Rainwater collection: by law or by citizen's decision, in the Municipality of Villa Victoria, State of Mexico Collecte des eaux de pluie: par la loi ou par décision citoyenne, dans la municipalité de Villa Victoria, État de Mexico

María X. MEJÍA^{1*}, Luis M. ESPINOSA², Miguel A. BALDERAS², Yered G. CANCHOLA²

¹ El Colegio Mexiquense A.C., México.

² Facultad de Geografía, UAMéx., México.

* Correspondence to: María X. Mejía. E-mail: mxmejia@cmq.edu.mx.

CC BY 4.0



Received: 19 January 2025

Accepted: 19 May 2025

Published online: 18 June 2025

How to cite this article: Mejía, M.M.X., Espinosa, R.L.M.,

(2025)

collection: by law or by citizen's decision, in the Municipality of

Villa Victoria, State of Mexico.

https://doi.org/10.4316/GEORE

Canchola,

Rainwater

Balderas, P.M.A.,

Georeview, 35, 1,

VIEW.2025.01.06

P.Y.G.

ABSTRACT: Identified in legislation and citizen actions, the rainwater harvesting initiative was seen as an essential alternative in the face of the water scarcity faced at the national level. In the study area, located in Villa Victoria, State of Mexico, a rainwater harvesting proposal is being developed. Water legislation and regulations in the State of Mexico provide the guidelines for this action, but they only focus on the use of rainwater for different activities, including the reduction of saturation in drainage and sewage systems In the study area, located in Villa Victoria, State of Mexico, a proposal for rainwater harvesting is being developed. The water legislation and regulations in the State of Mexico provide the guidelines for this action, but they only focus on the use of rainwater for different activities, including the reduction of saturation in drainage and sewerage systems. This is not considered a law, perhaps it will be soon, due to the scarcity of water at present. The costs for the installation of rainwater harvesting networks can exceed costs of more than three hundred thousand pesos, however, it is also possible to install systems with lower costs and reuse materials, which allows to carry out the objective and meet the expected results. It is important to implement cost-effective techniques so that the population can count on safe water during the rainy season and thus meet some of their daily needs.

KEY WORDS: water, scarcity, watershed, legislation, environmental education.

RÉSUMÉ : Français Identifiée dans la législation et les actions citoyennes, l'initiative de récupération des eaux de pluie a été considérée comme une alternative essentielle face à la pénurie d'eau à l'échelle nationale. Dans la zone d'étude, située à Villa Victoria, dans l'État de Mexico, un projet de récupération des eaux de pluie est en cours d'élaboration. La législation et la réglementation sur l'eau de l'État de Mexico fournissent les lignes directrices de cette action, mais elles se concentrent uniquement sur l'utilisation de l'eau de pluie pour différentes activités, notamment la réduction de la saturation des systèmes de drainage et d'assainissement. Dans la zone d'étude, située à Villa Victoria, dans l'État de Mexico, un projet de récupération des eaux de pluie est en cours d'élaboration. La législation et la réglementation sur l'eau de l'État de Mexico fournissent les lignes directrices de cette action, mais elles se concentrent uniquement sur l'utilisation de l'eau de pluie pour différentes activités, notamment la réduction de la saturation des systèmes de drainage et d'assainissement. Cette mesure n'est pas encore considérée comme une loi, mais elle le sera peut-être bientôt, compte tenu de la pénurie d'eau actuelle. Le coût d'installation de réseaux de récupération des eaux de pluie peut dépasser les trois cent mille pesos. Cependant, il est également possible d'installer des systèmes à moindre coût et de réutiliser les matériaux, ce qui permet d'atteindre l'objectif et d'obtenir les résultats escomptés.

MOTS CLÉS: eau, pénurie, bassin versant, législation, éducation environnementale.

Vol. 35.1 / 2025, 60-67

1. Introduction

Natural resources such as water for consumption are being depleted, it cannot be thought that water is forever and that it is for everyone, it has been privatized in various places, many towns and cities currently lack this vital liquid.. Planet Earth has a percentage of 0.007% of potable water (Toledo, 2002), the worrying thing is that water is becoming scarcer every day. Various solutions have been proposed, including the collection of rainwater for use in daily needs; however, this water has not been used directly for human consumption due to the presence of parasites, bacteria, chemical substances, among others.

