

FIRE PREVENTION AND MITIGATION PLAN IN COMMUNITIES AFFECTED BY POOR WASTE MANAGEMENT

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<https://doi.org/10.61117/ipsumtec.v7i2.314>

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Summary - Fires are the result of natural phenomena or can be caused or induced by human influence, i.e. they are encouraged by human-induced factors.

The environmental impact of the occurrence of fires ranges from loss of life and property, investment in material resources (hundreds of liters of water), generation of large amounts of Greenhouse Gases, particularly CO₂, which contributes to climate change, generation of Dioxins and Furans, which are highly toxic and dangerous synthetic substances, due to their effects on health, classified as carcinogenic, teratogenic and mutagenic, generation of photochemical smog, desertification of soils and loss of species habitats.

All to the detriment of air quality, in , it is a chain of environmental degradation. For these reasons we propose a Plan for Fire Prevention and Mitigation, focused on the current context of the State of Tabasco, taking into account the Shared Responsibility and Integrated Waste Management, which can be replicated by any sister state of the country that presents these terrible phenomena that contribute to environmental degradation. It is better to prevent before they occur, than to attack a fire that is already in process.

Key words: Fire, LGPGIR, Environmental Impact, Waste Management, Prevention.

Abstract -- Fires are the result of natural phenomena or can be caused or induced by human influence, in other

words, they are encouraged by factors that involve humans. The environmental impact of the occurrence of fires involves loss of life and property, investment in material resources (hundreds of liters of water), generation of large quantities of Greenhouse Gases, particularly CO₂, which contributes to climate change, generation of Dioxins and Furans, which are highly toxic-dangerous synthetic substances, due to their health effects, classified as carcinogenic, teratogenic and mutagenic, generation of photochemical smog, soil desertification and loss of species habitats.

Everything to the detriment of air quality, in short, is a chain of environmental degradation. We propose a Plan for Fire Prevention and Mitigation, focused on the current context of the State of Tabasco, taking into account Shared Responsibility and the management of Waste, which can be replicated by any State of the country that presents these terrible phenomena that contribute to environmental deterioration. It is better to prevent before they occur than to attack a fire already in process.

Keywords - Fire, LGPGIR, Environmental Impact, Waste Management, Prevention.

INTRODUCTION

Currently the State of Tabasco, which is our place of residence, has suffered serious environmental problems such as fires and floods, due to poor management and integrated waste management, which is why we present this proposal for real action to reduce the effects on the environment by these phenomena; which can be replicated in other States. Governments must

perform many basic functions for societies to thrive, and to feel well.

Among these central functions of the government are the provision of social services such as health and education; the provision of infrastructure such as roads, ports and energy; the protection of people against crime and violence; the promotion of basic science and new technologies; and the implementation of regulations to protect the environment. In environmental matters, the Government or State must ensure compliance with national environmental regulations in society and in Public and Private Companies and that the necessary and efficient infrastructure is in place for waste treatment, as well as support academics as consultants to transfer effective innovative technologies for waste treatment, environmental impact mitigation plans, or even granting benefits to Environmentally Responsible Companies. The State should be the driving force behind the national environmental policy, organizing and coordinating agencies, organizations and different levels of government, as well as society and the private sector (business and industry), including academics. The coordination of efforts on the part of the Public and Private Sectors becomes indispensable, in order to design and implement clear and coherent policies to catalyze the development of projects that encourage adoption of sustainable practices, a task that falls on the State. To ensure environmental protection, the State must establish regulatory frameworks or environmental policies that set the parameters for sustainable environmental management for the different economic activities of the Social, Industrial and Business Sectors with a Judicial Body with effective capacity to exercise its functions and guarantee effective enforcement of the laws [1-3].

Furthermore, without forgetting that everyone has the right to an adequate environment for their development and wellbeing, as established in Articles 4 and 25 of the Political Constitution of the United Mexican States, which establishes that the State is responsible for guiding national development in environmental matters to ensure that it is comprehensive and sustainable.

