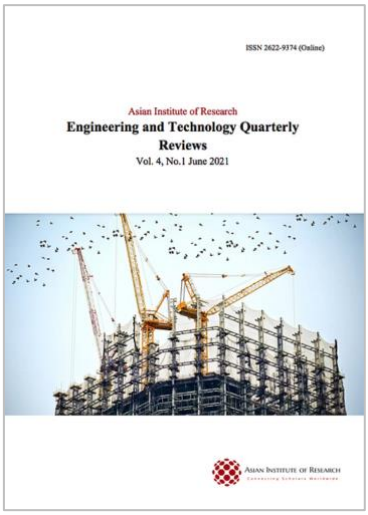

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Spatial and Functional Relations of Indigenous Farms Around La Cocha Lagoon in Southern Colombia

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Abstract
Regarding global environmental crisis, the effort of various institutions to reduce hunger have not yet been enough. The dominant model of extensive agro-industry reveals a serious problem of instability, due to the use of agrochemicals and the non-rotation of crops. In this context, the academic community is increasingly interested in alternative agricultural models such as indigenous agriculture. Indigenous communities from the Andes have inherited highly complex agroecological systems whose practices for stability could be replicated in other agricultural models around the world. This qualitative research focuses on the functional and / or spatial relations of the traditional indigenous farms of the Quillacinga ethnic group in southern Colombia and seeks to verify that their practices coincide with what is exposed in authority texts. These relations and their role in the stability of soil fertility are explained through diagrams. The information collected can be expanded and contrasted with other studies on other Andean ethnic groups. These studies would seek to make a contribution to reduce the instability of the extensive agro-industrial model and potentially contribute to reduce hunger in the world.

Keywords: Indigenous Agriculture, Agroecology, Agroecosystems, Quillacingas, Spatial Relation

1. Introduction

1.1 Background and Relevance

Concerning the global environmental crisis, there are several obstacles to environmental development. One of them is the dominant culture of consumerism and excessive industrialization, promoted by dysfunctional economic policies. (Holmgren, 2015). Despite the growing industrialization processes in food production, it should be noted that in 2011-2013 twelve percent of the world population was not able to meet their minimum dietary requirements, for which it is estimated that one in eight people in the world suffers from chronic hunger, the vast majority live in developing countries (Food and Agriculture Organization of the United Nations, 2013).

To solve this problem, the concept of Food Security is important, its four main principles are: availability, access, use and stability (FAO, 2015). However, the aforementioned principle of 'stability' is threatened in the extensive agro-industrial model, due to long-term infertility in the soil caused by the use of agrochemicals and non-rotation of crops. (FAO, 2015).

1.2 Theoretical framework

The long-term instability shown by the extensive agro-industrial model has awakened a growing interest in academia to investigate more stable agricultural models such as permaculture or traditional indigenous agriculture, furthermore the efforts of influential countries such as China are currently focused on strengthening their food security, threatened by environmental crises such as climate change (Piao et al., 2010). Within the theoretical framework to carry out this research, first-hand texts from influential authors were considered, as well as publications from international organizations such as the UN and FAO, as can be found in the bibliographic references. However, the main reference text for this work is '*Teoría y Práctica para una Agricultura Sustentable*' by the authors Altieri and Nicholls for the United Nations Environment Program. In this text, the authors point out that, in the Andean area and other areas of Latin America, traditional agricultural systems have been developed over centuries of cultural and biological evolution; Furthermore, indigenous peoples have developed or inherited agroecosystems that adapt well to local conditions such as the climate, these systems are highly diversified and are characterized by the following five points:

A - Conservation of the genetic diversity of species and of productive continuity.
B - Optimal use of space and local resources.
C - Recycling of nutrients, waste, water and energy.
D - Soil and water conservation.
E- Control of the succession and protection of crops. (United Nations, 2000, p. 34).

1.3 Research objectives

1.3.1 Primary objective

The primary objective is to verify that the agricultural practices of the *Quillacingas* ethnic group in the El Encano reservation coincide with the five characteristics of the indigenous agroecological systems of Latin America, previously mentioned. (United Nations, 2000, p. 34). This research focuses on verifying these characteristics exclusively in the aforementioned study area. However, other researchers can take the approach of this work as a guide to verify or analyse these characteristics in any other indigenous community from the Andes. Thus, the obtained results may allow the collection, organization and comparison of valuable information about the diverse agricultural knowledge of the Andean indigenous communities.

1.3.2 Secondary objective

The present work aims to document with a functional / spatial approach the systematic processes of traditional indigenous agriculture in the study area. The foregoing considering that there is a lack of written documentation in English about the great variety of indigenous ethnic groups that inhabit the Andes mountain range, especially about those who live in the specific territory in which this research is carried out. (Deruyttere, 2001).

