



Panoramic view of the High Andean communities of Cotacachi and the Cotacachi volcano.

Source: Ecuadorian Guide of Transport and Tourism



Agrobiodiversity of the High Andean communities of the Cotacachi canton.

Source: UNORCAC

'ANDEAN CHAKRA': An Ancestral Agricultural System of Kichwas Cotacachi Communities

January 2023



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I. SUMMARY INFORMATION TABLE



Name/Title of the proposed GIAHS	'ANDEAN CHAKRA': An Ancestral Agricultural System of the Kichwas Cotacachi Communities
Requesting Agency/ Organization and contact information	Union of Peasant and Indigenous Organizations of Cotacachi (UNORCAC)
Responsible Ministry and contact information	Ministry of Agriculture and Livestock (MAG) National Agricultural Research Institute (INIAP) With the support of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), FAO
Location and geographical coordinates	Country: Ecuador Province; Imbabura Canton: Santa Ana de Cotacachi Parishes: Imantag and Quiroga (rural area); El Sagrario and San Francisco (urban area). Local features: The productive system has been developed and conserved more actively in northern mountains, in the High Andean Zone. According to the cartography of the National Information System, the coordinates are the following: North: 786448.37 E – 10064790.94 N South: 762919.62 E – 10022866.20 N East: 809866.09 E – 10040802.89 N West: 720681.73 – 10030094.77 N.
Transport links between the site and the capital city or major cities	Capital of Ecuador: Quito The GIAHS site is located 80 km north of the city of Quito and 25 km south of Ibarra. The main access is through Troncal de la Sierra E35 (Panamericana Norte).
Area of coverage (expressed as 'ha') of the system (core area) and, where necessary, buffer zone	The 'Andean Chakra' production system extends over an area of about 6 171.23 hectares in the upper zone of the Cotacachi canton, in addition, this territory interacts with rural (6 152.89 hectares) and urban (625.80 hectares) areas. Therefore, the total area is 12.949,92 hectares.

<p>Agro-ecological zones for agriculture, forestry, fisheries, and aquaculture</p>	<p>The high mountain area comprises four agro-ecological zones including a variety of eco-geographical conditions:</p> <ol style="list-style-type: none"> 1. High zone above 3 600 m a.s.l.: a 'paramo' ecosystem, origin of most of the water sources that supply rural communities and the city; located within the Cotacachi Cayapas National Park. This area is covered in the upper area by herbaceous vegetation ('pajonales') and native shrubby vegetation in the lower area. This area is for community use for the collection of wild fruits and medicinal plants and in some communities, they dedicate themselves to raising alpacas and beekeeping, as a productive alternative. 2. Transition zone between 2 900 and 3 600 m a.s.l.: sub-humid zone for cultivation of potato (<i>Solanum tuberosum</i> L.) and Andean tuber crops, grasslands, broad beans (<i>Vicia faba</i> L.), barley (<i>Hordeum vulgare</i> L.), quinoa (<i>Chenopodium quinoa</i> Willd.), cattle and sheep breeding. 3. Mid-zone between 2 500 and 2 900 m a.s.l.: sub-humid zone with a prevalence of crop systems associated with a great variability of maize (<i>Zea mays</i> L.), beans (<i>Phaseolus vulgaris</i> L.), black-seed squash (<i>Cucurbita ficifolia</i> Bouché), broad bean, barley, quinoa, chocho (<i>Lupinus mutabilis</i> S.) and animal husbandry such as guinea pigs (<i>Cavia porcellus</i> L.), pigs (<i>Sus scrofa domestica</i> L.) and chickens (<i>Gallus domesticus</i> L.). 4. Lower zone, between 2 200 and 2 500 m a.s.l.: sub-humid zone, with crops such as maize, beans, black-seed squash sweet potatoes (<i>Ipomoea batatas</i> L.), vegetables, and fruit trees, citrus, tamarillo (<i>Solanum betaceum</i> Cav.) and Andean raspberry (<i>Rubus glaucus</i> B.), among others.
<p>Topographic features</p>	<p>The topography of the area is dominated by the high peaks of Cotacachi volcano with an altitude of 4 939 m a.s.l., and the enormous calderas of Cuicocha volcano, that has become a lagoon. The steep slope of the area extends from 2 200 to 4 939 m a.s.l. (Zehetner & Miller, 2006; Municipio de Cotacachi, 2015).</p> <p>The relief of the high Andean zone of Cotacachi canton are varied; the arable land that corresponds to the 'Andean Chakra' system is found at altitudes ranging from 2 200 to 3 500 m a.s.l. (Zehetner & Miller, 2006; Municipio de Cotacachi, 2015).</p>



<p>Climate type</p>	<p>According to the international classification, the type of climate in the area under study is Tropical Moist Climates (Köppen, 1900). The climate in the area is typical of an equatorial altitude, with almost constant temperatures throughout the year, but with marked daily oscillations. The variations of the climatic parameters on the landscape depend on the altitude. The average annual temperature is approximately 15 °C at 2 500 m a.s.l. and decreases by approx. 0.6 °C for every 100 m elevation (Zehetner & Miller, 2006).</p> <p>In the Inter-Andean Region, two rainy seasons are observed, from February to May (very intense and copious) and from October to November (lighter and less abundant); with a first dry season very marked between June and September, and with a second less accentuated in December-January (Portilla, 2018)</p> <p>Rainfall is relatively low; average annual rainfall is about 900 mm at 2500 m a.s.l. and increases by 1 500 mm at 4 000 m a.s.l. (Zehetner & Miller, 2006).</p>
<p>Approximate population</p>	<p>The Cotacachi canton has a population of 40 036 inhabitants, the 77.90% live in rural areas and the remaining (22.10%) in urban areas. The parish of Cotacachi has 17 139 inhabitants (INEC, 2010)</p> <p>Human settlements in the area for six centuries, with a strong pre-Inca, Inca and Spanish colony periods (Moates & Campbell, 2006).</p>
<p>Traditional communities and/or indigenous populations</p>	<p>100% of the population responsible for the Andean Chakra defines itself as Indigenous of the Kichwa nationality from the Otavalo People, according to the denomination for the Peoples and Nationalities of Ecuador. However, of the total population of the Cotacachi canton, where the territory of the Andean Chakra is located and with which it has interrelations, 53.5% self-identify as mestizo, 41.6% as indigenous, 2.5% as white, and 2.4% self-identify as black, mulatto and montubio (Municipio de Cotacachi Plan de desarrollo cantonal de Cotacachi 2020).</p>
<p>Main source of livelihoods</p>	<p>Agriculture and stock farming account for 57.7% of the total population in the Kichwa Cotacachi community's territory, with 25.5% of the economically active population in the rural parishes of Imantag and Quiroga, respectively. The main crops are maize, beans, quinoa, potatoes, and a variety of minor tubers, grasses, and fruit trees (Municipio de Cotacachi, 2015).</p>

II. EXECUTIVE SUMMARY



The Andean Chakra of the Kichua communities of Cotacachi is located in the upper part of the Andes Mountain Range, between 2,300 and 3,000 masl, north of Ecuador, 40 km north of the equator, in the province of Imbabura, in the hydrographic basin of the Chota-Mira rivers that flow into the Pacific Ocean.

The Andes are characterized by three dimensions composed of latitude, longitude, and altitude, and this has the effect of producing environmental contrasts at different elevations and human adaptation strategies derived from the aspect, slope, and topography of the region.

The indigenous communities that manage the Andean Chacras are located between the urban area of the city of Cotacachi and the Cotacachi Cayapas National Park. This region is considered one of the “hotspots”, due to its extraordinary number of species per unit area (Alarcon, 2001). The natural complexity of the Andes has been the basis for a complex human landscape of interdependent settlements, cultures, and economic systems due to the need to exchange labor, food, and other resources between zones. The traditional agroecological and socio-cultural practices of the Andes constituted adaptations to a unique vertical landscape. This landscape is characterized by its fluctuating and unpredictable climatic conditions, which in turn force farmers to innovate and diversify agriculture in order to avoid malnutrition and famine (Rhoades, 2006).

Ecuador is a small country of 256,000 km², it has four natural regions, the coast in the Pacific Ocean, the mountainous region of the Andes, the eastern or Amazon region and the insular region of the Galapagos Islands. Ecuador is on the list of the most megadiverse countries in the world.

The modern mosaic of Cotacachi's landscape is the result of the interaction between natural, human, and cultural processes. Its development has been strongly influenced by volcanic phenomena that have shaped the landscape into plateaus that run parallel to the watercourses. These processes have shaped the soils, hydrology and topography of the area and have determined the agricultural potential of the zone. In this context, indigenous communities have lived in this area for thousands of years and have used agricultural practices adapted to the climate and topography. The ancient terraces, probably of pre-Columbian origin, are proof of the communities' commitment to the conservation and sustainable use of natural resources. The terraces have now been transformed into agroforestry systems that serve to protect and cover the soil and dominate the landscape, giving it a multi-coloured mosaic appearance typical of the Andean zone. Therefore, the traditional agro-ecological and socio-cultural practices of the indigenous communities have been adaptations to a unique vertical landscape, characterized by fluctuating and unpredictable climatic conditions, which forces them to innovate and diversify agriculture to minimize the risks to their food sources and livelihoods. Thus, landscape management in the 'Andean Chakra' is based on Andean cosmovision in which all elements are an integral and harmonious part of each of the beings living in the 'Pacha Mama'.

The 'Andean Chakra' is an ancestral agricultural system of the Kichwas indigenous peoples in Ecuadorian Andean region. It has expanded to most of the peasant population in Andean region. It can be identified along the entire Andean corridor, from the south of Carchi province to the north of Loja province, although, with different levels of conservation in specific areas. The 'Andean Chakra' is an ancient production system that is the product of numerous generations of natural and human selection and seed exchange activities within and between communities, to produce successfully in different environments.

This agricultural system is mainly characterized by the implementation of integrated and interconnected agro-ecological models in the different climatic floors of the inter-Andean zone, which goes from 2 500 to 3 400 m a.s.l.

For 100 years, the knowledge and technologies inherited and innovated have enabled the conservation of an extensive agrobiodiversity (ABD), in special, management and reproduction of native seeds and varietal adaptations of the forests or other agro climatic floors and a series of functional practices for the ecological management of soil, water, crops and breeding which are essential for the ecosystem sustainability. The 'Andean Chakra' play an important role in the conservation of agro-diversity and a public service for humanity. 227 species and varieties have been identified, finding an average of 25 types of crops per 'Chakra', in addition, there is a great intra-specific diversity, especially of certain crops such as maize and beans.

In 2017, a study was carried out to identify agrobiodiversity conservation areas by the National Institute of Agricultural Research- INIAP, identifying optimal geographic areas for the conservation of native crops in farms in Ecuador (Tapia et al., 2018), using an objective methodology with ecogeographic, biological and demographic criteria, and with information on geographic coordinates available in the documentation system of the INIAP Germplasm Bank. As part of this process, the Andean zone of Cotacachi was identified as one of the territories with optimal conditions for the conservation of high Andean grains such as quinoa, amaranth, corn and beans.

The indigenous communities of Cotacachi have faced two interrelated issues for some time: food insecurity and environmental degradation. The UNORCAC was founded to address these issues and make it possible for peasant communities to use the relative abundance of the diversity of fruits and unique native crops. By conserving endemic plant varieties of tubers, roots, fruits, cereals, and medicinal plants, the initiative has improved the sources of income and nutrition for 3,225 peasant families. In addition, the initiative has developed a value-added process for local varieties and agrotourism. UNORCAC was the winner of the 2008 UNDP Equator Prize as the best conservation and community development initiative (United Nations Development Programme. 2012. Union of Farmer and Indigenous Organizations of Cotacachi (UNORCAC), Ecuador. Equator Initiative Case Study Series. New York, NY).

These 'Chakras' are characterized by having small areas with agro-diverse production that has contributed to food security, nutrition, medicine, ornamentation, fuel, and fodder, as well as for cultural uses and to produce handicrafts and utensils. The system in Cotacachi has enabled the in-situ conservation of species and varieties such as maize, beans, quinoa, and potatoes, among many others, which is why this territory has been considered one of the largest and best ABD preserved zones in the Ecuador and the region. The production is primarily intended for auto-consumption and the small surpluses are marketed to generate economic income for families, especially for rural women, becoming an important means of livelihood for the communities.

From its ancestral origin and, considering the agro-centric worldview of the Andean communities, the 'Chakra' is the centre of the development of material and symbolic life for Kichwa families and communities. Its production is focused on the satisfaction of food, medicine, housing and family and community festivals, as well as livelihoods for most of the rural population of the area.

A series of cultural manifestations have been built and developed based on the agricultural dynamics: gastronomy, rituals, festivals and, above all, a worldview that places the human community integrated to nature; therefore, any environmental conservation objective is in the spirit of survival and social and cultural sustainability, and vice versa. There is also a strong social cohesion and impact from community organizations in relation to public institutions and the private sector.

All these unique characteristics of the 'Andean Chakra' promote sustainable agriculture by preserving the landscape, preserving biocultural diversity, protecting watersheds, improving soil health and water quality, ensuring sustainable yields over time, using reduced external energy inputs, and adapting to challenging and diverse environmental conditions. Therefore, the 'Andean Chakra' has the requirements to be considered as Globally Important Agricultural Heritage Systems (GIAHS).

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ACRONYMS

AFC	Family Farming
ABD	Agrobiodiversity
CIALCO	Alternative Marketing Channels
DAG	Decentralized Autonomous Government
DIPEIBI	Council for Bilingual Intercultural Education
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environmental Facility
GIAHS	Globally Important Agricultural Heritage Systems
INIAP	National Agricultural Research Institute
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MAG	Ministry of Agriculture and Livestock
MAGAP	Ministry of Agriculture, Livestock and Fishery
MCP	Ministry of Culture and Heritage
PACS	Agrobiodiversity Conservation Services
UNDP	United Nations Development Programme
UNORCAC	Union of Peasant and Indigenous Organizations of Cotacachi
UTN	North Technical University



CONCEPTS

Acial: Whip used to herd cattle.

Aguarico: A cock that has no feathers on its head or neck, like cariocas.

Allelopathy: Different biochemical or biophysical effects that occur because of the influence of one organism on another, for example, plant species that secrete substances that can affect or benefit a neighbouring or subsequent species in the crop cycle.

Carioca: A chicken that has no feathers on its head or neck.

Catulo: The leaf that wraps the corn cob.

Chakra: This is a site for breeding plants and animals, but the 'Chakra' in the Andes is not only a plot owned by members of the community but also by nature and deities. The 'Chakra' is a polysemic word, it alludes to a place, but it is more than that, it refers to an environment that generates life, where I raise and am raised.

Chicha: A beverage made of 'jora', i.e. malted corn. It has been made since pre-Inca times and is a sacred drink used in ceremonies and festivals; the kernel is malted first and then fermented.

Chicharrones: Chunks of pork meat and fat which are fried until golden.

Chuzalunku: The strongest and the best

Cochas: Small water tank of little depth.

Copetones: Breed of roosters with a big crest.

Corn: Tender corn used to prepare different dishes.

Cucabes: Food for a journey.

Deity: Supernatural being that is worshipped since it has power over a specific area of reality and over the destiny of humans.

Doulas: People who share and live the childbirth with the mother, so they are known as godmother and midwife.

Dreamers: A specialty of indigenous medicine related to the interpretation of people's dreams.

Fallow land: This is the name given to the remains of the harvest, generally of maize and other products, which are kept on the ground.

Firewood stove: To heat the place and cook.

Flowerbeds: Flat or curved surface of earth that forms between two furrows.

Fregadores: A specialty of traditional medicine that cures bone and joint trauma by rubbing the area with medicinal plant leaves.

Fritada: A traditional dish made up of fried pork ribs and chunks of meat.

Frosts: Atmospheric phenomenon that consists of a drop in temperature until the water freezes.

Guacamayos: Wild vegetables.

Herbs healer: A person or a physician and healer who cures or relieves ailments with herbs.

Hornado: Pork cooked in the oven.

Huarmirasu: Every mountain, every lake, every river has its owner.

Huasipungo: A plot that a landowner gives to a labourer to grow their own food in exchange for his work.

Huata papa: Common name of a variety of wild potato.

Jaggery: Unrefined sugar cane, which is sold as rectangular, round or prismatic sugarloaf.

Jambi Mascaric: In Kichwa language it means looking for the remedy. This is the name of the UNORCAC women's project that promotes the indigenous medicine.

Kichwa nationality: Settled along the Ecuadorian Sierra, including other regions of the Ecuador, due to the migratory movements of the different peoples. They represent the multi-ethnic process experienced by the pre and post-Hispanic native peoples, which created a cultural link from the Kichwa language. The main peoples that make up the Kichwa nationality are: Caranqui, Natabuela, Otavalo, Cayambi, Quito, Panzaleo, Chibuleo, Salasaca, Waranka, Puruhá, Cañari, Saraguro and Amazonian Kichwa.

Land turn over: Preparing the soil for sowing.

Mama Cotacachi: Colloquial definition given to Cotacachi volcano because of the female meaning of its existence, linked to the binary notion of the indigenous cosmovision.

Mediano: Abundant food as an offering, in gratitude for the work carried out throughout his life since they were his godparents until death.

Mote: Stew that is made with husked and cooked corn kernels.

Motecasado: Husked mote mixed with beans or broad beans.

Pacha Mama: Nature in permanent contact with the human being.

Parish centre: The largest population in the Ecuador is within the parish who has authority over the same territory.

Pogyo yacu: Water source. The point of origin of underground water.

Prayers: A religious specialty of indigenous medicine that asks for the healing of illnesses through prayers.

Propolis: A waxy resin, of complex composition and viscous consistency, made by bees from resinous particles of different plants and that they use in the construction, repair and protection of the beehive.

Puquiales: Water springs.

Raymi: A party for the enjoyment and fun of all the partygoers, for which the indigenous people prepare themselves all year round saving their income gradually, to spend it in the celebration. The money saved is used to buy new clothes and food to receive the partygoers at home.

Rigs: A type of soil arrangement on the plain for cultivation, which is used in flood areas.

Rooting: Turn up the ground with the snouts.

Salt grinders: According to researchers, the name Cotacachi comes from Cutay - Cachi which in Kichwa means 'salt grinders'.

Small farmers: Farmer who keep many rustic and climate-resistant plant varieties and animal breeds alive. Most of them, together with their families, live below the poverty line and are engaged in farming activities.

Soguelo: Pass a tightrope over the spikes to remove the dew that bathes them.

Sumak Mikuy: In Kichwa language it means excellent food. It is the name of the peasant agro-industrial company.

Taita Imbabura: In the indigenous culture, he is the husband of Mama Cotacachi, and the couple has children like Yana Urku (black mountain).

Taita Pichincha: This volcano has two craters, one inside the other, which are the result of eruptions. It is the closest volcano to the city of Quito.

Taitas: The way to call father and other elders who deserve respect.

Tundum: Name of a ritual site for the indigenous communities of Cotacachi.

Tusa: Corncobe, waste from de-kernel.

Vicundo: Common name of a plant that corresponds to a bromeliad variety.

Yachags: A moral authority, a wise person who has passed through a long and difficult initiation. He is a strongly structuring element who maintains the cohesion of the group, a spiritual guide, a social pillar, and healer.

Yuyos: Wild herbs used as food spice.

Zaratanos: Of grey colour. Often used to call fighting cocks with grey feathers.

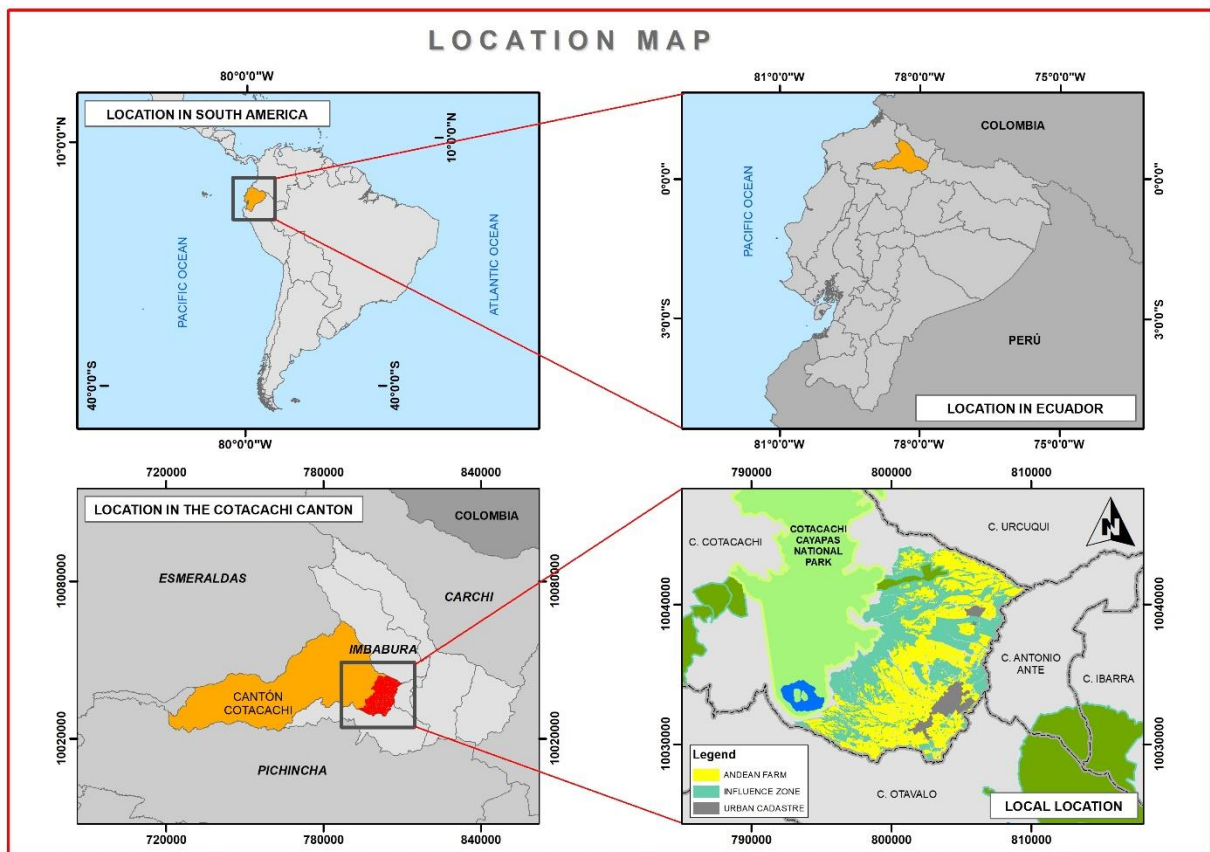
III. SIGNIFICANCE OF THE PROPOSED SYSTEM



PART A Specific values and features

The Cotacachi territory takes its name from the Cotacachi volcano, which foothills are inhabited by the canton communities. It is located 80 km north of Quito on the western plain of the Hoya del Imbabura. It is close to the Cotacachi Cayapas national park, the Cayambe Coca reserve to the east, and the Chocó Biosphere Reserve to the west; therefore, it is also a territory of bio cultural ecological connectivity.

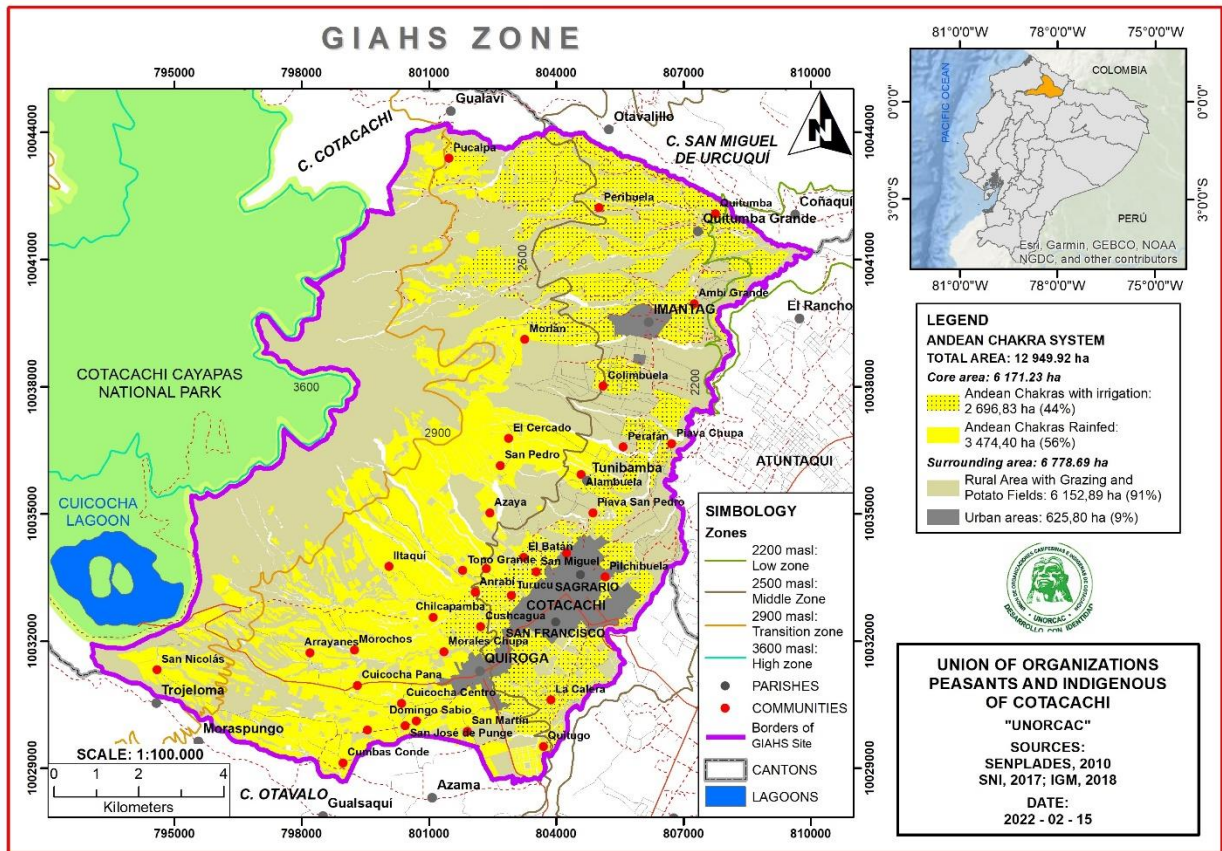
In the north, it borders with the Urcuquí canton and the Esmeraldas province; to the south with the Otavalo canton and the Pichincha province; to the east with the Antonio Ante canton, to the west with the Esmeraldas and Pichincha provinces. It extends over an area of 1 809 km², which represents a 33% of the total area of the Imbabura province, being the largest canton of this province (Map 1).



Map 1. Geographical location of the Cotacachi GIAHS area

The High Andean Zone of Cotacachi consists of four **agro-ecological zones** including a variety of eco-geographical conditions: a) High zone (3 600 m a.s.l.: a 'paramo' ecosystem), b) Transition zone (between 2 900 and 3 600 m a.s.l.: sub-humid zone), c) Mid-zone (between 2 500 and 2 900 m a.s.l.: sub-humid zone with a prevalence of crop systems associated with a great variability of crops), and d) Lower zone (between 2 200 and 2 500 m a.s.l.: sub-humid zone). The Andean zone has been the ancestral and historical settlement of the indigenous population and their communities, as well as traditional estates. In this Andean zone, a 60.7% of the total population of the canton lives on the eastern foothills of the volcano known as 'Mama Cotacachi', distributed in the parishes of El Sagrario, San Francisco, Quiroga and Imantag. The SIPAM Chakra Andina zone is represented by 6 171.23

hectares distributed in various communities that interact with rural areas (6 152.80 hectares) and urban areas (625.80 hectares); therefore, the total area is 12.949,92 hectares (Map 2).



Map 2. Location of the Cotacachi GIAHS area.

In the Ecuadorian Sierra, the two mountain ranges of the Andes are narrower and closer to each other, which affects the steepness of the mountains, and this in turn affects the amazing proximity of the ecological floors; after minutes you can go from one altitudinal floor to another (Moya, 2013). On the other hand, the proximity of the two mountain ranges of the Andes explains the presence of a great type of soils from volcanic origin, accumulated in the inter-Andean valleys and their great fertility.

Added to this is the great diversity of climates and microclimates found in the Ecuadorian Andes, due to the country's geographical position, being at the level of the equatorial belt, where air currents from the northern and southern hemispheres collide, creating an intertropical front, all this results in climate variability, thanks to differences in cloudiness, solar radiation, winds, and humidity.

According to Moya (2013), this biophysical context has been interpreted by the Ecuadorian Andean populations that has generated an adaptation and production system that could be characterized by:

- The maximum use of ecological floors, climates, and microclimates.
- The complementarity of the same.
- The development of active and varied product exchange networks.
- Strong mechanisms for community cohesion.



Cotacachi Volcano. Source: UNORCAC

The hydrography of the high lands is centred in rivers like Pichaví, Pitzambitze and Yanayacu. In the wild land area, there are several lakes such as Donoso de Piñán and Cristococha. The average temperature is 15 °C and the total annual precipitation is 1 259 mm (Zapata *et al.*, 2006). The vegetation in the area is classified as Low Dry Montane Forest and Moist Montane Scrub. In general, the vegetative cover is intervened by human activities, especially below 3 000 m a.s.l, where introduced eucalyptus (*Eucalyptus globulus* Labill.) forests and agricultural zones are found. The native vegetation forms bushes that are located in gorges, ravines or steep slopes, which offer protection from agriculture, grazing and burning. Above 3 000 m a.s.l, there are remnants of native forests.

The starting point for the development of this system is the peasant family and its 'Chakras'; however, the understanding and relevance of this system goes beyond the family production setting and is projected towards its capacity of complementarity outside the family production unit towards the territorial and regional scope. In other words, it becomes a relational and cohesive mechanism in the environmental, social, and economic spheres.

These 'chakras' acquire unique characteristics, differing from each other in the extension of available land, family food requirements, traditions regarding storage and recovery of seeds, association of crops, climatic factors and family work (Tapia & Fries, 2007; Morocho, 2008). Even though, the 'Chakra' shares many criteria with definitions such as family food gardens or productive family yards, considering variables such as proximity to the home, purpose and plant diversity (Niñez, 1987; Huai & Hamilton, 2009), the main difference is the deep cultural and spiritual roots of the traditional inhabitant of the 'Chakra' (Moncada *et al.*, 2018), as well as the levels of productivity and diversity, which allow a sustained access to markets and the development and innovation of other income sources for the family.

The ways in which the rural Cotacachi communities understand, take advantage of, and use the high Andean ABD represented in the 'Andean Chakra' system, evinces a valuable cultural heritage manifested in knowledge and skills for a comprehensive management of the agricultural landscape, which must be preserved, and is part of the food sovereignty of both the territory and the country, which is essential for the development, innovation, and entrepreneurship to generate livelihoods, and

which has positioned itself as a local territorial development policy.

This perspective also considers education, farming and the comprehensive development of the family, through the revival and integration of ancestral knowledge, making a traditional production system, derived from the pre-Columbian era, which remains a main element of the Kichwa culture (Merino *et al.*, 2011).



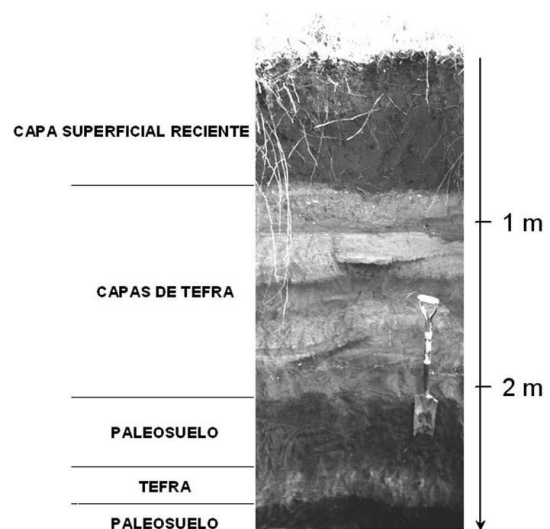
Figure 1. 'Andean Chakra' of El Cercado community. Source: UNORCAC (2018)

TYPES OF SOILS IN COTACACHI (Franz Zehetner y William P. Miller; 2006)

The primary materials of the volcanic soils of the Cotacachi communities are generally pumice and have a composition ranging from andesitic to dacitic. The soils in the southern part of the study area formed on the Cuicocha deposits 3,000 years ago, and are in their early stages of development, while the soils in the northeastern part have formed on deposits older than 40,000 years and, therefore, their development is at a more advanced stage.

Apart from the differences regarding the age and composition of the primary materials, the formation of the soils has been strongly influenced by the climatic differences corresponding to the changes in elevation along the volcanic spurs. The organic matter content of the soils (Figure 2.3), water storage capacity, structural stability, and phosphate retention increase with altitude.

At higher elevations, the clay mineralogy of the soils is dominated by active amorphous components, whereas, at lower elevations, the halloysite clay mineral is predominant (Zehetner *et al.*, 2003). The andic properties of soils increase with elevation and according to the US Soil Taxonomy (Soil Survey Staff, 1998), highland soils are classified as Andisols and low elevation soils as Inceptisols and Entisols (Zehetner *et al.*, 2003).



The recent volcanic deposits rest on an older and more developed surface formed on top of volcanic materials from previous eruptive episodes. A typical soil profile is presented in the figure below and shows the recent development of soils in a Cuicocha tephra series on top of a buried soil (paleosol) formed on an older tephra which, in turn, is on top of an even older paleosol. The primary material of this deeper paleosol is volcanic ash that has been cemented and hardened over time; locally this material is called Cangahua. In areas where recent soils have eroded, the paleosol may come very close to the surface or fully outcrop, thus again playing an agricultural role.

SOURCE MATERIAL AND TEXTURE

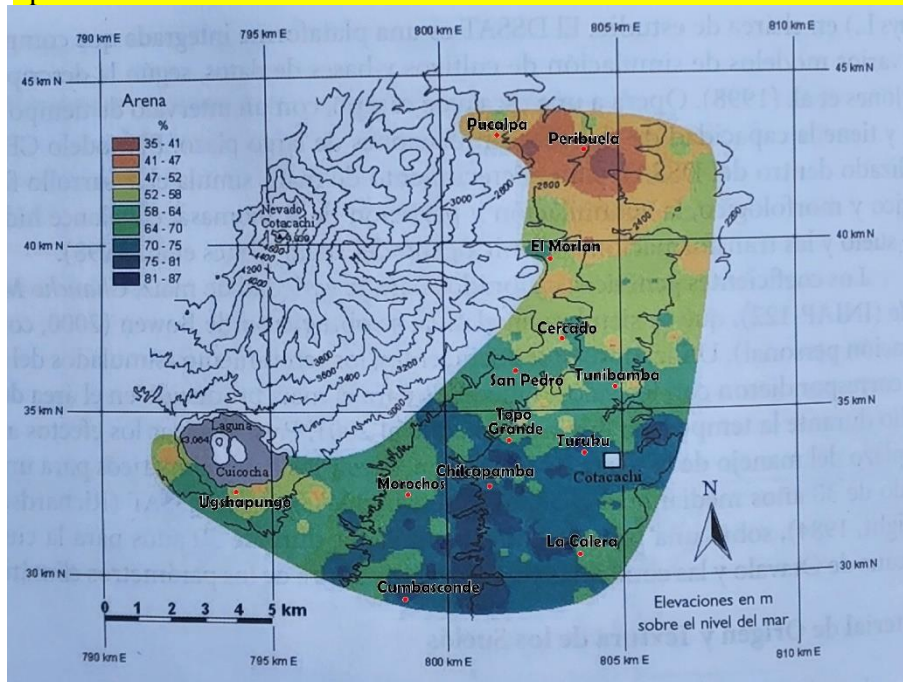
(Franz Zehetner y William P. Miller; 2006)

Initial classifications of soils were based on an evaluation of their ease of cultivation and management (Russell, 1988), which is determined, in large part, by the particle size distribution or texture class. Until today, soil texture is one of the criteria most widely used by farmers for local soil classification systems (Talawar y Rhoades, 1998). The distribution of the sandy and clayey content of the topsoil in the area of the Cotacachi communities is presented in the figures on the following pages.

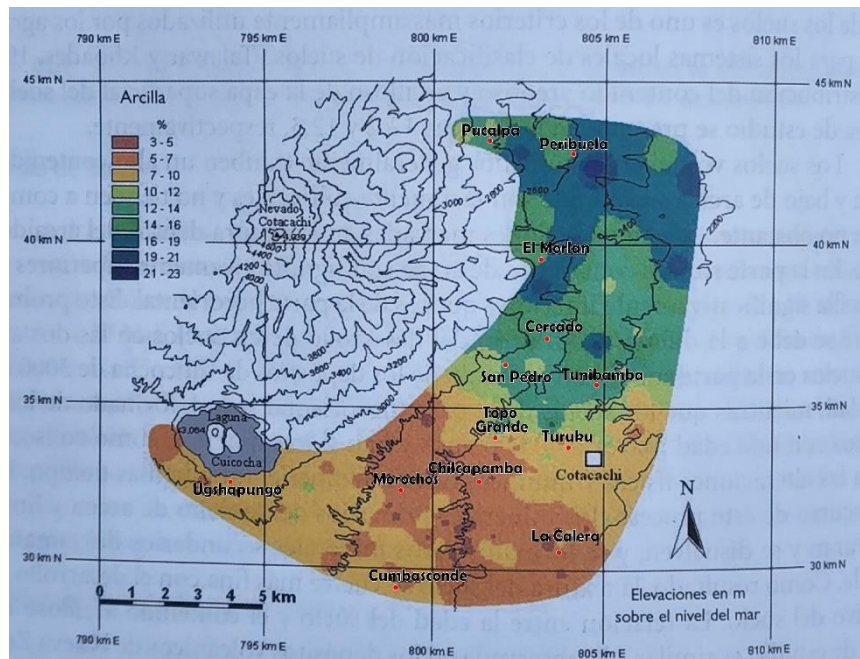
The volcanic soils studied generally exhibit a high sand and low clay content and are therefore easily arable and do not tend to compact; however, there are marked variations in texture within the study area. In the southern part, the sand contents are significantly higher and those of clay significantly lower than those of the northeastern part. This is probably due to the different duration of development of the soils in the two areas. The soils in the southern part have been formed from Cuicocha deposits that are 3,000 years old, while the soils in the northeastern part have been formed from deposits older than 40,000 years and have been exposed, as a consequence, to the physical and chemical alterations of the weather for a longer time. In the course of this process, primary sand and silt-sized minerals fracture and dissolve, and new clay-sized secondary minerals are formed. As a result, the soil texture becomes finer with the progressive development of the soil. The relationship between soil age and clay content in the study area is similar to that observed in New Zealand volcanic deposits (Lowe, 1986).

