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Environmental Management Strategies in Kichwa Communities of the Ecuadorian Amazon

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Abstract

Unemployment in Ecuador's Amazonian communities has increased significantly during the pandemic caused by the COVID-19 disease, primarily from March to August 2020; as a result, the population has shifted its focus to agriculture. This economic sector is specifically directed towards the overexploitation of timber resources and the hunting of animals. This study proposes an Environmental Management Plan for three agricultural farms located in the San Pablo de Ushpayaco parish, Napo, Ecuador, which sell primarily organic products in local markets. The fieldwork included a historical analysis of the sector, the diagnosis of survival strategies, relevant environmental aspects, identification of actors, and interests regarding access to resources. Different problems include the inefficient use of water resources, poor land use management due to its overexploitation through monoculture practices, absence of sustainable agriculture and livestock practices, poor crop rotation, low application of organic fertilizers, and lack of inputs and resources were identified. Poor agricultural practices have led to low production yields and limited economic profit for farmers. This Environmental Management Plan focuses on the prevention, mitigation, and compensation of the environmental impacts caused by agriculture and therefore improving the quality of life of the communities in the study case.

Keywords: Environmental management plan, sustainable agriculture, water management, agricultural management.

Estrategias de gestión medioambiental en las comunidades kichwa de la Amazonia Ecuatoriana

Resumen

El desempleo en las comunidades amazónicas de Ecuador ha aumentado significativamente durante la pandemia causada por la enfermedad COVID-19, principalmente de marzo a agosto de 2020; como resultado, la población ha cambiado su enfoque hacia la agricultura. Este sector económico se dirige específicamente a la sobreexplotación de los recursos madereros y a la caza de animales. Este estudio propone un Plan de Manejo Ambiental para tres fincas agrícolas ubicadas en la parroquia San Pablo de Ushpayaco, Napo, Ecuador, que venden principalmente productos orgánicos en los mercados locales. El trabajo de campo incluyó un análisis histórico del sector, el diagnóstico de las estrategias de supervivencia, los aspectos ambientales relevantes, la identificación de los actores y los intereses sobre el acceso a los recursos. Se identificaron diferentes problemas como el uso ineficiente de los recursos hídricos, la mala gestión del uso de la tierra debido a su sobreexplotación mediante prácticas de monocultivo, la ausencia de prácticas agrícolas y ganaderas sostenibles, la escasa rotación de cultivos, la baja aplicación de fertilizantes orgánicos y la falta de insumos y recursos. Las malas prácticas agrícolas han provocado un bajo rendimiento de la producción y un beneficio económico limitado para los agricultores. Este Plan de Gestión Ambiental se centra en la prevención, mitigación y compensación de los impactos ambientales causados por la agricultura y, por tanto, en la mejora de la calidad de vida de las comunidades del caso de estudio.

Palabras clave: Solid waste, production per capita, amount of leachate.

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I. INTRODUCTION

In the Amazon region of Ecuador, the economic sectors mainly booming are oil extraction activities and mining added to the overexploitation of timber resources and the development of agricultural practices that do not incorporate sustainability guidelines. On the other hand, in the province of Zamora Chinchipe, there is the organization of the Federation of Small Organic Agricultural Exporters of the South of the Ecuadorian Amazon, APEOSAE, which benefits cocoa and coffee crops mainly, in addition to peanut, oregano, banana and yuca s; which present an organic certification. That is why in 2017, the Ministry of the Environment, Water and Ecological Transition, through the action plan Reduction of Emissions from Deforestation and Degradation (PA REDD +) and the Ministry of Agriculture and Livestock (MAG) during 2017 began the "Comprehensive Amazon Forest Conservation and Sustainable Production Program" whose objective is sustainable agriculture and the reduction of deforestation (Guilcapi, 2018). Traditional farming practices complemented by hunting and fishing have long led people to a subsistence way of life. The province of Napo is located in the Amazon region; it comprises five cantons and 20 parishes. In this context, 57% of the total population of the Napo province belongs to the Kichwa nationality. Archidona city of this province registers approximately 80% of the population of the same nationality (Cueva et al., 2018). It must recognize that since colonization in 1964, various aspects have negatively impacted the life, customs, and traditional cultural values of native communities; in addition to generating aggressive deforestation caused by the new approach of encouraging the production of the agricultural sector of those times (Cueva, Vilca, & Simbaña, 2018). In this context, the present research aims to prevent, mitigate, and compensate for the environmental impacts of agricultural activity by establishing an Environmental Management Plan and proposing strategies for sustainable organic agriculture to improve the population's quality of life.