1.4 Definitions and relevant information.

The investigation was carried out in the territory of the *Quillacingas* ethnic group, specifically in the indigenous reservation of El Encano, which is located around the La Cocha lagoon in the village of El Encano, Municipality of Pasto, department of Nariño, southern Colombia. The *Quillacingas* have occupied these territories since pre-Hispanic times, they were advanced farmers in different thermal levels, their most important traditional crops are: corn, potatoes and beans (Quijano & García, 2018). Here are some important definitions for understanding the context of the participants.

- Worldview: It is the system of opinions and beliefs that make up the concept of reality for a certain person, society or culture. According to the worldview of the Quillacingas (like many other Andean ethnic groups) the elements of nature, including: plants, animals and humans, are incomplete by themselves, but they are part of a

system that complements them mutually. That is, neither is superior or inferior to the other, but rather they are interdependent.
-Chacra: It is the indigenous ancestral farm, where the soil, water, plants, animals, human beings and deities develop and relate affectionately. It promotes scenarios for the protection of natural resources, sustainable production, food security and food sovereignty. In addition, it is developed in a smallholding and protects the ancestral seeds.
-Mindala: It is the exchange of experiences and the exchange of knowledge that contributes to the collective construction of the historical memory of indigenous peoples (FAO, 2013).

2. Method

The qualitative method was used since the research focuses on a certain indigenous community and its environment. In addition, the triangulation tool was used in the following three scenarios: (1) to compare the information between various texts referenced in the bibliography, (2) to compare the information collected between the three participants and finally (3) to compare the information from the texts (theoretical) with the information collected of the participants (practical). On the other hand, the stages of the research were three: the stage of collecting information in texts, the stage of collecting information from the participants and finally the stage of analysing the collected information.

2.1 Stage of collecting information in texts

It consisted of a search, collection and reading of texts on: academic research, permaculture, food security, agroecology and indigenous agriculture (Lowder, Skoet, & Singh, 2014) (Kropff, Bouma, & Jones, 2001) (Earls, 1998). Then a tabulated and numbered selection and organization of the collected information was made, prioritizing pertinent and first-hand information (Schmidhuber, & Tubiello, 2007) (Altieri, 1999) (Colque, Urioste, & Eyzaguirre, 2015).

2.2 Stage of collecting information from the participants

Initially, the researcher made contact with one of the leaders of the El Encano indigenous reservation belonging to the *Quillacingas* ethnic group, the objectives and scope of the investigation were clearly explained to him, it should be clarified that the author of this article belongs to the Sister ethnic group of the *Quillacingas*, called *Los Pastos* ethnic group. Considering that the criteria for selecting the participants consisted of selecting examples of *Chacras* that are representative of traditional indigenous agriculture's customs, participants were identified, they are three families belonging to the reservation. The researcher made a series of visits and interviews aimed at learning about the spatial functioning of these *Chacras* and obtained maps, written records, photographs, and audio and video recordings. Finally, the information was organized, listed and numbered in tables that contain the elements of the *Chacras* and their functional and / or spatial relations.

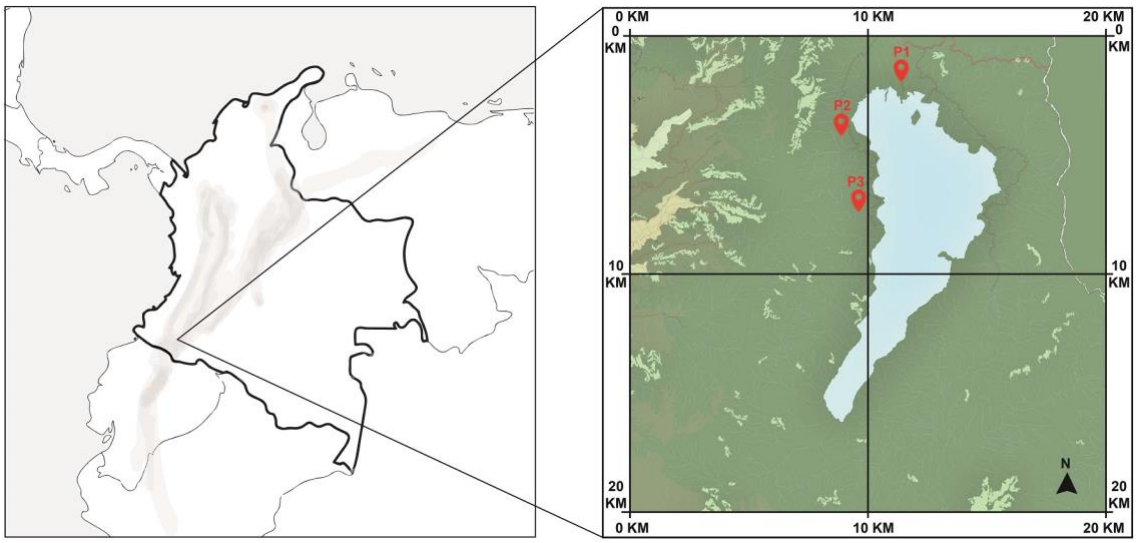
2.3 Stage of analysing the collected information