This research addresses the legislation and citizen actions regarding rainwater harvesting, which should be a necessary law at the national level based on environmental education and water care. Currently, water shortage is an environmental crisis of considerable importance, every day thousands of liters of rainwater are lost without being used for various daily activities, adopting a sustainable environmental education will allow taking actions on water care.

CONAFOR, (2017) suggests that, if the rainfall regime is not substantially modified, average availabilities of 3,285 m³ in 2030 and 3,260 m³ in 2050 would be expected as a result of population growth.Article 50 of the Regulations of the Water Law of the State of Mexico 2014 states that the strategies and actions included in the Water Program will tend to promote the gradual adoption of measures that guarantee the use of rainwater, and should consider, among other items, the following:

I. The projections on the rainwater susceptible to be used, either by means of its capture and later treatment, or by means of naturation systems.

II. The promotion of the development of technologies for the use of rainwater and its potential application in properties of the State.

III. Programs for:

(a) The massive and permanent dissemination of the importance and advantages of rainwater harvesting in individual properties for its use.

b) The promotion of a culture for the use of rainwater.

c) The installation of systems for rainwater harvesting and its use in individual properties, whether for private use or public access.

d) The training of users on the use, operation and maintenance of rainwater harvesting systems in individual properties.

The regulation law on rainwater harvesting focuses on the use of rainwater for various activities and the reduction of saturation in the drainage and sewage systems, as part of the actions of environmental conservation and water care, but it is not established as a mandatory law for the population, so it is "according to law or citizen's decision".

By 2025, almost two billion people will experience water scarcity, and two thirds of the world's population will experience some degree of water stress (Lee, 2016). Based on the above, it is noteworthy that various initiatives have been carried out for rainwater harvesting, however, these have not been applied by the population, businesses and industries in general because they are not mandatory.

In the Municipal Plan of Villa Victoria, in the section "Rainwater harvesting" (Organo Informativo del Ayuntamiento de Villa Victoria, 2022-2024), the benefits and scope of carrying out this practice are

exposed, however, it is not mandatory for the population, although at present there are localities that lack drinking water and others are only supplied once or twice a week of with vital liquid.

Rainwater harvesting could be a more common practice than it seems, since it is a matter of education and environmental awareness in the face of the current water shortage problems, as well as the lack of knowledge of the institutions and companies dedicated to the development of facilities for rainwater harvesting, limits the development of this sustainable practice.

Faced with the water problem, there are several institutions that have put forward solutions, among them we can mention the Postgraduate College of Chapingo, which provides advice for the construction and design of SCALL (rainwater harvesting and storage systems). The National Forestry Commission (CONAFOR) generated a rainwater capture, storage and purification system, which consists of a technological package that facilitates the capture and storage of rainwater with the technique known as SCAPT (rainwater capture system on roofs) or SCALL (rainwater capture system) on roofs, which includes grids and gravel filters that prevent water from dragging solids to the storage tanks (Comisión Nacional Forestal CONAFOR, 2017).

2. Study area

The municipality of Villa Victoria is located at 99°59'43" W longitude and 19°26'31" N latitude with an altitude of 2,600 meters above sea level. The study area has a territorial extension of 423.80 km2, with 128 localities and a dam of great importance, which feeds the hydroelectric system of the Cutzamala and Ixtapaltongo systems (Municipal Gazette, Villa Victoria 2022). According to the State Institute of Energy and Climate Change (s/a), atmospheric precipitation in Villa Victoria is 800 to 1200 liters per square meter, during the rainy season, in the months of May to September, with the presence of intense and frequent rains from July to August, the presence of thunderstorms and torrential rains have led to the overflow of rivers.

The amount of rainfall that is concentrated in the municipal capital, runs like large rivers, which highlights the limitation in adequate structure for its catchment, as well as in numerous localities.

3. Methods

The methodological development was based on the investigation of the legislation and regulations of the Water Law of the State of Mexico and the Municipal Plan of the study area, as well as the techniques that have been used for rainwater harvesting and its potential use in the study area.