Secondary or clay minerals formed by climatic alterations are characterized by small particle size, charged surfaces, and high reactivity, and therefore dramatically change the physical and chemical behavior of soils. The higher clay content in the older primary materials in the northeastern part gives the soils a higher water-holding capacity and a superior ability to retain nutrients against leaching as water seeps through the soils. On the other hand, the sandy soils found in the southern part, especially at low elevations, cannot store much plant-available water and are vulnerable to the loss of ions from mobile nutrients, such as nitrate and potassium, through leaching.

Spatial distribution of sand content in the soils of the Cotacachi communities



Spatial distribution of clay content in the soils of the Cotacachi communities



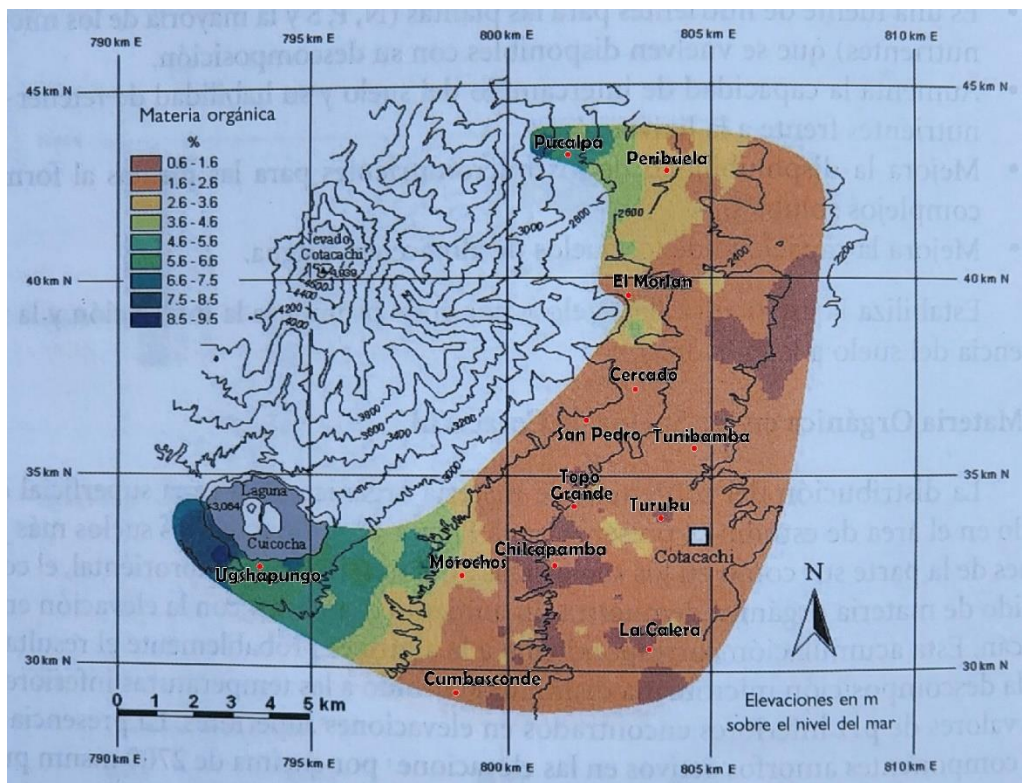
ORGANIC MATTER IN THE SOILS OF COTACACHI (Franz Zehetner y William P. Miller; 2006)

The distribution of organic matter content of the topsoil in the study area is presented in the figure on the next page. In both the younger soils of the southern part and the older soils of the northeastern part, the organic matter content shows a dramatic increase with elevation at the volcano. This accumulation at altitude is likely the result of decreased microbial decomposition due to the lower temperatures and lower pH values found at higher elevations. The presence of the active amorphous components at elevations above 2700 masl may also have contributed to accumulation by protecting

organic matter against microbial decomposition. The stabilizing effects of active amorphous components on the organic matter of the soil have been demonstrated by Parfitt et al. (1997), who reported the decrease in organic matter with the conversion of pastures to crops that were considerably higher in an Inceptisol than in an Andisol, the latter containing active amorphous components. The low organic matter content of sandy soils at lower elevations in the southern part of the study area further contributes to their low capacity to store water and retain nutrients. On the other hand, the ability to store plant-available water and to retain nutrients against leaching is greatly enhanced by the accumulation of organic matter in soils at higher elevations.

Organic matter is an important source of plant nutrients, with most of the nitrogen in the soil stored in organic compounds. The soils at higher elevations in the study area, rich in organic matter, have, as a consequence, a considerable amount of nitrogen. However, in order to be available to plants, organic nitrogen has to be mineralized (converted into mineral forms) in the course of decomposing organic matter. Due to the reasons mentioned above, the rate of microbial decomposition of organic matter decreases in soils at higher elevations, also decreasing the rate of nitrogen mineralization.

Spatial distribution of organic matter content in the soils of the Cotacachi communities



PART B Historical relevance

The first plants were domesticated about 10 000 years ago in the Andes and 4 000 years ago the first irrigated crops appeared. From very early on, crop rotation and intercrop systems were developed, with the soil rest as the central element to preserve fertility, although, in some areas the use of animal manure has been documented. When the conquerors arrived in the Andes in the 16th century, they were surprised by the development achieved by the Indians in the field of agriculture. Today we know that the Andes were one of the agricultural sites in the world, along with Mesopotamia, East Africa, China and Mesoamerica.

The Incas, after having conquered much of the equatorial Andean region during the 15th century, helped to spread certain crops and production systems, as well as the raising of llamas (*Lama glama* L.) and alpacas (*Vicugna pacos* L.). The construction of terraces had a boom during this time especially for the cultivation of key products for the Inca state establishment, such as maize and coca (*Erythroxylum coca* Lam.). However, much of the production continued to be controlled and determined by the local ethnic groups (Benzing, 2001).

Despite, the disruption of the ancestral societies, the most important technological elements and the ABD typical of this agriculture still survive, and they are currently expressed in a somewhat fragmented or modified 'Andean Chakra'. In addition, with the European presence, the number of crops (beans, barley) and animal husbandry (cattle, sheep) was increased, which together with the animal-pulled plough (yoke) and diverse farming tools (hoe) have been incorporated and are considered very typical elements of the Andean communities and the 'Chakra'.

Records from 1655, long after the forced reductions of 1580, show that Cotacachi bias in the Otavalo distribution, registers eight salt producers, plus 52 tributaries, around 300–400 inhabitants, most of them permanent residents. The Andean zone of Cotacachi has 40 036 inhabitants (INEC, 2010), however, the population projection for the year 2020 was 44 203 inhabitants (Ecuador en cifras, 2022). Cotacachi are an ethnic group with pre-Inca roots, and some researchers have suggested that their name derives from Cutay-Cachi or 'salt grinders', in Kichwa.

At the time of the conquest, the only descriptions of agricultural practices in the Ecuador come from the region of Quito and date back to 1573, by an anonymous author who literally wrote *...They cultivate corn on rigs, separated by little more than a foot. To sow, they make a hole with their finger and put two kernels of corn and one grain of beans. ...The potatoes are sown between the corn. The fields are always free from weeds. They use hardwood shovels to loosen the soil...*

In Ecuador, there are reports since 1582 of the great variety of native crops in this region: maize, potato, beans, chocho, sweet potato, many herbs called 'yuyos'. Many of these crops are grown in raised fields or rigs, which remains can still be seen around the indigenous communities. These rigs were mostly used in potatoes and maize crops. The spaces between the raised fields were also cropped with many varieties of herbs or 'guacamuyos'. Today the people around the indigenous communities still eat an often-ignored array of vegetables such as amaranth (*Amaranthus retroflexus* L.), watercress (*Nasturtium officinale* R.Br.) and yuyos. In addition to cultivated fields there was also an important vegetative cover of chaparral on the mountain slopes, many trees, and bushes in the ravines. These areas were used for the collection of wild fruits, firewood, wood, medicinal and dye plants (Ramirez & Williams, 2003).

According to studies by Moates & Campbell (2006) and included the publication 'Development with Identity' by Robert Rhoades, they state that the contemporary indigenous peoples of this area, like their ancestors, before the arrival of the Incas and the Spaniards, had strong ideological and cultural ties to nature. To this day, their concept of the world is characterized by a strong duality. The communities located in the higher altitudes represent the masculine, the sun, the head of a body, the white, the heat, the day. While the communities located in the lower altitudes represent femininity, the earth, the moon, the body, the darkness, the cold, the night.

Indigenous people and peasants perceive these cosmological elements as necessary and complementary, as they appear in all facets of life, including those related to religion, agriculture, and land use, and have existed since pre-Hispanic times.

Although, the 'Andean Chakra' cultivation system is a system extended throughout the entire Ecuadorian Andean region, there are areas and territories that have a greater conservation, and above all, a comprehensive management of the dimensions of what can be recognized as a Globally Important Agricultural Heritage System (GIAHS). The northern Ecuadorian Andes, specifically the

Cotacachi canton in the Imbabura province, has become a benchmark for the ownership, valuation, and projection of its local agri-food system, considered also as one of the main elements for the comprehensive development (economic, social, cultural and environmental) of the territory and its population.

The indigenous Cotacachi population has developed effective survival and coping strategies in relation to the difficult conditions of exploitation, discrimination and intolerance, that have historically existed in Cotacachi. One of the important contributions of the Kichwa people has been the development of a knowledge system that combines ancestral knowledge and the logic of Western knowledge.

PART C Contemporary relevance

One of the most relevant results of this system is the high level of agrobiodiversity (ABD) conservation and use, especially for food purposes. The production under this 'Andean Chakra' system has provided the peasant communities with a valuable ABD wealth and ancestral knowledge, developed during the last centuries, hence, the historical and cultural value for the Kichwas communities, for the country and Andean region. Since the colonial and republican times, this productive system was recognized as a representative of the landscape and identity of the northern Ecuadorian Sierra.



'Andean Chakra', Morlán – Cotacachi community. Source: UNORCAC

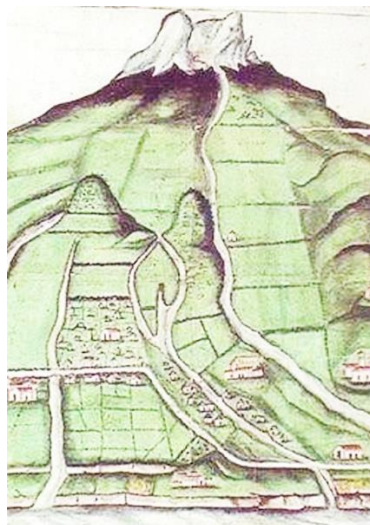


Illustration SXVIII. Ethnic communities in northern Ecuador-Settlements and crops at the Cotacachi foothills. Source: Chantal Caillavet, published in *Etnias del Norte* (2000)

The 'Andean Chakra' transcend the notion of the productive family garden that drives the family economy and ensures the security and food sovereignty of the families that grow them. These spaces safeguard a fabric of beliefs, knowledge and practices that give them a vitally relevant cultural and spiritual value within the Kichwa cosmovision.

The 'Chakra' of a family represents a space for experimentation and exchange, a space for in-situ conservation of seeds and a highly productive space in terms of diversity and food supply, as well as a space for innovation.

The 'Chakra' is made visible under two dimensions: a) vertical profile, which gives reference to the heterogeneity of strata resulting from the arrangement of individuals (trees, shrubs, herbs, crops), and which in turn has a direct effect on the amount of light that is received, the distribution of rainwater, the redistribution of nutrients and the impact on soil erosion; and b) horizontal profile that is related to the coverage and disposition of each individual, and that can have an effect on root development, allelopathic substances and soil nutrients (García, 1998; Aranguren & Moncada, 2018).

A core element in the management of the 'Chakras', are the seeds and the different mechanisms of selection, conservation and reproduction of native plant seeds that may be considered and therefore protected, as integral elements of the cultural heritage of the Cotacachi people and landscape. There are some cases of introduced species that now represent local varieties, different from those that were originally domesticated or introduced such as vegetables, barley, peas (*Pisum sativum* L.), etc.

From an agro-ecological perspective, they are spaces with a complex horizontal and vertical structure, which becomes relevant for the practices of food, health, culture, spirituality and family agro-economy. However, modernity has brought about changes in their management and now the practices of centuries-old tradition, in certain cases, are intertwined with technician methods that respond to the demands of markets and modern society.



'Chakra' with horizontal and vertical arrangement crops. Source: UNORCAC



'Chakra' with diversified crop. Source: UNORCAC

An example of the horizontal and vertical profile of a 'Chakra' in the community of Cumbas Conde, showing four categories of plant species: 64 species for food use, 21 species for medicinal use, 13 species for ornamental use and other species of mixed uses is shown in Figs 2 and 3 below.

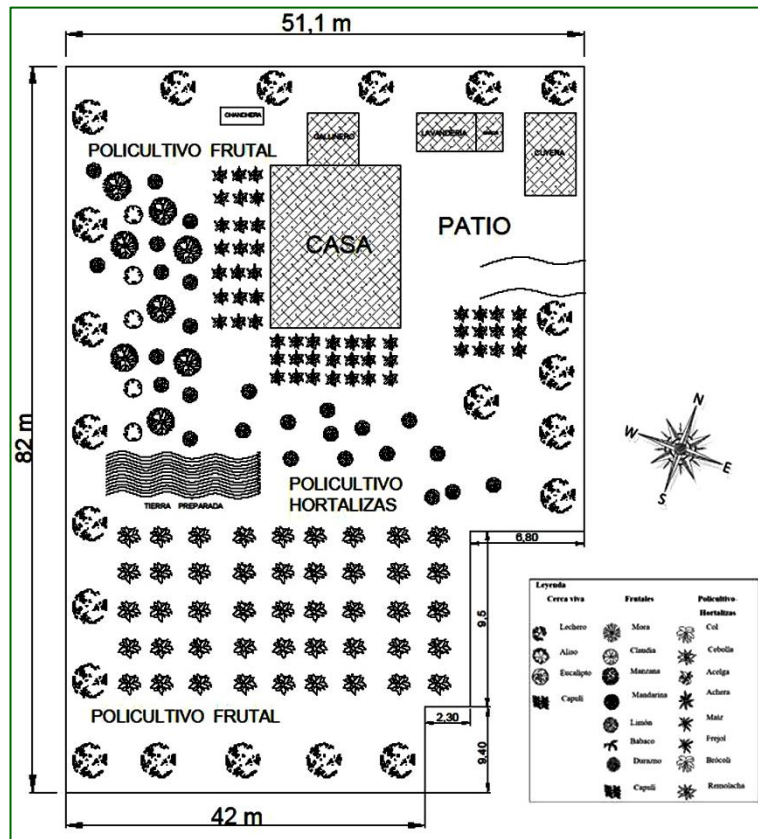


Figure 2. Example of the horizontal profile of 'Andean Chakra', Cumbas community, Cotacachi.

Source: Arroyo and Pabón (2018)

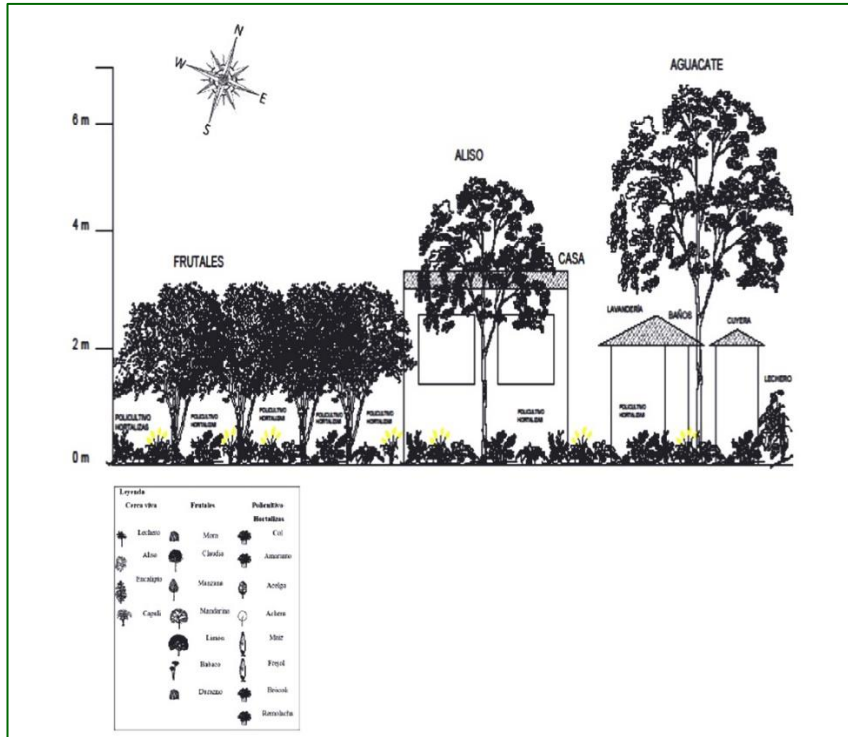


Figure 3. Example of the vertical profile of 'Andean Chakra', Cumbas community, Cotacachi. Source: Arroyo and Pabón (2018)

Agro-ecological production and special care of seeds has become a feature of the identity of Cotacachi's communities, manifested in many of the traditions, rituals, and community festivals. The symbolism and significance of seed for Andean communities places it beyond production, valuing it as a heritage that guarantees the continuity of life amidst diversity.



Seeds market. Source: UNORCAC

This ABD does not only mean material wealth but represents a strong symbolism for social cohesion and territorial identity, as well as the main source of income and livelihoods, innovation and promotion of the territory. In addition to be a heritage from the ancestors, the 'Chakras' maintain their great potential to continue sustaining communities and contributing to their economic, social, and environmental well-being, in the context of a changing world.

The diversity of species and crops provided by the 'Chakras' has a strong impact on the access to healthy, diverse, and culturally appropriate food for both the local population and the region, that is to maintain their food sovereignty. It is known that the aspects of availability and distribution often exceed the productive environments, it is also known that about 65% of the food eaten in the country comes from AFC environments, so the social and economic functionality of this productive system also impacts on the living conditions of nearby towns and cities (Ibarra and Quito) especially as larger markets.

Women's role is essential in the development and conservation of the 'Chakras', in terms of knowledge and principles transfer about food production, distribution and consumption. Women in Cotacachi have consolidated a space for participation, proposal, and even social control, with which there is an increasingly formal mechanism to include their demands and requirements in the spaces of debate and territorial decision making.



Woman of the Cotacachi rural communities. Source: UNORCAC

An extremely relevant aspect is the ownership by local stakeholders, grassroots organizations, territorial organization-UNORCAC and local government, of the conservation and promotion of biodiversity and territorial development with cultural identity. The processes of identification and strengthening of the bio cultural heritage of the territory have been developed for more than 20 years, consolidating, and projecting various local development strategies, which may be a vehicle for the conservation and protection of the 'Andean Chakra' system, and expand its impact as a relevant system for the conservation and sustainable use of its ABD, economic and social inclusion and intangible heritage safeguard.



Indigenous women selling their products. Source: UNORCAC

In addition to its direct contribution to the food, health, economy and general well-being of the farming family, the 'Andean Chakra' plays an important role in the conservation of ABD. Considering that crop genetic diversity is not uniformly distributed throughout the world, and that existing treasures of agricultural biodiversity interfere largely with some of the major centres of crop domestication (Gepts, 2006; Vavilov, 1992), and, that a large number of these treasures are located in many of the world's mountainous regions such as the Andes, including Cotacachi, farmers living in these regions continue to maintain ABD for various reasons. One such reason is the adverse environmental conditions, which prompts farmers to diversify crop production as a risk management strategy given the lack of adaptation of commercial varieties.

Local farmers have contributed and continue to contribute to the conservation and diversification of native seeds. This agricultural diversity is not only a cultural heritage and the basis of local food and economic security, but also contributes to food security in other countries, where Andean crops have become part of their agricultural landscape for many years.

At the international level, Andean smallholder farming systems ('Andean Chakra') contribute to the United Nations Decade of Family Farming (UNDF) in which family farmers are in the process of moving from subsistence to creating income-generating opportunities (SDG 1 and 10), implement resilient and productive agricultural activities (SDG 2), contribute to transform food systems to make them more sustainable (SDG 12), promote food systems that are more resilient to climate change (SDG 13), preserve biodiversity, the environment and culture (SDG 14 and 15), enable diversified food systems that create employment opportunities, particularly for youth (SDG 8 and 9) and women farmers are essential to achieve sustainable, productive and inclusive food systems (SDG 5). Similarly, they contribute to the Decade of Ecosystem Restoration with the aim of supporting and amplifying efforts to prevent, halt and reverse ecosystem degradation and raising awareness of the importance of successful ecosystem restoration. These systems also contribute to the implementation of the 2030 Agenda for Sustainable Development, 22 as well as other important United Nations outcome documents and related multilateral environmental agreements, including the Paris Agreement adopted under the United Nations Framework Convention on Climate Change and the achievement of the Aichi Biodiversity Targets 10 and the post-2020 global biodiversity framework.

PART D Comparative analysis

Table 1 indicate the differences and peculiarities of the 'Andean Chakra' with the 'Amazonian Chakra' in Ecuador, which is the product of the interaction between human beings, culture and nature as well as the co-evolution along the time with the intergeneration process of knowledge sharing. The objective of this comparative study allows identifying their unique features and similarities with other similar ancestral production systems. Information on the Chakra system in Peru is also provided.

Table 1. Comparative analysis of the 'Andean Chakra', 'Amazonian Chakra' of Ecuador, and 'Chakras' of Peru

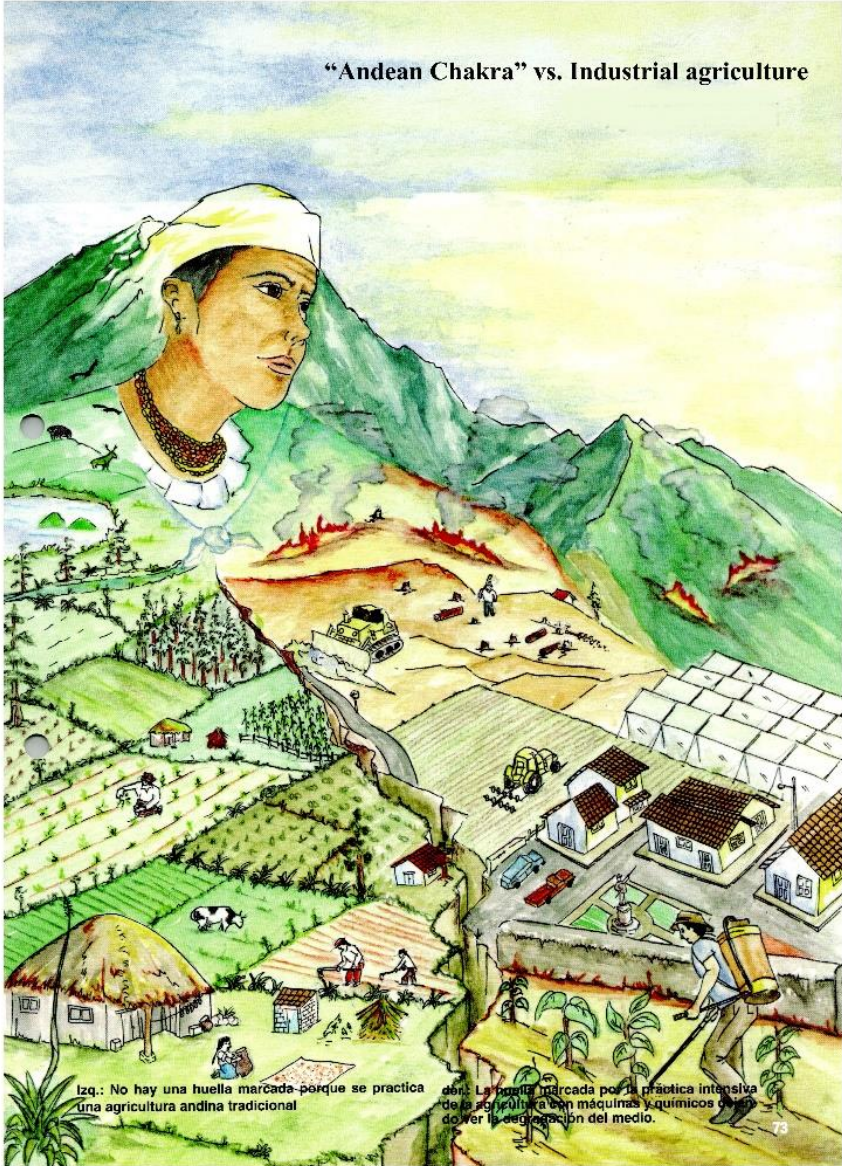
	Similarities of Andean Chakra with		Differences and peculiarities of Andean Chakra with	
	<i>other similar agricultural system in other Latin-American countries</i>	<i>Amazonian chakra</i>	<i>other similar agricultural system in other countries</i>	<i>Amazonian chakra</i>
Food and livelihood Security and Food Sovereignty	<ul style="list-style-type: none"> ▪ Native crops and livestock used for auto-consumption and the diet depends on local production. ▪ Use of plants for ethnomedicinal and ethnoveterinary uses. ▪ They have sustainable and diversified production for year-round markets. ▪ Surpluses are an income source through commercialization. ▪ Impact on access to healthy, diverse, and culturally appropriate food for the local population ▪ Individual and collective decisions on their production and management systems. ▪ The farm provides food security and economic income from sales and/or agrotourism activities. ▪ Community enterprises related to production and subsequent sale in local collection centers. 		<ul style="list-style-type: none"> ▪ A weekly agroecological fair led by the Women Committee of UNORCAC to improve the local food availability of fresh agrifood products, the food access, and to improve the women incomes: "La Pachamama nos alimenta" peasant fair. ▪ A bio-enterprise led by the Women Committee of UNORCAC to give value-added to native maize crops and to improve the women incomes: Saramama enterprise with its star product "chicha de jora" ▪ A bio-enterprise led by the Women Committee of UNORCAC to improve the food access to schools (school food rations) under the food sovereignty focus. ▪ 300 gastronomic dishes have been identified as part of the food heritage of the Cotacachi territory based on native varieties of maize. ▪ In the Andean chakras, the basic food products are grains, leguminous plants and Andean tubers, not products that come from gathering, hunting or fishing, an activity that prevails in the Amazonian chakras. ▪ Production focused more on family subsistence rather than purely commercial activity as seen in the economic activities of the Amazonian chakras. 	
Agrobiodiversity	<ul style="list-style-type: none"> ▪ High intra-specific and inter-specific agricultural diversity. ▪ Association and crop rotation is part of the chakra management system. ▪ Association management and crop diversification is developed to 		<ul style="list-style-type: none"> ▪ 227 species for food, medicinal, forage, forestry, handicraft, ornamental and ritual uses. ▪ The cultivation of corn is an integral part of the chakra, however, in the Andean zone it has greater relevance in food and culture. 	

	Similarities of Andean Chakra with		Differences and peculiarities of Andean Chakra with	
	<i>other similar agricultural system in other Latin-American countries</i>	<i>Amazonian chakra</i>	<i>other similar agricultural system in other countries</i>	<i>Amazonian chakra</i>
	<p>provide greater soil fertility and protection.</p> <ul style="list-style-type: none"> ▪ Presence of plant and animal species in interaction with the family component ▪ In-situ biodiversity conservation strategies. ▪ Community management of native seeds from the chakra. ▪ Firewood from trees or shrubs from the chakra are used as biofuel. ▪ Presence of various strata within the chakra provides the opportunity to manage shade and cover levels and allows for resilience to the effects of climate change. 		<ul style="list-style-type: none"> ▪ There are more short-cycle species than perennials, and the chakra management system is more dynamic; planting depends on the rainy season. ▪ In the Andean chakra there are few species used for handicrafts and ornamentation because the main function of the chakra is to feed the family. ▪ An annual seed exchange fair: 'Muyu Raymi' led by UNORCAC to foster and make visible the socio-economic and cultural value of local agrobiodiversity. ▪ A co-management strategy for biodiversity conservation with participation of government (INIAP's genebank) and community (UNORCAC bioknowledge center) and academics (Northern Technical University). 	
<i>Local and traditional knowledge systems</i>	<ul style="list-style-type: none"> ▪ Knowledge is dynamic, not static, knowledge and wisdom are inherited between the family and the community, so the collective memory is important for the management of the chakra. ▪ Close link between the farmer, the crop and the seeds, which is reflected in their festivities, rites and social agreements in the chakra. ▪ Re-valuation of knowledge on the use and management of agro-ecosystems. ▪ Strong social organization with its own norms and cultural rituals. ▪ Traditional knowledge has made it possible to determine the taxonomy of crops. ▪ Management and use of agrobiodiversity, transmitted between generations. ▪ Agricultural activities strengthen the identity of the people, as well as support adaptation and response to biotic and abiotic factors. ▪ Management of water sources is key to the sustainability of the systems. 		<ul style="list-style-type: none"> ▪ The availability of irrigation water requires more effort to collect and transport water to the communities and therefore to the chakras; however, most of them manage their crops according to the seasonal climate. ▪ Limited training in climate risks for the chakra system. ▪ There is an agricultural calendar that is also linked to the lunar phases. 	
<i>Cultures, value systems and social organizations</i>	<ul style="list-style-type: none"> ▪ Social and community organizations, public institutions and non-governmental organizations work to strengthen the productive and conservation dynamics of the chakra. 		<ul style="list-style-type: none"> ▪ Organized women's group with political influence at the cantonal and national levels. ▪ Municipal ordinances that guarantee the management and management of 	

	Similarities of Andean Chakra with		Differences and peculiarities of Andean Chakra with	
	<i>other similar agricultural system in other Latin-American countries</i>	<i>Amazonian chakra</i>	<i>other similar agricultural system in other countries</i>	<i>Amazonian chakra</i>
	<ul style="list-style-type: none"> ▪ Solidarity in the community is key to the functioning of the 'Chakras'. ▪ Community governance system. ▪ Customary rules for the management of agricultural systems are in force. ▪ The management of the chakra is family based. ▪ Active participation of women around the chakra and associated knowledge of crops for food and medicinal use. ▪ The participation of men in the management of the chakra is for activities that require greater physical effort. ▪ Valorization and visualization of the importance of the chakra and the family through gastronomic, medicinal, religious and educational events, among others. ▪ Promotion and development of differentiated markets for products from the chakra and its derivatives. 		<p>agrobiodiversity with emphasis on in situ conservation.</p> <ul style="list-style-type: none"> ▪ The celebration of the solar cycle or Raymis festivities, and their relationship with agrifood systems. ▪ Agrobiodiversity education from primary level educational units. 	
<i>Landscape features</i>	<ul style="list-style-type: none"> ▪ Landscape with a multi-colored mosaic resulting from the interaction of human, socio-economic, and political processes linked to land distribution. ▪ The 'Chakra' is related to topography and the integrated management of water, soil, and agrobiodiversity. ▪ Ecosystem services from the chakra for the benefit of humans. 		<ul style="list-style-type: none"> ▪ Family farming or production is different because the chakras are distributed at different altitudinal levels, from 2 200 m above sea level to 3 600 m above sea level. ▪ There is low biomass and carbon storage in the agroecosystem compared to the tropical forest ecosystems where the Amazonian chakras develop. ▪ Small spaces limit the presence of agroforestry systems. ▪ The chakras are usually subplotted to inherit to their children once they are married and can implement a new chakra, however, this generates greater fractionation to the productive area. 	

Source: Moncada et al. (2018); Carrera (2022); Unión Internacional para la Conservación de la Naturaleza (2021); Canahua et al., s/f.; FAO (2022); Jadán (2012); Grijalva *et al.* (2011); Arias-Gutiérrez *et al.* (2016); FAO (2015)

When comparing the 'Andean Chakra' with industrial or modern agriculture, it is observed that the 'Chakra' is not very technician, its production is not on a scale, it depends mostly on the physical capacities of the farmer and his family, the land is worked with tools such as the sickle, hoe or shovel, and the agronomic practices are based on ancestral and empirical knowledge. In the 'Chakra', agriculture is developed in polycultures that provide various types of food for consumption and a small surplus for the market. On the other hand, industrial or modern agriculture is characterized by incorporating science and technology to be more efficient, achieving greater production in monoculture systems with high use of fertilizers, agrochemicals, and modern irrigation systems. These differences between these two types of agriculture have promoted a greater number of productive units dedicated to industrial agriculture, which puts at risk the 'Chakra' system that is characteristic of peasant family agriculture and with millenary cultural beliefs.



'Andean Chakra' vs. industrial agriculture. Source: UNORCAC

IV. GIAHS SELECTION CRITERIA



1. Food and livelihood security

1.1 Contribution of the proposed agricultural systems to the food security and livelihood security of the rural communities

1.1.1 Food security indicators

The 'Andean Chakra' system cannot be understood as an agri-food system without identifying the various factors that influence food consumption. Conceptions about nature, access to production factors, forms of social organization and food classification systems are some of the factors that explain what, how, when and why certain foods are eaten (Moya, 2013), as well as the very state of food in the population.

Thus, food security and sovereignty in the Cotacachi territory presents features such as:

- Food sovereignty in the communities of Cotacachi is the right to maintain and develop their capacity to produce basic foods, respecting the native productive and cultural agrobiodiversity, that is, the right to produce their own food in the communities autonomously. Instead, food security is to maintain and develop their own capacity for the production of their basic foods (self-consumption) and food education, so that food is properly used, to maintain a healthy and active life. Therefore, food security is closely linked to food sovereignty as a right of communities to nutritious and culturally appropriate food, accessible, produced in a sustainable and ecological way.
- AFC producers, mostly considered 'small farmers' with land tenure in the range of 0.5 to 1 ha in which they combine diversified crops under the 'Andean Chakra' system, but also cash crops.
- Only 38% of the lands owned by the peasants are suitable for crops, according to the maps of land use capacity of the MAG, where the topography of the soil is a determining factor in defining the category of land use capacity, the lands of the communities are located on steep slopes of the mountains, which implies a low use capacity, according to this methodology. This requires higher investments to improve production quality or conditions, to which the agro ecological and diversified 'Chakra' systems have been the answer.
- There are areas of the Andean zone that have irrigation water and where the land is more fertile, but in other areas the land is sandy and with difficult access to water and fertilizers for production. The lack of fertilizer relates to the lack of available land in the area. Animals, cattle, sheep (*Ovis aries* L.), pigs, and guinea pigs are manure producing animals.
- The experiences of sustainable production and agro-ecology are mainly led by women: 80% of the farms are managed by women, as well as the participation in space for commercialization and exchange.
- There is a great diversity, use and social and commercial revaluation of native products: in terms of production and own or commercial use there is about 40 species per farm, 10 of which have permanent access to or acceptance in the markets.
- The objective of the 'Chakras' production is to ensure a healthy and diversified diet: 50% of the average production is for family consumption and the rest is sold. However, it is necessary to supplement the nutrient requirements with products outside the family production. Without clear data, there is evidence of dependence and the accelerated access to low cost and low nutritional contribution ultra-processed products especially for pregnant women, infants, and children between 3 and 5 years old.
- There is also evidence of changes in eating habits that do not include the wide diversified production of the 'Chakras'. Even with the extensive ABD, the diet of Cotacachi inhabitants is still reduced to a few varieties of foods and the levels of local use of ABD focused on

gastronomy are increasingly low.

- Ultra-processed foods such as sweetened soft drinks, cookies, candies, noodles, and products such as rice and legumes that were not widely consumed, currently invade communities with strong influence on children and youth, impacting malnutrition indicators, especially in children, as well as signs of obesity and cardiovascular disease.

1.1.2 Gastronomic diversity from the 'Andean Chakra'

The gastronomic diversity of the Cotacachi Andean territory, from its productive system 'Andean Chakra', has been extremely important for the family and regional diet. About 300 gastronomic dishes have been identified as part of the food heritage of the Cotacachi territory, largely dependent on maize farming, but enriched with the full variety of fruits and breeds.



'Andean Chakra' cooking in Cotacachi. Source: UNORCAC

Below is the diversity of gastronomic preparations of the Cotacachi canton identified as agri-food heritage:

- a) Soups, 'coladas' and 'locros': 73 for daily consumption or for festivities

The most common preparations in the kitchen of indigenous and peasant families in Cotacachi are coladas or mazamoras (milky corn pudding), 'locros' and soups.

Soups are peculiar because their base liquid is light and transparent despite containing many ingredients such as vegetables and potatoes. Coladas or mazamoras have a starch base-corn flour, 'uchu haku' or barley rice that makes them thick, just like 'locros'.

- b) Main course: 91 preparations

The main or second courses generally consist of some type of carbohydrate, in Cotacachi one of the most valued dry cabs is 'mote'. They consist of a mix of cooked grains, generally in 'tulpa' or firewood stove that are served alone or accompanied by cheese, potatoes, chili (*Capsicum baccatum* Buch.-Ham.) and sometimes meat.

During the maize harvest season, which runs from April to June, the main dish is prepared with tender grains, mainly 'choclo' (hence, the name 'choclo mote'), beans and in some cases broad beans and peas (Arellano, 2014).

c) Bread and 'tortillas': 33 preparations

These types of preparations are part of the feasts and rituals of the population; among its ingredients stands out maize and wheat and barley which were incorporated with the arrival of the Spaniards. The tortilla is a flat, thin, round bread, made mainly of maize, to which other type of products have been included, depending on the harvest season and the family preferences. It is prepared in a clay pot over a firewood or charcoal stove, in some cases, on alder (*Alnus acuminata* Kunth), passion fruit and edible canna (*Canna indica* L.) leaves, it is also steamed in leaf wrappers, corn 'catulo', 'vicundo' and edible canna.



Gastronomic fairs in Cotacachi. Source: UNORCAC



Gastronomic Cotacachi diversity. Source: UNORCAC



Gastronomic Cotacachi diversity. Source: UNORCAC

d) Beverages and sweet 'coladas': 62 preparations

Standard accompaniment of every meal. A rich tradition is the preparation of highly elaborate and nutritious drinks of fruit and cereals.



Gastronomic Cotacachi diversity. Source: UNORCAC

e) Accompaniments: 30 preparations

Indigenous families have a variety of sweet and savoury preparations, which are served as accompaniment to the day's meal, although, some of them are also often brought as 'cucabes' to ease hunger during the workday.

f) Sauces and chilies: 17 preparations

Preparations that spice up and accentuate the taste of other preparations that normally make them spicy.