It began by making a comparison of the information collected in the three representative cases, identifying coincidences and differences. Considering that enormous coincidences and insignificant differences were found, it was decided to discard the differences and focus on the coincidences by making unique tables and diagrams that include the information from the three case studies as if they were only one. The information was synthesized and organized taking only the functional and / or spatial relations relevant to the study. Tables, diagrams and illustrations were made to explain these relations, including: location, elements, general diagram, contribution, feeding, environment and food and organic resources. Finally, a comparison was made between the postulates of the information collected in the texts and the results of the information collected from the participants to achieve the objectives of the research.

3. Results

3.1 Location

The *Chacras* of the three participants (P1, P2 and P3) are surrounding the La Cocha lagoon, which is located in the southwest of Colombia in a highly mountainous area known as the knot of *Los Pastos*, the lagoon is part of the water system that feeds the Amazon river. Taking into account the large number of streams that flow into the lagoon, it should be noted that all the case studies have important relationships with water. The lagoon has spiritual and landscape importance for this indigenous community.



Scheme 1: Location of Participants around La Cocha Lagoon.

Photography 1: La Cocha Lagoon View.

3.2 Elements of the Chacra

Unlike extensive monoculture agribusiness, *Chacra* agriculture is an agroecological polyculture that functions as a system in which many elements are interrelated. Table 1 does not show all its elements, but the most representative ones; These elements are organized in the following categories: plants, animals, buildings, water, community and others. In addition, they are grouped into several subgroups according to their nature in the *Chacra*, these subgroups are defined as follows:

-GROUP A: Plants that, for convenience, are generally planted in the same area, not necessarily all the plants in the group must be present. For example, arracacha can replace potato.
-GROUP B: Plants that attract animals and insects that contribute to pollination and control of unwanted pests. For example, the flowers of the laurel plant attract hummingbirds which contribute to pollination.
-GROUP C: Native plants that were cultivated in pre-Hispanic times and that had been displaced since the colonial period, they are currently in recovery.
-TUBER: Plants whose important stems grow underground.
-AQUATIC: Plants or trees that thrive in high humidity environments.
-INDICATORS: Elements that through their physical manifestations indicate some related natural phenomenon. For example, rocket (*Eruca vesicaria*) indicates that the soil has a high level of acidity.
-CLIMBING PLANTS: vines, usually grow up on trees.
-WILD: Plants and animals that do not depend on human care.
-DOMESTIC: Animals that depend on human care.

Table 1: List of elements of the Chacra. The information in the table was provided by the participants.

NAME IN ENGLISH	**SCIENTIFIC NAME**	**FAMILY**	**SUB-GROUP**	**NOTES / USE**
PLANTS				
Basil	*Ocimum basilicum*	Lamiaceae	GROUP B	Medicinal. Soothing.
Thymus	*Thymus spp*	Lamiaceae	GROUP B	Aromatic.
Garden mint	*Mentha spicata*	Lamiaceae	GROUP B	Medicinal. Aromatic. Seasoning. Salads.
Lemon balm	*Melissa officinalis*	Lamiaceae	GROUP B	Medicinal. Soothing.
Mint	*Mentha*	Lamiaceae	GROUP B	Aromatic.
Glory-bower	*Clerodendrum thomsoniae*	Lamiaceae	WILD, INDICATORS	Salads. High protein content. Indicates acidity in soil which can be countered by using quicklime.
Oregano	*Origanum vulgare*	Lamiaceae	GROUP B	Seasoning.
Amaranth	*Amaranthus*	Amaranthaceae	GROUP C	
Quinoa	*Chenopodium quinoa*	Amaranthaceae	GROUP A, GROUP C	High protein content.
Chard	*Beta vulgaris*	Amaranthaceae		Salads
Turnip	*Brassica rapa*	Brassicaceae	GROUP B	
Watercress	*Nasturtium officinale*	Brassicaceae	AQUATIC	High iodine content.
Rocket	*Eruca vesicaria*	Brassicaceae	WILD, INDICATORS	Salads. Indicates acidity in soil. Grows naturally after the potatoes are harvested.
Cabbage	*Brassica oleracea*	Brassicaceae		Salads
Broccoli	*Brassica oleracea*	Brassicaceae		Salads
Cauliflower	*Brassica oleracea*	Brassicaceae		Salads
Potato	*Solanum tuberosum*	Solanaceae	GROUP A, TUBER	It is usually sown in humid soil one week after the lunar quarter. After it has germinated it is fumigated