The State has the main function of procuring the benefit of the population, ensuring economic policies that allow suitable conditions for sufficient material wealth derived from the profits from the production of companies and industries, captured through taxes. That is why the administration of economic resources through the provision of public services with sufficient coverage to the population that at the same time allow environmental protection and the assurance of public health is vital to help ensure adequate environments in development and welfare [4].

To perform all these functions, the State must develop a high capacity for organization, logistics, current management of innovative technologies in environmental matters, Information and Communication Technologies, Industry 4.0, Artificial Intelligence (ChatGPT), everything modern, and its application in an integral or holistic manner that leads to the solution of real problems, allowing it to be an efficient and modern State. In addition, public servants should preferably have suitable professional profiles, be experts in their field, and have teamwork skills, since interdependent groups are required, which apply knowledge in synergy, according to the requirements of the serious and complex problems that our country suffers from, in environmental and economic matters [2, 3, 5,6] [2, 3, 5,6].

It is a reiterative problem, the lack of experience in specialized fields, which causes that public officials do not perform their positions with efficiency, effectiveness, intervening with the objectives of their specific positions they hold as public servants in their work of management and implementation of environmental policies. In particular, the State can receive contributions from the Academic Sector, since they can contribute as consulting figures, which is required if the current policies on the part of the State have failed or even effective environmental policies are not implemented. According to Transparency International, for the year 2023, Mexico ranks 126 out of 180 countries in the Corruption Perception Index, which shows that it is perceived as one of the most corrupt countries in the world. Corruption permeates in the bad practices of hiring recommended by nepotism and / conflict of interest, who do not have the experience in the area to develop, instead of prevailing the hiring of trained individuals, with sufficient and proven merit, who develop ideas to solve problems, instead of it, those hired generate others by negligence, in addition to the existing ones [1, 5, 7-10].

Of course, this list of requirements to be met by our states or governments is only a brief subset of what people around the world expect from their governments. In fact, all too often they get the opposite: corruption, incompetence, war and lack of sufficient quality public services. This proposal is based on the culture of prevention, since, from an economic point of view, less investment in financial resources is required, and from the point of view of the physical integrity of the individuals and living beings that inhabit these places where forest fires occur, it is better that they do not occur.

It is for this reason, the concern as academics to contribute proposals from our area of knowledge, prevent the occurrence of these fire problems, since our State has had to pay high investment costs to attack the fires for all the material resources that this work requires, without undermining the danger and even loss of human lives and species of animals and plants, as well as environmental impact, since a forest fire generates large quantities of Greenhouse Gases, particularly CO_2 , which contributes to climate change, generation of Dioxins and Furans, which are highly toxic and dangerous synthetic substances, due to their health effects, catalogued as carcinogenic, teratogenic and mutagenic, generation of photochemical smog, soil desertification and loss of habitats [11-15].

DEVELOPMENT

Methodology

The following Plan arises as a proposal to prevent and mitigate fires, it will be based on a specialized search of the bibliography related to the factors that contribute to fires in Mexico and the world.

To this end, it will focus on the following information collection and analysis strategies:

- 1) Identify the significant variables or factors that influence the probability of fire occurrence.
- 2) Analysis of the General Law for the Prevention and Integral Management of Wastes (LGPGIR)
- 3) Establish the functions to be developed by society, professionals, businessmen, academics and the government with respect to fire prevention and mitigation.
- 4) Analysis of success stories in Mexican governments where there is a low incidence of fires.
- 5) Evaluation of the current conditions of the State of Tabasco with respect to the fires that have occurred.
- 6) Integration of administrative and planning actions for the formulation of the Plan.