MATERIALS AND METHODS

A historical analysis of the community was carried out. The case study of this document focuses

on the Archidona canton, San Pablo de Ushpayaco parish, Salazar Aitaka sector, where several farms are located (Figure 1), primarily organic, and their products are sold in local markets. Factors such as colonization in the province of Napo and the Amazon region were considered, it was formalized as of 1964 with the delivery of property titles by the former IERAC to individuals, organizations, and indigenous cooperatives, where there was aggressive deforestation caused by the new approach to incentivize the production of the agricultural sector of those times (Cueva et al., 2018). In addition, the territorial area of agricultural use in the province of Napo corresponds to only 7,821 ha, equivalent to 0.624%, which confirms that the soils of the Amazon are not primarily intended for agricultural practices.

In recent years, a significant portion of cattle farms has been abandoned due to the study sector's lack of profitability. Another visible aspect is that the frequency of tourists in the territory has declined notoriously due to the lack of an adequate system for promoting and disseminating the wealth of natural resources. Together with global pandemic occurrences, the latter spurred many families to look to the countryside, improving agriculture and planting some timber species, particularly in the early part of the year, rather than being forced to adhere to such a strict code of staying at home.

The identification of actors consisted of differentiating the degree of participation. Thus, the direct actors comprise fifteen family members who hold farms in the Salazar Aitaka sector. Three farms in the sector were chosen based on their owners' classification as Farm Salazas Aitaka, La Campiña and Nuevos Horizontes (Farm A, B, C, respectively). The indirect actors correspond to Provincial Decentralized Autonomous Government of Napo, the parish GAD San Pablo de Ushpayaco, the MAG.

The organization's analysis with which the management plan is working indicated the absence of a representative organization carrying out the common objectives in the sector. The activities are based on subsistence agricultural practices, and the main form of organization where decisions are made is the family structure. Many of these folks have families in the metropolitan areas of the Archidona canton and have seen an opportunity to forsake the fields and work in hourly wage trades as a means of

creating employment.

RESULTS AND DISCUSSION.

Survival strategies and existing productive activities were identified. In the province of Napo, agricultural production has been incipient, almost nil, due to the limited support of the institutions to provide technical assistance or financial support. Due to the deforestation of the Amazonian forests, there is no longer enough wood to exploit it, nor is raising cattle an alternative. Different products can be found in the farms A, B and C from this study, such as coffee, cocoa, banana, cassava, corn, citrus, custard apples, papayas, soursop crops, accouterments, guavas, guayas, guayusa, chonta, forest plantations, natural forest, among others. The owners of these farms are forced to implement good agricultural practices since there is currently a higher demand for organic products.

This study highlights the environmental impact and proposes a management plan considering the particularity of this territory, which has varied landscapes, timber resources, touristic resources, and its biodiversity. Additionally, the study identified the sources of contamination in water and soil. Results are presented in the following:

- A. Description of the area: The farms under study are located between 700 and 800 meters above sea level in the Salazar Aitaka sector, located in the jurisdiction of the San Pablo de Ushpayaco parish, which in turn is part of the Archidona canton, province of Napo. The ecosystems characterized in the San Pablo de Ushpayaco parish are the following: evergreen piedmont forest of the eastern mountain range, evergreen forest of the Amazon penepain a. Evergreen piedmont forest of the eastern mountain range. The topography is extremely irregular, with a complex micro-drainage, creating numerous micro-habitats, making possible an enormous floristic wealth (Báez, 2010).
- B. Environmental characteristics: The territory of the province of Napo is mostly made up of areas of conservation and protection use with 1'147.523 ha, which corresponds to 91.6% of the territory (Cueva et al., 2018).

In November 2000, the UNESCO MAB Program Coordination Committee officially declared the Sumaco Biosphere Reserve an area of great cultural and natural value. It seeks to improve the management of natural resources and improve the living conditions of local populations (SENPLADES, 2011). There are two plant formations in the San Pablo de Ushpayaco parish: The Evergreen Forest and the Piemontan Evergreen Forest, characteristic of the Ecuadorian Amazon (Báez, 2010).