				weekly.
Eggplant	*Solanum melongen*	Solanaceae		Salads.
Tamarillo	*Solanum betaceum*	Solanaceae	INDICATORS	Indicates good quality soil
Chili pepper	*Capsicum*	Solanaceae		Seasoning.
Cape gooseberry	*Physalis peruviana*	Solanaceae		Medicinal, diuretic, improves skin. Natural sweetener
Naranjilla	*Solanum quitoense*	Solanaceae		Currently adapting to climate change.
Bean	*Phaseolus vulgaris*	Fabaceae	GROUP A	Nourishes the soil.
Lupin	*Lupinus spp*	Fabaceae	GROUP B, GROUP C	High protein content. After harvesting, it gives the soil enough nitrogen to plant some Group A crops such as potatoes, maize or quinoa.
Broad bean	*Vicia faba*	Fabaceae	GROUP A	Salads.
Pea	*Pisum sativum*	Fabaceae	GROUP A, CLIMBING PLANT	Salads.
Parsley	*Petroselinum crispum*	Apiaceae		Medicinal, antihemorrhagic. Seasoning.
Celery	*Apium graveolens*	Apiaceae		Aromatic.
Arracacha	*Arracacia xanthorrhiza*	Apiaceae	GROUP A	
Oxalis	*Oxalis spp*	Oxalidaceae	GROUP C	Medicinal, anti-fever. Salads
Oca	*Oxalis tuberosa*	Oxalidaceae	GROUP C, TUBER	Natural sweetener. Nourishes the soil. The grain is dried in the sun and boiled in milk for consumption.
Yacon	*Smallanthus sonchifolius*	Asteraceae	GROUP A, TUBER	Natural sweetener.
Dandelion	*Taraxacum officinale*	Asteraceae	WILD, INDICATORS	Medicinal, purifies the liver, skin and blood.
Lettuce	*Lactuca sativa*	Asteraceae		Salads.
Common fig	*Ficus carica*	Moraceae		
Blackberry	*Moraceae*	Moraceae		It is sown in dry and sandy soil.
Sweet granadilla	*Passiflora ligularis*	Passifloraceae	CLIMBING PLANT	Currently adapting to climate change. Medicinal, digestive benefits.
Banana passionfruit	*Passiflora supersect*	Passifloraceae	CLIMBING PLANT	
Welsh onion	*Allium fistulosum*	Amaryllidaceae		Must be exposed to the sun. Seasoning
Calabaza	*Cucurbitaceae*	Cucurbitaceae	CLIMBING PLANT	
Maize	*Zea mays*	Poaceae	GROUP A, GROUP C	Usually sown in September or October.
Bay laurel	*Laurus nobilis*	Lauraceae	GROUP B	
Curly dock	*Rumex crispus*	Polygonaceae	WILD, INDICATORS	
Malva	*Malva sylvestris*	Malvaceae		Medicinal, anti-fever.
Valerian	*Valeriana officinalis*	Caprifoliaceae		Medicinal. Soothing.
Ullucus	*Ullucus tuberosus*	Basellaceae	GROUP A, TUBER	Medicinal, healing and antiacid.
Mountain papaya	*Vasconcellea pubescens*	Caricaceae		Attracts wild mammals.