DISCUSSION AND ANALYSIS OF RESULTS

Fires do not occur so easily, it is more that they do not occur without causes that provoke them. There are factors that contribute to these phenomena that are discussed in a theory known as the Fire Triangle. This theory is clear and predictive, indicating that for a fire to occur, fuels, comburent (oxygen in the air) and high temperatures must be present at the same time, in order to reach the energy required to activate combustion. [12,16]

Forest fires occur with greater ease and, probability, when temperatures are higher than usual. This factor has been present in the State of Tabasco with temperatures above 50°C , since May 6 of this year, these temperatures are extreme and probably with climate change will continue to worsen with the passage of time. Temperatures of up to 53°C and several days there were thermal sensations of 57°C , we know that water boils at 100°C , that is why, the qualifier of extreme.

It was detected that the problem of fires has mainly occurred in landfills and vacant lots in the current year 2024, in the State of Tabasco, as shown in Table 1.

Table 1. Fires reported by Civil Protection Tabasco in the period January-June 2024.

Location	Type of area	Date
Black Lagoon	Surrounding vacant land	May 14, 2024
Dos Montes Village	Vacant land (pasture land)	May 14, 2024
Sector Los Mangos Ixtacomitán 1st. section	Vacant land (pasture land)	May 14, 2024
Rancheria Tierra Nueva, 2nd Section, Huimanguillo, Tabasco	Vacant land (pasture land)	19 of May 2024
Ranchería el Desecho, 1st Section, Huimanguillo, Tabasco	Vacant land (pasture land)	May 19 2024
Tenosique and Emiliano Zapata	Vacant land (pasture land)	May 19, 2024
Peripheral	Vacant land (pasture land)	May 15, 2024
Tamulté de las Barrancas Colony	Vacant land (pasture land)	May 15, 2024
Teapa	Landfill	May 9 2024
Huimanguillo	Municipal Landfill	May 7 2024
Backside of Deportivo Torea in Colonia Atasta de Serra, the Plaza de Toros.	Vacant land (pasture land)	May 7 2024

Black Lagoon	Surrounding vacant land	24 and 28 of April 2024
Villahermosa- Teapa Highway Km 3 and Km 4.2	Surrounding vacant land	25 of April 2024
Villahermosa- Teapa highway, at the height of Fraccionamiento Parrilla 1.	Surrounding vacant land	22 of April 2024

Source: Page of Facebook page official
(https://www.facebook.com/Prociviltabasco?locale=es_LA).

The wastelands are desert areas where there is a lot of direct contact with turbulent air masses. Reforestation will help to reduce the amount of turbulent air, due to the impact of the trees, which slows the flow. In addition to all the other factors, trees contribute to CO₂ capture, soil cleaning, moderate environmental temperature regulation [16,17].

The fuel can be any garbage or material such as plastic bottles, paper bags, Sabritas bags, wood, oily rags, even dry grass, etc., that is abandoned on the ground of the vacant lot or landfill, which has not been properly taken to an open dump or in the best case, if possible due to its particular characteristics, to the recyclers.

Fire is triggered when these factors are combined in the right proportion. Similarly, by eliminating one of these factors, i.e., one of the sides of the triangle (Figure 1), heat (high temperatures), oxygen (air) and fuels (garbage) it is possible to prevent or attack a fire [12,18].



Figure 1. Triangle of Fire

Derived from the uncontrolled burning, in these, CO₂, Greenhouse Gas, is generated, contributing to climate change, destroying the habitat of species, in addition they can die, substances such as Dioxins and Furans are generated, which are highly toxic and dangerous due to the health effects catalogued as carcinogenic, teratogenic and mutagenic, soot, photochemical smog, all to the detriment of air quality, in short, it is a chain of environmental degradation [11-13].

Born from the serious consequences that have been presented to the environment in Tabasco and in many states of Mexico, the concern arises to help prevent and mitigate fires, these ideas that we will present below are based on the analysis and reflection of the General Law for the Prevention and Integral Management of Waste (LGPGIR), published on October 8, 2003, from it derives the Principle of Shared Responsibility, which we want to rescue, this explains that producers (Private Sector), consumers (Civil Society) and Authorities (State or Government) must collaborate. It also establishes the Principle of Integrated Waste Management, which includes sweeping, collection, separation at source, recovery (reuse, recycling), treatment, whether biological, physicochemical, thermal, innovative treatment, collection, storage, transport and final disposal of waste (sanitary landfills, dumps or landfills). Both shared responsibility and integrated waste management are combined through regulatory, operational, planning, administrative, financial, social, educational, monitoring and evaluation actions [19-21].