For the present research, it is suggested to consider and apply the SCALL (Rainwater Harvesting System), developed by the International Center for Demonstration and Rainwater Harvesting of the Postgraduates College (CIDECALLICP), which has developed seven prototypes, these being the following:

- The demonstration prototype, COLPOS 1 is a SCALL for human consumption and domestic use at the family level and has a catchment area of 130 m².

- COLPOS 2 is designed for aquaculture production for ornamental fish and human consumption.

- COLPOS 3 is designed to process rainwater into drinking water.

- COLPOS 4 is a system designed to obtain water for animal consumption, for which it has a catchment area of 424 m^2 .

- COLPOS 5 was developed to provide water for greenhouse crops.

- COLPOS 6 could be used to capture water and use it in the production of fodder for meat production. The SCALL Network for aerial control of forest fires (Anaya, 2016).

- COLPOS 7 was implemented for rainwater harvesting in a Mazahua area, there was a benefit for 4 500 people, resulting in the creation of a drinking water brand called MAZ-AGUA.

(Martínez P., 2017)

Villa Victoria, has 128 localities, of these 110 report having drinking water service, however, 18 localities do not have infrastructure for the installation of the service, part of the initiative consists of suggesting the installation of SCALLs in these communities, as part of the use of rainwater and the care of the environment, to solve problems involving the scarcity of water for daily activities such as washing clothes, sanitary cleaning and for irrigation agriculture and even for precision agriculture.

Each of the prototypes can be implemented in the study area and for the 18 localities that do not have drinking water service and infrastructure, however, it is important to identify the characteristics of the houses, carry out a socioeconomic study, identify the type of construction material, roof support and other physical characteristics of each place such as relief and soil type if necessary. The social work and the development of workshops will allow the dissemination in the localities, for the implementation of the SCALLs (See image 1), with the support of municipal authorities and specialised personnel to make known the scope and benefits of rainwater harvesting.



Source: Mexican Association of Rainwater Harvesting A.C. (s/a)

Villa Victoria can access unconventional facilities and affordable costs proposed by CONAGUA.

CONAGUA, (2023) has budgets of one hundred thousand pesos, the installation includes land clearing, use of PVC pipes, filtration, purification and others.

4. Results and discussion

Rainwater harvesting is not current, these techniques originated in Europe and Asia, they played an important role in agricultural production and life in general in arid and semi-arid areas. Part of

agriculture in the Middle East was based on techniques such as wadi diversion. In the Negev Desert in Israel, rainwater harvesting systems dating back 4,000 years or more were found (Organización de las Naciones Unidas para la Agricultura y la Alimentación, 2000).

Different institutions have developed studies related to rainwater collection, such as the Manual of Experiences of Rainwater Collection and Rainwater Use in Latin America, whose main objective is to provide knowledge to technicians to implement different collection systems.

It is highlighted that the collection of rainwater used to be used to solve the cultivation of rainwater, at present, it is highlighted that this activity is carried out with the aim of taking care of the environment and drinking water, which is increasingly scarce.

Reviewing the legislation, in the case of the Mexican State, is important to identify compliance with it.

4.1. Regulations of the Water Law of the State of Mexico

Article 50 of the Regulation of the Water Law of the State of Mexico 2014 exposes the strategies and actions included in the Water Program, among them rainwater harvesting (Gobierno Constitucional del Estado de México, 2014), same that is adopted gradually by the population, situation that is not carried out, it is suggested to carry out an update, so that rainwater harvesting is mandatory with the initial help of instruments and materials, by the municipalities, the same action is suggested for the Municipal Plan of Villa Victoria.

In the annual regulatory improvement program for 2023, in section 3- Diagnosis of Current Regulations in its subsection b Guidelines for the use of rainwater, it establishes in article 53 that the water authorities will promote the construction of hydraulic infrastructure that allows the use of rainwater, Article 93 stipulates that new developers of housing, industrial and service complexes are obliged to build facilities for rainwater collection and wastewater treatment (Comisión Tecnica del agua del Estado de México, 2023).

It is important to note that although it is stipulated as mandatory, the installation for the collection of rainwater for the different developers is not fulfilled, therefore, although the decision to carry out the collection of rainwater is not mandatory for the population, it is important to make the necessary amendments to the Water Law of the State of Mexico for the protection and water security of the populations, especially for those with greater vulnerability and enforce the same for the large companies, institutions and developers of housing complexes among others.