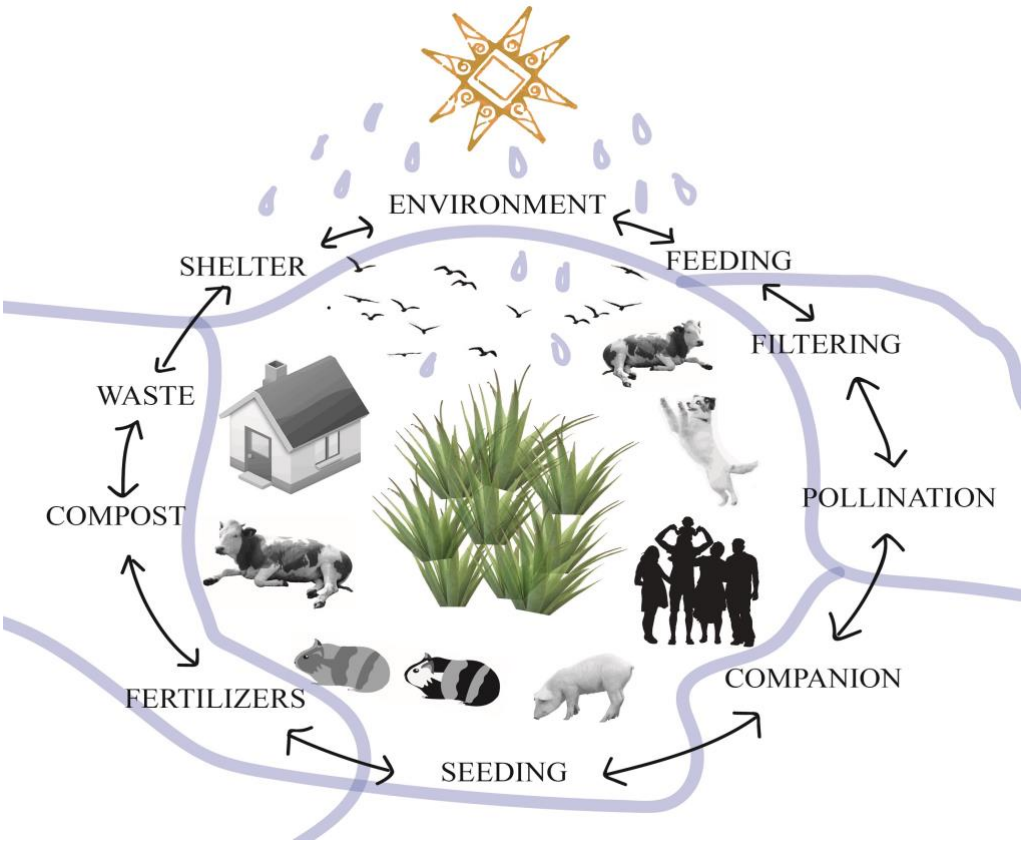
Mashua	*Tropaeolum tuberosum*	Tropaeolaceae	GROUP C, TUBER	Medicinal, antioxidant.
Azolla	*Azolla*	Salviniaceae	AQUATIC	Filters dirty water that flows into the ditches after washing the pig's shelter.
Garlic	*Allium sativum*	Amaryllidaceae		Seasoning.
Onion	*Allium cepa*	Amaryllidaceae		Seasoning.
ANIMALS			INDICATORS	Animal behaviour indicates natural or climatic phenomena such as earthquakes.
Guinea pig	*Cavia porcellus*	Caviidae	DOMESTIC	Spiritual, different colours have different meanings for indigenous peoples. They cannot eliminate gases so they must eat dry grass. Their faeces composts for 1 month.
Chicken	*Gallus gallus domesticus*	Phasianidae	DOMESTIC	Their shelters are made out of trees and vines like the calabaza. They walk freely on the ground contributing to fertilization and seeding.
Pig	*Sus scrofa domestica*	Suidae	DOMESTIC	Their faeces composts for 4 months. After death they bones are burned into ashes to mineralize the plants.
Cattle	*Bos taurus*	Bovidae	DOMESTIC	Their dairy products that are not consumed are exchanged with neighbours.
Goose	*Anserinae*	Anatidae	DOMESTIC	Take Care of the house. Their faeces composts for 1 month.
Dogs	*Canis lupus*	Canidae	DOMESTIC	Take Care of the house.
Insects			WILD	They contribute to pollination and pests' control.
Native birds			WILD	Their faeces contain seeds that contribute to seeding.
Violetear or hummingbird	*Trochilinae*	Trochilidae	WILD	Spiritual, different colours have different meanings for indigenous peoples.
Wild Mammals			WILD	Their faeces contain seeds that contribute to seeding.
CONSTRUCTIONS				
Shelter for chicken				It is composed of trees, vines and dry straw.
House for the family				Contains the traditional stove.
Shelter for guinea pigs				It is made of wood.
Pigsty				The waste from the cleaning of the pigsty that flows into the ditches is finally decontaminated by the azolla plant.
Greenhouse				Some plants such as broccoli, cauliflower, celery, chard or lettuce, etc. Are planted in the greenhouse and transplanted to another place when they have reached 15 cm in height.
WATER				

Artificial ditches				Transportation of products. Carries seeds naturally.
La Cocha Lagoon				Spiritual, purification. It is a substantial part of the water cycle.
Waste water				Leachate treatment
Rainwater			INDICATORS	Spiritual, natural signs.
TREES				
Black Cherry	*Prunus serotina*	Rosaceae		
Wax palm	*Ceroxylon quindiuense*	Arecaceae		
Alder	*Alnus glutinosa*	Betulaceae	AQUATIC	Its wood is used for small things such as handicrafts or firewood.
Elderberry	*Sambucus*	Adoxaceae		Its wood is used for small things such as handicrafts or firewood.
Eucalyptus	*Eucalyptu*	Myrtaceae		Eliminates the excess of water in the ground. Wood.
Yerba mate	*Ilex paraguariensis*	Aquifoliaceae		
Colombian pine	*Retrophyllum rospigliosii*	Podocarpaceae		Wood
Motilon	*Hyeronima macrocarpa*	Phyllanthaceae	GROUP C	Its fruit is used to make wine. Medicinal, antioxidant.
OTHERS				
Seeds				Spiritual. Wild animals are related to planting through the seeds present in their droppings.
Handicrafts				Spiritual. Wood from some trees is used as a material. Usually represent the scenery.
Grass			WILD	Forage
Hedgerow				surrounds every ‘property’, it can be made using blackberry plants and others.
Organic fertilizers				May include feces, sediment, dry straw, or quicklime
Natural Pesticide				May include quicklime, ashes, chili pepper or soap among others.
Kitchen organic waste				Feeding animals such as chicken, pig, goose, dogs.
Vermicompost				May include pigsty's waste, quicklime or dry straw.
Plastic waste				Vermicompost is covered with plastics to help decomposition
Plastic bottle waste				Some plants germinate in a recycled plastic pot to later be transplanted.
Sediment in ditches				Brings seeds
Traditional stove				It can be made of stone or brick. It is used for cooking. the family gathers around it. the *Mindala* takes place around it.
Ashes				Minerals for plants.