Gastronomic Cotacachi diversity. Source: UNORCAC



Gastronomic Cotacachi diversity. Source: UNORCAC

1.2 Products and services provided by the system

1.2.1 Crops and varieties for the food security of the population

Based on an ABD inventory conducted by INIAP, research reports from UNORCAC on ABD, input from community key informants and other secondary information, a list of crops and varieties that support local food security was developed (Table 2).

Table 2. Productive diversity for food security in the High Andean zone of Cotacachi canton

Crops	Landraces	Groups	Crops
Bean (<i>Phaseolus vulgaris</i> L.)	1) Allpa Bean	Fruits	1) Banana passionfruit (<i>Passiflora mollissima</i> L.H. Bailey)
	2) Cargabello		2) Capulí (<i>Prunus serotina</i> Ehrh.)
	3) Canary		3) Chigualcán (<i>Vasconcellea pubescens</i> A.DC.)
	4) Popayán		4) Sweet granadilla (<i>Passiflora ligularis</i> Juss.)
	5) Mixed		5) Mortiño (<i>Vaccinium floribundum</i> Kunth)
	6) Red Bolon		6) Red raspberry (<i>Rubus</i> spp.)
	7) Other (poroto negro sarda, conejo caca, fréjol vaca, lacri, toa, yura poroto, fréjol vaca rojo, sara poroto, fréjol vaca amarillo, fréjol vaca sarda, matambre)		7) Uvilla (<i>Physalis peruviana</i> L.)
Maize (<i>Zea mays</i> L.)	1) Yura Pintado	Others	1) Achogcha (<i>Cyclanthera pedate</i> Schrad.)
	2) Yura Blanco		2) Arracacha (<i>Arracacia xanthorrhiza</i> Bancr.)
	3) Amarillo Pintado		3) Ataco negro (<i>Amaranthus hybridus</i> subsp. <i>quitensis</i> (Kunth) Costea & Carretero)
	4) Tzapa Sara		4) Black-seed squash (<i>Cucurbita ficifolia</i>)
	5) Racu Sara		5) Chaucha pea (<i>Pisum sativum</i>)
	6) Huandango		6) Chocho (<i>Lupinus mutabilis</i>)
	7) Bola Sara		7) Jícama (<i>Smallanthus sonchifolius</i> (Poepp.) H. Rob.)
	8) Yana Sara		8) Lentil (<i>Lens culinaris</i> Medik.)
	9) Mulato Sara		9) Mashua (<i>Tropaeolum tuberosum</i> Ruíz & Pav.)
	10) Puca Huandango Sara		10) Mauka (<i>Mirabilis expansa</i> (Ruíz & Pav.) Standl.)
	11) Racu Puca Sara		11) Pumpkin (<i>Cucurbita</i> spp.)
	12) Sangre de Cristo		12) Quinoa (<i>Chenopodium quinoa</i>)
	13) Julin Sara		13) Small broad bean – janshi (<i>Vicia faba</i>)
	14) Canguil		14) Sweet potato (<i>Ipomoea batatas</i>)
	15) Morocho Blanco		15) Ulluco (<i>Ullucus tuberosus</i> Caldas)
	16) <i>Chulpi</i>		16) Uqa (<i>Oxalis tuberosa</i> Molina)
Papa (<i>Solanum tuberosum</i>)	1) Guata papa	Animals	1) Guinea pigs (<i>Cavia porcellus</i> L.)
	2) Chaucha		2) Chickens (<i>Gallus domesticus</i>)
	3) Purple potato		3) Cows (<i>Bos taurus</i> L.)
	4) Capiro potato		
	5) Chola potato		



'Pamba mesa'. Source: UNORCAC

According to the species recorded in Table 2, it should be noted that:

- Maize crop: The food diet of indigenous and peasant families in Cotacachi is based on 12 botanical races of maize. The most common maize products and varieties are: soft yellow or 'quillu sara', white or 'yurak sara' and black or 'yana sara', 'capia', 'yanga', 'chulpi', 'morocho'. There are various dishes made with corn that are essential in the local diet and food dynamics.¹
- Beans crop: six types of beans are generally eaten: the most common are canary, mixed, kill the hunger-it is known by that name because it is produced in times of other products' shortage. The inventory conducted by Bonilla (2017) identified 40 bean varieties, while Montalvo (2021) identified 48 bean varieties, with the Canario variety being the most common, this increase could be attributed to the seed exchange process that Cotacachi carries out annually.
- Potato crop: the potato usually eaten by the inhabitants is cultivated in their 'Chakras'.
- Other crops: they are widely used in a more or less extent: beans, dark lentils and 'sucu lentejas'; vegetables such as yellow carrot, cabbage, lettuce, beet, black seed squash, long onion.
- Free-range animals: within each 'Chakra' there is normally a space for free-range animals such as guinea pigs and chickens and in exceptional cases cows (in some cases for ploughing, milk production and very few for meat production).

In addition to considering the crop standards for ABD species, their use for food depends on the conservation and maintenance of various practices for the preparation and preservation of food, which are an essential heritage to ensure access to healthy, nutritious and culturally relevant food.

¹ Video attached. Water, spicy and taste. Maize chapter.

Taking into account that maize is the main crop of the 'Andean Chakra', it is important to know the cultivated area, production and management of the seed. Regarding the plot area dedicated to the cultivation of maize, the range is quite high. Minimum area dedicated on average is 0.4 ha, which is equivalent to nearly 28% of the average farm size. Maximum area for maize plantation is over 0.9 ha, which is equivalent to 71% of the plot area (Table 3) (Bioversity, 2015).

The mean annual production of maize is over 330 kg a year and the minimum yield is 1.7 t ha⁻¹. This productivity is low compared to other farming systems, and it is related with the low use of inputs and the environmental constrains (poor soils and non-irrigation). This low productivity, however, does not seem to represent a problem in terms of securing auto-consumption, although, it is likely that this is also the reason why the share of production that is sold in markets is also small, i.e. low surplus production. Regarding seed management, over 91% of the seeds planted come from previous harvest. In total less than 9% of the seeds are exchange, gifted or bought at local markets (Table 3) (Bioversity, 2015).

Table 3. Overall status of maize varieties

ABD Category	Indicators	Mean (Standard Deviation)
Cultivated area	Minimum planted area (ha)	0.24 (0.41)
	Maximum planted area (ha)	0.49 (0.83)
Production/yield	Annual production (kg)	329.88 (405.21)
	Minimum crop productivity (t/ha)	1.69 (3.59)
Seed management	Seeds from previous harvests (%)	91.25 (24.68)
	Seeds that have been bought (%)	3.53 (16.10)
	Seeds exchanged with other farmers (%)	1.35 (9.58)
	Seeds gifted (%)	3.84 (16.34)

Source: Biodiversity (2015)

1.2.2 Market connections and access

Farm products have traditionally been oriented towards family consumption and sale according to the level of production in surplus or family economic needs. At present, because of the reduction of the land size and the loss of soil nutrients, the surplus and its quality can be limited.

Hence, families have implemented strategies to maintain and enrich the quality of the soils and products, as well as access to stable and attractive markets. Strengthening the 'Chakra' production system and connecting it to markets, especially to CIALCO, has been consolidated as one of the best developed strategies to sell local ABD products. These circuits promote the generation of economic income from production by giving priority to alternative peasant markets that allow the direct commercialization for the local, regional, and even national supply and distribution of food products from the area, generating income sources for the population.

The production of the 'Andean Chakra' of Cotacachi has been commercially related to different CIALCOs (MAG, 2020) such as:

- Peasant markets.
- Supply of school feeding rations.
- Specialised shops.
- Agro-tourism / Restaurants and,
- Transformation and value addition.

One of the most representative spaces in Cotacachi canton is the Agro-ecological Fair *the Pacha Mama feeds us* promoted by UNORCAC and managed by the Women's Central Committee of

Cotacachi. This fair is held every Sunday and brings together 215 farmers, mostly women from the different communities of Imantag, Quiroga, El Sagrario and San Francisco parishes.



Weekly agro-ecological fair *The 'Pacha Mama' feeds us* at Cotacachi town. Source: UNORCAC Women's Committee.

More than 80 different products are sold at the fair which have been cropped according to an agro-ecological, organic, clean, and healthy approach, such as vegetables, roots and tubers, Andean grains, high Andean and warm climate fruits, animal products and by-products. The urban population of Cotacachi city and a small number of consumers from neighbouring cities such as Otavalo, Atuntaqui and Ibarra purchase at the fair. An important function of the fair is the exchange or barter of products between the same producers. More than 90% of the producers at the fair exchange their products with producers from other areas, facilitating access to products from other climate floors.

There are about 215 women and men producers in the fair, who currently sell their products in a common space, but individually. The fair allows them to generate an average weekly income of 69 dollars from the sale of their surplus (USD 15.3 per day worked on their farm), according to a study conducted by the Heifer Foundation in the Ecuador in 2016². The annual sales volume is approximately 400 000 dollars (Heifer, 2016) (Tables 4 y 5).

Income from sales is an important supplement to family income; 42% of this income is managed exclusively by women, 54% is managed jointly by men and women, and only 4% is used exclusively by men.

Table 4. Monthly and annual income from sales at the UNORCAC agro-ecological fair

Concept	Unit	Quant.	V/Unit (USD)	Monthly Total (USD)	Annual Total (USD)
Agro-ecological vegetables, tubers and fruits	kg	2 200	15	33 000	396 000
Contributions from organisations to keep marketing kits	Month	110	4	440	5 280
Total Income				33 440	401 280

Source: Business plan of the UNORCAC agro-ecological fair *The 'Pacha Mama' feeds us*. FAO/GEF/ MAGAP/ INIAP/Heifer Foundation Ecuador/Quito, Ecuador

² Business plan of the UNORCAC agro-ecological fair *The Pacha Mama feeds us*. FAO/GEF/ MAGAP/ INIAP/Heifer Foundation, Ecuador/Quito, Ecuador

Table 5. Contribution to the monthly and annual costs of the UNORCAC agro-ecological fair

Concept	Unit	Quant.	V/Unit (USD)	Monthly Total (USD)	Annual Total (USD)
Freight + Lunch (110 partners × 4 weeks)	fair days	440	5	2 200	26 400
Subtotal				2 200	26 400
Accountant	month	-	40	-	-
Keep marketing kits	month	440	1	440	5 280
Renting + Basic Services	month	1.	50	50	600
Other expenses	month	1	25	25	300
Subtotal				515	6 180
Total costs				2 715	32 580

Source: Business plan of the UNORCAC agro ecological fair *The 'Pacha Mama' feeds us*. FAO/GEF/ MAGAP/ INIAP/Heifer Foundation Ecuador/Quito, Ecuador

1.2.3 Peasant enterprises (value-added products)

In addition to the direct or indirect sale of livestock agriculture, one of the most relevant aspects for the generation of sustainable livelihoods for the families that produce in the 'Andean Chakra' is the development and maintenance of productive undertakings, to maintain the agro-ecological system, the generation of income and its productive autonomy for the family. For some years, the proposal and demand for territorial development of Cotacachi communities has been oriented towards the development of rural micro-enterprise initiatives that support the conservation of biodiversity and income generation.



Added-value-products from the 'Andean Chakra' ABD. Source: 'Sumak Mikuy'

These peasant enterprises have focused on developing products and services from simple and locally appropriate technologies adding value to local ABD crops and developing and innovating products from traditional recipes. The emphasis is on identifying market opportunities for the diversity of 'Chakra' products, but with a focus on demand from local and urban markets, as well as, identifying service opportunities such as prepared food processing and delivery, restaurant services, agro-tourism,

educational guides, among others.

a) 'Sumak Mikuy' peasant enterprise

The 'Sumak Mikuy' business has used simple and locally appropriate technologies to add value to native crops, based on traditional recipes. Products include Andean blackberry (*Rubus glaucus*) jam, black-seed squash (*Cucurbita ficifolia*), chili paste (*Capsicum* spp.) and dried cape gooseberry (*Physalis peruviana*).

These products are packed with natural fibres and sold to a large number of tourists who visit the Cotacachi area, the neighbouring town of Otavalo and Quito, the capital city. The marketing strategy adds value to the products by telling the story of the native crops and the indigenous farmers who produce them. The peasants are paid an additional premium for high-quality products and all profits from the business are reinvested in the community. The business includes about 130 local producers, most of whom are women. This action has also been supported by a beekeeper's association who produce beekeeping products from the forests, including Andean honey, pollen and 'propolis'.



Group of women and products of the 'Sumak Mikuy' enterprise. Source: UNORCAC

b) 'Saramama' peasant enterprise

'Saramama' is an enterprise led by indigenous women that aims to add value to the varieties of native corn produced in the 'Andean Chakra' by making the culturally valuable beverage 'chicha de jora'. The process begins with the production of native corn, reception and selection of the grain, processing in the artisanal processing plant, bottling, and marketing in stores in the city of Quito. This initiative has generated economic income for 40 rural women, in addition to valuing native corn varieties and the traditional knowledge of the gastronomic heritage of indigenous communities. In addition, this enterprise has contributed to the strengthening and empowerment of the women's organization and the dissemination and appreciation of the gastronomic and cultural heritage of the Kichwa indigenous communities.



'Chicha' producing enterprise. Source: UNORCAC

1.2.4 Agro-tourism

In recent years, products diversification in the territory has leveraged tourism initiatives, focused on farm production, and use in the 'Chakras'. These initiatives encourage tourists to visit the communities, have a first-hand experience with the peasants and their relationship with agricultural biodiversity, agricultural practices, food, medicine and local indigenous rituals. Agro-tourism has developed as a complementary activity to agricultural work and promotes conservation of ABD and related knowledge, while generating income for participating families. Host families have enriched the ABD in their homes and are able to communicate their cultural and natural richness and provide visitors with an authentic shared intercultural experience. It is estimated that rural families who have developed this alternative can generate an average monthly income of USD 130 in addition to the impacts of ownership and valuation of the agro-centric identity.



Agro-tourist activities in the 'Andean Chakra'. Source: UNORCAC

At present, there are five communities that host tourists and 25 people from the communities who have obtained a tourist guide's licence from the Ministry of Tourism (MUT). New groups have also been created to expand the visitors' experience, for example, music, dance and craftsmen's associations, which complement the entire indigenous culture. This tourist offer is managed by the tourism company 'Runa Tupari', which is an initiative of the indigenous communities. The offer is

aimed at tourism related to agrobiodiversity, agro-ecological management, gastronomy, handicrafts, indigenous medicine, landscape and community coexistence. Agro-tourism has been successfully developed as a complementary activity to agricultural work and promotes the conservation of ABD and traditional knowledge, while generating additional income for families. There is also greater awareness of the need to improve waste management within communities (United Nations Development Programme, 2012).



Rope soled sandals manufacturing. Source: UNORCAC

Hence, as previously mentioned, the ABD from the 'Chakras' is an essential element for food security and sovereignty of the Cotacachi and regional communities, apart from contributing substantially to the development of livelihoods for peasant families and a special contribution to poverty alleviation and extreme poverty.

Strengthening the 'Andean Chakra' management has contributed to a 50% increase in crop land for household consumption, along with educational campaigns on nutrition for farmers and on ABD in public schools, food procurement in urban markets has decreased by 50% and local diets and household savings have improved. In total, 1 284 people are growing maize, 1 178 beans, 236 potatoes, 385 peas and 179 quinoas. Micro-enterprise initiatives have substantially improved household incomes; those involved in tourism receive approximately USD 120 per month, those involved in the agricultural business receive USD 316, and those in the beekeeping sector receive USD 195 per month.

1.3 Farming structure and management

According to the 2010 Census, the economically active population is 14 582 inhabitants, of which 14 137 inhabitants receive remuneration for their work, within this group, 40.4% of the inhabitants correspond to indigenous women; in terms of productive activities, 36% of the population is engaged in agriculture, livestock, forestry and fishing (PDOT, 2015). Activities related to agrobiodiversity conservation have improved the sources of income and nutrition of 3 225 farming families, many of these families belong to the Kichwa indigenous peoples (UNDP, 2012).

The use of biodiversity, soil and climate have marked the local mountain landscape. The first factor has been the structure of land tenure, characterized by small areas (≤ 1 ha) delimited by living fences made up of native timber line and semi-timber line, which forms a barrier against landslides resulting from erosion. Added to this is the low level or absence of mechanical soil preparation. The traditional crop techniques, diversification, intercrop and rotation, ensure a permanent soil coverage, thus, limiting the effects of the erosive processes typical of mountain lands, practices that have marked a multi-coloured landscape.

A 'Chakra' can be identified as the family productive unit that is connected to the house and that maintains its condition of family farming and the territorial link, which is currently threatened by

different causes (Map 3). In the case of the Cotacachi territory, there are 'Chakras' smaller than one ha, in few cases between 1 and 3 ha and very few of more than 3 ha.

The UNORCAC supported the implementation of agroecological chakras which is integrated by approximately 500 families from 29 communities, in addition, there is also a marketing space Fair the "*Pachamama nos alimenta*" where 200 families sell their products, this space strengthens the direct relationship from producer to consumer and solidarity economy (GAD Cotacachi, 2019).

In Cotacachi there are seven communities with 140 families that are linked to community tourism with agricultural production, handicrafts, art, among others, this activity represents only 25% of their total income (GAD Cotacachi, 2019) approximately 120 USD per month; those involved in agricultural activities receive 316 USD per month and those who are related to the beekeeping sector obtain 195 USD per month (UNDP, 2012). According Arrollo and Pavón (2018), there is an annual income between 1000 and 1500 USD from the sale of surpluses from agricultural and livestock activities, money that returns to the family group for food and also for maintenance of the chakra such as the purchase of seedlings and vegetable-type seeds.

1.4 Contribution to sustainability and resilience

From the point of view of economic sustainability, the Ministry of Economic and Social Inclusion indicates the procurement of external products such as: salt, jaggery, sugar, garlic (*Allium sativum* L.), paiteña onion (*Allium cepa* L.); very few acquire processed condiments. Instead of lard or oil, some people buy pork fat, fry it to get the lard and make 'chicharrones'. In the communities there is a prevailing use of 'jaggery sugar' that replaces sugar, while in other communities towards the 'parish centres', sugar, salt, vegetable oil and other processed products began to be consumed.

One of the characteristics of the 'Chakra' system, is that in addition to having specific characteristics for food crop and production, it has also developed almost simultaneously a territorial and cultural relations and exchange system, as a strategy for food access and diversification. Barters, are also recognized as traditional practices of social cohesion and their relations of reciprocity are very active-when someone harvests, shares the first products with their relatives, neighbours and friends of the same community. They also have reciprocal relationships with people from other communities, within the framework of complementarity (Moya, 2013).

The healthy and varied products of the 'Chakra Andina' are a source of growth for the family economy, conserve and restore biodiversity and the balance of ecosystems. In addition, it uses production methods that can help to adapt to phenomena associated with climate change, and thus contribute to the sustainability and resilience of agroecosystems.

1.5 Threats

- Changes in eating habits; traditional food diets are replaced with foods and beverages of industrial origin.
- Unbalanced diets with health implications, e.g. overweight and obesity.
- Little appreciation and knowledge of the qualities and importance of native crop varieties
- Loss of traditional knowledge related to gastronomy, due to the consumption of other types of food that are not produced in the 'Chakra'
- Lack of access to fair and direct markets
- Lack of incentives to promote agro-ecological practices (mainly from agri-food policies),
- Lack of access to productive resources, e.g. irrigation systems.
- Loss of production due to climate change.
- Incorporation of modern agricultural technologies with the incorporation of agrochemical inputs, without sufficient training and control.

- Agri-food policies that promote conventional agriculture and its technologies.

1.6 Challenges

- Strengthen family farming and agroecological production to satisfy access to healthy and nutritious food.
- Encourage the production of bio-inputs in the 'Chakras' to avoid dependence on commercial products.
- Promote Farmer Field Schools as permanent training mechanisms, so that farmers have spaces for learning and exchange of experiences.
- Regulate commercialization spaces to encourage responsible consumption and local economy.
- Contribute to the eradication of hunger and malnutrition (SDG 2).
- Promote the consumption of non-traditional products
- Produce quality native seeds to improve production.
- Promote gender equality, empowerment of women and youth through formal and informal education.

2. Agrobiodiversity

2.1 Cultivated, reared, and harvested plants and animals

The agricultural diversity of the Kichwa and Cotacachi 'Andean Chakra', has a higher farm crops richness and diversity compared to other regions, both in terms of the average number of native varieties and the uniformity of the crops. This high diversity is due to the planting of local native varieties, particularly grains. The main strategy of farmers is to maintain on-farm crop diversification rather than specialise in planting a limited number of crops. This agricultural strategy responds to farmers' need to produce crops for self-consumption, as marketing options are limited by the small size of many 'chakras' and the harsh agro-ecological conditions (Willart, 2015).

The ABD provides a wide range of eco-system services to local farmers, but also to society at large. It maintains crop genetic diversity to maintain biomass levels, improves the resilience of agricultural ecosystems under highly variable environments, and at the same time, contributes to ensuring food security in the 'chakras'. But ABD also supplies other important cultural eco-system services. By increasing the diversity of crops and varieties, farmers not only ensure food supply, but also generate more stable vegetative cover, leading to such added benefits as prevention of soil erosion or improved soil nutrients and maintenance of soil moisture. Many native varieties and traditional varieties also have cultural and religious use value, which means that conserving ABD is also closely linked to the preservation of indigenous cultural identity.

2.1.1 Agricultural diversity and uses within the 'Chakras'

Within the traditional Cotacachi agricultural system, the 'Chakra' is a typical element adjacent to the rural houses that provides multiple benefits to the farming families. The 'Chakras' can be considered microenvironments rich in species that are used for food, medicine, ornamentation, fuel, and fodder, as well as for their cultural (ceremonial) uses, and for the manufacturing of crafts and utensils. Due to its proximity to the house and the diversity of cultivated plants, this space represents a convenient and accessible source of fresh and nutritious agri-food products for the family, with a role of integration of the family in the productive and reproductive environment.

The Cotacachi communities are in one of the world's main centres of crop domestication. Managing a system such as the 'Andean Chakra' has enabled the adaptation and reproduction of multiple species.

To cite a few examples, the crops include numerous native varieties of maize, Andean roots and tubers, such as lesser yam (*Dioscorea esculenta* (Lour.) Burkill), mashua, ulluco and arracacha, pseudo-cereals such as quinoa and amaranth; tropical fruits, such as tamarillo, cape gooseberry, banana passionfruit, mountain pawpaw and blackberry; legumes such as chocho, Lima bean (*Phaseolus lunatus* L.), beans, pinta bean (*Phaseolus coccineus* L.) and highland squash, such as black-seed squash and pumpkin (*Cucurbita* spp.) and varieties of chilies (*Capsicum* spp.).

The essential value of the ABD in the Cotacachi territory is the result of a historical and natural process, guaranteeing the well-being and balance in nature and represents a natural heritage that has contributed in many ways to the development of human culture and represents a potential source to meet future needs.



Seeds fair in Cotacachi. Source: UNORCAC

227 crop species and varieties have been identified in the peasant 'Chakras' and their environments, which are used for food, medicine, ritual, ornamentation, and fodder. According to ABD inventories, in average, 25 types of crops have been found per 'Chakra', and there is a great intra-specific diversity, especially of certain crops such as maize, beans and potatoes.



Seeds Fair starting ritual – Cotacachi. Source: UNORCAC Women's Central Committee

Achieving and maintaining these levels of biodiversity is the result of an ecological cultivation system, which emulates the principles of diversification, similarity, and opposition of plants from natural environments, what allows the selection of the most suitable species to take advantage of the horizontal and vertical space (Echarri, 2007).

The diversity of species found in 'Chakras' at the family level can be extended to 227 species among food, medicinal plants, fodder, forest, ornamental and ritual plants, with their intra and inter-specific variability, which can be observed in Table 6, 7, 8, 9, 10, 11, 12 and 13.



Sample of 'Andean Chakra' biodiversity in Cotacachi. Source: UNORCAC

Table 6. Diversity and uses of grains in chakras of the high Andean zone of Cotacachi.

N	Species		Uses							
	Common name	Scientific name	Food	Medicinal	Fodder	Forest	Ornamental	Ritual	Crafts	Compost
1	Barley	<i>Hordeum vulgare</i>	X	X	X			X		X
2	Broad bean	<i>Vicia faba</i> L.	X	X				X		X
3	Chickpea	<i>Cicer arietinum</i> L.	X							X
4	Common amaranth	<i>Amaranthus retroflexus</i>	X							X
5	Common Bean	<i>Phaseolus vulgaris</i>	X	X	X			X	X	X
6	Common wheat	<i>Triticum aestivum</i>	X	X	X			X		X
7	Green amaranth	<i>Amaranthus hybridus</i>	X							X
8	Lentil	<i>Lens culinaris</i> M.	X					X		X
9	Love-lies-bleeding	<i>Amaranthus caudatus</i>	X							X
10	Lupino	<i>Lupinus mutabilis</i> S.	X		X					X
11	Maize	<i>Zea mays</i> L.	X	X	X			X	X	X
12	Oat	<i>Avena sativa</i> L.	X		X			X		X
13	Pea	<i>Pisum sativum</i>	X					X		X
14	Quinoa	<i>Chenopodium quinoa</i>	X					X		X
15	Rye	<i>Secale cereale</i> L.	X		X					X

Table 7. Diversity and uses of Andean roots and tubers in chakras of the high Andean zone of Cotacachi.

N	Species		Uses							
	Common name	Scientific name	Food	Medicinal	Fodder	Forest	Ornamental	Ritual	Crafts	Compost
16	Achira	<i>Canna edulis</i>	X							X
17	Arracacha	<i>Arracacia xanthorrhiza</i>	X							X
18	Mashua	<i>Tropaeolum tuberosum</i>	X	X						X
19	Melloco	<i>Ullucus tuberosus</i>	X	X				X		X
20	Potato	<i>Solanum tuberosum</i>	X	X				X		X
21	Sweet potato	<i>Ipomoea batatas</i>	X	X						X
22	Uqa	<i>Oxalis tuberosa</i>	X					X		X
23	Yacon	<i>Smallanthus sonchifolius</i>	X					X		X

Table 8. Diversity and uses of vegetables in chakras of the high Andean zone of Cotacachi.

N	Species		Uses							
	Common name	Scientific name	Food	Medicinal	Fodder	Forest	Ornamental	Ritual	Crafts	Compost
24	Basil	<i>Ocimum basilicum</i> L.	X	X						X
25	Beetroot	<i>Beta vulgaris</i> L.	X		X					X
26	Black-seed squash	<i>Cucurbita ficifolia</i>	X	X	X			X	X	X
27	Forage cabbage	<i>Brassica oleracea</i> var. <i>viridis</i>								X
28	Cabbage	<i>Brassica oleracea</i> var. <i>capitata</i> L.	X	X	X					X
29	Caigua	<i>Cyclanthera pedate</i> Schrad.	X							X
30	Carrot	<i>Daucus carota</i> L.	X					X		X
31	Celery	<i>Apium graveolens</i> L.	X							X
32	Chard	<i>Beta vulgaris</i> var. <i>cicla</i> = <i>B. vulgaris</i>	X		X					X
33	Chili	<i>Capsicum</i> spp.	X							X
34	Colza	<i>Brassica napus</i> L.	X							X
35	Coriander	<i>Coriandrum sativum</i> L.	X							X
36	Garlic	<i>Allium sativum</i>	X	X				X		X
37	Lettuce	<i>Lactuca sativa</i>	X							X
38	Onion	<i>Allium cepa</i>	X							X
39	Panra	nd	X							X
40	Parsley	<i>Petroselinum crispum</i> (Mill.) Fuss	X	X						X
41	Pumpkin	<i>Cucurbita</i> spp.	X	X				X		X
42	Radish	<i>Raphanus sativus</i> L.	X		X					X
43	Salchichon	nd	X							X
44	Spinach	<i>Spinacia oleracea</i>	X							X
45	Tomato	<i>Solanum lycopersicum</i> L.	X							X
46	Urpiuca	nd	X							X
47	Watercress	<i>Nasturtium officinale</i>	X	X						X
48	Wild cabbage	<i>Brassica oleracea</i> var. <i>Sabellica</i>	X	X	X					X
49	Yurasucho	nd	X							X
50	Zucchini	<i>Cucurbita pepo</i> L.	X							X

Table 9. Diversity and uses of fruits in chakras of the high Andean zone of Cotacachi.

N	Species		Uses							
	Common name	Scientific name	Food	Medicinal	Fodder	Forest	Ornamental	Ritual	Crafts	Compost
49	Andean raspberry	<i>Rubus glaucus</i>	X							X
50	Apple	<i>Malus domestica</i> Borkh.	X							X
51	Avocado	<i>Persea americana</i> Mill.	X	X						X
52	Babaco	<i>Carica × pentagona</i> Heilborn	X							X
53	Banana passionfruit	<i>Passiflora mollissima</i>	X							X
54	Beach strawberry	<i>Fragaria chiloensis</i> L.	X							X
55	Cape gooseberry	<i>Physalis peruviana</i>	X							X
56	Cherimoya	<i>Annona cherimola</i> Mill.	X	X	X			X		X
57	Common guava	<i>Psidium guajava</i> L.	X							X
58	Common pear	<i>Pyrus bourgaeana</i> Decne.	X							X
59	Fig	<i>Ficus carica</i> L.	X	X						X
60	Grape	<i>Vitis vinifera</i> L.	X							X
61	Greengage	<i>Prunus domestica</i> subsp. <i>italica</i> (Borkh.) Gams	X							X
62	Guaba	<i>Inga edulis</i> Mart.	X							X
63	Lemon	<i>Citrus limon</i> (L.) Osbeck	X	X						X
64	Ley lime	<i>Citrus aurantiifolia</i> (Christm.) Swingle	X							X
65	Loquat	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	X							X
66	Mandarin	<i>Citrus reticulata</i> Blanco	X	X						X
67	Mountain pawpaw	<i>Vasconcella pubescens</i>	X							X
68	Naranjilla	<i>Solanum quitoense</i> Lam.	X							X
69	Peach	<i>Prunus persica</i> (L.) Batch	X					X		X
70	Sour guava	<i>Psidium guineense</i> Sw.	X							X
71	Sugar cane	<i>Saccharum officinarum</i> L.	X					X		X
72	Sweet granadilla	<i>Passiflora ligularis</i>	X							X
73	Sweet orange	<i>Citrus sinensis</i> (L.) Osbeck	X	X						X
74	Tree tomato	<i>Cyphomandra betacea</i>	X	X				X		X

The Andean chakras present a wide diversity of medicinal plants, many of which have been identified by their scientific names, however, there are 66 plants that are only known by their local names (Table 10).

Table 10. Diversity and uses of medicinal plants in chakras of the high Andean zone of Cotacachi.

N	Species		Uses								
	Common name	Scientific name	Food	Medicinal	Fodder	Forest	Ornamental	Ritual	Crafts	Compost	
75	Aerva	<i>Aerva sanguinolenta</i> (L.) Blume		X						X	
76	Allpa anis	<i>Tagetes pusilla</i>		X						X	
77	Aloe vera	<i>Aloe vera</i>		X				X		X	
78	American aloe	<i>Agave americana</i> L.		X					X	X	
79	Apple geranium	<i>Pelargonium odoratissimum</i> (L.) L'Hér.		X			X			X	
80	Atuksara	<i>Phytolacca americana</i> L.		X						X	
81	Borage	<i>Borago officinalis</i> L.		X						X	
82	Cachicerraja	<i>Sonchus asper</i>		X						X	
83	Cat's claw	<i>Uncaria tomentosa</i> DC.		X						X	
84	Cestrum	<i>Cestrum</i> sp.		X						X	
85	Chamomile	<i>Matricaria chamomilla</i> L.		X						X	
86	Common daisy	<i>Bellis perennis</i> L.		X			X			X	
87	Common nettle	<i>Urtica dioica</i> L.		X						X	
88	Common verbena	<i>Verbena officinalis</i> L.		X						X	
89	Congona	<i>Peperomia congona</i> Sodirol		X						X	
90	Curly dock	<i>Rumex crispus</i> L.		X						X	
91	Dandelion	<i>Taraxacum officinale</i> F.H.Wigg.	X	X						X	
92	Dulcamara	<i>Solanum dulcamara</i>		X						X	
93	Epazote	<i>Chenopodium ambrosioides</i> (L.) Mosyakin & Clemants		X						X	
94	Equiseto	<i>Equisetum arvense</i>		X						X	
95	Fennel	<i>Foeniculum vulgare</i> Mill.		X						X	
96	Flax	<i>Linum usitatissimum</i>		X						X	
97	Geranium	<i>Pelargonium</i> sp.		X			X			X	
98	Greater plantain	<i>Plantago major</i> L.		X						X	
99	Green anise	<i>Pimpinella anisum</i> L.		X						X	
100	Lemon balm	<i>Melissa officinalis</i> L.		X						X	
101	Lemon grass	<i>Cymbopogon citratus</i> (DC.) Stapf		X						X	
102	Lemon verbena	<i>Aloysia citrodora</i> Paláu		X						X	
103	Malva blanca	<i>Malva</i> sp		X						X	
104	Malva sisa	<i>Malva</i> sp		X						X	
105	Marco	<i>Aristeguietia glutinosa</i>		X		X				X	
106	Micromeria/"sunfo"	<i>Clinopodium nubigenum</i> (Kunth) Kuntze		X						X	
107	Mosquera	<i>Croton ferrugineus</i> Kunth		X						X	
108	Myrtle	<i>Myrcianthes hallii</i> (O.Berg) McVaugh		X		X	X			X	
109	Oregano	<i>Origanum vulgare</i> L.	X	X						X	
110	Pacunga /Dry love	<i>Bidens pilosa</i> L.		X						X	

111	Peppermint (other variety)	<i>Mentha x piperita</i> L.		X						X
112	Prickly sow-thistle	<i>Sonchus asper</i> (L.) Hill		X						X
113	Ricino	<i>Ricinus communis</i>		X		X				X
114	Rosemary	<i>Salvia Rosmarinus</i> Schleid.		X						X
115	Rue	<i>Ruta graveolens</i> L.		X				X		X
116	Saint mary	<i>Pyrethum parthenium</i>		X						X
117	Shanshi	<i>Coriaria ruscifolia</i> subsp. <i>microphylla</i> (Poir.) J.E.Skog		X						X
118	Sleepy plant	<i>Mimosa pudica</i> L.		X						X
119	Sow thistles	<i>Sonchus</i> sp.		X						X
120	Thymus	<i>Thymus</i> sp.		X						X
121	Tigradillo	<i>Clinopodium tomentosum</i> (Kunth) Govaerts		X						X
122	Tzimbalo	<i>Solanum caripense</i> Dunal	X	X						X
123	Wild poppy	<i>Papaver rhoeas</i> L.		X						X
124	Wormwood	<i>Artemisia absinthium</i>		X						X
125	Alcumaqui	nd		X						X
126	Alelia	nd		X						X
127	Aliyuyo	nd		X						X
128	Allpachichera	nd		X						X
129	Ambo	nd		X						X
130	Ampu yura	nd		X						X
131	Ahuja	nd		X						X
132	Cachijigua	nd		X						X
133	Chulco	nd		X						X
134	Corlabí	nd		X						X
135	Escobilla	nd		X						X
136	Hierba de leche	nd		X						X
137	Hierba de sal	nd		X						X
138	Huaita	nd		X						X
139	Jily yura	nd		X						X
140	Juana yuyu	nd		X						X
141	kiwa	nd		X						X
142	Juyanguilla	nd		X						X
143	Landi kiwa	nd		X						X
144	Jimbogata	nd		X						X
145	Jirabiro	nd		X						X
146	Lechugín	nd		X						X
147	Milma	nd		X						X
148	Mote	nd		X						X
149	Mulli	nd		X						X
150	Ñacha sisa	nd		X						X
151	Nardo	nd		X						X
152	Nigua	nd		X						X
153	Osnaquigua	nd		X						X
154	Pandra	nd		X						X
155	Pataco yuyo	nd		X						X
156	Peruano	nd		X						X

157	Picu yuyo	nd		X						X
158	Pigola yuya	nd		X						X
159	Pilche kiwa	nd		X						X
160	Piqui	nd		X						X
161	Piqui hierba	nd		X						X
162	Pishcojigua	nd		X						X
163	Puca sisa kiwa	nd		X						X
164	Pulanco	nd		X						X
165	Puler	nd		X						X
166	Quijolon	nd		X						X
167	Quillo yura puruto	nd		X						X
168	Quitalki yura	nd		X						X
169	Renata	nd		X						X
170	Rurajuashua	nd		X						X
171	Sagala	nd		X						X
172	Salinero	nd		X						X
173	Sara kiwa	nd		X						X
174	Sagala	nd		X						X
175	Salchichón	nd		X						X
176	Salinero	nd		X						X
177	Sara kiwa	nd		X						X
178	Shauza vara	nd		X						X
179	Siempre viva	nd		X						X
180	Sigze	nd		X						X
181	Sin Verguenza	nd		X						X
182	Sisañan	nd		X						X
183	Sombrajigua	nd		X						X
184	Vicundo	nd		X						X
185	Yuramatico	nd		X						X
186	Wagra	nd		X						X
187	Yana	nd		X						X
188	Yuyanguillo	nd		X						X
189	Yuyu	nd		X						X
190	Zetzera	nd		X						X

Table 11. Diversity and uses of forest plants in chakras of the high Andean zone of Cotacachi.

N	Species		Uses							
	Common name	Scientific name	Food	Medicinal	Fodder	Forest	Ornamental	Ritual	Crafts	Compost
191	Acacia	<i>Acacia melanoxilum</i>				X				X
192	Alder	<i>Alnus acuminata</i>				X				X
193	Andean lupin	<i>Genista monspessulana</i> (L.) L.A.S.Johnson				X				X
194	Arrayán	<i>Luma apiculata</i>				X				X
195	Capulí	<i>Prunus serotina</i>	X			X				X
196	Chilca	<i>Baccharis latifolia</i> Pers.		X		X		X		X

197	Cypress	<i>Cupressus macrocarpa</i> Hartw.				X				X
198	Ecuadorian walnut	<i>Juglans neotropica</i> Diels	X			X				X
199	Elderberry	<i>Sambucus nigra</i> L.		X		X				X
200	Eucalyptus	<i>Eucalyptus</i> sp.		X		X				X
201	Guarango	<i>Caesalpinia spinosa</i>				X				X
202	Laurel de cera	<i>Myrica pubescens</i> Humb. & Bonpl. ex Willd.				X				X
203	Lechero	<i>Euphorbia laurifolia</i> Lam.		X		X				X
204	Lemon-scented gum	<i>Corymbia citriodora</i> (Hook.) K.D.Hill & L.A.S.Johnson		X		X				X
205	Lupina	<i>Cytisus monspensulanus</i>				X				X
206	Molle	<i>Schinus mole</i> L.				X				X
207	Pencil willow	<i>Salix babilonica</i>		X		X				X
208	Poroton	<i>Erythrina edulis</i> Triana	X			X				X
209	Pumamaki	<i>Oreopanax ecuadorensis</i>				X		X		X
210	Sarajigua	nd				X				X
211	Tree poppy	<i>Bocconia frutescens</i> L.				X				X

Table 12. Diversity and uses of ornamental plants in chakras of the high Andean zone of Cotacachi.