Based on the above, it is important to adapt some of the articles and enforce them according to the Law in favor of the environment and water care, to make the population and the different companies understand the importance of rainwater collection or harvesting, to highlight the benefits and the effects of not carrying out this practice, It is important to consider that a large part of the population, especially the most vulnerable, does not have the necessary liquidity for an adequate installation for rainwater harvesting, however, a rustic installation will also fulfill the purpose and will help to a good and sustainable development of the population.

4.2. Rainwater harvesting and sustainable development

Rainwater harvesting should be promoted in order to carry out sustainable development from three aspectseconomy, society and environmentfor the care of agricultural and livestock activities, with the objective of reinforcing food security based on adequate soil conservation, the correct

development of rainfed and irrigated agriculture, based on the shared responsibility of government and society.

The climatic variability generated by anthropogenic activities, known as Climate Change, has given rise to extreme weather events with abundant rainfall that have caused material damage and human losses, almost as a contradiction, in the streets, towns and cities, This makes it clear that it is important to act in the face of water scarcity and to consider that while it is possible, rainwater should be used for sustainable and adequate development.

The United Nations World Water Development Report (2020) exposes important aspects, highlighting that food security, human health, urban and rural settlements, energy production, development Industrial, economic growth and ecosystems depend on water.

So how can we face adaptation in the future in the face of the loss of a resource as vital as water, if it is already lacking today? (ONU, 2020)

4.3. Benefits of rainwater harvesting

Rainwater harvesting provides a water reserve for agricultural development, daily activities, washing clothes and sanitary use, helps to conserve the environment and care for drinking water, and also reduces the overload of rainwater in the sewage system, flooding, asphalt breakage, and sidewalks, among others. Of the 128 communities that make up the municipality, only 110 have a drinking water system and the remaining 18 do not have the service, with 20,748 registered water intakes, the supply is through surface water specifically from the spring called ojo de agua, located in the municipal capital (Organo Informativo del Ayuntamiento de Villa Victoria, 2022-2024). Rainwater harvesting is an excellent alternative for localities that lack drinking water service.

Rainwater harvesting can also reduce the risk of flooding, especially in cities that have been affected in terms of road and even housing infrastructure, and although it is not possible to collect all of it, it will solve part of the problem; therefore, it is essential to implement environmental education starting with basic education and among the population in general. The population dynamics has been overtaken by incorrect consumerist practices, which have generated uncontrolled pollution that is reflected in cities, streets, parks, rivers, seas, among others. This situation has caused the storm drainage systems to be affected by the accumulation of garbage, which does not allow the water to be drained properly, resulting in flooding. Correct urban planning is a fundamental part of the city's synergy. The constant revision of the drainage network and the increase of sewage systems to capture rainwater will reduce the vulnerability to flooding.

With the current rainwater harvesting techniques, such as the SCALLs proposed to be implemented in the Municipality of Villa Victoria, it is already possible to use this water for human consumption, which is an important advance for the population, one more reason to carry out the harvesting according to the Law for a common good, however, It is important to consider that considerable economic support is required for the cost of materials. This first stage is proposed for the 18 communities that lack drinking water. Duraplas, a brand that sells water tanks, states that depending on the amount of rainfall, it is possible to identify how much water can be collected according to the following formula: (MarcadorDePosición1)multiply the average rainfall (mm) for the local area by the roof surface area (m2), the approximate amount is 28,125 litres per month on average.

In order for rainwater to be consumed, the following must be considered: all organizations responsible for processing, storing or distributing water for human use and consumption must comply with the modification to the Official Mexican Standard: NOM-127-SSA1-1994, "Environmental Health. Water for human use and consumption. Permissible limits of quality and

treatment to which water must be subjected for its potabilization" (Comisión Nacional Forestal CONAFOR, 2017).

5. Conclusion

Rainwater harvesting is a sustainable alternative that can address the shortage of drinking water, the dissemination of this activity in the population will increase the opportunities for a more profitable agriculture and with greater market opportunity and it is even possible to increase crop capacity, through the implementation of rainwater for irrigation during the dry season and it is even possible to reduce water costs for irrigation and avoid food insecurity.