Paths				Circulation, access, transport and commerce.
Quicklime				Multipurpose
Solar radiation				Drying products. Spiritual.
Dry Straw				Multipurpose
COMMUNITY				
Barter				Exchange of dairy products, seeds, handcrafts, animals, fruits, etc.
Mindala				It is the exchange of knowledge and experiences within the community.
Family				
Neighbours				Practice barter.

3.3 General Organization

According to the worldview of the *Quillacingas*, the elements of the *Chacra*, including humans, are not organized according to a vertical hierarchy, in which there are superiors and inferiors. For them, each of the elements of the *Chacra* has a specific function and has a certain type of relation with others. (Feeding, Shelter, etc.). It is worth mentioning that the sun and water are elements of spiritual importance (Quijano & García, 2018).

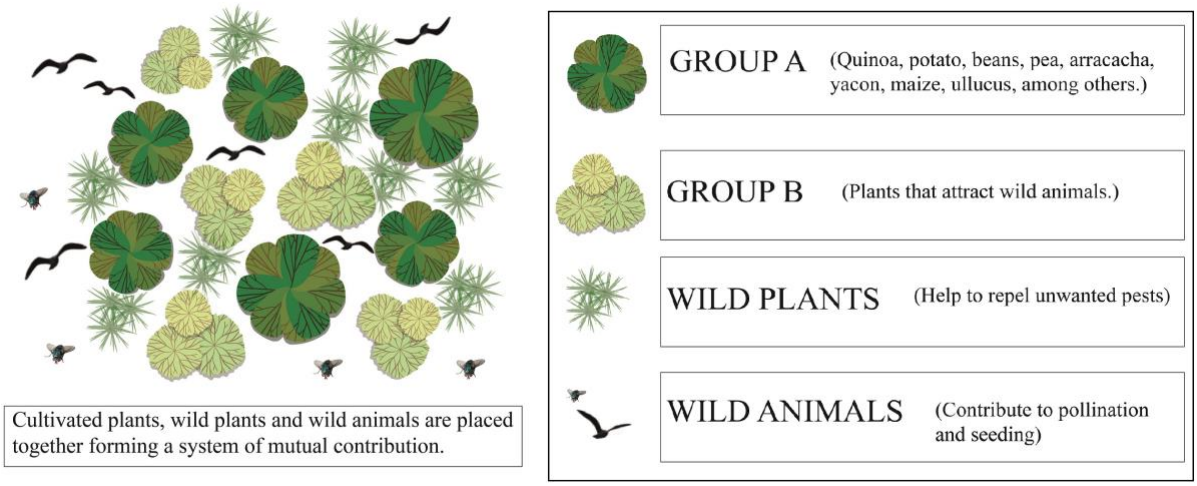


Scheme 2: General organization of a Chacra.

3.4 Pollination and contribution

For there to be a contribution and pollination process in crops, the location of the plants in the sowing is a key aspect. Cultivated plants, plants that attract desirable animals, native plants that repel undesirable animals, and

native animals that contribute to pollination are mixed in one zone. Consequently, the sowing of the polyculture becomes an agroecological system in which each element has a certain location, function and contributes to others.



Scheme 3: *Pollination and contribution.*

3.5 Environment

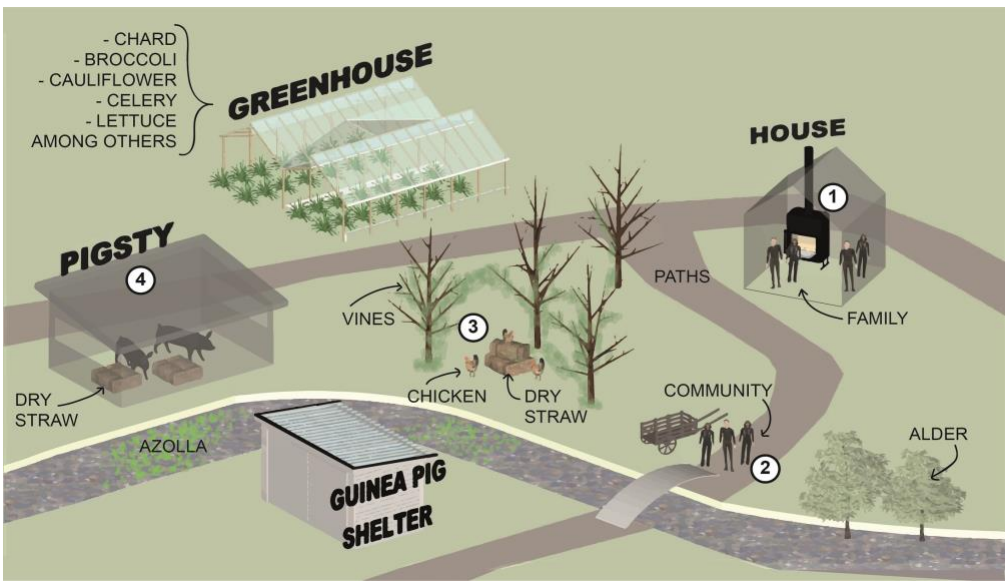
The constructions within the *Chacra* are located organically, according to their functionality and are connected through trails. Scheme 4 lists four functional and / or spatial relations that exemplify how the environment is arranged in the *Chacra*:

○;1: The family gathers around the traditional stove known as 'Tulpa', around it they eat and talk, it is also the place where they receive friends and neighbours.

○;2: The trails are spaces to mobilize and transport products, these also serve for community meetings and bartering with neighbours.

○;3: The chickens that are loose throughout the *Chacra* and whose excrements nourish the soil, take refuge in the dry straw that is placed under the trees wrapped in climbing plants.

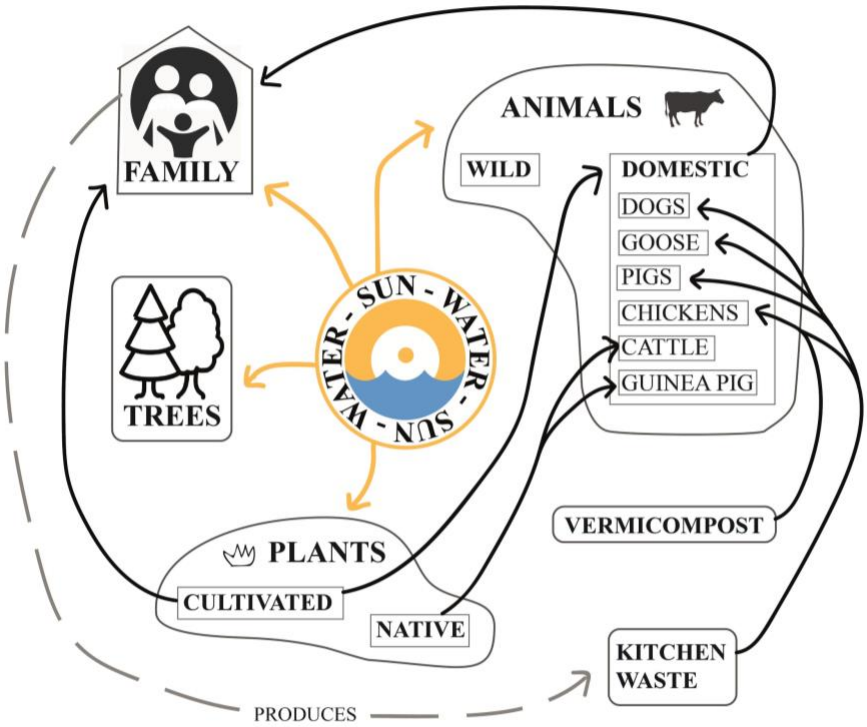
○;4: The pigsty is made up of dry straw in a wooden shed. When it is washed, the waste that flows into the nearby ditches is filtered by the azolla aquatic plant.



Scheme 4. Environment.

3.6 Feeding

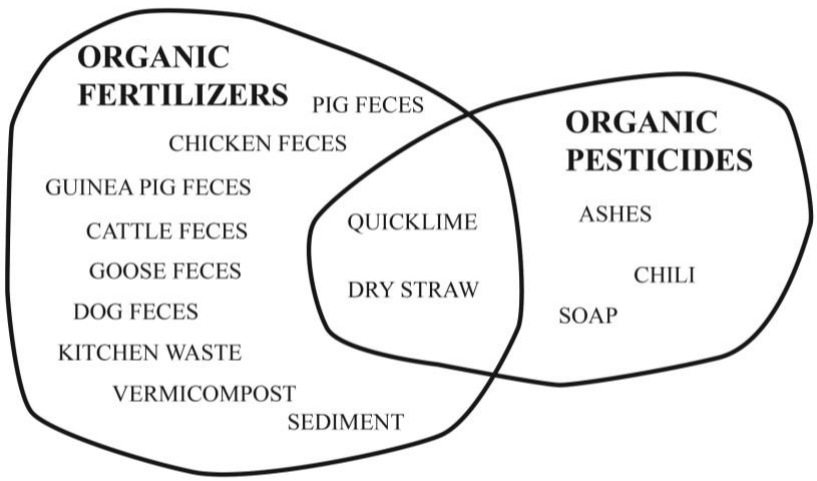
The elements of the *Chacra* feed each other, internally, which means, the food is produced within the same *Chacra*. The sun and water play a central role in this relationship as they feed the family, trees, animals and plants. The other elements feed each other, for example, native plants feed the cows and guinea pigs which in turn feed the family.