Regulatory, operational, planning, administrative and financial actions correspond to the State, but as we have seen the lack of real action, we as researchers present this plan that contributes in an integral way to these actions and the rest.

Therefore, we developed two programs, the first Plan "Limpiemos Villahermosa", based on the one carried out in Tuxtla Gutierrez Chiapas, Limpiemos Tuxtla (Figure 2), organized, planned and directed by Civil Protection of Tuxtla Gutierrez, which will contribute to the second Plan "Free of Fires Villahermosa", and in the Municipalities of Tabasco that consider its replication, or even the States that require these fire mitigation and prevention plans.



Figure 2. Announcement by Civil Protection of Tuxtla Gutiérrez, Chiapas.

This plan includes reforestation and cleanup (collection, washing and separation of waste, as well as sending it to recyclers), actions to be carried out in vacant lots and landfills, applying the shared responsibility stated in the LGPGIR (Society, State and Private Sector), as shown in Table 2.

Table 2. Shared responsibility between Society, State and Private Sector in the "Villahermosa Fire-Free" Plan

Shared responsibility LGPGIR		
Civil Society	State	Private Sector
Mano de obra for the work of cleaning, collection, washing and separation from waste, including reforestation at vacant lots.	Supplies required operations and of investment for the plan, organization and planning from events, agreements from collaboration with the Private Sector.	Support of the Social and Environmentally Responsible, and of those who join this work of interest global.
Therefore, the Fire Free Villahermosa" can be the following administrative and planning actions: Identify the areas where fires have previously occurred (as presented in this study, based on what is reported on the Facebook page of Civil Protection Tabasco are dumps and vacant lots). But a more formal study can be made of at least 3 previous years (taking into account the hottest years such as this year), based on the records of Civil Protection and relevant public agencies with access to this data (State Responsibility).		

Schedule appropriate dates for citizens to carry out waste collection and separation activities, as well as reforestation in seasons when we do not suffer from extreme environments, i.e. extreme heat or floods, in order to take care of and protect the integrity of the citizens.

It must have a Civil Protection registry, or request by official letter to the pertinent Public Institution, either, CONAGUA, etc. To make the programming of the dates of these works trying pleasant environments.

Step 3. Estimate the number of environmentally conscious and responsible citizens, according to the extension or perimeter to be cleaned and reforested.

Step 4. Make public campaigns for the call of citizens, with announcements throughout the City for the participation of these works, with QR code to make the reservation of the event and contact phone number. Step 5. Training citizens in separation of recyclable and non-recyclable waste, as well as protective, safety and hygiene measures for proper waste management.

Step 6. Estimate the quantity of bags, masks, gloves, brooms, buckets, disinfectant, soap, plants, shovels, drinking water, gasoline, collection trucks for the specific area to be cleaned and/or reforested.

Step 7. Make arrangements on the part of the State for the Private Sector to provide economic support from Socially and Environmentally Responsible Companies, and those that join this work of global interest, they have earmarked financial resources for environmental work required in these projects, they even have support from advertising and as they will be massive events, they will be interested in collaborating.

The State should also arrange with appropriate legal figure for the State recyclers to collect the material already sorted and clean, all the material to be recovered, it is feasible to negotiate the payment of gasoline or consumables for the delivery of this waste, since each recycler buys recyclable waste depending on the type and weight of the waste.

We also seek support so that there are enough garbage collection trucks in our State, so that we no longer observe streets with garbage, or even places where garbage bags are broken by stray dogs, contributing to biological vectors, from rats, cockroaches and feces in the air, seeking to modernize the cleaning and garbage collection service. The concept of garbage has become obsolete with the advent of the term waste. Garbage is bad and generates impacts to the environment, waste is not, by introducing the concept of recycling. Waste separation is indispensable for recycling. Recycling of materials is facilitated when they are not mixed and are free of organic matter.