The shortage of drinking water has affected different parts of the State of Mexico, in what concerns Villa Victoria, there are several localities that suffer from water shortages and some others only receive water once a week.Rainwater harvesting will help meet basic sanitation needs and even basic necessities. Water for human consumption from rainwater treatment is already possible with the various SCALL techniques developed by the International Center for Demonstration and Rainwater Harvesting of the Postgraduate College, based on the above it is essential to make a massive diffusion through various media to publicize the name of those institutions and companies engaged in the installation of infrastructure for rainwater harvesting and even let the population know that they themselves can build their catchment system at low costs.

Finally, it is necessary to revise Article 50 of the Regulation of the Water Law of the State of Mexico, with the objective of establishing rainwater harvesting as a Law, for the care of the environment from sustainable development and environmental education, as well as to reduce the over exploitation of aquifers and groundwater and the development of water wells or wells that lead to soil instability, subsidence, and sinkholes, among others.

Establishing rainwater harvesting as a law will initiate an authentic care of the environment, starting with the conservation of natural resources, an adequate agricultural practice through crop rotation and the reduction of agrochemicals, for an appropriate soil health, as well as the care of the vegetation cover and the constant reforestation of those natural spaces that are the lungs of the population, it will also allow the water cycle not to be affected by the lack of vegetation and humidity in the soils.

The care of the environment implies a teamwork from governments and society, especially in the understanding that each of the natural resources that are still available, are non-renewable resources and that the life time of each of them has an expiration date, the lack of knowledge and awareness, is what has placed humanity in a vulnerable situation and risk to food insecurity and meteorological risks through the material and human losses during many years.

Humanity has advanced in technology through inventions that somehow try to provide a solution to an imminent loss of resources and food, it is true that technology and public works have shortened distances, but it has opened great distances between human beings and awareness of the reality that represents the risk of the loss of the so valued vital liquid, which is water.

References

Anaya, M. G. (2016). XXVI DIPLOMADO INTERNACIONAL. Texcoco, México: Colegio de Postgraduados.

- Comisión Nacional Forestal CONAFOR. (2017). *Sistema de captación, almacenamiento y purificación de agua de lluvia.* Jalisco, México.: Instituto Mexicano de Tecnología del Agua (IMTA).
- Comisión Tecnica del agua del Estado de México. (2023). *Programa Anual de Mejora Regulatoria 2023.* Estado de México: Gobierno del Estado de México.
- CONAGUA. (2023). Proyectos tipo y presupuestos de sistemas de captación de agua de lluvia (SCALL) y saneamiento básico a nivel vivienda en zonas rurales. Ciudad de México: Subdirección general de agua potable, drenaje y saneamiento.
- Gobierno Constitucional del Estado de México. (12 de septiembre de 2014). Reglamento de la Ley del agua para el Estado de México y Municipios. *Ley de agua para el Estadio de México y Municipios*, pág. 81.
- Lee, K. E. (2016). Rainwater harvesting as an alternative water resource in Malaysia: Potential, policies and development. *Journal of Cleaner Production*, 126.
- Martínez P., R. I. (2017). Sistemas de captación del agua de lluvia y la generación de conciencia ambiental en la comunidad mazahua, estado de méxico. Montecillo, Texcoco, Edo. de México: Colegio de Postgraduados, Campus Montecillo.
- Mejía M.M.X, E. R. (2025). "RAINWATER HARVESTING: ACCORDING TO LAW OR CITIZEN'S DECISION". *GEOREVIEW*.
- ONU. (2020). Informe Mundial de las Naciones Unidas sobre el Desarrollo de los Recursos Hídricos. ONU.
- Organización de las Naciones Unidas para la Agricultura y la Alimentación. (2000). *Manual de captación y aprovechamiento del agua de lluvia experiencias en América Latina*. Santiago, Chile: Oficina Regional de la FAO para América Latina y el Caribe.
- Organo Informativo del Ayuntamiento de Villa Victoria. (2022-2024). *Plan de Desarrollo Municipal de Villa Victoria.* Villa Victoria, México: Gaceta Municipal.
- Toledo, A. (2002). El agua en México y el mundo. Gaceta Ecológica, 9-18.