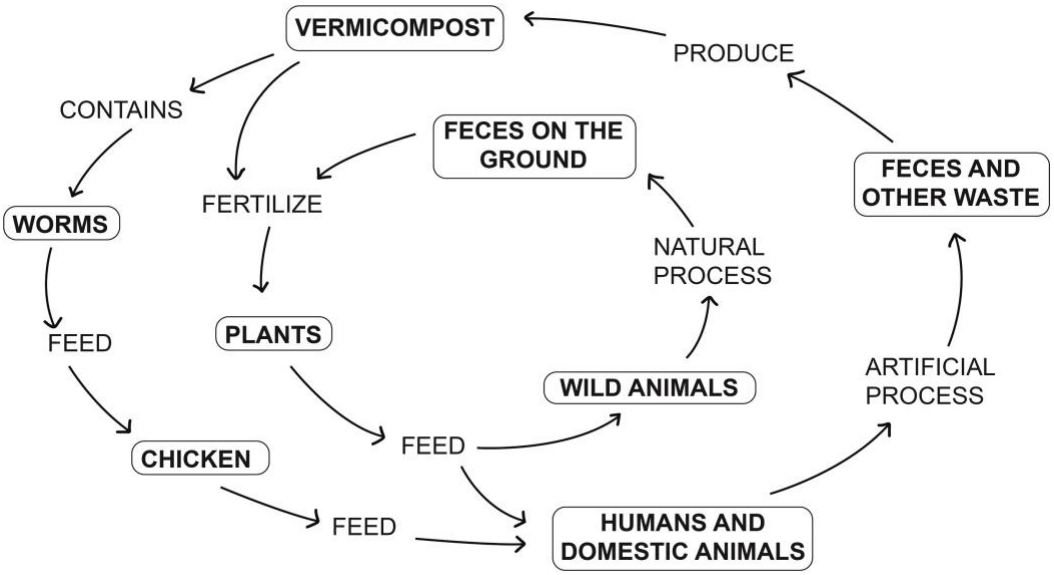
Scheme 5: Feeding.

3.7 Organic fertilizers and Organic pesticides.

Organic pesticides and fertilizers are made mostly with local ingredients, in scheme 6 their components are specified, the only common ingredients are dry straw and quicklime. On the other hand, it is worth mentioning that the relationship of organic fertilizers is cyclical and therefore is sustainable over time (scheme 7).



Scheme 6: Components of Organic Fertilizers and Pesticides.



Scheme 7: Cycle of organic fertilizers.

4. Discussion

4.1 Meaning of the results.

Considering that the primary objective of the research consisted in verifying in the practices of the participants the five characteristics of the indigenous agroecological systems of Latin America exposed by the authors Altieri and Nichols in the main reference text of this research. It was found that, among the three participants, all meet the five characteristics.

A - Conservation of the genetic diversity of species and of productive continuity. They comply because they use native seeds, their *Chacras* are polycultures that promote the diversity of seeds and species, and produce food continuously throughout the year.

B - Optimal use of space and local resources. They comply with the optimization of space through organic spatial organization and comply with the optimization of local resources through barter and the sustainable use of resources such as wood or wild animals and plants.

C - Recycling of nutrients, waste, water and energy. They comply because waste is reused to make natural fertilizers through composting, organic pesticides and the optimal use of water.

D - Soil and water conservation. They comply because the *Chacras* are part of an agroecological system that cares for the soil and water through the non-use of agrochemicals and rest periods for the land.

E- Control of the succession and protection of crops. They comply because they practice crop rotation and because different kinds of plants are planted in the same area so that there is a contribution between them to nourish themselves and repel pests (United Nations, 2000, p. 34).

4.2 Review of the method.

The use of the qualitative method, the triangulation tool and the organization of the research in stages was useful to achieve the objective of the research. However, the academic community lacks a generic method that can be used to investigate Andean agriculture regardless of ethnicity and location. This article is unique considering the little information written in English about the agriculture of the *Quillacinga* ethnic group with a functional / spatial approach.

4.3 Impact of the research.

It is expected that this work can be used as a contribution to the creation of methodological models that allow studying traditional indigenous agriculture with a functional / spatial approach; and that can be used with other

ethnic groups from the Andes mountain range. Therefore, the valuable knowledge that these communities keep through oral tradition can be useful to solve the problem of stability as a principle of food security, which is important to reduce famine in the world. (FAO, 2017).

Acknowledgments

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