- C. Current land use: 41.10% of the parish's territory corresponds to agricultural lands characterized by having soils with a high presence of silt to deep silty loam and an acid pH of low fertility. Moisture retention is higher than 100% for being very porous soils. Clay-silty soil can also be observed, with a low surface drainage capacity (SENPLADES, 2011).
- D. Potential land use: The soils in the Salazar Aitaka sector of the San Pablo de Ushpayaco parish, Napo province have similar characteristics in their composition and therefore are used in agricultural activities mainly with a chakra approach; The tendency to obtain economic income to improve their quality of life, has motivated the diversification of agroecosystems, with the help of MAG, especially in the improvement of soils and biological control of pests, and the participation of BanEcuador in the facilitation of soft loans with rates low-interest rates and reasonable terms.

Human intervention in diversified agroecosystems is notorious and evident. Similarly, there is a close link between ecosystems and trophic interactions to maintain the diversity of pest populations (FAO, 2018). In this sense, biodiversity has a function in an agroforestry system; timber and non-timber trees produce shade, giving rise to the growth of shade-tolerant crops such as vanilla and orchids (Sarandón, 2009).

Several practices that promote farm diversity include the inclusion of additional species of flora and fauna crop and animal diversification,

such as the continued use of legumes after a production cycle is complete, the presence of vegetation strips along crop boundaries, the avoidance of chemical insecticides to strengthen biodiversity, the possibility of obtaining a green certification, and the use of living fences (Sarandón, 2009). The use of chicken manure allows increasing the capacity of water retention

and provision of nutrients for the crops, the application of fertilizers (Estrada, 2005), since it is used harvest and weeding remains, pieces of wood, domestic waste, to the same as animal manure (Brechelt, 2004). The existing threats in the use of resources are shown in Table 1 where problems, conditioning, stakeholders and consequences are identified.

Table 1. Threats of Inadequate Soil Management

PROBLEMS	CONDITIONING	INVOLVED	CONSEQUENCES
Soil overuse and inadequate management systems			
Inefficient use of water resources	There is no adequate collection system or equipment to optimize the water. Access to capture the water is not conducive to being at a lower altitude than the land where the houses and crops are located. There is no source of electrical energy that allows the use of equipment such as water pumps to store and supply water for different purposes: human consumption, filling swimming pools, etc.	Owners and workers	It is not possible to live in adequate conditions due to the lack of water in the houses. Its use cannot be considered to develop larger projects, such as chickens, fish, sawmill, movement of machines. Production is void in such circumstances There is no economic income for the owners, By not being able to use these trees, the use of this land for other purposes is prevented.
Little use of timber resources	It is a forest in certain sectors of a primary type. There is no machinery human strength to mobilize this resource	Owners and workers	It is impossible to supply the productive chain involved in the proper use of this resource, such as carpenters, artisans, transporters.
Misuse of the territory	The fertile layer is very thin, at least in its initial phase, a special treatment is required that represents an important economic investment in order to create a physical space where the selected plant will be housed in order to be able to take advantage of it in a correct way that guarantees a high production level	Owners and workers	It is not customary to plant a great diversity of fruit species because a study of the soil is not done, and it is believed that its low fertility and high costs do not allow it, so it is ignorance rather than a reality that

E. The prioritization of the identified threats is presented in Table 2. This was carried

out with the different actors to identify the problems and prioritize them.

Table 2. Identification of programs that could contribute to solving these problems

PROGRAM	SUBPROGRAM	PROJECTS	ACTIVITIES
Management of water resources	Assessment of water quality and its use in recreational activities and human consumption	Monitoring of water and its potential consumption	Implementation of a water catchment system
			Physical-chemical analysis and registration of water quality every six months
	Use for tourist purposes	Use for tourist purposes	Notification to the owners of the previous results for their potential use or consumption in certain activities
			Location of points with tourist potential: adventure, spa, recreation with nature, also for academic research purposes
Use of water for the generation of electricity	Use of water for the generation of electricity	Harnessing as a source of electrical energy	Adequacy of the entrances with ecological trails, signage, labels with the scientific and common names of the representative species
			Construction and adaptation of swimming pools for sport fishing
			Measurement of water flow for the possible implementation of an electricity generation dynamo, near human settlements, poultry sheds, swimming pools and other productive areas that require lighting.
Management of timber and non-timber trees	Management of timber resources	Baseline and alternatives	Adaptation of the electrical system for lighting homes, sheds, etc. and to move medium-sized machinery
			Carrying out an inventory that includes timber species and their estimated quantity in the territory
	Management of non-timber resources	For agricultural purposes	For the replacement of exploited timber resources, reforestation with native and endemic species is essential.
			The integral use of wood, not only obtaining boards, planks, etc., but also its residues: leaves and branches can be used in fertilizers and the remaining parts of the trunk for handicraft activities
			Use and planting of bamboo species for the production of handicrafts, food purposes, trails, furniture, buildings
Use of species with medicinal potential	Use of species with medicinal potential	Supply to the production chain in fairs, markets and online platforms	
		Establishment of a fair price according to the reality of the demand	
			To reach the consumer with the products directly to avoid intermediaries in the commercialization that increase the prices
			Inclusion in like-minded producer associations that promote fair trade and organic production
			Identification of species with medicinal value
			Potential investigation of the chemical properties and composition of the species that ancestral medicine identifies