N	Species		Uses							
	Common name	Scientific name	Food	Medicinal	Fodder	Forest	Ornamental	Ritual	Crafts	Compost
212	Achira	<i>Canna indica</i>					X			X
213	Angel's trumpet	<i>Brugmansia</i> spp.		X			X	X		X
214	Calla lily	<i>Zantedeschia aethiopica</i> Spreng.					X			X
215	Carnation	<i>Dianthus caryophyllus</i> L.					X	X		X
216	Carrizo	<i>Arundo donax</i> L.					X		X	X
217	Cholán	<i>Tecoma stans</i>				X	X			X
218	Dahlia	<i>Dahlia variabilis</i> Hort.					X			X
219	Llinllín-Caper bush	<i>Senna hirsuta</i> (L.) H.S.Irwin & Barneby				X	X			X
220	Madonna Lily	<i>Lilium candidum</i> L.		X			X			X
221	Peruvian Lily	<i>Alstroemeria</i> sp.					X			X
222	Rose	<i>Rosa floribunda</i> hort. ex Andrews		X			X			X

Table 13. Diversity and uses of fodder plants in chakras of the high Andean zone of Cotacachi.

N	Species		Uses							
	Common name	Scientific name	Food	Medicinal	Fodder	Forest	Ornamental	Ritual	Crafts	Compost
223	Alfalfa	<i>Medicago sativa</i> L.		X	X					X
224	Chuchi malba	nd			X					X
225	Kikuyo	<i>Pennisetum clandestinum</i>			X					X
226	King grass	<i>Pennisetum Purpureum x Pennisetum Typhoides</i>			X					X
227	White clover	<i>Trifolium repens</i> L.			X					X

This diversity of plants found in the 'Chakras' represents the inter-specific variability between species, so the agricultural variability is much higher. There are 150 species used as medicine, however, 66 crops have not been taxonomically identified, nor are there any other known uses. In crops related to food, 81 species identified by the families, which gives account of the value and importance of the 'Chakra' in the family and community life, going beyond just economic or transaction value of the crops (Table 14).

Table 14. Categories of ABD species used in the 'Andean Chakra' of the High Andean zone of Cotacachi

Biodiversity categories	Number of species found
Medicinal	150
Food	81
Forestry	26
Ornamental	15
Fodder	19
Ritual	27
Handicrafts	05

Source: ABD inventory, UNORCAC-2017

The agro-biodiversity inventory carried out in the agro-ecological producers' group "*La Pachamama nos alimenta*", which is made up of 220 producers from four parishes, identified 41 botanical families comprising 104 species (34 fruit trees, 30 vegetables, 19 medicinal plants, 9 grains and legumes, 5 cereals, 7 roots and tubers). The diversification of the chakras motivates the members of the group to improve their diet and maintain their traditions, and indirectly promotes the conservation of germplasm (Chiza, 2018).

The research conducted by Méndez (2021) in 10 communities of Cotacachi identified 68 agricultural species cultivated by farmers and with various uses: 61 species are intended for human food being corn, beans, potato, broad beans, cucurbits and peas the most used in the communities; 24 species are used in animal feed among cereals, legumes, roots and tubers, example of this is the use of corn after harvest, where the broken grains or with pest damage are used in pig feed, while the leaves are used to feed cattle type cows; 40 species are used in seed fairs for exchange, this allows them to increase the diversity of the farm and knowledge about crop management; 21 species are used as medicine; 26 species are related to spiritual or ritual aspects; and 46 species are used as biomass for the generation of organic fertilizer for the farm.

2.1.2 Maize variety in the 'Andean Chakra'

Maize is not only a commodity, since it represents an important part of the relationships of rural communities and people's livelihoods, in addition to its value in the identity of Andean and Mesoamerican culture-*we are men and women of maize*. Furthermore, it is the basis of the diet of the indigenous peoples and a core element of their culture and tradition.

In the Ecuador, maize crops are distributed over almost the entire territory, from sea level to the highlands (3 200 m a.s.l.) on fertile soils, as well as on poor, stony, flat or sloping land, on hills with rainfall of 63 to 6 000 mm year⁻¹, resulting in the wide yields. Ecuador is one of the countries with the highest genetic diversity of maize per unit area, therefore, preserving it represents an important natural resource for the survival, rural sustainability and food security of future generations (Yáñez *et al.*, 2003).



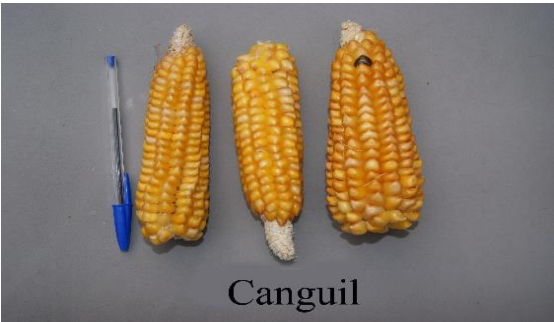


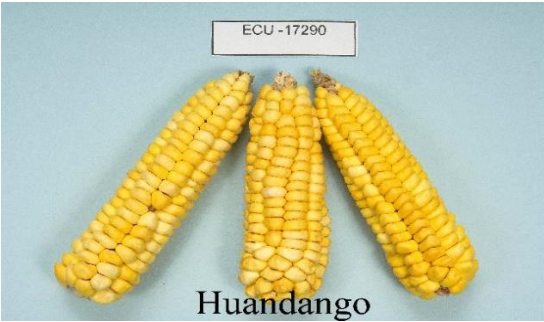


Maize varieties in the 'Andean Chakra'. Source: UNORCAC

Twenty-nine breeds of maize have been identified in the country, seventeen of which are found in the Sierra (Timothy *et al.* 1963). It is very likely that these breeds were different in ancient times, mainly due to the type of cross-pollination and the planting system (mixtures of materials from different breeds) maintained by farmers. Twelve out of the seventeen botanical breeds in the Sierra have been identified in Cotacachi. In the validation process carried out with farmers and UNORCAC promoters, 90 common names in Kichwa were registered with their respective translations. In relation to richness, the average number of maize landraces planted is over 4 (Bioversity, 2015). Brush & Perales (2007) found average richness of local maize landraces per household in Chiapas below 2, highlighting the important role Cotacachi as a ABD hotspot.

Table 15 details the morphological characteristics of each of the botanical maize races in the 'Andean Chakra' of Cotacachi (Timothy *et al.* 1963).

Table 15. Botanical species of maize and their morphological characteristics are present in the 'Andean Chakra' of the High Andean zone of Cotacachi

 <p>Blanco Blandito</p> <p>Round, large, white and floury kernels; the “tusa” is white or red.</p>	 <p>Chaucho</p> <p>It is also known as Chaucha-Huandango, a mixture between two species Mishca and Huandango, forming a new type of maize, long cylindrical ears, thin “tusas”, with large, almost round kernels (Yáñez, et al., 2003).</p>
 <p>Canguil</p> <p>Kernels are yellow or white, the corncob is short, thin and cylindrical with pointed kernels.</p>	 <p>Chillo</p> <p>Large, pointed, yellow and floury kernel. The “tusas” are thin, usually white</p>
 <p>Chulpi Ecuatoriano</p> <p>Kernels are flattened and wrinkled, the cobs are short of thick “tusa”, usually white.</p>	 <p>Huandango</p> <p>Floury kernels of an intense yellow colour. The corncobs are long, thin and cylindrical with red “tusas”.</p>



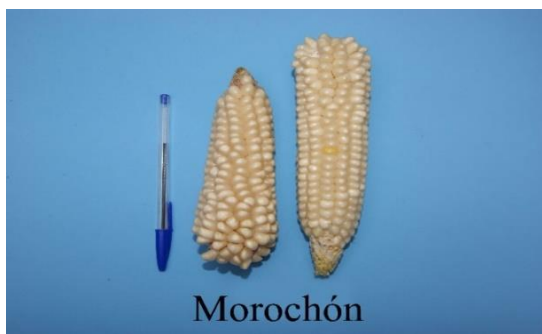
Mizhca

Floury yellow kernel, mostly conical cobs, red or white “tusa”.



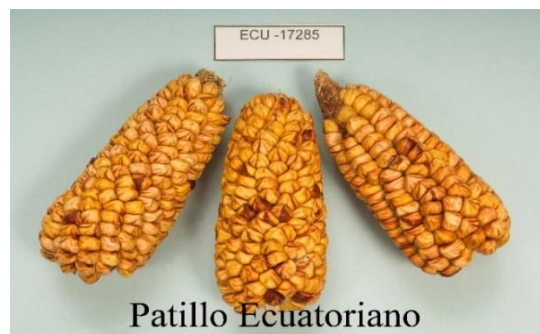
Montaña Ecuatoriano

They are white-kernelled, of the morocho or hard type, some with a pearly appearance. The corncobs are long and thin.



Morochón

Also known as morocho, it is characterised by its white and hard kernels, the cobs are medium sized and cylindrical.



Patillo Ecuatoriano

White or yellow kernels, mostly round. The cobs are small, conical or oval, the “tusas” are generally red.



Racimo de Uva

Round kernels. They are closely grouped to give the appearance of a bunch of grapes. The cobs are medium sized, conical or oval. The “tusa” is reddish to purple in colour.



Sabanero Ecuatoriano

Hard white kernels. The cob is short and conical.



Girl with maize seeds in Cotacachi. Source: MCYP

2.1.3 Beans variety in the 'Andean Chakra'

Beans are very important legumes for agriculture and the local diet. Cotacachi farmers manage a great variety of beans, each with specific features and properties. Varieties such as mixed, 'bolón', 'matambre', 'popayan', canary beans, among others, are sown with white, black, red, yellow, brown and grey seeds.

Most bean varieties are vine-like plants intercropped with maize, and it is also common to sow the 'matambre' variety between the furrows of other crops such as 'chocho' and quinoa. Fig. 4 shows bean varieties found in the 'Andean Chakra' of Cotacachi.

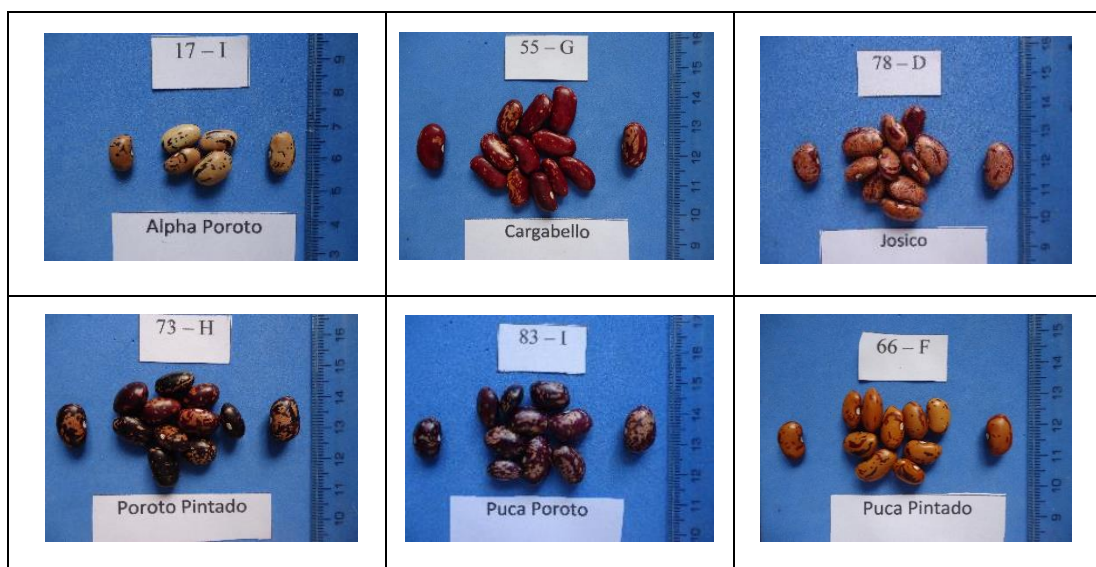








Figure 4. Bean varieties in the 'Andean Chakra' of the High Andean zone Cotacachi.

2.1.4 State of Agrobiodiversity (ABD)

As part of the ABD inventory (UNORCAC, 2017), an analysis was carried out of the state of conservation of the crop at family and territorial level, through community workshops and with a participatory methodology of identification and evaluation of the type of crop and/or domesticated cultivars, in relation to the land extension and the number of family farmers.

From this work it was possible to determine the *State of Agrobiodiversity in ten communities in the Andean Zone of Cotacachi* (UNORCAC, 2017) with the following findings:

- By 2017, nine types of maize are at risk³; 57% of the varieties found in the territory are at risk such as: 'canguil', 'mulato sara', 'racu sara', 'puca sara', 'huandango sara', 'julin sara', 'chulpi', 'yana sara' and 'yura sara'. The varieties at greatest risk are 'racu sara', 'mulato sara' and 'yura morocho'.
- On the other hand, families plant in large areas maize for sale such as 'tzapa sara' and 'bola sara'. As far as beans are concerned, the varieties are red ball, canary and 'allpa poroto'. Similarly, peas and broad beans are sown in large extensions in the 'Chakra'.
- As of 2017, the crop considered lost at the community level is 'centelina' wheat, which is a type of rye wheat, also known as black wheat. This is the only crop that was deemed as completely lost and was mentioned by all communities.
- Other crops which are no longer planted or where seeds are rarely found are miso, 'centelina', lentils and pumpkin.
- Black-seed squash is perfect for maize intercropping, its use in rural life means that it remains one of the ideal crops for food security.
- Andean roots and tubers such as sweet potato, 'ulluco' and 'huata papa' increased their risk rating by 2017, like miso, mashua, white carrot, 'uqa' and jam bean.
- Among the fruit trees that increased their risk rating are the chigualcan (*Vascocellea pubescens*), capuli (*Prunus serotina*) and passion fruit, the latter mainly due to the beliefs and fears of the inhabitants about the presence of snakes.

³ Risk levels defined as crops in small production areas and cultivated by a small number of producers.

To the identification of threaten varieties and risk levels, farmers were also asked to state what requirements they were most in need to continue supporting the conservation of ABD and particularly landraces at risk (Fig. 5) (Bioversity, 2015).

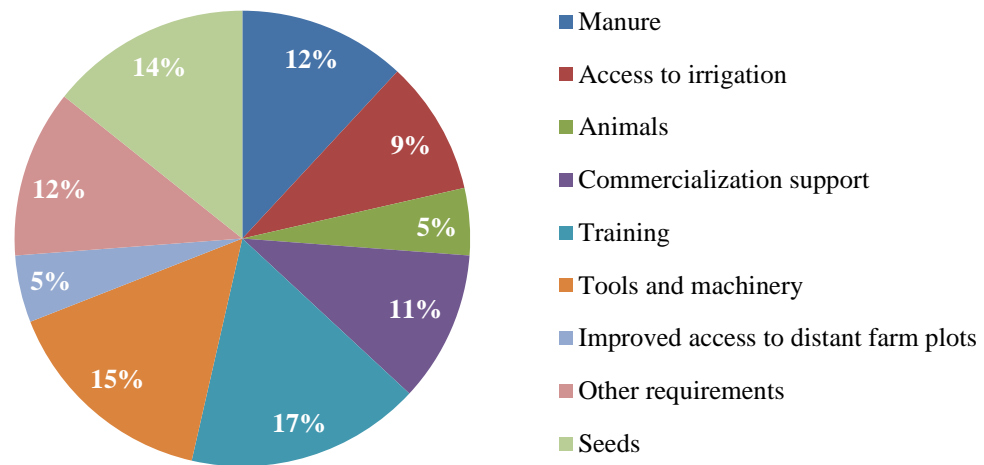


Figure 5. Farmers requirements to maintain local landraces in Cotacachi.

Table 16 summarizes the overall ranking of threaten landraces in Cotacachi. This ranking was made based on the crops and landraces selected for PACS and was based on three criteria: 1) the threaten score; 2) farmers' willingness to cultivate them; and 3) varieties that could be cultivated alone without intercropping, which will facilitate the monitoring process (Bioversity 2015).

Table 16. Ranking of threaten landraces in Cotacachi based on the four-cell-analysis

eID	Crop or landrace	Scientific name	Threaten Score
1	Miso	<i>Mirabilis expansa</i>	276
2	Canguil	<i>Zea mays</i>	225
3	Mashua	<i>Tropaeolum tuberosum</i>	215
4	Lenteja	<i>Lens culinaris</i>	190
5	Zanahoria Blanca	<i>Arracacia xanthorhiza</i>	142
6	Oca	<i>Oxalis tuberosa</i>	120
7	Puca Huandango Sara	<i>Zea mays</i>	101
8	Julin Sara	<i>Zea mays</i>	101
9	Bolon Rojo	<i>Phaseolus vulgaris</i>	100
10	Ataco Negro	<i>Amaranthus</i> sp.	90
11	Achogcha	<i>Cyclanthera pedata</i>	88
12	Yura Pintado	<i>Zea mays</i>	84
13	Chulpi	<i>Zea mays</i>	82
14	Cargabello	<i>Phaseolus vulgaris</i>	79
15	Huandango	<i>Zea mays</i>	78
16	Chigualcan	<i>Vasconcella</i> sp.	70
17	Yana Sara	<i>Zea mays</i>	67
18	Yura Sara	<i>Zea mays</i>	53
19	Camote	<i>Ipomoea batatas</i>	45
20	Tzapa Sara	<i>Zea mays</i>	42
21	Sangre De Cristo	<i>Zea mays</i>	41
22	Melloco	<i>Ullucus tuberosus</i>	37
23	Granadilla	<i>Passiflora ligularis</i>	32
24	Amarillo Pintado	<i>Zea mays</i>	30
25	Racu Sara	<i>Zea mays</i>	27
26	Morocho Blanco	<i>Zea mays</i>	15
27	Popayan	<i>Phaseolus vulgaris</i>	15
28	Mulato Sara	<i>Zea mays</i>	11
29	Guatapapa	<i>Solanum tuberosum</i>	1

2.1.5 'Andean Chakra', a conservation area on a traditional Andean farm

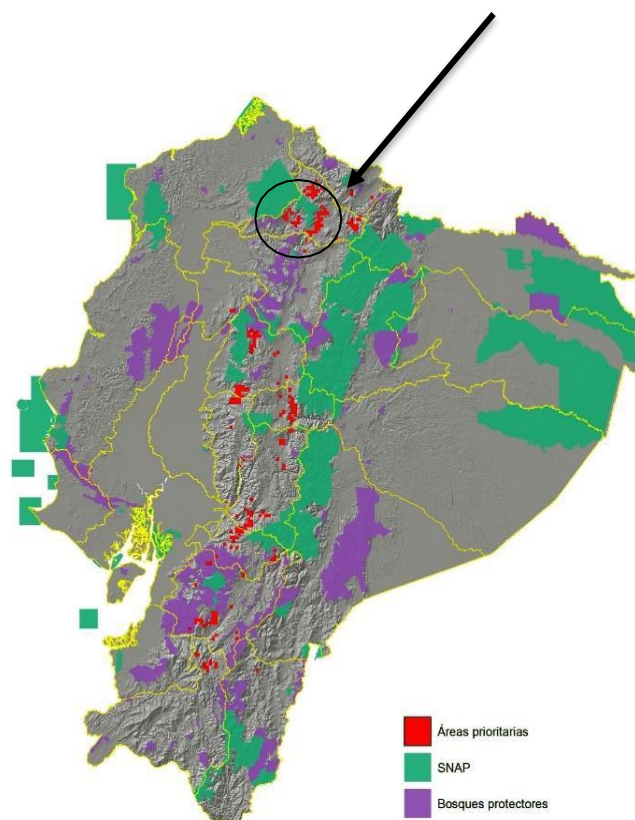
One of the most recent studies, led by INIAP, suggests the importance of research into the 'Chakra' production system to:

Identify areas for ABD conservation on the farm 'Chakra' (Tapia et al., 2018), as they act as reservoirs of diversity and at the same time serve as trial plots for farmers to test the value of the varieties in relation to their livelihood needs (Eyzaguirre & Linares, 2004).

At the same time, farms contribute to environmental regulation, income generation and the aesthetic value of the agricultural landscape (Sunwar et al., 2006). In addition, diversity cannot only increase the probability of adaptation and survival over time (Nunney & Campbell, 1993) but also provide material for genetic improvement (Feuillet et al., 2008).

As part of National Biodiversity Strategy, a model of National Biodiversity Indicators was designed (Tapia et al., 2015) which included a proposal for the analysis of eco-geographical diversity areas on farms where varieties of a selected set of native crops that are strategic for food security are grown.

An ABD, INIAP-FAO Conservation Areas study was carried out in 2017, identifying optimal geographic areas of on the farm conservation of native crops in the Ecuador (Tapia et al., 2018), using an objective methodology under eco-geographic, biological and demographic criteria, and with information on geographic coordinates available at the INIAP Germplasm Bank documentation system. As part of this process, the Andean zone of Cotacachi was identified as one of the territories with optimal conditions for the conservation of High Andean grains such as quinoa, amaranth, maize, and beans. Map 3 shows in red colour the main geographical areas for conservation where the 'Andean Chakra' of Cotacachi is located.



Map 3. On-farm conservation areas for High Andean grains in Ecuador.
 Source: ABD conservation zones (Tapia *et al.*, 2018).

2.1.6 Variety of 'Andean Chakra' reared animals

Although, in traditional Andean culture and in the 'Chakra', the consumption of meat and animal by-products is secondary to the consumption of vegetables; animal breeding is very decisive for family and community development due to its multi-functionality.

However, what is remarkable is the type of relationship between the farmer and the breeding, because unlike the industrial livestock, the relationship is based on respect for the animal needs, which does not exclude the possibility of using their products. In the 'Andean Chakra' the farmer has a special affection for their animals and consider them as family members (Benzing, 2001).



Indigenous woman and daughter feeding the hens in the 'Andean Chakra'. Source: UNORCAC

In the Andean chakra it is common to find several species of animals related to food, cultural and spiritual aspects. This is detailed as follows:

1. Guinea pigs: it is very difficult to find an indigenous family that does not have at least one guinea pig litter which is the main animal breed in the 'Chakra'. The most common breeds are:
 - Curi: with straight, short hair and a rosette on the forehead
 - Chachaco or spotted: with short, straight hair, with some swirls in rosettes in different parts of the body.
 - Chivilo: with long, straight hair.
 - Improved, Macabeo, or Peruvian: round shape, large size, short yellow and light orange hair, thick hand.

A few years ago, it was common to raise guinea pigs inside the peasant house in the kitchen area and see them running under beds and tables. This practice, which could be considered unhealthy, had some logic because the animal was hidden and less stressed. Today, it has been demonstrated that if small boxes are integrated into the cage systems as a hiding place, there is a remarkable improvement in the animal's welfare and in the long term productivity.

2. Cows of great economic and agronomic importance. There are three types of cows.

- Creole cows: they adapt to high altitude areas and feed on natural grass. They are thin, have horns, generally black in colour, with a small udder, live from 12 to 15 years, give birth five times and are disease-resistant. Although, they have a low milk production (6 l day^{-1}), they are very useful for agricultural work.
- Improved Creole breeds: Holstein breed characteristics-medium build; require more care; not very resistant; not adaptable to high altitude areas; need improved grasses; they are

milked twice a day and can produce 15 l day⁻¹; live between 8 and 10 years and have 6 to 7 births.

- Dairy or Breed cows: the least common cows in the 'Andean Chakra', because they require a mild climate and a maximum altitude of 3 000 m a.s.l. They are very delicate, of great build and large udder. They feed on improved and balanced grasses. Susceptible to diseases; however, they can produce up to 25 l day⁻¹, live up to 8 years and have 4 or 5 births.

3. Pigs: there are three types of pigs.

- Creole pigs: they are small, black, very rustic and need little care. They give birth to 6 or 7 piglets, feed on food waste, vegetables and crop residues, are raised outdoors and tied with ropes. They are useful for 'rooting' the soil after the pass of a yoke or tillage. They are bred for 1 or 2 years before cooking in the oven or frying and have a lot of fat (the lard is very useful for Andean cooking). Sows are kept for 6 or 7 years.
- Improved pigs: they are bigger, white, or a mix of black and white. They need more care; are raised in pens; sows give birth to up to nine piglets and are kept for up to four years. They feed on food and harvest waste, but balanced or concentrated bran should be added. They require a lot of care and treatment and are low in fat. They are eaten after six months or a year.

4. Chickens: there are two types of chickens.

- Creole chickens: small, thin yellow leg hens. Roosters have big crests, abundant feathers, black, grey, red, 'zaratanos', 'aguaricos', 'cariocas', 'copetones'. Resistant to disease, slow growth, hard and red flesh. They do not require much care, but should mate to lay eggs. They are free range chickens in the 'Chakra'.
- Laying hens: thin legs, black or red hens. Medium build and grow faster. They feed on grains, grasses, vegetables or balanced feed. They require more care, pen and nest. They lay large eggs, and do not wait for mating with the rooster.

2.2 Ecological functions

Having high levels of biodiversity in the chakras contributes to agricultural productivity and sustainability through ecosystem services, as mentioned by Koohafkan and Altieri (2010) the agroecosystem function is optimized through the interaction that arises from the addition of species in an agroecosystem. Thus, for example, in the Andean chakras one of the essential combinations of the productive dynamics is the planting of corn accompanied by beans, this combination increases the supply and recycling of nitrogen in the soil, they are also the agricultural species most used in the preparation of traditional foods, and represent a great cultural value in ceremonies or rituals of the indigenous cosmovision.

Plants that are commonly considered weeds or of little importance, are revalued within the chakras for their application as repellents, green fertilizers, medicinal, which increases the diversity of these spaces (Fernandez et al., 2014), in addition, the structure and composition in ecosystems influence the richness of arthropod populations (natural enemies and pollinators) that counteract the presence of pests (Nicholls, 2008). For example, the evaluation carried out by Puma (2020) in four communities in Cotacachi during an agricultural production campaign identified the presence of at least 2 000 insects distributed in nine orders: Hymenoptera, Hemiptera, Coleoptera, Diptera, Lepidoptera, Odonata, Neuroptera, Thysanoptera and Phasmatodea.

At the chakra level, agroforestry systems are represented by trees, shrubs and herbaceous or association of perennial or annular agricultural crops and livestock, this management system supports soil

fertilization, provides the system with various goods with economic value for the family, example of tree strata is composed of species such as eucalyptus (*Eucalyptus globulus*) and alder (*Alnus acuminata*), among others, which provide shade to the agricultural yard and good support to the soil; living barriers serve as biological corridors and spaces for the interaction of various pollinators and seed dispersers; forest species such as the milk tree (*Euphorbia laurifolia*) is used as living fences to delimit the chakra, species of greater height such as avocado (*Persea americana*) and lemon (*Citrus limon*) guarantee shade to the spaces established for animal husbandry (Arrollo and Pabón, 2019).

The farmers take advantage of the protected and fertile microenvironment of the 'Chakra' to multiply their seeds, make seedlings, keep live samples of interesting species or varieties and to test, acclimate and evaluate new materials. Of course, all plants in the 'Chakra' are subject to strong human selection pressure, and those plants that for some reason do not meet the objectives or preferences of the family are eliminated. Thus, due to the direct and constant use of the ABD, the 'Chakras' serve as refuges for previously widespread crop varieties and, therefore, the 'Chakra' represents a very important environment for in-situ conservation of these genetic resources, as well as for the transfer and exchange of knowledge between families and communities.

Given the evidence of the ecological, social and economic value of the biodiversity managed in the 'Chakra' system, different approaches to this production system have been taken, in order to draw attention to its impact on local food availability and also for the country.

Just as nature provides various ecosystem services to humanity, ABD in the 'Andean Chakra' also provides benefits such as climate regulation, pollination support, soil conservation, recreational benefits and the cultural and spiritual connection of farmers with 'Pacha Mama'. This ABD is key for the agro-ecosystem to function and provide support services such as soil fertility, pest and disease regulation through biological control and nutrient cycling (Fig. 6).

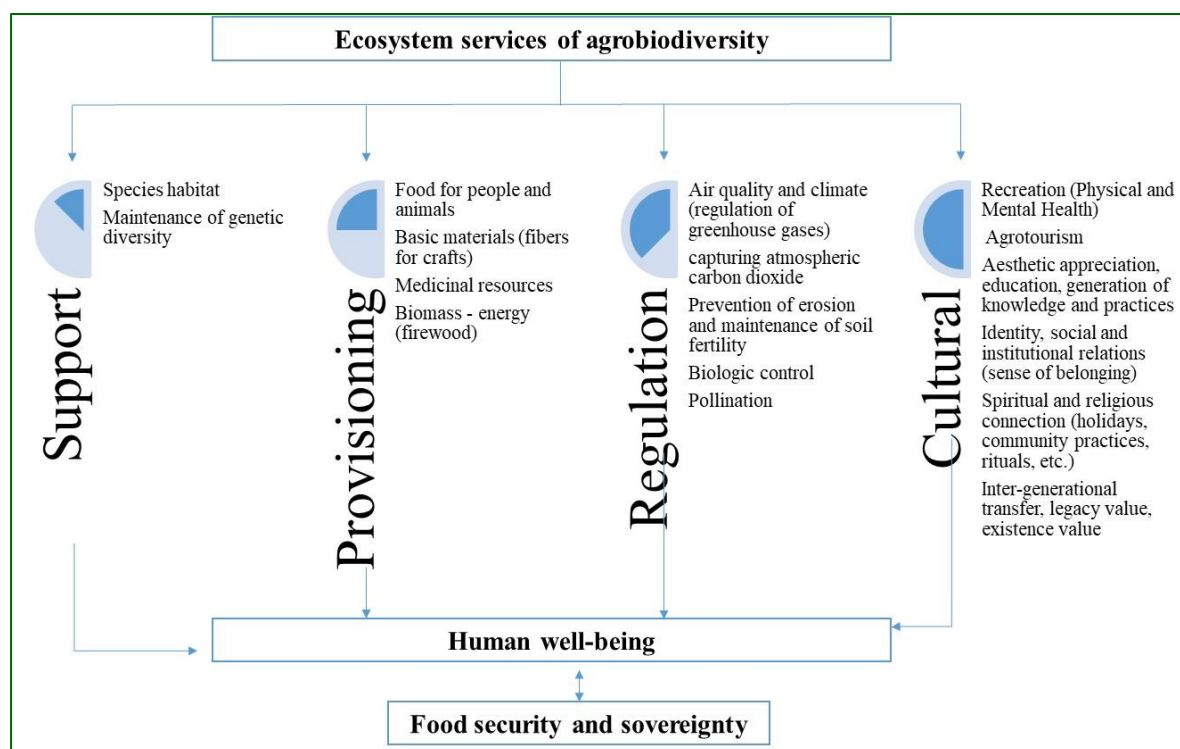


Figure 6. Ecosystem services of agrobiodiversity

Table 17 shows the status of the different aspects related to ABD cultivation and management in Cotacachi. In relation to crop diversity, indicators were developed to account for diversity on-farm, at the community level and at regional level. At farm level, average crop richness (S) is above 20. The largest share of these crops corresponds to vegetables (6), fruits (6) and grains (6). Other cultivated crops include: tubers (2), aromatic plants (<1) and animal fodders like alfalfa (<1) (Bioversity 2015).

Overall crop diversity (H) per farm is equivalent to 2.7. This value is high compared to the H global average, which ranges between 1.5 and 2.0 (Bellon *et al.*, 2014). Regions with H above 2 are rare and mostly located in Asia, i.e. Turkey and India (*ibid.*). Within the Andean region, Cotacachi's H value is also well above the mean regional average. Over 65% of Cotacachi's crop diversity is due to the high diversity of traditional crops and particularly of maize varieties (19%). These share of cultivating local landraces is similar to the one found in other extensive European agricultural landscapes, e.g. Colares (Portugal) and Duoro (Spain) (Veteläinen *et al.*, 2009). However, 65% implies an average of 11.8 local landraces cultivated per farm, a much larger value compared to that one found by Veteläinen *et al.* (2009) (4.5). This evidences that Cotacachi on-farm endemicity and diversity is remarkable. At the community level, 53% of the farmers stay cultivating local landraces of maize and beans. The remaining 47% of the farmers, are most likely working outside their own farms as labourer or mason, and they do not cultivate local landraces anymore (Bioversity, 2015).

In terms of crop evenness (J) at the farm scale, is close to 1 (0.9) indicating there is an even distribution of landraces sown across all farms, i.e. there is not a trend towards the specialization in the cultivation of certain type of crops and varieties within farms. At the regional or landscape scale, the crop heterogeneity index is slightly above average (0.6) (Bioversity, 2015).

In relation to production, only 2.6% is destined for the market and the rest is for children and adult food (Bioversity, 2015). In what respects to seed management, over half of the seeds (53%) are seeds stored by the farmer from the previous harvest. Nearly 28% of the seeds planted on average are bought at local markets and almost 18% are gifted. Seed exchange among friends, family or neighbors is very low, accounting for less than 2% of the seeds sown. With regards to traditional seeds, seed management strategy is quite similar, although, the share of traditional seeds planted by farmers from their previous harvest is slightly higher (56%). Farmers also come to markets to buy an important share of the seeds the sow during the harvest (25%). The great majority of these bought seeds are fruits and vegetables (Bioversity, 2015).

Regarding the productive aspect of ABD, the Food Consumption Score Index (FSC) shows that food intake, in terms of quality and quantity, for both adults and children are acceptable. According to the thresholds defined by IFPRI (2009), scores below 35 point towards a situation of sub-nutrition, while in Cotacachi average values for both adults and children are close or above 70. Standard deviations show a wide range of variability, but nevertheless, FSC scores are above the threshold indicating the inexistence a potential sub-nutritional problem (Bioversity, 2015).

Among the agro-ecological practices developed, farmers' practices are mostly oriented towards securing plant growth (81%) and the maintenance of soil functions (67%). Most common soil and plant growth practices include, intercropping, fallow, manure, composting and border planting. Other spread practices include pest control measures like the use of natural pesticides and fungicides (48%) as well as seed exchange rituals among community members (43% farmers). The share of farmers applying water conservation measures like water harvesting is much smaller (25%). Rainwater harvesting mostly involves the construction of water tanks and this yet unaffordable for many farmers. In fact, existing water tanks have been to a large extent financed through micro-credits by organizations like UNORCAC. From a cultural point of view, farmers at Cotacachi carry out a wide range of activities. The fact that this region is one of the most important hotspots of maize varieties, has contributed to develop a wide spectrum of maize dishes, including drinks, soups, sweets, and tortillas. Over 48 recipes of different types of dishes prepared with local maize landraces have been identified. Among the oldest farmers (> 40 years), over 50% still cooks many of these dishes, but this

percentage is much smaller among younger farmers (<40 years). This result implies that this traditional knowledge is progressively been lost (Bioversity, 2015).

Among the interviewed farmers, very few have received training in ABD related issues (less than 44%). Much of the training these farmers have received is related to different aspects of crop production (14%). Likewise, 5% of also are undertaking courses to improve animal management and production on farm (Bioversity, 2015).

Table 17. Status of ABD cultivation and management in Cotacachi and associated ecosystem services (ES)

ADB dimension	Indicator	Mean Value (Standard deviation)	Type of ES delivered	Scale of benefit delivery
Crop Diversity (on-farm, community and landscape)	Crop Richness (S)	20.4 (11.7)	Supporting and Regulating	Local to Global
	Crop Diversity (H)	2.7 (0.7)		
	Crop Evenness (J)	0.9 (0.1)		
	% Local landraces planted on-farm	65.0 (11.4)		
	% Local maize landraces planted on farm	19.3 (17.0)		
	% Farmers planting local landraces of maize and beans	52.8 (25.7)		
	Landscape crop heterogeneity	0.6 (0.0)		
Production	Adults Food Score Index	68.2 (22.6)	Provisioning	Local
	Children's Food Score Index	75.8 (22.7)		
	% Harvest sold in markets	2.3 (6.7)		
Seed Management	% Seeds from previous harvest	52.7 (25.5)	Regulating/Cultural	Local to Regional
	% Seeds bought at local markets	27.9 (22.3)		
	% Seeds exchanged among farmers	2.0 (5.1)		
	% Seeds gifted	17.5 (18.2)		
	% Seeds of local landraces from previous harvest	55.6 (28.4)		
	% Seeds of local landraces bought at local markets	25.0 (23.3)		
	% Seeds of local landraces exchanged among farmers	2.1 (6.1)		
	% Seeds of local landraces gifted	17.2 (19.2)		
	% Local landraces preserved ex-situ	79.6 (14.6)		
	% Farmers applying soil conservation measures	66.7 (9.8)		
% Farmers applying plant growth measures	81.4 (22.8)			
% Farmers applying pest control measures	48.3 (12.2)			
% Farmers applying seed dispersal measures	43.1 (17.6)			
% Farmers applying water conservation measures	25.0 (14.0)			
Cultural and Educational	% Farmers maintaining culinary knowledge (<40)	29.5 (19.8)	Cultural	Local to Regional
	% Farmers maintaining culinary knowledge (>40)	53.1 (9.2)		
	% Farmers receiving ABD training on:			
	Commercialization	1.6		
	Gastronomy	< 1		
	Gastronomy and Medicine	< 1		
	Undefined	8.6		
	No training	66.4		
	Animal production	4.7		
	Animal and crop production	3.1		
	Crop cultivation	13.8		
Food sovereignty	< 1			

2.3 Contribution of agrobiodiversity to the sustainability and resilience of the system

The Andean Chakras play an important role in the conservation and use of agrobiodiversity. 227 species and varieties have been identified, finding an average of 25 types of crops per Chakra, in addition, there is great intraspecific diversity, especially of certain main crops such as corn, beans and squash, and other secondary crops such as high Andean fruit trees. Throughout Ecuador, 29 races of corn have been identified, of which 17 belong to the Highlands Region; 12 races of those 17 were identified in the small area that covers the Andean Chakra of Cotacachi (Tapia, 2011). This conservation is the result of the work of farmers and the collective action of peasant organizations.

