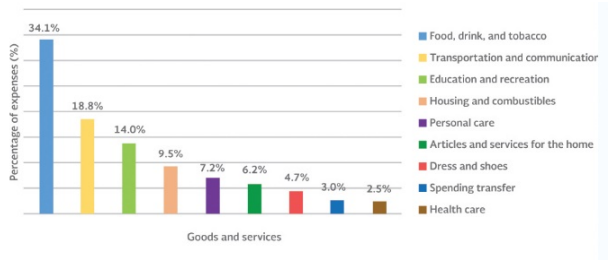

Fig. 19 Distribution of family spending [3].

4. Conclusion

The socio-economic study carried out in the homes of Erongarícuaro, Michoacán, reveals the purchasing power of the population based on the goods and services had in each home, this includes radio, television, refrigerator, washing machine, vehicles owned, computer, landline telephone, cellular phone, cable television, and internet. The majority of homes find themselves in the 41-60% category, in other words more than half the population has enough purchasing power to buy or contract the aforementioned items.

Generally, all the homes have access to public services, which are understood to mean electricity, piped water from the public network, drainage, television and trash collection, nevertheless, during the study it was discovered that the majority of the population have these services in the 61 to 80% interval and that the percentage difference (20%) up to now has not been bridged, meaning that actions need to be taken to achieve total coverage for the town's inhabitants.

One very peculiar characteristic that was analysed in this study was the identification and classification of homes with a made with different materials including those with dirt floors. The importance here lies in distinguishing which homes are made with material that corresponds to the medium and high social strata so as to prevent them from trying to use the low-level housing status which would entail special and unfair privileges upon contracting a water intake that rightfully should correspond only to those the lowest social sector.

Concerning the measure of the Economically Active Population, several facets are dealt with. The EAP plays a key role within society given that they are the ones that generate family earnings through which purchasing power is had for the contracting or purchasing of different goods and services that a house needs to subsist and satisfy its needs. This is why the different types of jobs and quantity of minimum wage salaries earned through labor were investigated in order to determine the percentage of each social status in

accordance to monthly earnings and economic solvency for the payment of water and treatment services in the municipality. Using work activities as a reference for the region and the state, the following distribution of labor was found for the town, 11.05% belong to the main sector (fishery, agriculture and livestock), 23.19% belong to the secondary sector (mining industry, art crafts and construction) finally, 65.76% belong to the third sector (commerce, transport, services tourism and hotel industry) [2].

In town Erongarícuaro, Michoacán, the majority of the population, between the 61 to 80% has the wherewithal to pay for the acquisition of goods and services necessary for a home, among them the payment for water service. Returning to the INEGI's 6.2% recommendation covered in part two of this study (Material and Methods), $130.00 Mexicans pesos (7 USD or 6.5 Euros) per month can be set aside for the payment of basic household goods and services which is substantially above the current rate meaning that the majority of people do not require a subsidy.

Moreover, this investigation served to identify the different levels of the social strata such as low, medium and high and concluded that only the low sector required a subsidy.

An important conclusion here is that the backlog of payments is not due to the economic capacity of the population since 87.34% of the economically active population does have the economic resources to pay the established water rate.

The objective and conclusion of the study is to propose a realistic and trustworthy alternative for the payment of potable water and treatment services based on per-capita monthly earnings and to avoid rates that might be raised for purely political reasons. What is sought, however, is to have percentage adjustments according to the economic indicators of the commercial world with special consideration for those with the least economic resources so as not to debilitate their economy and family needs.

The final conclusion is that with 67% payment compliance, a break-even point can be reached and every percentage above that represents profit that the water utility can use to become self-sufficient.

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