Proper Soil Management	Soil evaluation and improvement	Soil characterization	Carrying out a physical-chemical analysis of the soil: pH, Nitrogen, Phosphorus, Mineral Salts, to identify the state of the land, its potentialities and deficiencies
		Soil resource optimization	<p>Crop diversification to optimize soil management, and the recommendation is to plant legumes in open spaces and on a rotating basis.</p> <p>The use of chicken manure and fertilizers</p> <p>Strengthening soil quality with recovery times and crop diversification</p> <p>Collection of the fertile soil layer of the land, placing it around the plantations</p> <p>Soil disinfection, twice a year through lime applications around the plants, as directed by MAG technicians</p>

Faced with the indiscriminate felling of our country's forests and the existence of farms that in other times were prosperous cattle ranches, a short-term alternative for the commercialization of wood emerges, such as the Balsa, which in recent times has increased its demand. It is used in the aviation industry, and due to its great buoyancy, it is also required to manufacture floats, belts, lifeboats, even signaling buoys, it is also used as an acoustic or thermal insulator. However, its production must be evaluated with great caution to avoid monocultures and the wide of the agricultural frontier. Another species that has aroused the interest of farmers is the planting of Pawlonia, also known as the wood of the future. It is used to manufacture furniture, musical instruments, surfboards or kitesurfers, it also builds boats and means of transport, among other uses. The possible zoning points have been determined to plant the trees above in farms A, B, and C.

It should be noted that the land areas of farms A, B, and C, where the plantain, cassava, soursop, citrus, chonta, and other products are grown, have been determined according to the topography of the land. Since it does not exhibit extensive plains and certain spaces are rocky and brittle formations, it has also been considered a great advantage that the only carriageable penetration route goes through the farms, so the plantations were carried out at the edge of the road. Chonta is a product rich in protein.

Possible sources of financing for the programs. The National Finance Corporation (CFN) is a credit institution that aims to contribute to the strengthening of national production through SMEs.

Individuals, granting them loans with interest whose rates are 8.95% on a large scale, with the possibility that the higher the amount of capital the interest rate is reduced and BanEcuador, with a similar purpose, but on a smaller scale for productive projects of small and medium farmers, with an interest rate of 11%, especially for the production of corn. These economic resources are focused on financing working capital immediately to credit subjects whose credit record does not have observations or questions of non-compliance in their payments, whose projects are in the process of expansion in a short time. Individuals or legal entities with ongoing projects and yearly sales of between USD 84,000 and USD 5,000,000, with an equity value of at least USD 25,000 and a suitable financial history (National Financial Corporation, 2020). The Organic Law for the Comprehensive Planning of the Amazon Special Territorial Circumscription contemplates in its Article 43 what concerns preferential credits, and in Article 60 that mentions the Fund for Amazonian Development, are possibilities of economic support that are being established in the recently created regulation (National Assembly of Ecuador, 2018).

CONCLUSIONS

Several strategies to boost farm diversity include adding more species of flora and fauna, using vegetation strips along crop boundaries, avoiding chemical insecticides to increase biodiversity, acquiring a green certification, and using living fences. The application of chicken manure improves the capacity of crops to retain water and provide

nutrients and the application of fertilizers. It was possible to identify and prioritize the main problems when managing agricultural systems in Amazonian farms to obtain relevant data for planning control measures. One of the main components was planning programs that sustainably mitigate these problems based on water and soil resources correctly.

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Figura 1. Zoning of Farms A, B and C.