The conservation of the intraspecific diversity of crops has been a global concern for many decades due to the risk that a large amount of this diversity could disappear with agricultural and economic development, that is, genetic erosion. However, in the chakras of small farmers, a great quantity of crop diversity is still cultivated and preserved in areas considered to be domestication and diversity centers; which implies maintaining the evolution of crops, local knowledge and landscapes, and this in turn contributes to maintaining the ability of crops to adapt to change.

Maintaining and the production of the Andean Chakras produces both private and public benefits. The former refers to the benefits that farmers obtain directly and are available to them, such as food, medicine, culture, and income generation, while the latter refers to public benefits for humanity by contributing to the genetic diversity available to adapt crops to changing environmental and socioeconomic circumstances, essentially to maintain the resilience of agricultural and food systems, especially to face climate change (Bellon, 2014).

Farming practices are based on empirical knowledge, the optimization of available resources and the ability to make them work in precarious contexts is part of resilience; activities that farmers carry out in the face of climate adversity give farmers the opportunity to mitigate the effects of climate change (Rodríguez and Meza, 2016).

A resilience practice is the diversification of crops in the Andean chakras, it is very common to plant maize varieties associated with varieties of beans, zambo or squash, rows of quinoa, chocho and other crops. This traditional technology provides multiple advantages, the main one being related to the secure provision of a variety of staggered food over the course of the agricultural cycle, although in some cases productivity is low, it guarantees family food security.

Chakra agrobiodiversity supports the ability to respond and adapt to a myriad of changing ecological and social processes. Many native and traditional varieties have cultural and religious use value, implying that conserving agrobiodiversity is closely linked to the conservation of indigenous culture (Jarvis et al., 2010). The great diversity of crops and varieties, resource use technologies and conservation practices linked to the Andean chakra, generates and maintains favorable environments that are the basis for other important flora and fauna communities within the production system.

Accordingly, Figs 7 and 8 provide an overview on the specific links between overall ABD, and in particular maize related ABD, with the prevailing socio-economic, cultural and environmental factors. In both cases, these links were mapped through a Principal Component Analysis (PCA), to identify major trends influencing ABD (Bioversity, 2015).

Fig. 7 describes the main factors underpinning overall crop diversity on farm. The most important factor (explaining 21% of the variance) is farm structure and environmental conditions on farm. Farms with larger and flatter plots, where soil fertility is low tend to have larger crop diversity. Plot farms tend to be located near the houses, and therefore hold similar agro-climatic conditions (Bioversity, 2015).

The other main factor explaining on-farm diversity is the degree of isolation of farmers and

communities (explains 16.3% of the total variance). Those farmers who do not receive any ABD related training, which are not engaged in supporting institutions related to ABD; where seed management mostly relays on using seeds from the previous harvest; and where most of the production is for self-sufficiency, appear to influence negatively overall crop diversity, as well as diversity of local landraces. On the contrary, those farmers better connected to markets, which buy much of their seeds at local markets or supply shops, appear to have a greater overall crop diversity. In fact, these farmers produce for auto-consumption, but also try to sale part of their production in markets. Diversity and richness values in these farms are probably higher compared to other communities because they have increased the number of fruits and vegetables planted on farm, leading to an overall increase of crop evenness (Fig. 8) (Bioversity, 2015).

Considering the mentioned above, the Andean Chakra is an ancestral production system of the Kichwa indigenous communities of Cotacachi that has been and continues to be the source of food and health, using traditional wisdom, as well as the main source of income for the local population, both through direct sales to urban consumers, as well as the generation of value-added products, using modern technological innovations, and lately with the incursion into agrotourism, which offers a great future potential that can be strengthened.

The Andean Chakra is recognized for conserving a great diversity of crops and their intraspecific diversity in permanent adaptation and evolution process facing social, economic and cultural conditions, as well as changing agroecological environments, contributing to generate a diversity of winning combinations of genes and traits that are constantly updated in response to multiple and varying situations. This process is supported by the great wealth of traditional knowledge and cultural practices typical of the identity of the Kichwa indigenous communities, as well as the great collective work led by peasant organizations of men and women.

Therefore, the Andean Chakras must be conserved for their contribution to conserving the sociobiological systems that maintain the evolution of crops in the countryside and provide a direct benefit to local communities, and also generate public benefits to humanity.

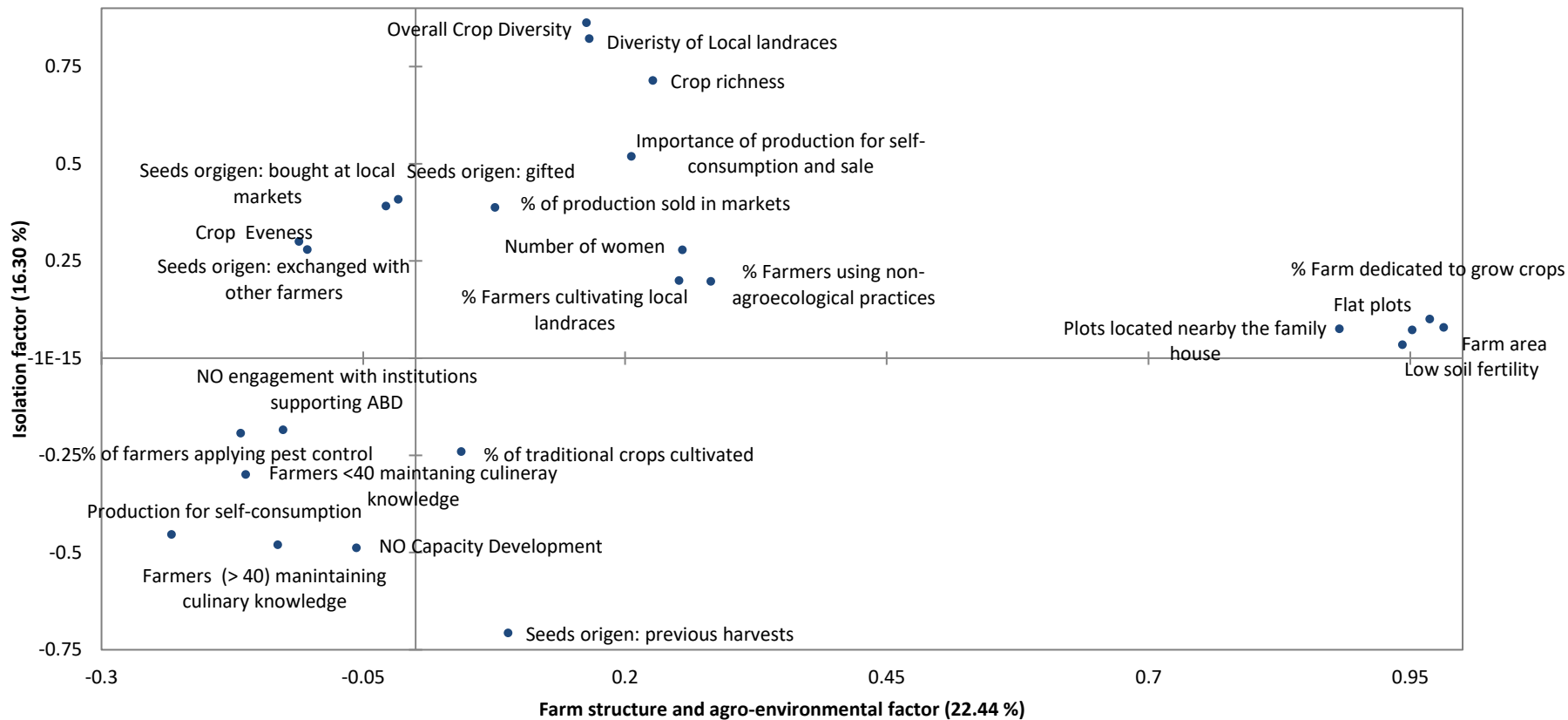


Figure 7. Factors explaining overall diversity on-farm in Cotacachi

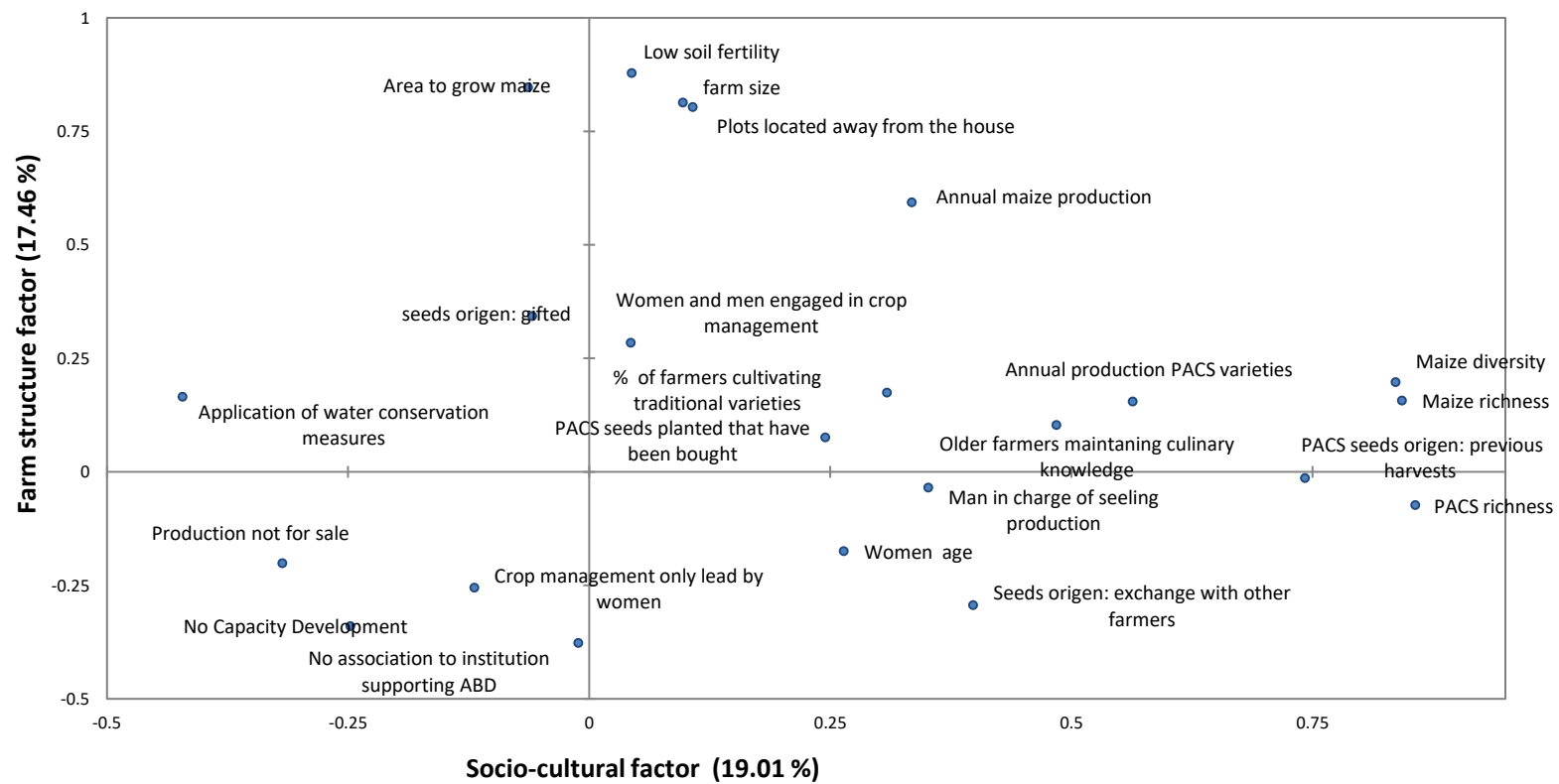


Figure 8. Factors explaining maize and PACS varieties conservation on-farm

Factors influencing on farm maize diversity are slightly different (Fig. 8). The main factor explaining maize diversity and the conservation of PACS varieties on farm is socio-cultural (explains 19% of the variance). Farms with larger maize diversity values overlap with farms with a strong presence of older women, which have maintained their culinary knowledge over time and where seed management strategies rely in the use of seeds from the previous harvest but also on the use of seed exchange networks. In these farms, irrigation is absent, most of the production is for self-consumption and women play an active role in crop management. Also, ABD related training is scarce. The second factor explaining the presence of high diversity maize values on farm is related with the farm structure (explaining 17.6% of the variance). Larger farms, with low soil fertility and where a large fraction of the plots are used for cultivating maize varieties, and thus, have larger annual maize productions, have a positive effect on maize diversity scores. Maize varieties have different cultivation cycles, therefore those farms which have plots located at different altitudes and distances from the family house (i.e. slightly different climate conditions) also have a positive effect on maize diversification on farm. The majority of these maize rich farms are led by farmers who are not really engaged with institutions supporting ABD (Bioversity, 2015).

2.4 Threats

- Migration of the young population of the indigenous communities to the cities, abandoning the agricultural activity and its ABD
- Promotion of improved seeds with higher yields and accompanied by technological packages that include agrochemicals that displace native varieties and traditional agricultural practices
- Expansion of the urban area, which affects land use change.
- Homogenization of markets with the incorporation of imported products.
- Changes in food systems because of globalization.
- Increased genetic erosion due to factors such as: inadequate public agricultural policies, reduced use of ABD, deforestation, among others.
- Climate change involving higher temperatures, changes in precipitation frequency, pest and disease resistance that could jeopardize agricultural production and diversity.
- Poor agricultural practices, inadequate use of phyto-sanitary products.
- Poor quality seed for production

2.5 Challenges

- Identify genetic material with the potential to adapt to different environmental conditions.
- Incorporate youth and children in the conservation and sustainable use of ABD through education.
- Use modern knowledge and cosmovision for the intensification of sustainable production and local development.
- Access to sources of financing for conservation and production, through community banks and seed capital.
- Increased number of biodiverse 'Chakras' allowing for greater crop diversity, a balanced nutritional diet and contribution to climate change adaptation and mitigation processes.
- Increase the diversity of cover crops to increase plant biomass, which improves water quality and reduces runoff.

3 Local and traditional knowledge systems

3.1 Agricultural practices/technologies and associated knowledge

3.1.1 Plants sanitation: pests and diseases

The presence of biodiversity in agricultural systems slows down the homogenization and simplification of agro-ecosystems, allowing greater resistance to pests and diseases, and prevents erosion through soil cover (Altieri, 1999). Producers have different methods to keep crops free of pests and diseases, such as manual, mechanical, biological and chemical control (Prado & Gómez, 2018).

In research carried out in Cotacachi to groups of producers 'La Pachamama nos alimenta', it was identified that the management of pests and diseases of the chakra implies the use of preventive and suppressive practices (Fig. 9) (Chiza, 2018).

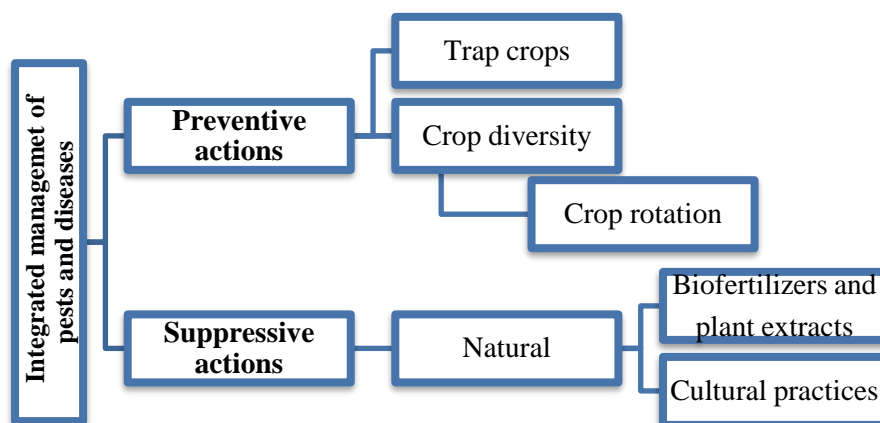
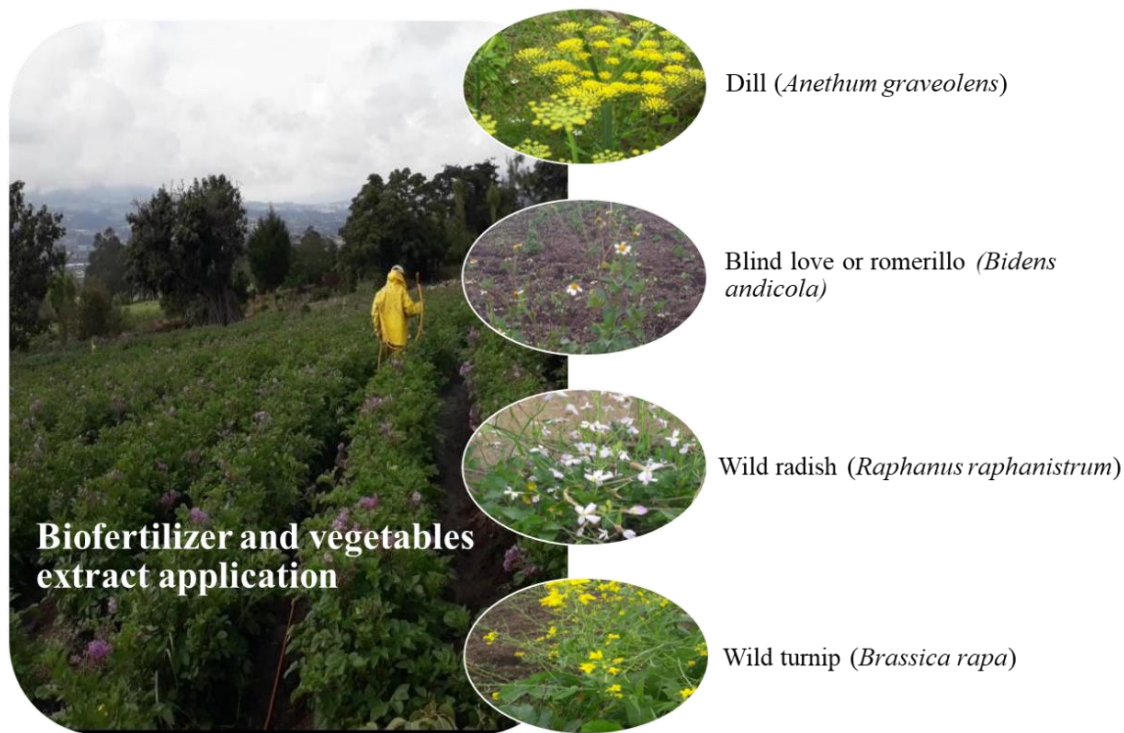


Figure 9. Management and control of pests and diseases carried out by a group of producers 'La Pachamama nos alimenta' in Cotacachi

Based on the study by Chiza (2018) preventive practices are related to the use of trap crops, diversity and crop rotation. An example of trap crops to repel harmful insects is the planting of vegetables together with medicinal plants such as 'romero' (*Rosmarinus officinalis*) or 'ruda' (*Ruta graveolens*). In the management system related to the diversity of crops, it is common to observe the sowing of legumes such as broad beans, lupine, beans along with grains such as corn, as well as crop rotation that is related to crop cycles; An example of this practice is planting potatoes, then some legumes such as peas, and then a cereal such as barley.



Agroecological management of potato crops with the use of biofertilizers and plant extracts in chakras of the Cotacachi canton. Source: Puma (2021).

Regarding suppressive practices, the producers of '*La Pachamama nos alimenta*' mention that these practices are carried out when there is visible damage to the plant, applying for its control, biological insecticides based on chili, garlic, onion and 'ruda', easy to prepare and low cost. The cultural tasks carried out by the family are: drying the seed in the sun for several days and selecting the material with damage or the presence of pathogens. Finally, when there is a threat to production, farmers mainly use green seal chemicals in the hope of reducing crop damage, as mentioned by one farmer, "*sometimes it is necessary because you don't know what to do to save the little plant*" (Chiza, 2018).

The most common plague is the Golden grosbeak (*Pheucticus chrysogaster* Lesson), that attacks during the sowing period, October mainly, Various strategies have been developed against this bird such as putting ashes on the crops, sowing sigses (*Cortaderia nitida* Pilg.) in the boundaries to avoid the entrance of the birds, flags and also scarecrows, in the peas fields. Because of its usefulness in controlling pests and diseases, the ash is carefully stored throughout the year in deep containers (Villota, 2010).

In recent years, potato production has been affected by the presence of the potato psyllid (*Bactericera cockerelli* Šulc), which transmits the disease called 'potato purple tip' and has caused production losses of up to 100% (INIAP, 2018). In studies carried out in the communities of Cotacachi (Tunibamba, Chilcapamba, Ugshapungo and San Nicolás), it was determined the use of vegetable extract of plants of the agroecosystems such as *Anethum graveolens*, *Ruta graveolus*, *Capsicum annuum* Pepper, *Ricinus communis*, *Allium sativum*, *Brugmansia arborea* to control pest when they are under the economic threshold. However, there are some farmers that applied nine chemical products, if pest population

increase, it is mainly related to the lack of knowledge about agroecological alternatives to crop manage (Puma, 2021).



Training in agroecological management of potato crops. Source: Doris Chalampunte-UTN

3.1.2 Crop diversification and integration with the forest (agroforestry)

All the elements that talk and interact with the reproduction of life are part of the 'Chakra', namely, soil, water, crops, animals, farmers. In that sense, in each 'Chakra' there is a permanent dialogue that allows an evolution, co-evolution and interaction between each element. As far as crops and raising are concerned, it is desirable to reach a high diversity and genetic variability, which, with an adequate management, reduces the need to use pesticides or other expensive inputs which, at the same time, benefits the ecosystem.

One of the final purposes, besides the crops of different products, is to reach production levels in line with the stability cycles and requirements of all the elements that are part of a 'Chakra', that is, soil, water, crops, breeding and families.



Community nursery for agroforestry, Cotacachi. Source: MCYP

The use of trees within the 'Chakra' or surroundings is part of its agro-ecological management. The distribution of areas for cultivars within the 'Chakra' is regulated by the type of ecosystem and the quality of the site and this applies to forest plantations (Sánchez & Chuquiruna, 2006). Trees serve as barriers against the wind, are used to establish boundaries, provide organic matter for the soil and produce food for people and animals (Morocho, 2008).

The principle of diversification is the response to the family's food demands, but it also responds to the understanding of the functioning of crop and livestock species and the relationships between them to optimize their production, care for and nourish the soil, shade, decorate, cultivate medicine, as well as adapt it to dynamic temporary and spatial arrangements.

In other words, the availability of a variety of crops enables farmers to choose those adapted to different environments, as well as support their culinary and religious traditions and other cultural values. The composition and arrangement of 'Chakra' species is a dynamic set, composed of a diverse mix of annual and evergreen plants, herbaceous, shrubs, trees, roots and tubers, as well as useful weeds and other plants that were born spontaneously.

The 'Chakra' is also the environment for breeding animals such as chickens, guinea pigs, rabbits, pigs, sheep and cows, in small pens. The 'Chakra' animals are fed with lower quality products from the 'Chakra' which are not used for human consumption and wild plants that grow between the crops. Animals such as sheep and cows graze on the community high lands, trails, and riverbanks.

In the 'Chakra' there may be an area to compost residues, food waste and animal dung to produce fertile

manure. One of the most important aspects of the Andean farming is the intercropping, a practice that indigenous families have been doing for years. The intercropping is based on the joint planting of crops with different periods of maturation and harvest, thus, seeking to develop a relationship of mutual reciprocity. The productive systems are structured in such a way that the diversity of plants provides complementary support, nutrient fixation, shade, protection against pests, and thermal regulation, among others.

In the plot next to the house, maize, beans, potatoes, maize, quinoa and broad beans are planted, while in the wild wetland wheat, barley and 'uqa' are planted. For example, it is used to plant maize of all colours, since it is believed that, in this way, the cane will come out sweeter, besides introducing 'tusas' in the maize furrows. The maize is sown every two steps, together with the thick bean seed, in the middle the 'matambre poroto', the 'chochos' beans are located on the contour of the land, performing like a fence so that people and animals do not step on the crop, while the quinoa is planted in rows to protect the crop against the late blight (*Phytophthora infestans* (Mont.) de Bary). Additionally, black-seed squash, potatoes and arracacha are planted, rotating the crops with barley, wheat, peas and 'matambre poroto'. When larger areas of land or other properties are available, barley is planted, followed by maize.

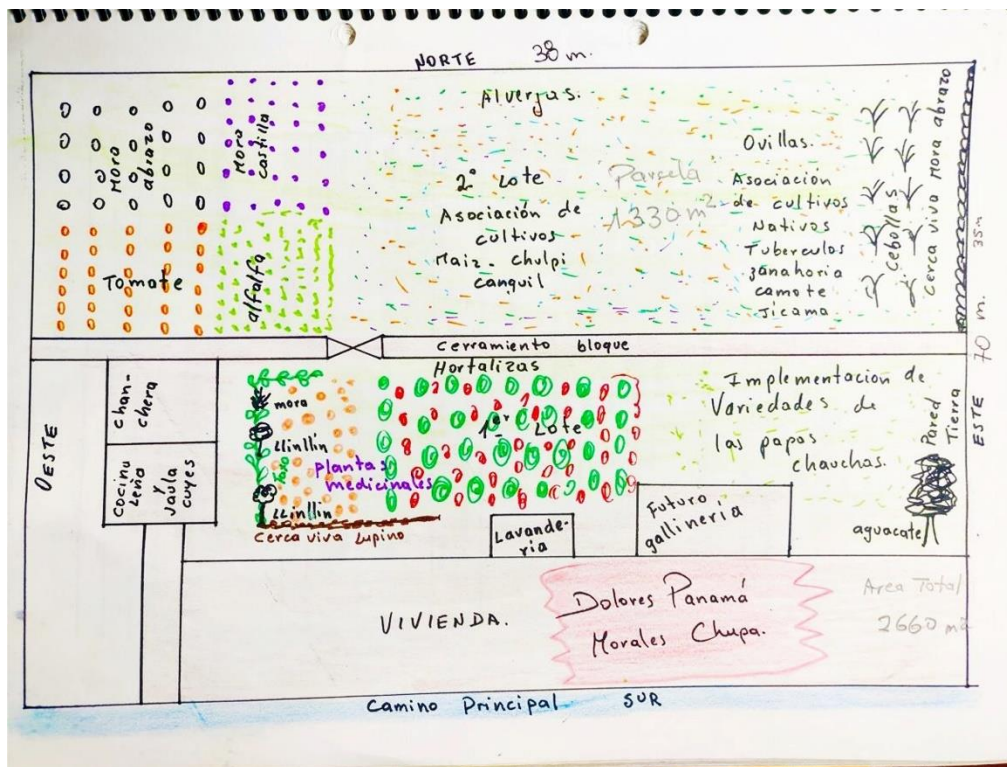
Some of the intercropping that still exist today are:

- Maize intercropped with beans, peas, broad beans, 'allpa poroto' or 'chaucha poroto', black-seed squash, pumpkin, 'chaucha' potato, quinoa in rows and chocho beans in 'flowerbeds'.
- The maize crops system works based on complex intercropping and periodic rotations. Since the maize grows first, it serves as a support for the development of the bean, while its roots feed colonies of bacteria that fix the nitrogen needed to renew soil fertility. Pumpkins or *black-seed squash* grow at ground level and complete the vegetative cover.
- 'Chocho' with 'allpa poroto', this type of bean comes out dry long before the 'chocho'.
- Many of the families who work on intercropping try to make the most of the small area of land they have to obtain maximum crop diversification and thus, ensure a diversified and complete nutritional diet, which on the one hand means a permanent use of the soil with the same crops, but at the same time supplement and guarantee an adequate soil management (Villota, 2015).

3.1.3 Crop rotation

Some families say they rotate crops every two years and depending on the extension of the 'Chakra', they usually sow maize with beans, quinoa, 'chocho', broad beans, during September and October, the beginning of the rains season, and then they alternate with peas, wheat, barley, rye, then lentils and finally, 'chochos' with 'matambre poroto', during March and April. Then the land is left for a year to fertilize it by 'sogueo', then the land is moved with a hoe ('cuchicara' shovel) to sow potatoes (Villota, 2010). Depending on the area, maize or potatoes begin the rotation cycle on land recently reclaimed for agriculture or after a 1 to 4 years' rest. Barley generally follows potatoes and beans, and peas or broad beans follow in the third year at higher elevations.

Experimental evidence shows that crop rotations are effective in reducing pest populations, particularly those that are crop-specific (Ramírez & Williams, 2003).



Drawing made by Dolores Panamá, owner of the 'Chakra', in the Morales Chupa community in Cotacachi.

Source: UNORCAC

Some benefits of intercropping and crop rotation (Gortaire, 2017) are:

- Supply of nutritionally adequate food (rate of carbohydrate from the potato and vegetable protein from the broad bean).
- The different root depths allow the recovery of the fertility of the substrate and the mobility of mineral nutrients from lower soil layers and horizons.
- The addition of legumes (broad bean), which, due to their capacity for atmospheric nitrogen fixation, contribute significantly to the fertility process.
- The disruption of the cycles of pests such as the white potato tuber worm (*Premnotrypes vorax* Hustache), and other effects.
- The improvement of the soil structure by aeration and clod breaking (by potato tubers in the soil), addition of lignified and fibrous material (the remains of the cereal harvest).
- Allelopathic effects (the potato performs better after broad bean cultivation).
- The addition of quinoa planted in crosses or 'chocho' planted on the border, besides being highly nutritional quality foods, have antagonistic effects to certain pests and diseases (visual barrier, repellent toxins at root and air level).

3.1.4 Seeds management

The agro-climatic and topographic heterogeneity that favours diverse microclimates in the Andes Sierra has given rise to a complex process of plants and animals domestication and genetic improvement.

Such domestication has not been a simple task, much less fast. It is remarkable that, at present, despite the scientific progress, there are few and less important plant species added to the agricultural domain. All of

the crop species known today are the result of ancestral efforts of the agricultural communities, and modern achievements in genetic breeding are merely a refinement of something that has already been done (Blanco, 2001).

Ancestral Andean agriculture created seeds by reversing trends and biological forces of vegetables in their favour, for example: the wild 'chocho' disseminates its seeds, while the peasant seed cannot discriminate its grains because the pods do not explode; the wild potato conquers new spaces through long traveling stolons and through domestication, it was possible to produce the tubers grouped at the foot of the plant; the grains of the teosintle (wild maize) germinate partially and progressively, maintaining disaster-proof living seeds in the long term and, instead, the planted maize has an opposite performance: uniform and simultaneous germination. Wild quinoa generates toxic and bitter substances that protect it from predation; domesticated quinoa has reduced these contents.

In other words, ancestral agriculture has managed to balance the natural conservation force that aims at the survival of the species, against the need for food and development, this ancestral effort is the key to the food security and sovereignty of the people.

The care, selection and preparation of the seeds, is a process that deserves much attention. Some keys of the domestication and traditional seed breeding process are:

- Identify priorities: taste, flavour and needs.
- A good and diverse genetic basis to test the intra specific crossings (not to homogenize).
- Introduce and adapt foreign species, while protecting native varieties.
- Selection: the best breeding method, was key in obtaining the best varieties of maize, quinoa, chocho, beans, and others.
- Isolation: do not allow free pollination in plants such as maize, with spatial and temporary methods (do not sow at the same time varieties that can be crossed, or do it in distant and protected lands).
- Hybridization: the opposite to the previous point, that is, testing crossings of different materials to enhance vigour, set characters, clean viruses, among others. These two processes are not a communal but individual strategy of farmers who prefer not to mix maize varieties, in order to have access to buyers who prefer unmixed maize varieties.

The seeds, especially maize, are separated in the same farmland; one of the aspects taken into account for their classification in the field, is to observe that the kernel is thick, healthy and the 'tusa' is thin. Once the cob is selected, it is visually divided into three well-differentiated parts; the kernels at the base are usually used for family feeding, the kernels in the centre for seed and those at the apical end or rotten kernels, as animals feed.

In some places they advise to de-kernel the corncob to be used as seeds, so that the corn lasts all year round. To date, these seeds are usually stored in clay pots, either the kernels or the corncobs. The seeds of the other grains: beans, peas, lentils, are selected based on the thickness and appearance of the plant, so some of them are also selected directly in the field. The rotten corns are discarded. When selecting tuber seeds, attention is paid to the number of sprouts, mainly potatoes.

3.1.5 Seeds storage

The way to store food, be it grain or tuber, is related to the use. In general, women, due to their special care and meticulousness, oversee separating the grain for family food, for animals feed and that used as seeds.

The grain for seed until recently was kept in places exclusive for this purpose, whit bitter herbs such as rue and 'marco' to protect against pests such as 'redondilla'. The maize seed was placed in ashes to protect it

from the moth (*Tinea pellionella* L.), a practice rarely used nowadays. However, heaps continue to be used as a technique to store grains for consumption and/or seeds.



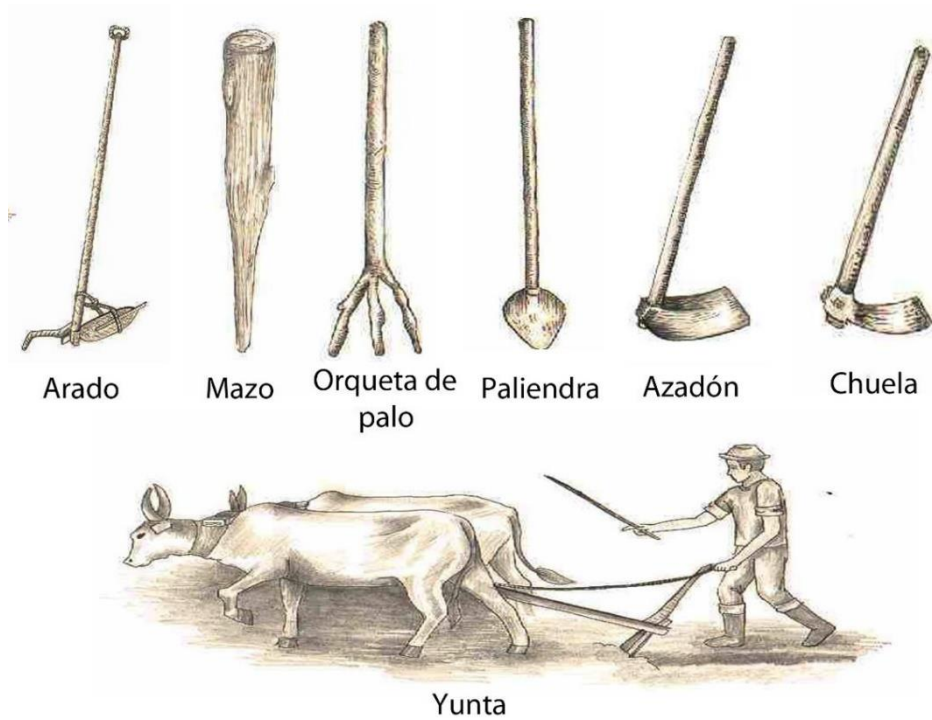
Maize seed stored in heaps. Source: UNORCAC

Some of the forms or spaces to store seeds are:

- The soberado (attic), a construction inside the house generally used to store the maize in the 'tusa', which was destined exclusively for family food. Marco and young eucalyptus branches were laid out for pest control, especially, 'redondilla'.
- The 'polos' were tubes made of fibre-mats to keep the harvest of wheat, barley, peas, lentils and beans, and they used to put young eucalyptus on the top.
- The 'maumas', on the other hand, were large clay pots to keep all kinds of grains, preferably seeds, which used to hold about two quintals.
- The mud 'pondos' (pots), called 'maltas' were also used to store seeds.
- Young eucalyptus branches are laid down on the floor of the poles, malts and 'maumas', then the seeds are put on top of them which are finally covered with ashes.
- The 'guayungas' (heaps) are wooden sticks crossed in the rooms of the house, generally in the kitchen, to hang corns tied with their leaves, which are used as seeds and consumption.
- Grains of wheat and barley were stored in sacks of 'cabuya' (*Agave* spp.), and wheat, barley, beans, and peas were stored in clay pots.
- Holes were made in the ground to store potato seeds. Potatoes for consumption were stored with branches of prairie clover (*Dalea coerulea* (L.f.) Schinz & Thell.).
- The 'troje' (granary) is a hut where the sun and the wind can enter, the firewood stove is in the middle, when the grains are in the 'troje' and firewood stove is used the food is not damaged.

3.1.6 Ploughing tools

- The yoke: which is made up of a pair of oxen or bulls.
- The 'buga': is a thin, sharp stick to prick the oxen to move on.
- The plough: is used to prepare the soil, to loosen and to pull furrows. Years ago, they used wooden heads and brought two heads to the field to replace that one worn out due to the constant pass on the soil – 'migra'.
- The wooden 'paliendra': an arrow-shaped shovel is used to loosen the soil. It is made of a straight shovel like a paddle and is used to make the furrows after the soil is prepared.
- The 'utipala' or 'cutipala': also used today as a digging hoe. This tool is made of iron, it is used to crumble clods, make furrows, loosen the soil.
- The 'cuchicarapala': is a kind of straight shovel.
- Wooden mallets: or wooden logs collected from the forest, mallets-shaped were also used to break up the clods.
- The 'shagshana' or 'achuela' to sharpen the wooden head; it is used as the digging hoe.
- Other tools were the 'acial' and the pick (Villota, 2010).



Soil preparation tools (ploughing). Source: UNORCAC



Cutipala



Paliendra

Sowing tools. Source: UNORCAC

Tools used for harvesting

- The sickle: to harvest barley, which is used until today.
- The 'jalasumba': type of bag made with a cloth, where they put beans, corns, peas, lentils.
- The 'aza': it was a bag of cloth tied with a sash to carry the harvest.
- The 'tipidor' (corn husker): it was a sharp stick used to remove the corn ear from the 'catulo', in the past they only used the fingernail.
- The baskets: which were made of reeds or 'sarsaparilla' (*Smilax aspera*), to carry the tubers.
- The Mates: a kind of bowl, used mainly for tubers harvest.
- Jute sacks: with a capacity of one quintal, made from 'cabuya' (Villota, 2010).