If they are mixed, that is garbage. Separated, it is waste. In addition, separating waste at the source (before mixing it in the garbage can) and channeling it to its proper recycling, significantly reduces the volume of waste that would be in direct contact with the environment when placed in a final disposal site. Table 3 shows some recycling plants located in the State of Tabasco [20, 22-25].

Address of recyclers located in the State of Tabasco.

Recycler	Type of waste received	Address
Piro Piro Recyclables	Receive paper and cardboard (economic payment per kilo)	Villahermosa - Cárdenas Highway Km. 13, Ranchería Lázaro Cárdenas, 86280 Villahermosa, Tabasco, Mexico.
Recitab	They receive PET plastics (Terephthalate Polyethylene)	Carlos Pellicer Cámara Peripher Arco Norte #200,

	HDPE (High Density Polyethylene) LDPE (Low Density Polyethylene) PVC (Polyvinyl Chloride) PP (Polypropylene) PS (Polystyrene) Others (Plastic mix) (Economic payment per kilo)	José María Pino Suárez, 86029 Villahermosa, Tabasco, Mexico
EBEN-EZER Recycler	They receive: PET HDPE Paper Metals Scrap Aluminum cans (Economic payment per kilo)	Industrial City, next to the Catholic Church of Villa las Flores, Villahermosa, Tabasco, Mexico.

Therefore, waste collection trucks should be specialized, not garbage trucks, and instead of one, at least two, one for plastic waste, wood, glass, textiles, paper, metal, and another for food waste (tortilla, meat, eggs, vegetables, etc.), infectious waste (used needles), biological waste (toilet paper, diapers) and hazardous waste (expired medicines, batteries).

Article 4 of the Political Constitution of the United Mexican States establishes that everyone has the right to an adequate environment for their development and well-being. Within this "Let's clean up Villahermosa" Plan, the garbage in the drains should also be collected, which contributes to clogged drains and flooding caused by rainwater that cannot be pumped efficiently to the sumps.

CONCLUSIONS

This contribution demonstrates that there is a need for capacity in public and elected positions, since proposals must be presented to solve the problems of the States, there should no longer be bad practices of hiring recommended candidates, without experience in the area to be developed, but the hiring of qualified individuals who develop ideas to solve problems should prevail.

Now it is up to the Civil Protection of the State of Tabasco and the State Government to listen to these proposals and carry them out, the plan is already designed, as well as to hire trained personnel for the development of any activity to be carried out for the benefit of the Tabasco Society. Even, since it is a contribution that can be found in IPSUMTEC's web page, <https://revistas.milpaalta.tecnm.mx/index.php/IPSUMTEC>, it can be replicated by any Government or sister State of our Country.

These programs must be permanent, so that there really is a transformation of our State and we rescue its beauty, we respond to the commitment of caring for the State and our Country, as academics and activists of environmental care. It is important to remember that it is more economically and environmentally feasible to prevent than to solve a problem of floods or fires, even eutrophicated lagoons and rivers due to poor waste or sewage management.

We hope that this contribution with knowledge and planning that is required to solve the environmental problems that currently affect Villahermosa, in terms of fires, will permeate throughout our State as an efficient solution and will be carried out in the coming years, since the environmental devastation we are experiencing is undoubtedly worrisome.

We will seek to strengthen this research work with two lines of future research, the associated with the study and analysis of the places where fires have occurred in our state, at least 10 years prior to the current year of research based on the official records of Civil Protection and relevant public agencies with access to these data to establish the effects of global warming in the occurrence and frequency of these events, depending on the increase in global temperature in the year analyzed. Also, as a second line we will carry out a study of the effect of environmental education to promote a sustainable environmental culture, limited to students of the Tecnológico de Villahermosa, and students of Higher Secondary Education.

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