Hoz



Tipidor



Aza



Jalasumba

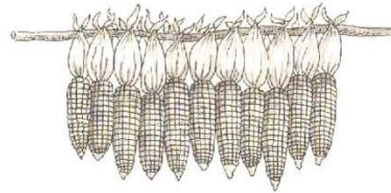


Canastos

Tools used in harvesting. Source: UNORCAC



Troje



Guayunga



Sacos de yute



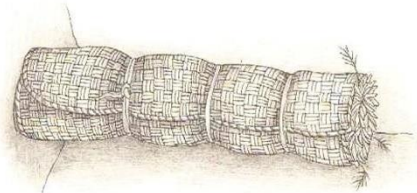
Maumas



Pundos



Soberados



Polos

Tools used in seed storage. Source: UNORCAC

3.2 Natural agricultural resources management

3.2.1 Ecological complementarity

To access to different natural resources and reduce the environmental risks, contemporary indigenous peoples of Cotacachi, like their ancestors before the arrival of Incas and Spaniards, have strong ideological and cultural ties to the environment. To this day, their concept of the world is characterized by a strong duality: the communities located in the higher altitudes represent the masculine, the sun, the head (of a body), the white, the heat, and the day, while the communities located in the lower altitudes represent femininity, the Earth and the moon, the body, the darkness, the cold, and the night. The Cotacacheños perceive these cosmological elements as necessary and complementary. They appear in all facets of life, including those related to religion, agriculture and land use, and have existed since pre-Hispanic times.

At present, ecological complementarity is still in place, but the farming activity has decreased significantly due to the fragmentation of the landscape. Wheat and barley, two introduced crops, prevail in the high

lands. Traditionally, this would be the area where the tubers, such as 'mashua' and 'uqa', were grown. According to interviews conducted during this research, 'mashua', a native Andean root, was an important staple crop until a generation or two ago, but now it is used primarily as a medicinal plant and is rarely included in the daily diet. On the other hand, corn is still a major crop in the diet of Cotacachi people. Even farmers in the highlands, who do not have access to the crops in the lower areas, grow maize for ritual and nutritional purposes, albeit in small plots and even though it takes twice as long in the lower areas to mature. The cultural importance of maize crops cannot be underestimated (Rhoades, 2006).

The communities maintain the strategy of using several altitudinal floors. The higher zone, that is, the wild land, is owned and used by the community as a protection zone for water sources and for grazing. The houses of the community members are located in the middle zone and have small farming plots for food production. The strategy to access to products from various agro-climatic floors is through bartering, solidarity, and marketing in the peasant marketing fair where a part of the production is sold to the urban population and another part is exchanged among the farmers.

3.2.2 Soil fertility and ecological management. Living soil-'Allpa Mama'⁴

For the ancestral Andean cultures, the centre of the 'Chakra' is the living soil, the mother earth. It is paradoxical that only recently, with the development of ecological sciences, systems sciences and biophysics, the agricultural soil has been recognized as a living organism, an organic-mineral matrix that harbours the development of life. Considering the soil as a living being, and even more, as a mother from whose fertility life springs, is decisive when it comes to relating to it, to building the techniques and practices that will make it vital and sustainable.



Illustration of 'Mother Earth' – Cotacachi. Source: UNORCAC

⁴ Kichwa: English translation "Mother Earth"

In line with the conceptual and cultural matrix of the Kichwas communities, considering the 'Chakra' as the space for raising life, brings to light a very important factor as soil nutrition, protection and enrichment to guarantee its current and future fertility. To this end, a series of practices have been designed and implemented, namely⁵:

- Talanqueras: pens where animals, generally hoggets and llamas, stay at night. These pens are built with branches or wooden strips, which allow mobility for periods of 3 to 6 months, and are the main form of soil fertilization, since resting is not a common practice (due to demographic pressure and economic and food needs).



Talanquera in the 'Chakra'. Source: MCYP

- Coverage: keeping the soil covered, either with crops or decaying organic matter, or with 'cultivated fallow' or litter; it is a very important practice that preserves the soil moisture and avoids direct solar radiation. This energizes the meso and microorganisms of the upper soil horizon, which, in turn, are decisive for nutrient, humification and mineralization cycles of organic matter. In short, bare soil is dead soil.
- Rotations and intercropping: the various temporary and spatial combinations of crops have remarkable effects on soil fertility because of the differentiated use and mobilization of nutrients at various depths and by the introduction of legumes and their nitrifying effect or by various 'allelopathies'.

⁵ The following is taken from the first GIAHS site identification report in Ecuador, developed by the MCP and FAO.



Diversified 'Chakra'. Source: MCYP

- Terraces: given the topographic conditions, it is common to have terraces for crops, whether they are of slow formation (by sowing herbs or bushes in counter-slope lines) or bench (created manually). Their main function is to counteract river erosion on sloping land. The notorious effects of this practice (besides the obvious: to avoid accelerated mobility of water on slopes) are:
 - ✓ Moisture retention and infiltration, plus adequate drainage when there is water excess.
 - ✓ Avoid the accelerated movement of cold air masses and generate less cold air mass turbulences from the ground surface, which has positive effects against 'frosts'.
 - ✓ Design larger cultivation areas.
- Agroforestry designs: the use of living barriers, which are generally medium-sized trees or shrubs, prevents the incidence of winds and thus, reduces soil erosion. It also has effects on the generation of an internal microclimate that facilitates the vegetable crops and other products sensitive to wind and frost.



Vegetative cover in the 'Chakra'. Source: MCYP

Unlike the western custom of planting trees in stands, the Andean farmer does it in the 'Chakra', which is the space where the trees are domesticated. This is the place for crops that serve as food for their families, animals, healing, protection, and rituals. That is why unlike trees in stands, those in the 'Chakra' are not destroyed so easily-*The tree was something sacred, now it is regarded as an economic asset. The tree was God, like a more brother living in the plot* (personal conversation with Felix Chuma).

- The yoke plough: farmers know that the use of the yoke allows better soil removal and greater aeration, without the excessive tamping caused by heavy machinery, and avoiding the aggressive 'turning over' of the disc plough that overlaps the lower layers of soil and exposes them to solar radiation and drying out.



Yoke plough. Source: UNORCAC

- Fertilization with animal manure, mainly guinea pig, sheep, bovine, and pigs. The traditional practice involves spreading the material to the ground directly before planting, and is used in two ways: dry, that is, the use of previously decay and stabilized material (between three months and one year), and fresh or wet faeces.

In the first case, the objective is to make nutrients more available to the soil and crops⁶. In the second case, the aim is to *heat the soil*, which is why this is called hot fertilizer that in some cases may be positive in areas of high altitude, cold seasons, and frosts, due to the heat from decay. Also, 'firewood stove' ashes are used as fertilizer, this provides certain minerals to the soil, but functionally inhibits the presence of certain microorganisms and insects that are sensitive to the change in pH caused by the ashes.

It is worth mentioning that the reason for using these fertilizers is different from that of conventional agronomy, since the aim is to nourish the soil and not the crop itself; this has technical basis since the organic matter provided will be processed by the meso and microorganisms of the soil, promoting the biodynamics responsible for the moistening and mineralization of this matter, which is essential to guarantee the fertility and consequent crops productivity.

- Functional rest and green manure: this is the traditional practice to restore fertility through the

⁶ However, we know that is available between three and six months

return of natural vegetation, or in other cases, with the sowing of functional mixtures such as vetch-oats, broad beans, grasses and alike. Although, it is a less common practice (for the reasons already described), if applied, it plays an important role due to the accumulation of organic material that is incorporated into the soil once the green manure has achieved good size and land cover (generally at the beginning of blooming), in high zones and rainy seasons the contribution of rainwater nitrogen, increased by electric discharges, is also part of the resting period (it can reach 5 kg/ha/year).

3.2.3 Comprehensive management of water harvesting and irrigation systems

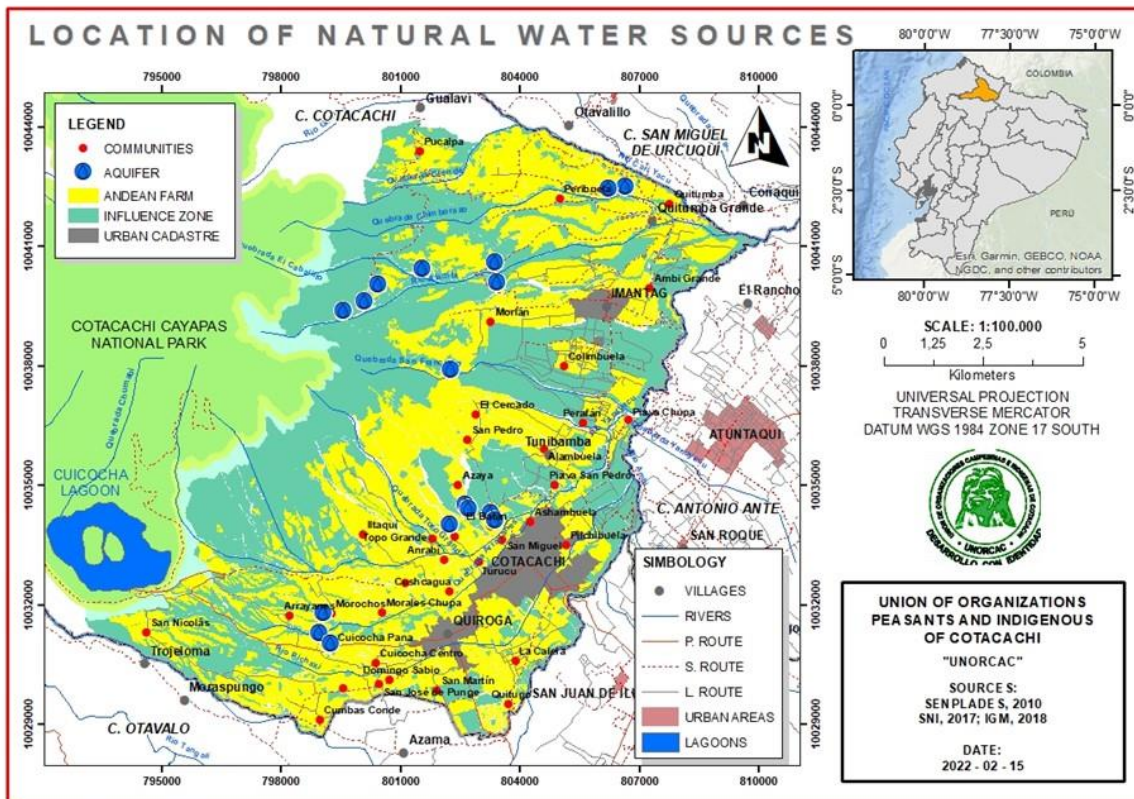
As for many of the world's farming areas, in the equatorial Andean zone the decisive factor in food production is water. However, in most indigenous and peasant communities, the absence of irrigation is the most common factor; in other words, dependence on rainfall is the determining factor in almost all cases (Benzing, 2001).

In the 'Andean Chakra', and if there are no irrigation systems, the capacity of the soil to retain water in a way that is available to the plants is essential, and this depends on the texture and structure of the soil, but more so on the content of organic matter. High organic matter content means more soil water retention and quantity, and this is an indispensable condition to maintain and stimulate the biodynamics and productivity of the 'Chakra'.

Despite the changing climate and modernization have destructured much of the Andean peasant knowledge regarding climate forecast, some indicators can still be recognized:

- The observation of physical phenomena such as the rainbow (the height at which it appears), the shapes of the clouds, the heat of the sun.
- Observation of meteorological elements such as wind, hail, rain, frost, fog, lightning, which announce the proximity, end, or intensity of winter.
- Observation of some plants, amphibians, insects, birds which in turn respond to the percentage of relative humidity.

In the 'Andean Chakra' every natural source of water is used for agricultural purposes: thawing water, rivers, lagoons, springs, wild wetlands, artificial lagoons formed by rainwater, among others. In terms of infrastructure, water catchment and distribution were the most impressive components of ancestral Andean agriculture, and although, many of them have been lost, it is clear that the water systems of the Andean communities are the result of formidable efforts over long kilometres of resourceful ingenious outlines (Map 4).



Map 4. Existing springs in the Cotacachi GIAHS. Source: UNORCAC

Regarding access to irrigation water in the proposed zone for GIAHS, dryland farming chakras (without access to irrigation) are predominant in 63% of the families, corresponding to 56.3% of the surface area; while only 37% of the families have irrigation, corresponding to 43.7% of the surface area (UNORCAC) (Figure 1). The highland communities located above 2600 masl do not have access to irrigation, especially those located in the southern zone of the GIAHS polygon, which are the communities of: Ugshapungo, San Nicolas, Cumbas Conde, San Antonio, Arrayanes, Morocho, Itaqui, Topo Grande, San Pedro, Cercado, Alambuela (upper part), Morlan (upper part), Chilcapamba (upper part).

The chakras that do not have access to irrigation have a greater intraspecific diversity of crops such as: corn and beans, mainly. In these communities, corn and other associated crops are planted according to the rainfall cycle. It begins to rain in September/October and rains are present until May. Likewise, there is a rest period (fallow) on the land where corn is grown. Rest lasts 3 to 4 months from June to August and part of September. In areas without irrigation, the so-called summer sowing is carried out, where short-cycle species (four/five months) are cultivated such as: peas, barley, bush beans, quinoa, amaranth, potatoes. The sowing of the cycle crops is carried out in March and they are harvested in July. The non-irrigated area has an average annual rainfall of 900 - 1000 mm per year, this makes it possible to maintain crops in these areas. In years with little rain, production decreases.

On the other hand, areas with access to irrigation have a greater interspecific diversity of crops. The communities that have access to irrigation are located in the lower zone, between 2,350 and 2,500 masl, in the northern zone of the GIAHS polygon. In this zone, corn and associated crops are sown, and vegetables and fruit trees are incorporated to these crops.



'Andean Chakra' landscape.

Source: Atelier PARETO – UNORCAC – Comité de Mujeres UNORCAC y FAO – Ecuador (enero 2023).

The production system of the Andean Chakra makes up one whole system, which is conceived as a space for the nurturing and reproduction of life, where women are the protagonists that manage poly-crop models with agricultural practices that encourage the regeneration of ecosystem services such as maintaining the fertility of the soils. The Andean Chakra production system adapts, with its techniques and customs, to the conditions of the availability of resources (for example, irrigation). The main agricultural practices of the Andean Chakra are: the association of crops, crop rotation, mixing of varieties, resting periods, the incorporation into the soil of plant remains from the crops, fertilization practices and fertilizer with bio-inputs from animal droppings, the use of seeds from the previous year's harvest, the exchange of seeds and knowledge for the enrichment of the agrobiodiversity of the chakra system, the use of agrobiodiversity for food heritage, which encourages conservation through the use and consumption of agrobiodiversity, and strengthens food sovereignty.

3.3 Contribution of local and traditional knowledge to sustainability and resilience

Peasant societies, for many defined as traditional, harbour a repertoire of ecological knowledge that is generally local, collective and holistic (Toledo & Barrera-Bassols, 2009). Indigenous peoples such as the Andean Kichwas have generated cognitive systems from their relationship with the environment. This knowledge, transferred from generation to the next, can be defined as holistic because it is intrinsically linked to practical needs, that is, it is the accumulation of an interesting repertoire of signs, symbols, concepts and perceptions about the use and management of local ecosystems for family, community, and cultural life.

The resulting phenomenon is a historical process of knowledge accumulation and transfer, not exempt from experimentation (Johnson, 1972), which takes the form of a spiral on various space-time scales:

From each farmer, since during each productive cycle his or her experience is gradually increased based on what was learned in the immediately previous cycle, to that of culture (ethnic group), since

knowledge is perfected (and adapted) generation after generation, to the local reality of each present time. In this perspective, where knowledge is accumulated collectively, the individuals of the different generations acquire a substantive importance (Toledo & Barrera-Bassols, 2009).

The Andean culture can be defined from an agro centric cosmovision and to understand it, it is important to recognize how the Andean world is not made up of objects but of people⁷ who talk, who raise and are raised. In this sense, life, knowledge, and wisdom emerge from a conversational relationship between people and the footprint it leaves on others. The Andean conversation is seminal, engenders dialogue for living and not for seeking the truth, it is relational.

The space in which the raising⁸ takes place is the 'Chakra'. A farmer is concerned not only for the 'Chakra', that is for the human 'Chakra', but for the 'Chakra' that is raised by the members of nature and deities. One chakra will be healthy if all the others in the landscape are vigorous. In this way, the health of the human community is related to the health of their 'Chakras' like that of nature as a whole. The ritual ceremonies are conversational for the well-being of all these communities, because the harmony in one of them is connected to the harmony of the whole.

This cosmovision of the world and relationships has developed a rather complex knowledge matrix to mainstream different understandings of the cosmos and the environment. In keeping with the same, we can identify a broad knowledge catalogue about nature's structure or elements, the relations between them, the processes or dynamics and their functional potential (Toledo & Barrera-Bassols, 2009).

These principles and concepts of life creation and reproduction shape the Andean cosmovision as agro centric, so the symbolic value of the 'Chakra' goes beyond the single vision of agricultural technology and integrates it as a core element in the way the world is understood and related.

As regards the 'Andean Chakra' and the relationships developed around them, there is detailed knowledge of taxonomic character about constellations, plants, animals, fungi, rocks, snow, water, soil, landscapes and vegetation; or about geo-physical, biological and ecological processes, such as earth movements, climatic or hydrological cycles, life cycles; blooming, fruit growth periods, germination, oestrus or nesting periods; ecosystem recovery (ecological succession) or landscape management; dynamic (of patterns and processes), relational (linked to relationships between elements or natural events) and utilitarian dimensions of natural resources and landscapes.

It is extremely complex to review every knowledge and principle of understanding and development of it. However, it is worth highlighting the relevance of the 'Chakra' that has allowed the consolidation of a management model for diversified productive areas, or biodiverse 'Chakras', as laboratories for active and local selection and domestication, which would then be exchanged with the diversity of other 'Chakras' in other territories and more easily than in other areas.

The adaptation and development of knowledge within the 'Andean Chakra' system has had to respond to the needs of:

- The maximum use (production and recovery) of the ecological floors, climates, and microclimates.
- The complementarity of the same.

⁷ Each element of the ecosystem is recognized as a person: the soil, the crops, the forest, the river, the minerals, the family. Each and every one has its own subjectivity.

⁸In the Andean environment "Chakra" refers to raising in the "Chakra" rather than producing in the "Chakra", what relates to the concept of a creative and not just a productive relationship.

- The development of active and varied product exchange networks.
- The existence of strong mechanisms of community cohesion.

The above adaptation strategies are developed within the 'Chakras'. For peasants, the 'Chakras' serve as sites of introduction and experimentation with new species and varieties obtained through seed exchange and knowledge sharing and innovation. Without ignoring the dialogue and exchange with new technologies and production systems.



Community farming in the 'Chakra'. Source: MCYP

Ancestral, highly effective, complementary, and sustainable farming practices can be recognized in the territory, with their own transfer mechanisms. The knowledge and ancestral farming techniques that are still remembered, and practiced, are highly friendly to the environment and the 'Pacha Mama'; knowledge of the lunar cycle, management of ecological floors, cultivation of species diversity, appropriate use of soils, community, and family farming, are some of the elements considered when producing food (Villota, 2010).

3.4 Threats

- Abandonment of the chakra, change of economic activity and migration can cause intergenerational loss of agricultural knowledge.
- Fragmentation of cultural identity due to technology, religion, foreign education, can affect customs, values, and community knowledge.
- The management of the chakra represent a viable economic means of sustenance, however, it is a means that satisfies food needs, so the incorporation of non-agricultural activities such as community tourism, handicrafts, commerce, construction services, domestic services, among others, it is a source of income, but it can also transform traditional livelihoods and associated knowledge, if they are not carried out by taking care of ancestral practices and customs.
- Change of traditional food for processed foods and the homogenization of the diet, can lead to the loss of associated knowledge.

- Lack of use of traditional medicine
- Attempt to appropriate traditional knowledge by various national and international actors may cause greater distrust to provide information on the use and/or management of the 'Andean Chakra'.

3.5 Challenges

- Use ABD and peasant knowledge to eradicate hunger and promote sustainable production systems (SDG 1, 2 and 13).
- Safeguarding and revaluing knowledge on the management and use of ancestral agroecosystems, as well as ABD and its wild relatives, will allow resilience to climate change processes, in addition to having crops and food available all year round.
- Strengthen the food culture based on nutraceuticals.
- Strengthen spaces for the exchange of knowledge and ABD such as the Muyu Raymi seed fair, which in turn reaffirms the local food heritage.
- Strengthening of environmental education in rural academic units as transmission mechanisms for the revaluation and exchange of knowledge.
- Recognize the role of women in the conservation of biodiversity, food production, traditional medicine, as well as in the transmission of knowledge.
- Promote the active participation and empowerment of women in community organization, to claim local knowledge.
- Implement school projects to revalue traditional agricultural techniques that reflect the forms of family farming in each community or territory.
- Incorporate bilingual and intercultural education in the rural sector, as well as use the 'Chakra' as a space for informal education, with interaction of different age groups for the transmission of intergenerational knowledge and family learning.
- Carry out inventories of ABD and associated traditional knowledge in each community to establish a permanent record that is a mechanism for community empowerment.
- Strengthen the collective memory, mainly of the ancestral and traditional knowledge of the elderly ('tayas and mamas') in each community to improve the living conditions of the inhabitants.
- Promote community practices of mutual aid, such as the 'mingas', to maintain a series of customs and fundamental social rules in family consolidation.

4. Cultures, value systems and social organizations

4.1 Cultural identity and agriculture

Considering that the 'Chakra' system in the Cotacachi territory is considered an agro productive

activity⁹, it should be understood beyond this economic-productive approach of the territory, since it goes beyond the social use and cultural meaning of the relationship with the land¹⁰ or 'Pacha Mama'. This is a current and constant characteristic throughout the Andean region, where the relationship with the land is based on the notion of origin and permanence in it (Rebai, 2008), or even on correlation and correspondence. Therefore, it is important to understand the territory from its social construction in relation to the land, both in symbolic and tangible aspects.

The first data about the inhabitants of this area refers to pre-Inca communities that settled around the Cotacachi volcano. Later, towards the end of the 18th century, the traditional system of administration and exploitation of the equatorial zone - the estate - located in the Northern Sierra generating practical and symbolic mechanisms of organization and domination known as 'huasipungos', which remnants can still be seen today, and which have marked the social, cultural and economic relations of the entire Ecuadorian Sierra (Ferraro, 2004).

However, and by way of distinction from other territories, the populations of the northern Andes or northern the Ecuador are different from those of the central and southern Andes, both because of their ecological, geographical, and linguistic conditions, and because of their socioeconomic organization. These distinctions can be seen even in the bartering patterns that existed in pre-Hispanic times. In the north, the ecological levels are closer than in the rest of the Andes; this means that the pre-Inca societies of that area could function, presumably, without establishing distant colonies, as in another territory (Ferraro, 2004).

The pre-Hispanic socio-economic systems are still in place among the Andean peoples of the Ecuador, despite the transformations they have experienced throughout history. The Ecuadorian Sierra hosted the process of Spanish colonization and, therefore, its populations have experienced the transformations of their ways of life more intensely and for a longer period. However, it is also true that they are populations with a strong determination to preserve or recreate their identities, practices and customs.

4.1.1. Agro-centric culture

Understanding that the Andean Cosmo vision is relational among people in a living world and that the place where relationships develop and are brought to fruition is the 'Chakra', one can understand how agriculture and grazing can be considered ritual activities in the Andes. Through agriculture, the human community directly assumed the commitment to contribute annually to the renewal of life, of nature and to contribute to the rebirth of life each year (Rengifo, 1995).

One of the essential values of this approach to agriculture is that it is not in opposition to the natural environment, it is embedded into it, because it recognizes part of it or the 'Pacha Mama'. The presence of the 'Chakra' is not to dominate nature, but to accompany it, to dialogue and reciprocate with it. In a living world like the Andean one, in a world always giving itself, in a world in continuous recreation, agriculture means to increase the variability of nature and to increase, even more, the multiple forms of life that it shelters. The 'Chakra' is a recreation of nature with the participation of the human community (Rengifo, 1995).

But agriculture is also relational not only within a 'Chakra', but it is also the place where the family dialogues with other families and are united as part of a community. This relationship facilitates and

⁹Agro-productive activity refers to a variety of uses of biodiversity: agriculture, harvesting, beekeeping, forestry, fungiculture, gastronomy and food related services.

¹⁰The term "land" is not just the soil, but the entire ecosystem including soil, water, seeds, flora and fauna.

encourages exchanges and the feeling of interdependence. The 'Chakra' is then a reinforcement of the bonds of the human community, being the place where the union between the families of the human community is strengthened, it is where the union of the human community with nature and the union of the human community with the 'deities' is strengthened. Hence, the Andean religiousness is deemed agro-centric.

To learn to raise and to be raised, it is necessary to live, to commit oneself to the world in this giving, the commitment of human society is expressed in agriculture, in making 'Chakra'. For the Andean society, to make 'Chakra' is the core ritual that expresses the human commitment in the recreation of life. Knowledge revolves around agriculture and its most genuine expression is the 'Andean Chakra' which is the space of reciprocity of all members of the natural community.



Ritual at a seeds exchange market. Source: UNORCAC

Cultivating diversity and variability of seeds, in crop mixtures in various 'Chakras', however small these may be and with their own knowledge of breeding (signs, secrets, cultivation practices), is not enough; it is necessary to ask the 'deities', both Andean and Catholic, through the so-called rituals to accompany and protect, to obtain crops and share them with everyone.

The 'Chakras' deeply define the character of knowledge in the Andean human culture through:

- The technical skills related to agricultural tasks have a great repertoire.
- The stars become agricultural indicators.
- The core of social organizations is agriculture.

- The arts have a profound agricultural content.
- The language is rich in agricultural expressions.

From de agricultural perspective, 'deities' have power and influence, because agriculture is life (Rengifo, 1995).



Ritual for sowing and water. Source: Women's Central Committee, UNORCAC

4.1.2. Cultural expressions linked to the ABD

Addressing the impact of the 'Chakras' on the local food system of Cotacachi, forces us to recognize the specificities of feeding them in the territory, because the history of peoples is shaped through food, but also reveals the fact that cultures are not the sum of isolated elements but of complex and coherent systems, in which everything that enters, and leaves passes through the intangible sieve of the symbolic. This sieve is the condition that each culture is unique and unrepeatably (Moya, 2013).

One of the important contributions of the Kichwa Cotacachi people has been the development of a knowledge system that combines ancestral knowledge and the logic of Western knowledge. Local knowledge and wisdom regarding human relations and the intimate landscape remains; intergenerational grandparent-child dialogues are maintained, not only as a way of entertaining children but also as a way of transferring the ideology of identity. The relationship between human beings and nature, the transformation and transcendence and the connection of everything with everything, are central elements in the indigenous cosmovision. For men, women, youth, boys and girls from all communities and from all times have listened and will continue to listen with clear naivety to the stories, traditions, beliefs, myths, tales and legends related to agriculture and nature that play and are intertwined with the territory and the environment, some that are still alive in the collective memory of their people, while others lie forgotten but alive in the minds of the elders of the place.

And we still have the heritage that we are trying to record and revitalize today, which is the story of the old, the oral traditions and myths that have been repeated from one generation to the next in a cultural legacy that in no way should be avoided or wasted.

4.1.2.1 Records of the social memory related to beliefs, stories, legends and myths of Andean agriculture and its environment

In all cultures the elements of nature have always aroused interest and fear. It has become quite difficult for people to explain a series of facts related to these elements; hence, human inventiveness has given free rein to the creative imagination through stories, myths, tales, legends, beliefs and symbolic elements, trying to explain those questions that are not easy to answer.

Cotacachi canton is not exempt from this phenomenon, and thanks to the oral tradition, a series of explanations regarding the elements of nature and other subjects have been transferred from one generation to the next. However, over the years and with the advent of other explanations, these beliefs run the serious risk of falling into disuse, thus, further compromising the oral tradition of this territory.

And so, beliefs, stories, legends and myths, an amazing mythology of incredible facts in which men and gods, stars and animals, elements and more, are mixed with the evolution of the ancient inhabitants and have linked to this beautiful repertoire, which still delights and amazes us and makes us wonder if these so many facts really happened, dismal and supernatural facts and the reason why they no longer occur (Table 18).

Table 18. Stories, myths and agro-food beliefs of the High Andean zone of Cotacachi

Expression	List of stories and legends: ¹¹
Stories	<ul style="list-style-type: none"> • Padre Dios y Madre Agua (Father God and Mother Water) • La formación de las montañas (The creation of the mountains) • El 'Taita Imbabura' y la 'Mama Cotacachi' (The 'Taita Imbabura' and the 'Mama Cotacachi') • Los enamoramientos del Cerro Cotacachi (The infatuations of the Cotacachi Mountain) • La erupción de la 'Mama Cotacachi' (The 'Mama Cotacachi' eruption) • La historia de los 'chuzalunku' y la fuerza del 'Taita Imbabura' (The history of the 'chuzalunku' and the strength of the 'Taita Imbabura') • El 'Taita Pichincha', el arcoíris, el rapto de la mujer y el 'tundum' de la Calera (The 'Taita Pichincha', the rainbow, the abduction of the woman and the 'tundum' of La Calera) • La historia de 'Huarmi rasu' y 'Pogyo yaku' de Tunibamba (The story of 'Huarmi rasu' and 'Pogyo yaku' of Tunibamba) • La 'Huarmi rasu' y la puerta de entrada al cerro (The 'Huarmi rasu' and the entrance door to the Hill) • La 'Mama Cotacachi', el origen de la laguna y las aguas que van a Intag (The 'Mama Cotacachi', the origin of the lagoon and the Waters going to Intag) • Del agua de la laguna que sabe revelarse (The water of the lagoon that knows how to reveal)

¹¹ The details of the stories and other expressions are contained in the document “inventory of cultural expressions of Cotacachi canton” (Flores & Ruiz, 2019).

	<ul style="list-style-type: none"> • El granero dentro de los cerros (The barn inside the Hill) • Las plantas se movían (The plants which moved) • Cuento del maíz (Story of the maize) • Cuento del trigo (Story of wheat) • Cuento de la lancha (Story of the boat) • Leyenda de madre tierra y taita fruto (Legend of Mother Earth and Taita Fruit) <p>NT: free translation of the Stories' names.</p>
Myths	<ul style="list-style-type: none"> • Mythological origin of maize • Mythological origin of bean • Mythological origin of jicama • Mythological origin of mashua • Mythological origin of ulluco • Mythological origin of arracacha • Mythological origin of potato • Mythological origin of sweet potato – kamuti • Mythological origin of chochos • Mythological origin of quinoa
Beliefs	<ul style="list-style-type: none"> • Beliefs related to nature • Beliefs related to agricultural production <ul style="list-style-type: none"> ○ Signs of soil preparation ○ Sowing season ○ Weeding ○ Plough ○ Signs of good yield ○ Warning signs of poor yield ○ Crop-based beliefs • Beliefs related to animals handling

Source: Inventory of myths, legends, and traditions of Cotacachi, 2017

4.1.2.2 Social uses, rituals and feasts

- Feasts: The feasts of interest to this study are based on the harmonious relationship between human beings and nature; among them we have four feasts related to the different stages of maize growth and production, the base crop for food security and sovereignty of indigenous families (Chancusig. & Guilcamaigua, 2008), which are detailed in Fig. 10.

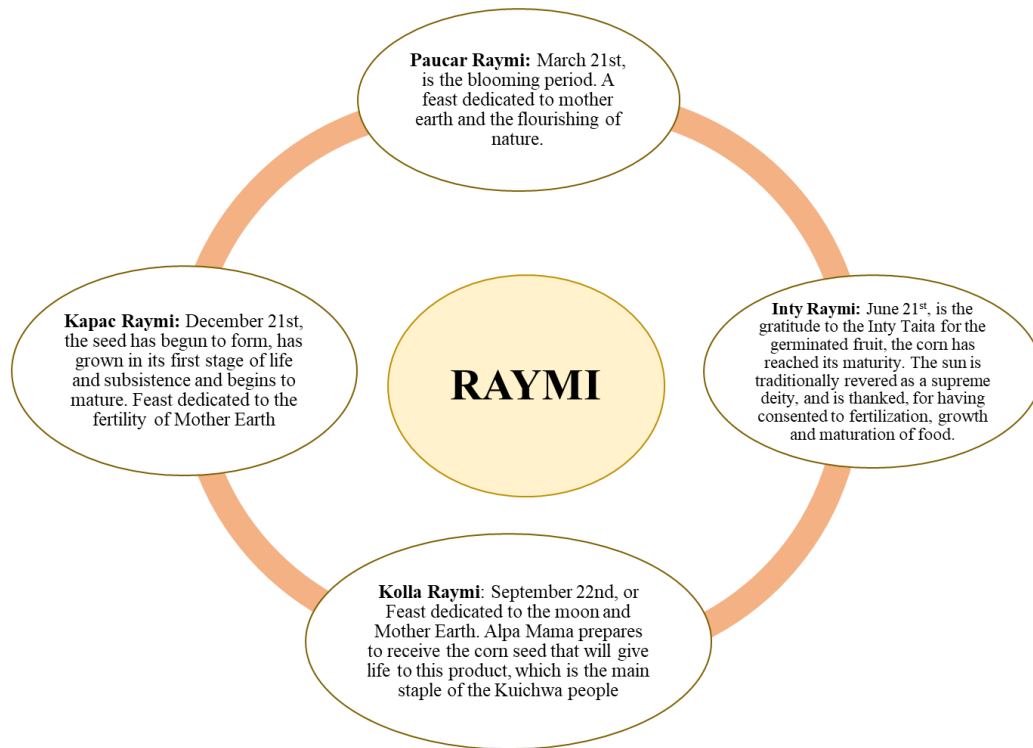


Figure 10. Calendar of agricultural festivals in the High Andean zone of Cotacachi



Agro-Culinary Calendar of Cotacachi. Source: UNORCAC

4.1.3 Traditional community practices¹²

Traditional community practices that are still in effect in the communities of the High Andean zone of Cotacachi:

- **Minga:** is the main institution of indigenous reciprocity, which is one of the fundamental bases of Andean social organization. The 'minga' consists of the contribution of joint work and solidarity of all members of a social group. The 'minga' is a ritual and ceremonial act of community and family cohesion, based on solidarity and reciprocity. This practice evinces the distribution of roles, and not hierarchies, in community and family activities.



Indigenous people from El Morlan commune working in the 'minga' to install the water system. Source: UNORCAC

- **Barter:** is an expression of Andean complementarity and reciprocity. The agriculture of the indigenous and peasant communities of the Andean zone of Cotacachi is mainly focused on self-consumption. Sometimes, the family participates and benefits from barter or exchange of products in surplus, between zones of different altitudes (wild wetlands and subtropical zones) and, therefore, diverse agricultural and livestock products, as well as implements of great use for daily life.

¹² Expansion and description of the practices in the "Inventory of Cultural Expressions of Cotacachi canton", 2017



Farmers from communities in the higher and lower zones exchanging their products. Source: UNORCAC

- The 'chukchina' or 'chukchir' is practiced when the harvest is finished, and some residues are left. People have the right to take all what they need until nothing is left, so nothing is wasted, because a ripe product requires a lot of work and sacrifice and it is not fair that this could be lost (pers. comm. Luz Maria de la Torre and Carlos Sandoval). This practice is still maintained in the Cotacachi communities and during maize and potato harvest, the communal people, either in groups of acquaintances or relatives, go to the large estates of the area, or move to other nearby sectors. When they go to 'chukchir' they use to take something in exchange, like food (guinea pig, potatoes, 'motecasado', etc.), which is given to the owner, or they also help with the harvest, after which they stay to 'chukchir'.
- The Pampa Mesa: this is one of the ancestral traditions called the common table or everyone's table. However, it is not limited to the fact of sitting in the same place and eating equally, but it has to do with sharing what each one has, since everyone contributes with a little bit of food for the whole group. All of this is placed on large tablecloths on the ground so that it is within everyone's reach.



Community 'Pampa mesa'. Source: UNORCAC

- Waste management: Although it is not a traditional community practice, the management of organic and inorganic waste in urban and rural communities is for the rights of the population to live in a healthy and ecologically balanced environment, which guarantees sustainability and good living, Sumak Kawsay (Constitution of the Republic of Ecuador, 2008).

Regarding the management of solid waste in rural communities involved in the Andean chakra, families have the custom of separating garbage into organic and inorganic waste. Organic materials are incorporated into the soil as fertilizers, either directly or through composting processes. Inorganic materials are collected in containers made by each community; once a week the municipal garbage collection car passes by and takes the garbage to the city's sanitary landfill. Most communities have in their internal regulations, provisions that prohibit the dumping of garbage on roads, riverbanks or near water sources, establishing sanctions for those who violate the norm.

4.1.4 Knowledge and uses related to the universe and nature, traditional production techniques and knowledge - Gastronomy¹³

Food is an essential aspect of the ethnic identity and agricultural lifestyle of indigenous and peasant people. Memories, knowledge, and experience are stored in the crops and in daily meals whose

¹³ More information and description of the practices in the 'Inventory of Cultural Expressions of Cotacachi canton', 2017

flavours, aromas and textures are part of the landscape and local history shared by the inhabitants and communities of the territory. The gastronomic culture carefully guarded especially by women of the Andean zone of Cotacachi is very broad, especially in terms of preparations due to the complexity of the preparation processes, the combination of foods, the use of diverse cooking methods, and the variety of foods; culinary knowledge and skills that are still alive and are transferred from mother to daughter in their daily work.

This richness is reflected in around 300 preparations including soups, 'coladas', 'locros', main dishes, drinks, sauces and sides dishes (78 correspond to corn-based preparations) that have been identified throughout the territory where indigenous and peasant communities are settled.



Recipe book of Cotacachi's ancestral gastronomy. Source: UNORCAC

The knowledge related to Andean cuisine is treasured by indigenous and peasant women, who have internalized and transferred culture rich in languages and meanings. The transfer of knowledge is done orally and by experience, in general, from mothers who teach their daughters in a process of learning by doing.

4.1.4.1 Festive gastronomy

All this variety of preparations are also related to family and community cultural events, in connection with a calendar of social activities, which obviously have to do with the availability of food according to the season. In the gastronomic culture of Cotacachi there are at least 20 events or feasts with a specific menu for each celebration. Again, maize has a special and relevant place amidst all this gastronomic offer.

All the rituals and festive events are occasions of reciprocal exchange which can be of restricted or generalized. The restrictive exchange, for example, are those that occur at the bride's request for marriage and at the wedding, which are occasions in which the parents of the groom give a 'mediano' to the parents of the bride and the latter distribute it among the people who are to be invited to the wedding. The generalized exchange, for example, are funerals, where everyone brings their contribution, everything is mixed and distributed among the people present.



Maize preparation. Source: MCYP



Preparation of 'Chicha' made of maize for ceremonies and feasts. Source: MCYP

It should be made clear that none of the forms of exchange is chosen arbitrarily but depends on local etiquette. There are slight variations from community to community. Many of these variations are due to evolving customs.

In addition to the 'mediano', there are other types of food gifts, such as the 'agrado', which is a gift that the parents of the groom give to the parents of the bride, when they are going to speak for the first time and do not know if they will be accepted or not. Another form is the 'boda', which is food given during

the 'mingas' or when the house has just been roofed and a family member gives the owner of the house beef, chicken, and pork as 'boda'.

Once the gastronomic richness of the Kichwa Cotacachi people settled in the Andean zone of the canton was identified, an evaluation was made of the state of conservation of the knowledge linked to the diversity of preparations that still remains in the daily lives of the families living in the area. It must be recognized that changes in food diets have led to neglect daily activities related to food, through which close ties of social cohesion were developed over the years, sharing knowledge and transferring cultural patterns, leading to the devaluation of the self; hence, the accelerated disuse of traditional preparations, eating habits, the loss and forgetting of basic ingredients and rituals surrounding food.

4.1.5 Intercultural health

Due to the development of an agro-centric culture, health is related to the management of the 'Chakra'. The idea that a sick man cannot take care of the 'Chakra', and consequently cannot take care of his family is very common, as well as the idea that illnesses are the result of what one eats and, consequently, health is related to the good cultivation of the 'Chakra' and the consumption of traditional foods, goes in line with the saying – *The body is treated like the 'Chakra', one is a reflection of the other.*

The ancestral indigenous peoples have incorporated into their daily lives the knowledge about health that they have inherited from previous generations. Although, the processes of colonisation have eroded and weakened these knowledge, certain principles that underpin indigenous intercultural medicine can be currently seen in their practice.¹⁴

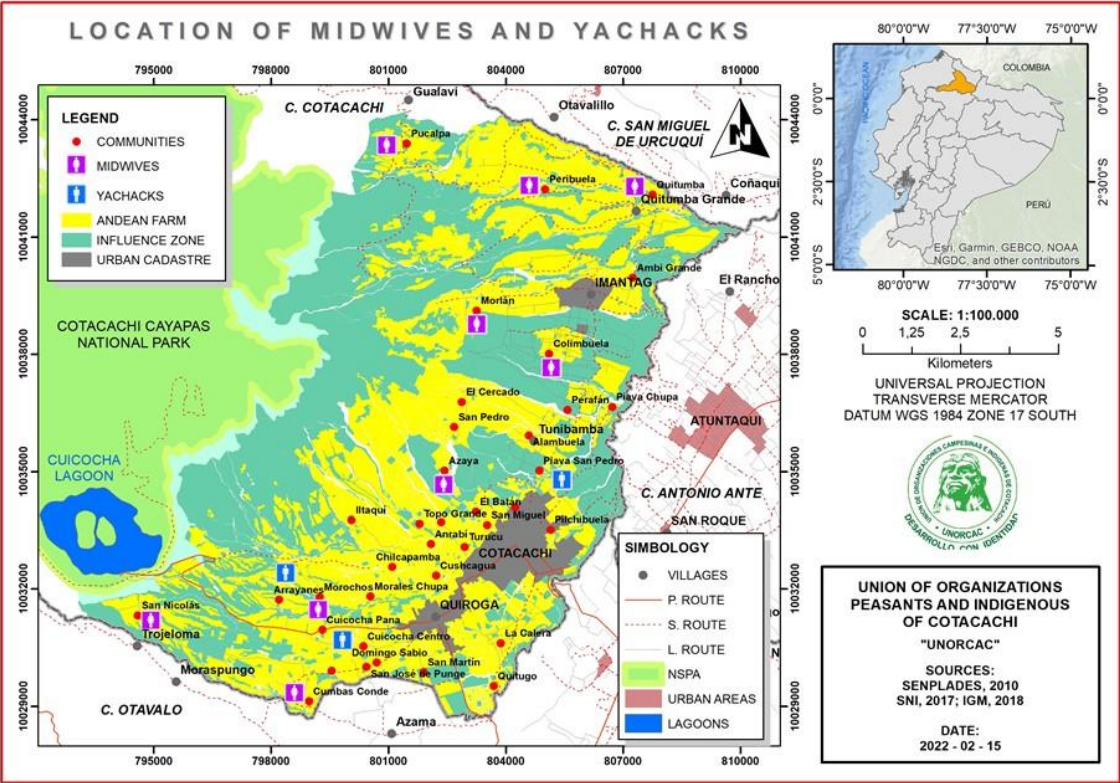
- Respect for nature – where the life is born, and which sustains life.
- Respect for the community - sense of belonging.
- The bipolarity of warm and cold - a concept applied to both the diagnosis and treatment of diseases.
- The life cycle of seeds - a concept that in Andean medicine prevents and predicts diseases.
- The healing and sacred ritual - expressed in different cultural manifestations.

The knowledge and practices stemming from these principles are developed by a group of ancestral health providers among 'doulas', 'taitas', 'yachaks' (Map 5), 'fregadores', 'herb healers', 'prayers', 'dreamers'. According to Cotacachi Cantonal Health Plan, traditional health agents serve 8 to 30% of the population in the Andean region, although, according to the 2005 census of living conditions in Cotacachi, at least 77% of the population in the communities were treated by an ancestral health provider during the last year.

Over the last few years, organisations, collaborators and even the Ministry of Health have made substantial efforts to get the recognition and training of women health volunteers, which has led to the development of the 'Jambi Mascaric' project. The comprehensive individual, family and community health, to promote and carry out preventive health activities in the communities, has gradually increased until establishing a fixed space for the provision of services, training and exchange about health, nutrition, women, family, education, culture, heritage, sports and recreation.

¹⁴ Cotacachi Cantonal Health Plan. Inter-sectoral Health Council. 2001

This is also a space for the active participation of women who, from the Andean cosmovision, receive the knowledge and strength from 'Mama Cotacachi'; the springs, waterfalls, lakes, stones transfer knowledge, ritual, and health, under a gender complementarity a parity vision. The vitality of knowledge and health practices is closely linked to the cultivation of 'Chakras', the conservation of species and varieties for medicinal use, experimentation and transfer of knowledge. Thus, the 'Chakras' have an impact on family life and well-being, but not only as food, but also as a source of medicine and prevention for physical and mental illnesses.



Map 5. Map of midwives and 'yachacks' distribution in the Cotacachi GIAHS. Source: UNORCAC



Exchange of medicinal plants. Source: UNORCAC

The maintenance of the 'Chakras' and related medicinal practices, represent a strategy for the vindication of the Andean identity and knowledge, and the right to intercultural health of the families that recognize in this care and reproduction matrix.



Group of 'doulas'. Source: UNORCAC



Intercultural health campaign. Source: UNORCAC

4.2 Management of the system

There are several farmer organizations that strengthen the technical and organizational capacities for the maintenance of the Andean chakra system, including local farmer organizations, public institutions, as well as non-governmental organizations and international cooperation organizations (Figure 11).

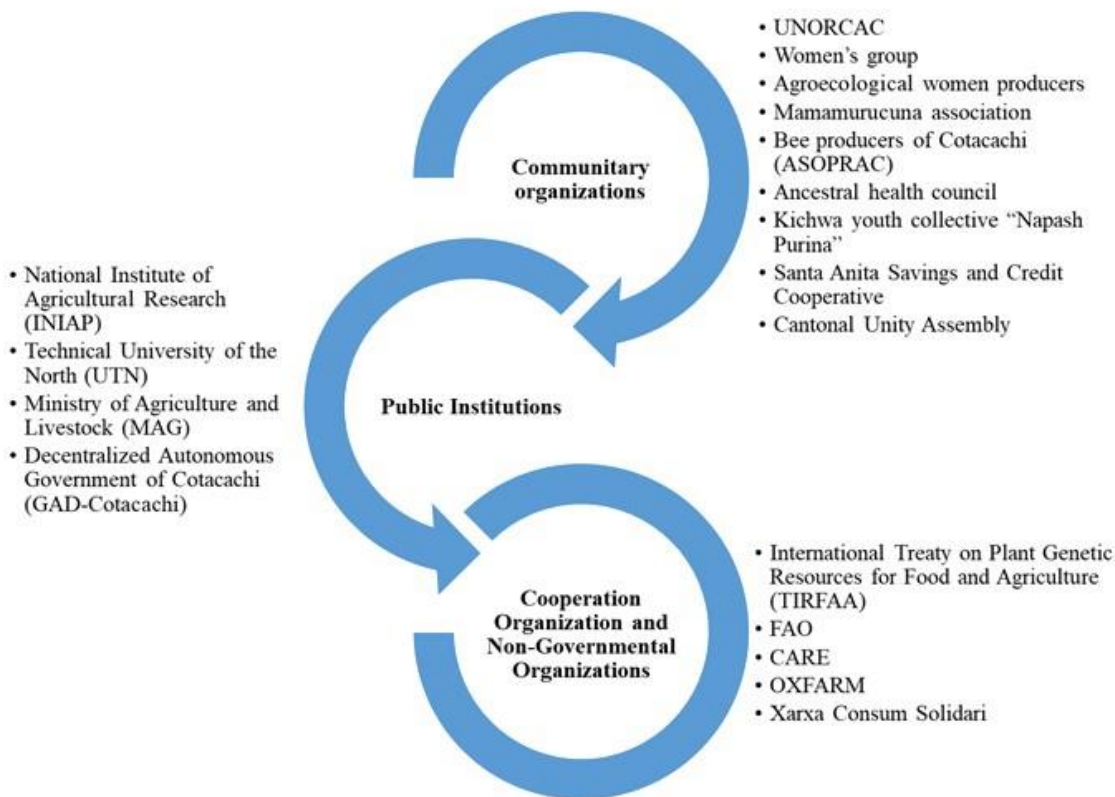


Figure 11. Organizations linked to the management and conservation of GIAHS sites in Cotacachi.

a) Community organization

- Union of Peasant and Indigenous Organizations of Cotacachi (UNORCAC), is a territorial community-based organization that groups 45 peasant communities, its mission is to promote community development with identity based on community organization, reaffirmation of cultural identity, conservation and rational use of natural resources and economic development of the communities; as priority actions the issues of food security and sovereignty, conservation and use of agrobiodiversity and advocacy in public policies.
- The community organization of Andean women of Cotacachi, brings together women from the indigenous communities of Cotacachi. Its main mission is to vindicate women's rights and to value the role of women in community development, as well as to promote family farming and the conservation of seeds and traditional knowledge.
- The Association of Agroecological Producers groups more than 300 producers from the indigenous communities of Cotacachi. Its mission is to promote agro-biodiverse and agroecological chakras and to promote the producers' fair as a space for direct marketing between the producer and the consumer for the consumption of native varieties.
- The Mamamurucuna Association brings together producers of Andean grains to promote the cultivation and fair marketing of crops such as quinoa and amaranth.
- The Asociación de productores apícolas de Cotacachi (ASOPROAC), a rural organization dedicated to the promotion and commercialization of beekeeping production.
- The Ancestral Health Council is an organization that aims to strengthen the practices of

ancestral medicine and the use of medicinal plants of the chakras and their environment.

- The Colectivo de Jóvenes Kichwas NAPASH PURINA is an organization of young people from the indigenous communities of Cotacachi whose purpose is to rescue and reaffirm social and cultural practices in order to strengthen the involvement of young people in community development.
- The Santa Anita Savings and Credit Cooperative is a social and solidarity economy organization created by UNORCAC to promote the financial inclusion of rural families, especially family farmers.
- Asamblea de Unidad Cantonal is a space for citizen organization that contributes to the processes of public policy advocacy for the development of the canton of Cotacachi.

b) Public Institutions

- National Agricultural Research Institute (INIAP) through the Department of Phyto-genetic Resources, cooperates in the conservation of agrobiodiversity through the Research and strengthening of the Bioknowledge Center and community seed bank, training in seed production, multiplication and restitution of native seeds and the relationship with the national germplasm bank.
- The Universidad Técnica del Norte is a public university that cooperates in agricultural research and in linking young students with the management of the Andean chakra.
- The Ministry of Agriculture and Livestock, through the Undersecretariat for Family Farming, supports the promotion and certification of family farming through training and support for marketing in solidarity fairs of producers.
- The Autonomous Decentralized Government of Cotacachi has an ordinance for the promotion and conservation of agrobiodiversity and traditional knowledge that allows it to support different phases of the Andean chakra production system.

c) Cooperation organizations and Non-Governmental organizations

- International Treaty on Plant Genetic Resources for Food and Agriculture (TIRFAA), supports the conservation and use of agrobiodiversity as a mechanism for the fair and equitable distribution of benefits to farmers.
- FAO - Ecuador, through the forests and farms mechanism, supports the strengthening of the value chain of family farming and agrotourism.
- CARE is an international cooperation organization that has supported the strengthening of community food security and the participation of women.
- OXFAM is an international cooperation organization that has supported the productive systems of the indigenous communities of Cotacachi.
- Xarxa Consum Solidari (Solidarity Consumption Network of Barcelona) is an ONG that provides ongoing support in the search for funding to support food security, organizational strengthening and women's participation.
- Over time, all of these peasant organizations, governmental institutions and international cooperation agencies have supported UNORCAC's proposal to build a development model with identity where the Andean chakra is the basis for promoting local development.
- The initiative to apply the Andean chakra system to SIPAM has been a process of several years that was born from the initiative of UNORCAC and the Central Women's Committee of UNORCAC in recognition of its territory and its agro-centric culture:
- UNORCAC in its strategic plan 2008 - 2018 proposed as a strategy to conserve and value the heritage manifestations, the declaration of cultural heritage of agrobiodiversity to the territory

of their communities, as a mechanism to conserve and value the natural, tangible and intangible assets related to agriculture and agrobiodiversity.

- In August 2015, the peasant communities of UNORCAC, especially organized women, and supported by the rural parish councils of the Andean zone of Cotacachi, presented a community manifesto to the mayor of Cotacachi requesting that the municipality declare their territory as agrobiodiversity cultural heritage.
- In October 2015, the Assembly of Cantonal Unity of Cotacachi in its annual summit, took as a resolution "Support the declaration of the territories of indigenous and peasant communities of UNORCAC as cultural heritage of agrobiodiversity, as a strategy for the conservation of agrobiodiversity and ancestral knowledge linked.
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- In November 2015, the territory of UNORCAC communities was recognized by the Ministry of Heritage of Ecuador and FAO as an Important System of National Agricultural Heritage SIPAN.
- In the participatory construction of the Territorial Planning and Development Plan of Cotacachi 2015- 2030, UNORCAC proposed that the declaration of cultural heritage of agrobiodiversity be incorporated into the planning of the municipal administration.
- On May 19, 2019, the Decentralized Autonomous Government of Cotacachi Canton enacted the Ordinance that protects and promotes agrobiodiversity, knowledge, wisdom and cultural manifestations associated with it in Cotacachi Canton.
- Finally, in 2020, the Ministry of Agriculture of Ecuador, at the request of UNORCAC, presented the application file of the Andean chakra system of the Kichwa communities of Cotacachi to FAO Rome.
- The action plan proposed as part of the application file is part of the strategic plan of UNORCAC and its grassroots organizations and has the support of cooperation organizations and governmental institutions.

As part of the communities and social organization concern, a series of conservation strategies have been raised from the communities themselves about the erosion of knowledge and loss of identity and ABD linked to the Kichwa culture, namely: ABD inventories, validation of common species denominations, restoration of landraces and their wild relatives, cataloguing of traditional knowledge of agricultural biodiversity, restoration of landraces and endemic crops and the establishment of an ethno-botanical garden.



Participatory processes of species identification. Source: UNORCAC

These efforts constitute a unifying approach to classify the genetic resources and traditional knowledge of the area and thus, create a biological reserve and a body of knowledge on its ethno-botanical uses. It is furthering in-situ conservation of native crops together with the efforts of INIAP for ex-situ conservation of the country's germplasm collections. UNORCAC's farmers' networks work closely with INIAP technicians to achieve the restoration and adequate cultivation of landraces. Then, seed exchange among farmers helps further disseminate the use of these varieties among Cotacachi's communities.

Likewise, the use of varieties of medicinal plants and native crops has been included in formal and informal education; this work of Organization includes an ABD education programme designed to be taught by teachers in local schools. UNORCAC engages teachers to develop teaching materials and an ABD guide for teachers. This programme has been included in the official curriculum. An ethno-botanical garden is being created to supplement this educational work on ABD health and its usefulness for communities.



UNORCAC Ethno-Botanical Garden. Source: UNORCAC

One of the priorities of UNORCAC's awareness efforts has been reducing malnutrition. The organization has increased the dietary diversity and is supporting the garden with local varieties of crops, such as roots, tubers, grains, vegetables, or fruits. In addition, UNORCAC has promoted nutritional education with popular methods, such as plays performed by women from the community or community fairs with food and ancestral recipes.



Educational processes in rural schools of Cotacachi. Source: UNORCAC

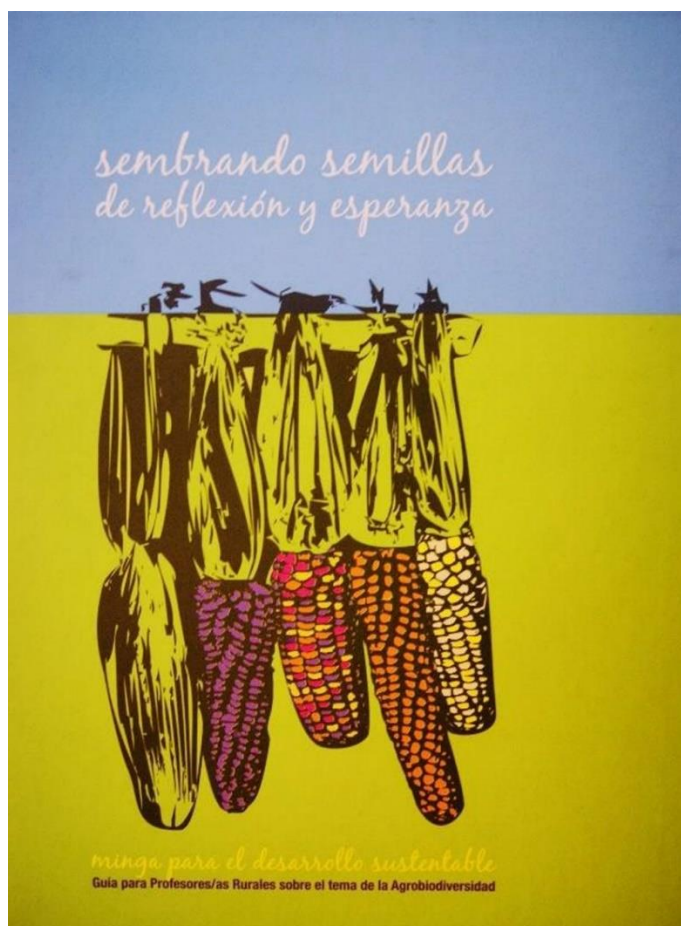
In the awareness process about the need for ABD conservation, UNORCAC has established the Association of Environmental Educators, which brings together teachers from 19 local schools. These schools are recognized by the State as Bilingual Computer Training Centre (CECIB) and have been established for the Kichwa communities, where teaching is provided in Kichwa and Spanish. This recognition has prompted a series of events and activities with participation of teachers and students and have brought agricultural culture to a wider audience of Kichwa students.



Educating children in species recovery. Source: UNORCAC

These students have also organized themselves into ecological associations. Through this platform, teachers and students have developed joint school-community events, in which students share what they have learned about ABD with their parents and other community members.

The integration of biodiversity conservation into the official curriculum has been achieved thanks to the support of volunteer teachers and the DIPEIBI.



ABD Education Guide for Cotacachi Schools. Source: UNORCAC

4.3 Contribution of culture, value systems and social organizations to the sustainability and resilience of the system

4.3.1 Social organization for territorial development

The Cotacachi territory, and the northern Ecuadorian Sierra, is one of the most relevant areas and has a long history in the organic constitution of indigenous and peasant associations and organizations to demand their rights, as well as to propose and implement territorial development processes that allow for the communities not only to achieve economic development indices but also to strengthen political participation, cultural identity and environmental conservation.

Thus, it is necessary to highlight the presence of UNORCAC as a second-degree non-profit class Organization, made up of 45 communities and various indigenous and mestizo peasant base organizations, located in the Andean zone of Cotacachi canton, Imbabura province, created on 19 April 1977, and legally recognized by Agreement of the Ministry of Agriculture and Livestock - MAG, No 0139, on 21 April 1980.

UNORCAC presents its vision as a *representative social organization, with territorial jurisdiction within Cotacachi canton, demanding social, ecological, and economic justice, recognized nationally*

and internationally. The communities, families and organized groups participate in the construction of Buen Vivir - Alli Kawsay. It has a strong cultural and territorial identity, revaluing and saving ancestral knowledge and know-how. It applies an economic model based on respect for the 'Pacha Mama' and reciprocity, with fertile, productive land and developing activities that supplement agricultural work. Everyone participates in a quality education and health system. Critical and proactive, promoting the practice of inter-culturalism and the realization of a fair and supportive society (UNORCAC, Action Plan 2008–2018). The organizational structure of UNORCAC is presented in Fig. 12.

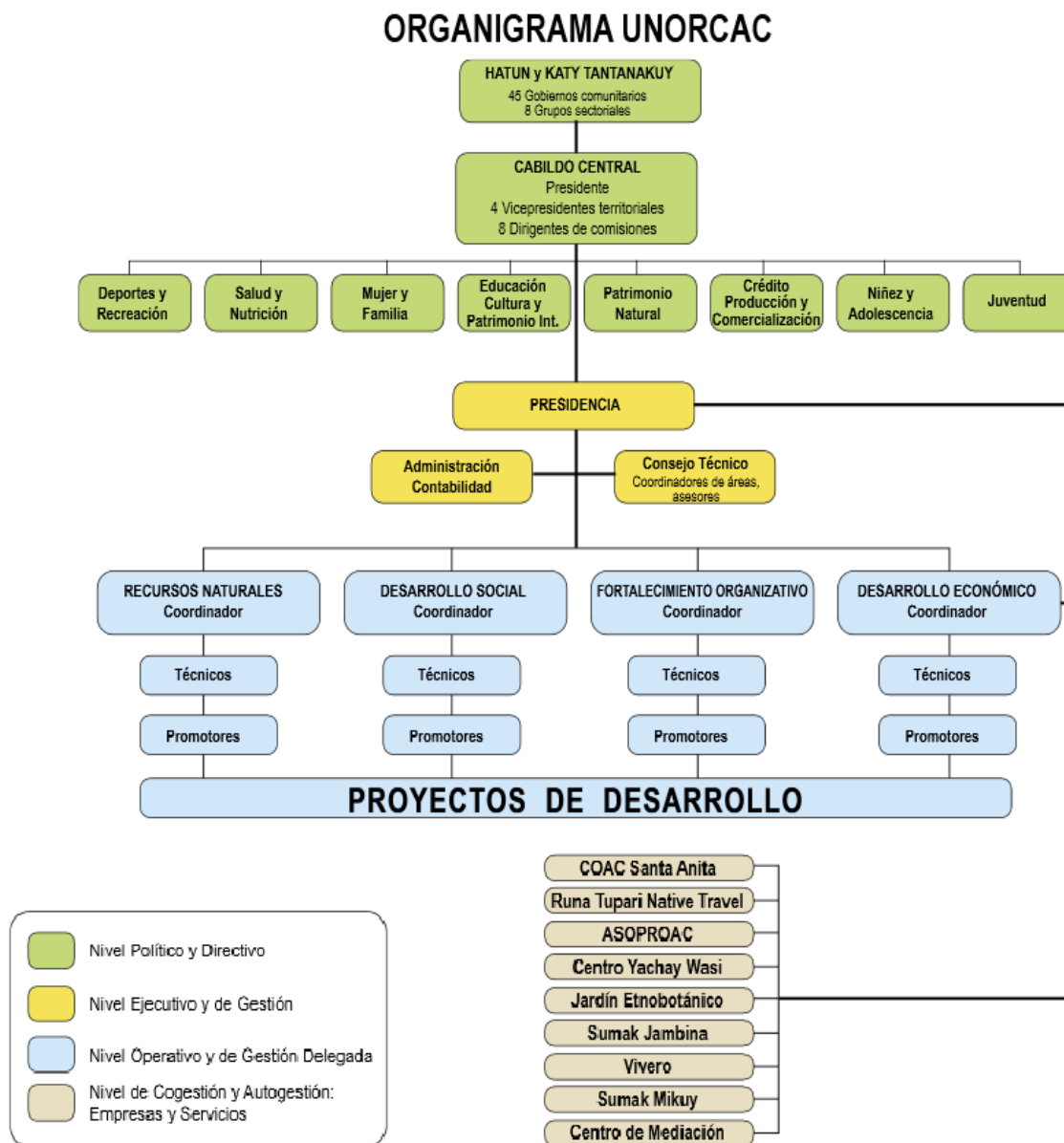


Figure 12. UNORCAC’s Organization Chart. Source: UNORCAC, Action Plan 2008–2018

UNORCAC brings together producers and other stakeholders of the agricultural sector, and national and international development agencies to promote the sustainable rural development of the inter-Andean valleys of the Ecuador. The organization has promoted the conservation and sustainable use of plant genetic resources through the reintroduction and conservation of native crop varieties; and at the same time contribute to sustainable rural development in the area and improve living conditions by reducing poverty through ABD conservation.

Women have worked in ABD conservation in the canton through the Women's Committee of Cotacachi that group around 27 groups in the UNORCAC and promote a series of actions for the care and conservation of biodiversity and the life of the communities.

The following general lines of action have been defined:

- Organizational Strengthening, Citizen and Electoral Participation
- Water, Land and Biodiversity.
- Agricultural Production and other Production Alternatives.
- Identity, Justice, Education and Knowledge Management.
- Intercultural Health.

The organization believes that agricultural practices should include technologies and management processes that ensure ecologically responsible, profitable and equitable distribution. By creating new markets for products resulting from local and diversified cultivation, and revitalizing their knowledge and traditions related to local ABD, the ethnic, cultural, and social values of local crops are recognized and strengthened.

A relevant aspect is the centrality of the symbolic and material care and integration of ecosystems and communities as a unit of life in the life of the organization. In that sense, the development of a series of not only productive but also cultural and artistic expressions linked to the ABD.

4.3.2 Women's role, participation, and representation

Several studies and approaches to work in the 'Andean Chakra' show the fundamental role that women have in its maintenance and conservation. Most of the sensitive activities such as seed management, crop care, harvesting and subsequent treatments, as well as gastronomic and medical development, have been historically and culturally carried out by women, from a perspective of reproduction and social care of life, which goes beyond the mere economic and productive activity.

Some recurring aspects of women's work are, however, on the rise in the globalized world. In the countryside we see that women have to work more because men migrate, as a result of poverty in rural areas caused by the lack of land (Brassel *et al.*, 2010). They now have multiple roles to play: domestic work, agriculture, paid work and organization.

Peasant culture, especially the practices of indigenous women, provides an example to the world of how to live food sovereignty and the sovereignty of their bodies, even though, few know the phrase. They are an example of how women have assumed and maintained for years the Andean cosmovision and spirituality, and the care of Mother Earth.

Women are the backbone to ensure food sovereignty of families and communities, as well as the conservation of seeds and traditional knowledge, being the most important actors for the reaffirmation of cultural identity. These statements are supported by the high level of participation of women (89%)

in the activities that UNORCAC implements to strengthen food sovereignty. The percentage of women's participation in the different actions and undertakings is presented below (UNORCAC, 2020):

- 76% implementation of agro-ecological plots
- 74% beneficiaries of farm loans
- 89% seed conservation
- 70% agroecological training
- 85% seed fair
- 100% recovery of gastronomic heritage
- 90% users of the farmers' fair "La Pachamama nos alimenta"

Women spend an important part of their time managing the chakra from planting to harvesting, investing about three hours a day; regarding the division of agricultural work by gender, 71% is direct participation of women, while in 29% of farming families in Cotacachi there is an equal distribution of agricultural work between men and women (CARE 2017).

Among the activities around the management of the Andean chakra is the preparation of the land at planting times and the responsibility falls in most cases on men and sons, because it is physically demanding work. Activities related to planting, fertilizing, watering, harvesting, transporting and selling at the fair are almost exclusively women's tasks.



Agricultural activities carried out by men for chakra management. SOURCE: Doris Chalampunte-UTN

The women's productive activities include raising and selling small animals, selling prepared food, and occasional work as day laborers in harvesting activities. Ten percent of the women supplement their income by participating in the Runa Tupari community tourism project, which provides food services and room rentals to domestic and foreign tourists.

Responsibilities in the home, production and organization show that women are overburdened in their tasks, with limited support from their sons, daughters and husbands, either because they are engaged

in other income-generating activities or because they are studying. When women were asked if they felt they were overburdened with work, 50% answered "no", possibly because they assume these responsibilities as natural.



Women in agricultural work, Cotacachi. Source: MCYP



Women in agricultural work, Cotacachi. Source: MCYP

The women's organization explicitly uses food sovereignty as a framework for organization and discourse in its demands to the government, allowing women to advance towards the construction of transformative proposals that are directly related to peasant autonomy over production, the demand for equitable access to productive resources, the recovery of agrobiodiversity, agro ecological production, the realization of marketing fairs and seed exchange, among others.

With this background, in 1996 the Central Committee of Women of UNORCAC was created, in 2008 it was constituted as a legal organization whose main objective is to maintain the recognition of the role of women in community governments, in the government structure of UNORCAC, and in all other areas of the canton Cotacachi and the country. Its range of action is wide, they have managed to form 31 groups that work on issues of ancestral medicine, community boxes, embroidery, handicrafts, tourism, gastronomy and agro-ecological production, actions that improve their food, socio-economic and leadership conditions, strengthening and being the guardians of the identity of their communities.



Women participating in Cotacachi seed fairs. Source: Doris Chalampunte-UTN



Women in culinary work, Cotacachi. Source: MCYP

In conclusion, women play a central role as agricultural producers, in the conservation, selection and reproduction of seeds, maintenance of agrobiodiversity; they have an important role in the care economy, and in their link with the feeding of peasant families and communities through planting, harvesting, food processing and preparation; they also actively participate in the development of marketing strategies, exchange and promotion of the consumption of food and ancestral and peasant seeds; the care and breeding of water; and the maintenance of the community and organizational structure (CARE, 2017).

4.3.2.1 *The Andean chakra and the role of women during the pandemic COVID-19*

The COVID-19 pandemic has disrupted the lives of families around the world. At the local level, the general fear among the indigenous communities of UNORCAC was evident, the lack of knowledge and the lack of actions to mitigate the risk of COVID-19 spread by the authorities, caused the communities to impose strong restrictions on mobility within and outside the territory for fear of contagion. For example, road closures made it difficult for men to travel to urban areas, where they maintain economic activities such as day laborers in construction or floriculture; likewise, women were affected because they were unable to move their agricultural products to community fairs. At the family level, this meant an almost instantaneous loss of both sources of economic income, so that the peasant chakras became the main source of family work and food provision for the family and for sharing food among the community.

The role of UNORCAC and especially of the women's organization was to strengthen food production in the peasant chakras by providing vegetable seedlings and seeds, as well as reopening the peasant marketing fair following the biosecurity measures and opening hours established by the national and local authorities.



Delivery of vegetable seedlings to indigenous communities of Cotacachi. Source: UNORCAC



Biosecurity measures adopted by the communities at community fairs. Source: UNORCAC

Another of the actions generated and led by the women's organization with support from the FAO "Forests and Farm Facility (FFF)" project was the home delivery of baskets of products from the chakra to urban families. This activity boosted the rural family economy through fair trade, recovering sources of income and providing the population with healthy food.



Delivery products to families in the urban area. Source: UNORCAC

The solidarity processes that the indigenous communities of Cotacachi have carried out with COVID-19 have had an impact on the collective interest in ancestral medicine, food bartering, the recovery of seeds and crops that are not widely consumed, and the reintegration of young people into farming activities. These actions mark a positive change and demonstrate that peasant and indigenous family farming continue to sustain the cities and are an indispensable source of fresh and healthy food.



Agricultural activities carried out in the chakra. Source: UNORCAC

4.4 Threats

- The migration of the young indigenous population to the cities constitutes a threat, where the incidence of the media and the globalization of culture induces the loss of the cultural values of the indigenous communities.
- Historically, discrimination against the indigenous population has caused cultural values and principles not to be valued.
- The little interest of the new generations in participating in traditional organizational structures such as community governments and UNORCAC
- The incidence of external actors, especially political parties, divide and generate confrontation within communities, weakening community organization.
- Presence of public institutions and NGOs that promote organizational models according to their institutional interests that do not strengthen traditional organizational structures.

4.5 Challenges

- Strengthen the cultural and territorial identity of the Kichwa people of Cotacachi through the valorisation, protection and dissemination of ancestral practices.
- Promote research on the cultural heritage of the Kichwa communities of Cotacachi, systematization, dissemination and transfer of experiences to the population.
- Revaluation and revitalization of the cultural heritage of the communities, especially festivals, rituals, handicrafts, gastronomy, ancestral medicine, and dance, among others.
- Strengthen the bio-knowledge centre of the 'Andean Chakra' and promote the creation of community cultural and environmental interpretation centres in the Kichwa indigenous communities.
- Strengthen the organizational capacity, performance and participation of the communities and organized groups of the Kichwa communities of Cotacachi, with emphasis on the participation of women and youth.
- Recognize, value, and strengthen the role of women as guardians of the cultural identity and native ABD of the indigenous communities.

5. Landscape features

5.1 General description of the landscape

Robert Rhoades (2006), in the publication *Development with Identity*, details the weather and landscape in Cotacachi; part of his research is presented below. The modern mosaic of the Cotacachi landscape is the result of far-reaching interaction and feedback between natural and human processes. To understand how this landscape evolved, we have to start with the prehistoric times tens of thousands of years before the first human being stepped on the base of the Cotacachi volcano. Zehetner & Miller (2006) analyse contemporary geological conditions from the permanent collision between the Nazca and South American plates, the rising of the Andes, and the resulting volcanism. These processes shaped the soils, hydrology and topography of the area, and these elements, in turn, determined agricultural practices in the area. Both a blessing and a threat, the Cotacachi volcano has been a source of rich soils and water of glacial origin while simultaneously inspiring fear among the Cotacacheños, as earthquakes and eruptions have repeatedly destroyed crops, villages, and life.



Cotacachi Volcano – Cultivated Landscape. Source: UNORCAC

Moates & Campbell (2006), demonstrate how the contemporary landscape represents the culmination of past events; these include local adaptations during the pre-Inca period and the influence of the Inca, the Spanish, the Catholic Church, the State, the Ecuadorian nation and the global economy of today. The traditional vertical system of production and complementary exchange has shown its elasticity and continuity despite the dramatic changes experienced during large periods. Nevertheless, the historical transformations of the landscape, the traditional principles applied by local inhabitants and still maintained, offer lessons for modern efforts in the field of sustainable development.

The analysis of land use and land cover change documents the dramatic changes in the last fifty years from 1963, just before the agrarian reform. This analysis shows the growth of urban areas, the

intensification of agriculture, the reduction in the size of cultivated areas due to the fragmentation of estates, the reduction of primary and secondary native forests, and the expansion of eucalyptus plantations and forms of agro-industry, such as floriculture. Indigenous lands acquired after the agrarian reform are being further fragmented through inheritance, while new land use systems, such as timber and flower plantations, are taking root in the landscape.



Ushapunto, panoramic view of the Andean chakras near the Cuicocha lagoon. Source: UNORCAC



Productive landscapes of the GIAHS area. Source: UNORCAC

Despite, the urban growth pressure and the fragmentation of the land surface, the 'Andean Chakra' of the Kichwas communities maintain their traditional agricultural practices adapting to these new realities. They resist and fulfil their role of food production, the cultural and religious connection and above all, preserve ABD and the traditional knowledge. Fig. 12 shows simulations that demonstrate the evolution of the landscape over the last 80 years. It can be seen how the urban environment is gaining space in the agricultural space, which is currently maintained thanks to the presence of the 'Chakras' of the Kichwa communities and especially the work of women who withstand losing their ancestral agriculture.

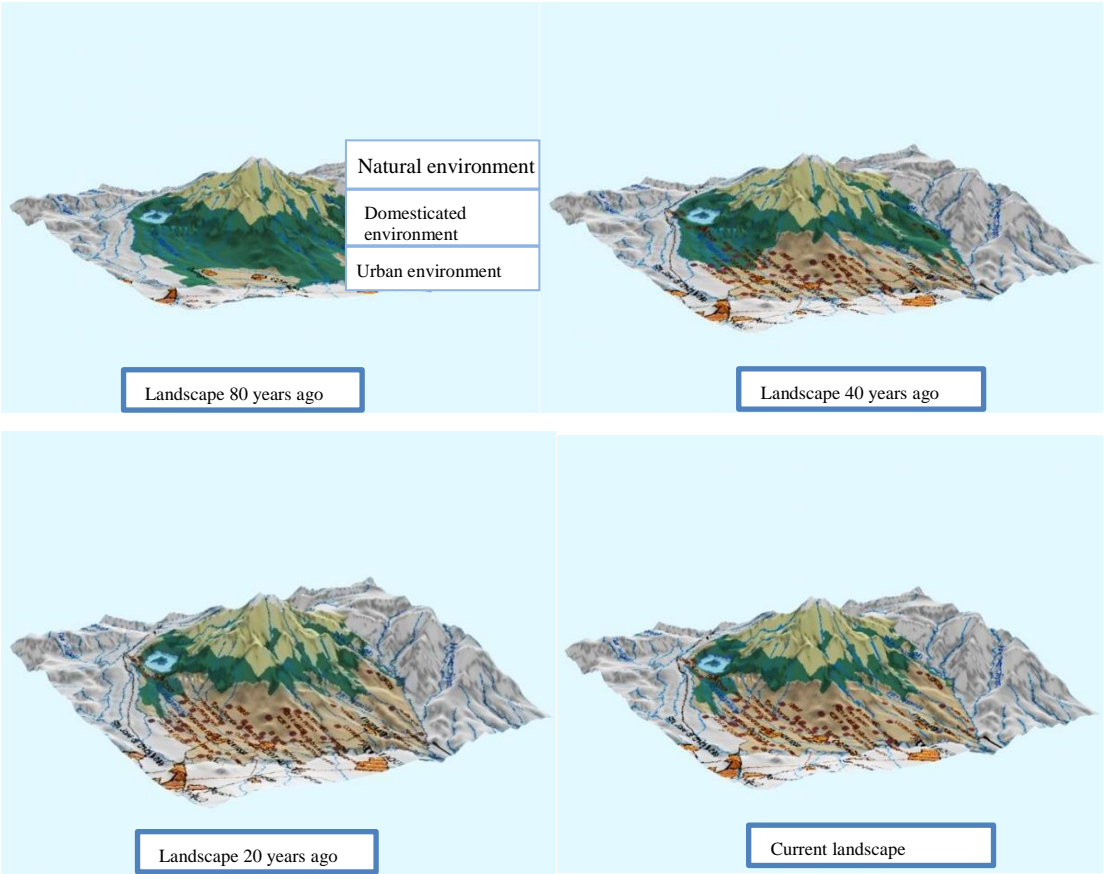


Figure 13. Simulations of the landscape of the Kichwas community's territory in the High Andean zone of Cotacachi. Source: UNORCAC



Andean landscape, chakras of Cotacachi. Source: UNORCAC



Andean Chakra and the distribution of productive plots next to farmers' houses. Source: UNORCAC

5.2 Natural context and land uses

The Andean experts propose the concept of verticality to explain the strategies developed by humans to exploit and control as much as possible the ecological floors and niches. While verticality has

historically played a central role in the development of Cotacachi's Andean communities, historical forces, including colonization and globalization, have permanently undermined traditional farming.

Changes in the human ecology of the area are understood as a body of past events beginning with the pre-Inca management of the land, followed by the influence of the Incas, the Spanish and contemporary conditions in the indigenous land use. The impacts of the Incas and the Spaniards on local land use practices were numerous and profound, as were the more recent effects of national and international institutions.

The traditional agro-ecological and socio-cultural practices of the indigenous communities constituted adaptations to a unique vertical landscape, characterized by fluctuating and unpredictable climatic conditions, which obliges them to innovate and diversify agriculture in order to minimize the risks to their food security. Ecological complementarity and communal socio-economic relations offered protection against environmental inconsistency to reduce irrigation. This was achieved by diversifying crops and spacing sowing and harvesting in different ecological zones located at different altitudes. The socio-cultural traditions of the indigenous communities emphasize communal solidarity and reward over individual material accumulation. Labour exchange strategies ensured that families had sufficient labour power to meet their needs. Today these strategies have been weakened by more recent exogenous introductions that deny indigenous communities the ability to practice ecological complementarity.

Upon their arrival, the Spanish conquerors quickly assumed control of entire basins, opting for the most fertile valleys, and the indigenous communities were unable to do anything to prevent the appropriation of their traditional lands. The ecological complementarity of the past was dismantled by the estates' blockade of traditional exchange routes and the end of the indigenous population's access to the lands where they once harvested or planted. Some traditional products were cropped in smaller quantities and subsequently replaced by products brought from the old world. The introduction of domesticated animals by the Spaniards caused serious impacts on the landscape of the area. The result of the landowners' ownership of the best agricultural lands in the valleys meant the displacement of the indigenous communities to high lands.

Compared to the indigenous inhabitants of the region, the newly arrived Spaniards had very different perceptions of the landscape. Not only did they see the natural environment strictly in terms of resources that could be capitalized on and owned, a very different perception from the indigenous and communal perception of the land.

The colonial times characterized by a system of large extensions controlled by landowners and with an indigenous labour force obliged to stay within the large estates due to the monopolization of basic resources such as water and firewood, what made the indigenous population dependent on the landowners. Some indigenous communities escaped this phenomenon by moving to higher altitudes where conditions for survival were much more difficult. The 1943 census reported 43 estates in Cotacachi.

The colonial domain of the Spaniards destroyed the basis of existence of the indigenous communities such as vertical, multi-channel and agro-ecological subsistence. In addition, land management practices on the estates were different from those of the indigenous peoples in the area, prioritizing crops that were not native to the local communities. Eventually the estates adopted some native crops and the indigenous people also adopted Spanish cultivars and tools.

During the colonial times, the Catholic Church played a major role in the fragmentation of the landscape as it owned large portions of land in the Cotacachi region. The priests of the city demanded tithes from the peasants that represented 10% of the harvest, in addition to forcing them to work on their estates in exchange for religious services. Without a doubt there was a great impact of the imposed religion on the indigenous population, to such an extent that they integrated the ritual and the Catholic cosmovision into their indigenous cosmovision.

In the Republican era, in more recent times, the agrarian reform took place, between 1964 and 1973; it was a process imposed from a higher level and had several impacts on the landscape of Cotacachi. The intention was to have a more equitable distribution of land through the division of large estates. Unfortunately, this law was not adequately applied in Cotacachi. The evidence for this is that up to 80% of the population lives on only 20% of the land. Indigenous people live in the lands they have historically occupied next to large estates, but not because of the division of large estates. The lands of indigenous families are typically small and less suitable for planting compared to estates and are not able to support the growth of the indigenous population, which results in poverty and migration.

Finally, another phenomenon that has influenced changes in the landscape and traditional agricultural practices has been the impetus given by governments through the promotion of improved seeds and technology packages with chemicals and increased mechanization with the use of large tractors. According to research, these technologies threaten productivity and long-term sustainability, especially regarding the loss of genetic resources.

At present, the interaction between the estates and the indigenous communities is that the estates hire indigenous people as agricultural workers to work on their farms that use modern technology such as production in greenhouses, flower production, and extensive production of crops for export. In addition, some estates have been transformed into tourist inns and others have sold their land to foreigners, for the construction of residences for pensioners, especially from the United States. In a few cases, farmers have organized and bought a small share of the estate's land to give to their children and continue with traditional agriculture, but this is not a viable alternative because of the high cost of land.



Turuko-Cotacachi community landscape. Source: UNORCAC



Cotacachi community landscape. Source: UNORCAC

The indigenous Cotacachi communities are located in the inter-Andean valley about 35 km north of the equator, at the foothills of the Cotacachi volcano. The topography of the area is dominated by the high peaks of the Cotacachi Volcano (4 939 m a.s.l.) and the enormous calderas of the Cuicocha Volcano, transformed into a lagoon. The steep slope of the area extends from 2 200 to 4 939 m a.s.l. The development of the landscape has been strongly influenced by volcanic phenomena, such as pyroclastic flows, pumice stone and ash falls, and subsequent mudslides caused by heavy rains and earthquakes. Water currents have deeply undermined the land, formed ravines and dividing the landscape into high plateaus that run parallel to the water courses.

The climate in the area is characteristic of an equatorial high-altitude environment, with almost constant temperatures throughout the year, but with marked daily oscillations. The variations of the climatic parameters on the landscape are a function of the altitude. The average annual temperature is approximately 15 °C at 2 500 m a.s.l. and decreases by approximately 0.6 °C for every 100 m of increase in elevation.

Rainfall is generally dominated by low intensity events, the average annual rainfall is about 900 mm at 2 500 m a.s.l. and increases with altitude up to 1 500 mm at an altitude of 4 000 m a.s.l. The area is drained by small rivers such as the Yanayacu, Pitzambiche and Pichavi that flow into the Ambi River, which in turn is a tributary of the Mira River, which runs through north-western the Ecuador until it flows into the Pacific Ocean. The availability of water at altitudes above 2 700 m a.s.l. is limited, especially during the dry summer months, and the water is drained by small rivers that are strongly

contested to meet the agricultural, industrial, and domestic demands of Cotacachi's communities and urban centre.

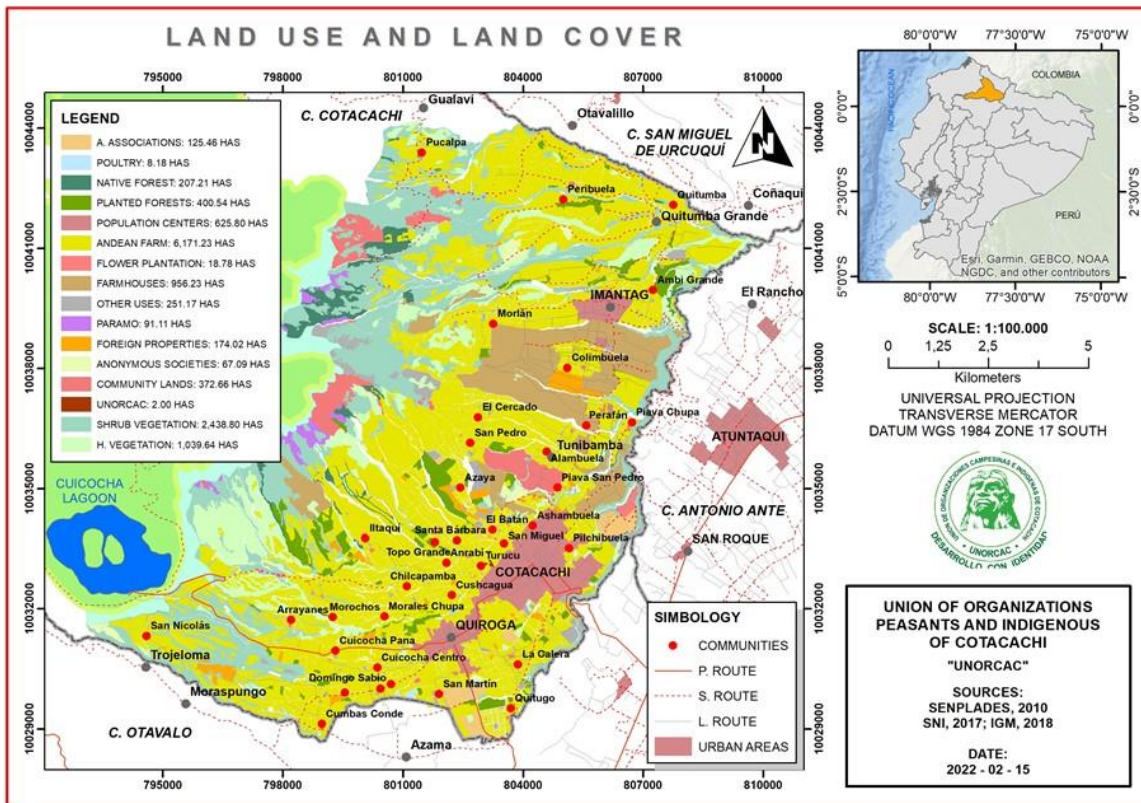
Soil formation has been strongly influenced by climatic differences corresponding to changes in elevation along the volcano's foothills. Soil organic matter content, water storage capacity, structural stability, and phosphate retention increase with altitude.

The High Andean area comprises four agro-ecological zones including the Cotacachi Cayapas national park. The macro-area influenced by GIAHS coverage corresponds to 12 949.92 hectares, the area of the 'Andean Chakras' (6 171.23 hectares) that is the GIAHS zone represent 47.65% of the macro-area, distributed in several communities, this GIAHS zone interact with rural areas (6 152.89 hectares) such as communal population centers and páramo zones, native forests, shrub and herbaceous vegetation, as well with urban areas (625.80 hectares). The interactions generated in the territory are social, ecological, and economic. In addition, the SIPAM zone is a privileged area because of the high scenic and landscape potential generated by the interaction with the conservation area such as the Cotacachi Cayapas National Park (Table 19, Map 2 and 6).

Table 19. Percentage of land use and land cover of macro-area influenced by GIAHS

Unit of use or vegetation cover	Year 2010 (ha)	%
Andean Farm: GIAHS zone of Andean Chakra	6 171.23	47.65
Shrub vegetation	2 438.80	18.83
Herbacea vegetation	1 039.64	8.03
Farmhouses	956.23	7.38
Population centre	625.80	4.83
Planted forest	400.54	3.09
Community lands	372.66	2.88
Other uses	251.17	1.94
Native forest	207.21	1.60
Foreing properties	174.02	1.34
Agricultural associations (areas)	125.46	0.97
Paramo	91.11	0.70
Anonymous societies	67.09	0.52
Flower plantation	18.78	0.15
Poultry	8.18	0.06
UNORCAC	2.00	0.02
Total	12 949.92	100.00

The categories described in Map 6 are the result of information obtained from the Cotacachi Municipal Cadastre. The land use categories are related to the productive activities developed in the territory, for example: the Association category integrates around 125 ha and belongs to the San Nicolás association, which is a group of farmers that bought the land from the State (product of the expropriated land from a banker); the Poultry category are the chicken breeding sheds, they are located in the Colimbuela and Quiroga commune, the activity is developed by farmers in the area and also by private companies; the Farmhouses category includes farms, the largest of which is the “The Maria farm” that surrounds the Colimbuela commune; the Anonymous societies category are lands that are in the name of companies with various agricultural and livestock purposes; the category H. vegetation refers to herbaceous vegetation (natural pastures and non-cultivated lands) and is present in all the communities.



Map 6. Vegetative cover and land use of the GIAHS zone. Source: UNORCAC

The main characteristics of this agricultural system have been developed in a specific agro-ecosystem such as the equatorial Andean zone which, although, it shares characteristics with the American Andean region, has certain peculiarities.

In this natural environment is the 'Andean Chakra' that is a Kichwa term related to the cultivation of maize (*Zea mays* L.) (Bolaños-Fabre, 2015) associated with beans (*Phaseolus vulgaris* L.) and black-seed squash (*Cucurbita ficifolia* Bouché). The 'chakras' are family agricultural spaces, which are mostly managed under an agro-ecological approach, where there is a generational transfer of knowledge, which is why it is considered a traditional production system from the pre-Columbian era (STOA Project, 2009).

The municipal ordinance of the Cotacachi canton for the application of the land use management plan classifies land use categories related to land fragmentation, which contributes to the maintenance of the 'Andean Chakra' production system and contributes to its sustainability.

The lands under the Andean farm system have several specifications established in the municipal ordinance on the land use and management plan of the Cotacachi canton, in which the fragmentation of the land is regulated according to categories of use. The categories of land use where the Andean farm is located are:

- Rural production land: it is used for agricultural production, aquaculture, livestock, forestry and tourism activities, with a focus on environmental conservation and food sovereignty.
- Rural protection land: special biophysical, environmental, landscape, sociocultural

characteristics, or because they present risk factors, deserve specific protection measures.

- Conservation zones: these are areas that have a high historical, cultural, landscape, environmental or agricultural value, to guide actions that allow the conservation and valuation of their environmental and/or heritage characteristics.

The lands of the Andean farms meet these specifications and according to the municipal land use ordinance of the Cotacachi canton, limitations are established for fragmentation, with minimum areas to be divided. However, due to the existence of this regulation, there is pressure for the fragmentation of the land by peasant families due to ancestral customs of inheriting plots of land to their children, even when these plots are small.



Productive landscapes present in the SIPAM zone of Cotacachi. Source: UNORCAC

5.3 Agricultural landscapes

The landscape management of the 'Andean Chakra' starts from this matrix of knowledge in which all the elements of life on earth are part of a living world whose vitality depends on the harmonious relationship between each of the beings that inhabit the 'Pacha Mama'.

The Andean landscape will be the visible face of this relationship, which is manifested in a series of ancestral rituals and traditions that accompany the development of crops, breeding and food; these give it a spiritual sense and a deep connection with the reality of the 'Ashpa' ('Allpa') 'Mama' (mother

earth – living soil), 'Yaku Mama' (living water) and the 'Pacha Mama'¹⁵ (the natural context and universal life energy), and have been key in maintaining the cohesion and expansion of the social fabric, which is expressed in the family, the indigenous community and its organizational forms.

But the chakra is also the place of symbiosis between the human community and nature. Based on the elements of the natural landscape: soil, water, flora, fauna, climate, is that the human community makes chakra. In this sense, the development of the 'Chakras' starts from a specific rationality based on concrete objectives and with sustainability criteria, all of these developed by the peasant families that maintain and develop the knowledge that was transferred to them from their ancestors. In the Andes we find very varied systems of production and each one worked in a different and peculiar way (Rengifo 1995).

But the sum of this diversity of knowledge, know-how and 'Chakra' models, have configured a productive and cultural landscape based on the AFC and its production spaces, but which are integrated into its agro ecosystems (Table 20) and involve other elements such as water and watersheds, seed management and wild species, among others, from the understanding of the conditions of each territory or agro-climatic zones. As Valladolid (2010) mentions, the 'Chakra' cannot *shine* if the landscape does not also *shine*, for which water must be *raised* (seeding and harvesting rainwater in the 'cochas', 'puquiales'); to make sure that water supply for plants, animals and, above all, families living in the communities does not run dry. Also, to make the landscape *shine*, the soil must be *raised*, by means of platforms, stone fences or by planting trees, bushes, and native herbs around the 'Chakras' to *raise* favourable microclimates in the 'Chakras' for growing plants and to protect them from frosts, hailstorms and strong winds that can knock them down.

Table 20. The agro-climatic zones of the 'Andean Chakra'¹⁶

Name	Area	Altitude range and climate characteristics	Predominant ABD
Urku	High zone	Above 3 600 m a.s.l. / paramo Cold Humid – modified or intervened wild wetland ecosystem	Andean potatoes and tubers - sheep, cattle, and South American camelids.
Hana Urku	Transition al zone	2 900 to 3 600 m a.s.l. / sub- humid cold	Andean potatoes and tubers, barley, oats - rangelands – some cases manage to produce adapted variety of maize, quinoa.
Pukru Pamba	Med zone	2 500 to 2 900 m a.s.l. / Dry and temperate	Traditional system of maize (bean – cucurbit intercropping), barley, wheat, pea, broad bean, potato, quinoa, 'chocho'. Breeding of guinea pigs and bovines.
Ura Llacta	Transitional	2 200 to 2 500 m a.s.l. / sub- humid warm	Livestock, traditional system of maize, taro (<i>Colocasia esculenta</i> (L.) Schott), sweet potato, arracacha, tree tomato, lentil.

Source: Gortaire, 2014

¹⁵ The living soil is also often referred to as 'Pacha Mama'.

¹⁶ Adaptation of the information provided during the visit to Cañar canton. Courtesy of Nicolás Pichasaca-Mushuk Yuyay

These areas are diverse and complex. On each floor, family farming or 'Chakra' production is different. The indigenous Kichwas communities have developed their life and culture in these diverse territories, however, the largest population is living in the middle and high lands.

Some essential characteristics of pre-Columbian agriculture and its continuities in The Andes:

- Simultaneous use of ecological floors to access different natural resources and reduce environmental risks.
- Domestication of a significant variety of plants.
- Crop rotations and intercropping.
- Sophisticated forms of water management (channelling, 'rigs', 'cochas').
- Terrace and soil conservation systems.
- Restoration of soil fertility through rest periods (in extensive systems) and use of animal manure (in intensive systems).
- Use of astrological, vegetable and animal indicators to determine sowing dates.



Pucalpa commune. Source: UNORCAC

Despite the destructuring of ancestral societies, the most important technological elements and ABD characteristic of this farming system still survive, which are currently expressed in the 'Andean Chakra', although, sometimes fragmented or modified. In addition, with the European presence, the number of crops (broad beans, barley) and animal breeding (cattle, sheep) was increased, which, together with the animal traction plough (the yoke) and diverse farming tools (digging hoe), have been incorporated and are considered as very typical elements of the Andean communities and the 'Chakra'.

Most of the plant cover in the area has been altered from its natural state by human activities. The areas located above 3 000 m a.s.l., corresponding to the wild wetland ecosystem, are covered by scrublands, bushes and a few remnants of native forest. In the area below 3 000 m a.s.l., the landscape is dominated by agricultural use and introduced eucalyptus forest. Most of the agricultural land is located on high plateaus with slopes between 0 and 20%. The steep slopes of the ravines offer shelter for scrub. The bottom within the ravines is used as grasslands.

Indigenous communities have inhabited the area for thousands of years and have employed agricultural

practices adapted to the climate and topography. The ancient terraces, probably of pre-Columbian origin, are evidence of an early awareness of the importance of conserving natural resources. The terraces, which have now disappeared due to the fragmentation of the land, have given way to living fence agro-forestry practices that serve to protect and cover the soil. They dominate the landscape, giving it the appearance of a multi-coloured mosaic typical of the Andean area.

Over the past 500 years, social and agricultural structures have undergone dramatic changes involving the enslavement of the indigenous population within the centuries-old estate system; an agrarian reform in the mid-1960s; the advent of the green revolution in the 1970s; and, most recently, an awareness in indigenous communities of the value and conservation of their heritage.

Today's agriculture shows marked differences between the practice on the estates, and the small plots of land in the indigenous communities. Large-scale estate farming is characterized by intensive management of large quantities of inputs and a high degree of mechanization. In the indigenous communities the situation is different, most peasant families have less than one hectare of arable land and few heads of cattle. Due to limited resources and the desire to maintain traditional practices, the use of fertilizers and pesticides is rare, they use animal manure as a form of soil fertilization. Land management operations, such as ploughing and planting, are usually done manually or with the help of the 'yoke'. Irrigation is only available to some communities located in the lower zone.

5.4 Settlements and associated built structures

In the territory of the Kichwa communities of Cotacachi there are 43 communities with an approximate population of 16 000 inhabitants distributed in 3 225 families; On average, each community has 75 families, ranging from 15 families to 224 families. The houses are located around a plaza or sports area, where there is a chapel and generally a school, but most of the houses are scattered. The construction materials of the houses have been transformed in recent times, going from local materials such as clay bricks, wood, tile roofs and plant material to cement and iron constructions. The communities are supplied with drinking water through community systems self-managed by the users themselves, who capture the water in the upper part of the 'paramo' area and convey it to the communities. All communities have access through third-order roads, have electricity and most have internet access.

50% of the communities have irrigation water through traditional conduction systems with earth ditches, and in recent times they are being covered with cement to improve conduction efficiency.



Types of houses in the Andean farm. Source: UNORCAC

Construction materials are mainly sourced from mines located in the GIAHS area. By way of background, it can be said that mining in Ecuador is concentrated in small and artisanal mining; In recent years, mining megaprojects have been initiated, an example of this is the Llorimagua project in the Íntag area (Imbabura) (Murillo & Sarcher, 2017), which has generated socio-environmental conflicts with the communities of the Íntag valley, whose purpose is to preserve water resources, ecosystems and biodiversity (Sarmiento *et al.*, 2020).

Another type of mining is non-metallic, which is an activity that is directly linked to civil construction and has a direct impact on the country's economy. This type of mining uses processes such as explosions, excavations, removal of topsoil, transfer of materials, which alters the natural landscape and erodes the soil (IUCN, 2017). In Ecuador, this activity focuses on the extraction of rocks, sand, limestone, gravel, silica, clay, gypsum, kaolin, among others (Cornejo, 2016).

In Cotacachi, non-metallic mining activity is allowed and about 64 ha are registered for the exploitation of quarries, 17 of them in the parish of Quiroga; the areas allowed for this activity are arid and stony land (Municipality of Cotacachi, 2015; Andrade, 2017).

This type of mining activity is concentrated in the extraction of gravel, sand and granules; however, this activity has caused a strong environmental impact in the parish of Quiroga due to the destruction of the vegetation cover, air pollution by fossil fuels, the spread of dust and sand, affecting the health of mine workers, in addition, it is an activity without control and planning. However, non-metallic mining in the area does not represent a threat to the 'Andean Chakras' (Table 21).

Table 21. Environmental impacts of non-metallic mining activity in the parish of Quiroga

Component	Environmental impact
Air	Ambient noise Dust clouds
Soil	Soil nutrient loss Land use changes Soil erosion
Water	Changes in the pluvial system
Biodiversity	Removal of topsoil Loss of flora and fauna associated with the environment
Landscape	Impact of the presence of machinery and mining development Impact on the opening and use of roads Impact on restoration works in the area

Source: Andrade (2017)

5.5. Sustainability and resilience

The traditional agricultural and cultural practices and the socioeconomic context related to the indigenous communities and the 'Andean Chakra' that have shaped the Andean landscape of Cotacachi, such as the intense fragmentation of the land and the agroforestry practices of delimiting properties with live fences using native plants, have allowed sustainability and resilience and contribute to create agroecosystems protected from soil erosion and the generation of favourable conditions for agriculture and biodiversity conservation. The practices of planting crops alternating in time and space, the association and diversification of species characteristic of the 'Andean Chakras' have contributed with direct services to the communities (food security, livelihoods), as well as the

conservation of ABD that also contributes to the sustainability and resilience of the life of the communities and the local landscape.

Rhoades, 2006, in his publication *Climate Change in Cotacachi*, presents a historical analysis of the documentation evidencing climate change in the communities of Cotacachi, one of the evidences the author documents is the loss of glacier in the Cotacachi volcano in recent years, and how as a consequence the permanent flow of water in the streams that descend the slopes of the mountain has decreased. Historical meteorological data from the scarce measuring stations in the area show a trend of increasing average annual temperature of up to 0.5 degrees Celsius in the last 50 years and a slight decrease in average annual precipitation.

Regarding peasant perceptions, the author documents three main themes: seasons and patterns of rainfall, glaciers and snow in Cotacachi, and water availability. The community members emphatically state that there is less and less rain for agriculture and the rain that falls is scarce and irregular, and this causes confusion in the timing of soil preparation and sowing. Regarding the glacier of the Cotacachi volcano, they state that it had snow and the top was white and currently is non-existent. Regarding the availability of water, peasants express that the rivers and water sources had a higher flow rate and were more abundant and currently there is a great decrease that has led to conflicts over access to water for consumption and irrigation.

Other perceptions of farmers regarding agriculture is the presence of more pests and plant diseases, special emphasis is placed on the presence of an insect called weevil (gorgojo) that attacks corn grains in plantations and in storage, which makes it difficult for them to store the grains for several months as they did before, the attack of this insect did not exist in the communities above 2700 masl and it does exist currently and mainly affects seed storage. They also state that corn can now be grown at higher altitudes. Before they sowed up to 2,700 masl and now they sow and harvest up to 2,900 masl and they state that it is due to the increase in temperature.

In response to the concurrence of these adverse conditions, farmers persist with their agricultural practices such as crop diversification, sowing associated crops, sowing in mixtures of varieties that allow them to maintain soil cover in different strata that contribute to maintaining soil moisture and has minimized the attack of pests and crop diseases. The association of crops prioritizing varieties of legumes that contribute to the incorporation of nitrogen to the soil that, added to the incorporation of animal manure and crop waste, improve the quantity of organic matter in the soil and the retention of moisture.

5.6 Threats

- Land fragmentation due to traditional customs such as inheritance.
- Transformation of agricultural land use to housing because of population growth.
- The introduction of agricultural and forestry monocultures that can change the characteristic landscape of the Andean farm.
- Introduction of new agricultural technologies, such as greenhouses.

5.7 Challenges

- Valuing the territory linked to the 'Chakra Andina' with recognition as an ABD zone, heritage declarations, developing seals, brands and certifications of origin and fair market to produce the GIAHS territory, which generate greater sources of employment and economic income for families, especially young people linked to the Andean chakra.

- Avoid land fragmentation and urbanization through advocacy in the development and implementation of public policies that regulate land use in favour of the 'Andean Chakra', and the conservation of the natural and cultural landscape of indigenous communities.

V. ACTION PLAN FOR DYNAMIC CONSERVATION

1. Conclusions from the characterization of the 'Andean Chakra' of Cotacachi.

- The territory of the Cotacachi's indigenous communities presents high levels of ABD, many of which have endemic characteristics, intercropping and rotation practices that contribute significantly to the regulation of agro-ecosystems and to the provision of agro-ecosystem services of local and global significance.
- The great wealth of ABD is closely related to the traditional knowledge and cultural richness of the communities, since they have a broad knowledge base on agricultural practices, uses of ABD and the environment, which has been accumulated through long series of observations transferred from one generation to the next. Women are the holders of more traditional knowledge and therefore play an important role in the conservation and use of biodiversity.
- The indigenous communities of Cotacachi have an agro-centric culture where living agricultural systems are maintained in permanent evolution with changes in the environmental surroundings; they have developed multi-coloured territorial landscapes, closely related to their cultural and spiritual identity, which constitute the basis of the existence and sustainability of life in the communities and are an important contribution to global food sovereignty.
- 227 species and varieties have been identified in the indigenous communities of Cotacachi, which are cropped and cared for in the 'Chakras' and their environments. The species are used for different purposes in food, medicine, ritual, ornamentation, fuel, and fodder. According to the agricultural diversity indices, the Cotacachi indigenous communities have a crop diversity score of 2.7, a value that is higher than other areas of the planet that range from 1.5 to 2.0 such as Asia. The Cotacachi index score is well above the average for the Andean region (Willart, 2015), which shows that the wealth in biodiversity is remarkable, and is a TREASURE for the Ecuador and the world.
- Tapia & Carrera (2011) provide information from the inventory carried out with 379 farmers of the Cotacachi indigenous communities where there is an interesting genetic variability of traditional crops, mainly maize, beans and black-seed squash, and other secondary crops such as tree tomatoes, blackberries, banana passion fruit, sweet granadilla, chili, and pumpkins. Forty-seven common names of maize and 42 of beans were identified, the most cultivated being yellow corn and 'matambre' and mixed beans, which are used mainly for food (flour and drinks) and in some cases as medicine, with the products in surplus for sale.
- Twenty-nine races of maize have been identified in the country, 17 of which are found in the Sierra (Timothy *et al.*, 1963). In Cotacachi canton, 12 maize breeds and a high varietal mix have been identified.
- The conservation of ABD by Cotacachi's farmers is a direct consequence of its usefulness and use, especially in food, medicine and rituals. The uses vary according to the time of year what means periods of scarcity or abundance for peasant families. Each variety and each part

of a crop has its uses, in due time. Women are the owners of the valuable knowledge of the multiple uses of ABD.

- The gastronomic richness of the Andean zone of Cotacachi is reflected in around 300 preparations among soups, 'coladas', 'locros', main dishes, drinks, sauces and side dishes that have been identified throughout the territory where indigenous communities are settled, and 78 of which are corn-based dishes.
- The farmers of the Andean zone of Cotacachi still maintain traditional agricultural practices and their respective tools for soil preparation, sowing, cultural work, pest, and disease control, harvesting, products storage and seed selection, which have remained almost unchanged over millennia.
- The exchange, the delivery of 'mediano' or the 'ración (portion)', are practiced as mechanisms of reciprocity between families for accompanying in the farming tasks, but also as an indirect mechanism of seed exchange.
- In the communities of Cotacachi, traditional knowledge persists about the relationship between agriculture (biotic and abiotic factors) and the stars. It is common to take into account the phases of the moon to develop or not an agricultural activity.
- Several beliefs, legends and myths related to ABD and its relationship with nature persist in Cotacachi communities. There are beliefs related to the agricultural cycle and cultural work, breeding of domestic animals and mythological origin of crops.
- Indigenous medicine, practiced by men and women of the communities, is based on the knowledge of the use of medicinal plants that grow, cultivated or not, on the farm and in its environment. Traditional knowledge means that each plant, according to its medicinal use, has its own classification as a 'hot' or 'cold' plant; these ancestral uses of plants have contributed to their conservation. Men and women who practice indigenous medicine in Cotacachi use over 120 types of plants.

1.1 Diagnosis of elements of the 'Andean Chakra' system

1.1.1 Traditional farming practices

Bearers of knowledge

The traditional knowledge of techniques and knowledge for agricultural production is in the hands of men and women of the indigenous communities of UNORCAC, especially the elderly who maintain the farming activity as the basis of their livelihood.

Origin of knowledge

The knowledge they apply, the seeds and tools they use for agricultural activities, come from their parents and grandparents and are passed down from generation to generation.

Knowledge transfer

Traditional knowledge is transferred from one generation to the next through experiential oral communication. Parents teach their children the traditional knowledge and practices of agriculture,

which they in turn received from their grandparents; all family members are an integral part of the peasant production systems.

Importance to the community

Agricultural activities and animal breeding, which are closely related, have been and still are the livelihoods and the source of family income, especially for women and the elderly; in addition, they are related to a series of cultural expressions and practices that contribute to strengthening the family and community ties that are the basis of the identity of the population of the indigenous communities.

Sensitivity to change (threats)

From a cultural perspective, the traditional knowledge of agriculture is experiencing a significant decline. Today, young farmers are less and less familiar with the knowledge and know-how promoted by their ancestors, and it is very likely that they are introducing major changes to the farming techniques, characterized by using external inputs and basic mechanization.

The difficult conditions in which agricultural activities are carried out, marked by a small amount of land per family and the absence of water for irrigation in some cases or scarce water for irrigation in others, the devaluation of traditional agricultural production, the lack of incentives to maintain it, among other factors, means that the new generations of young communal farmers have few options for making a living from traditional agriculture, a situation that leads to migration outside the communities in search of new forms of family livelihoods, triggering a process of gradual loss of traditional agricultural knowledge and practices.

Related Elements

The most important natural element and product of the millenary management of agriculture, is the rich diversity of seeds and the related knowledge of production and use.

1.1.2 Agrobiodiversity

Bearers

The abundant ABD in the indigenous Cotacachi communities constitutes a community heritage that has been created, maintained, and used by the communal families, in especial, women who are the guardians of the ABD. The farmers in the communities are the owners of the crop diversity and maintain agriculture as their main family livelihood, despite the adverse conditions in which it is developed.

Origin of the material

Native seeds are used in the communities and come from the harvests of the previous cycle, maintaining continuous evolutionary and adaptation processes to environmental and cultural changes.

Transfer

The main source of seed is the inheritance from fathers and mothers to their children, together with traditional knowledge. Other sources of native seeds are related to various cultural and agricultural community practices and gastronomy. Some examples are: the delivery of the 'ración- portion' at harvest time, the delivery of 'medianos', the exchange of seeds, the 'barter', the 'chuchir', among others.

Importance to the community

Native agricultural biodiversity provides a wide range of benefits to local farming communities, but also to society at large. Ensuring food supply is of paramount importance, but also the timing of the crop creates a more stable vegetative cover of the soil, which prevents erosion and loss of soil nutrients, as well as a number of environmental and economic benefits to the AFC. Most native varieties have multiple uses from food, medicine to rituals, therefore, ABD is an important basis for the cultural identity of indigenous communities.

Sensitivity to change

Despite the importance of ABD for communities and the population, there are many factors that threaten the long-term conservation of traditional crops and the genetic evolution of crop diversity. The most relevant threats are: 1) migration of young people to the cities in search of job opportunities, abandoning agricultural activity, which means that native varieties are no longer sown and begins a process of ABD loss; 2) changes in eating habits, which means that traditional food is no longer eaten but replaced by foods and beverages of industrial origin, thus, leaving aside the use of native varieties, which also means that these crops are not sown; 3) the promotion of improved seeds with better yields and technology packages with agrochemicals, have displaced the native varieties and traditional agricultural practices; 4) the little valuation and lack of knowledge of the qualities and importance of native varieties, in addition to the relation with certain social strata that reduce their attractiveness for marketing and consumption.

1.1.3 Knowledge and uses in food

Bearers - support: individuals, organisation, institutions

Women are the bearers of the gastronomy knowledge. In Cotacachi communities, women in each of the families, especially those over 45 years old, are the bearers of this knowledge. This is a collective knowledge, as there are about 30 groups of women organized around the Women's Central Committee of UNORCAC, who are reassuring this knowledge and becoming the guardians of the knowledge and flavours of Cotacachi indigenous communities.

Origin of the knowledge and/or material

The knowledge about gastronomy, its diverse agricultural ingredients, the utensils used, the preparation processes, are knowledge that is passed on from one generation to the next as the legacy from their ancestors.

Transfer

The knowledge is transferred orally and by experience; in general, mothers teach their daughters in a process of learning by doing.

Importance to the community

The knowledge and enjoyment of the gastronomic wealth of the communities has been and is the basis of their food security and sovereignty and is also part of their cultural identity and religiousness. Gastronomy is invaluable, it is a symbol of family and community prestige. Also, the valuation of all this gastronomic knowledge is reflected in the spaces of commercialisation of traditional foods that constitute a source of income, especially for women.

Sensitivity to change

The traditional knowledge of gastronomy is weakened, the new generations are part of the migratory movement from the farm to the city, losing interest in acquiring this knowledge and adhering to new food patterns that leave aside the traditional flavours and knowledge. Children are greatly influenced by the media to transform their eating habits, replacing traditional food and drinks with products of industrial origin, which means that traditional recipes are losing space in the family diet.

Related Elements

The elements closely related to traditional knowledge in gastronomy are the agricultural diversity and the utensils used in the preparations.

1.1.4 Knowledge and use of 'Chakra' plants in traditional medicine

Bearers

Indigenous peoples' health practices are in place even though they have been denied the possibility of developing their ancestral knowledge and wisdom. According to studies carried out by UNORCAC, more than 300 ancestral health providers have been registered in the Andean region, including 'doulas', 'yachags', 'fregadores', 'herbs healer', 'prayers' and 'dreamers'. UNORCAC has an indigenous health programme called 'Jambi Mascaric', which has a network of health care providers who are located in the affiliated communities of the Organisation.

Origin of the knowledge and/or material

The knowledge and practice of indigenous medicine based on the knowledge of a variety of plants, have been put into practice in their daily lives by the indigenous communities of Cotacachi since ancestral times and have been inherited by generations.

Transfer

The ancestral knowledge of indigenous medicine is mainly transferred orally from one generation to the next.

Importance to the community

According to the Cotacachi Cantonal Health Plan, traditional health agents serve 8 to 30% of the population in the Andean zone. However, according to the Census of Living Conditions carried out by UNORCAC, 77% of the population in the community's resort to an ancestral health provider as primary care.

Sensitivity to change

Traditional medicine has commonly been discredited by formal health care systems, relating it with witchcraft, sorcery, and even persecution. At present, there are important efforts to interrelate the two most practical medicines, the official or western and traditional indigenous medicine, with no intention to exclude or absorb the other, but finding a health model under equal conditions. There has been a great influence on public policy by the entire indigenous movement to include the traditional knowledge into public regulations, especially indigenous medicine. However, there are always threats, the main one being the low interest of new generations in continuing with this traditional knowledge and practices.

2. Vision

Farmers in Cotacachi's indigenous communities use the richness of the diverse agricultural resources of the 'Chakras' and their traditional knowledge as a basis for their food security and livelihoods, preserving them for the country and the world.

3. Plan objective

Over the next five years, the conservation, access and use of the diverse agricultural resources of the 'Andean Chakra' and traditional knowledge will be improved as a strategic element for food security and livelihoods of indigenous communities in Cotacachi.

4. Identification of stakeholders and institutional skills

- Decentralized Autonomous Governments (DAG): Provincial Government of Imbabura, Municipal Government of Cotacachi and Parish Boards.
 - ✓ Sponsorship and financing of projects aimed at safeguarding the heritage of the 'Andean Chakra' system.
 - ✓ Inclusion of projects in the planning of the DAG that represent at least one pillar of this safeguard plan.
 - ✓ Finance possible consultancy to draw up a strategic communication plan to accompany, position, visualise and guarantee the implementation of this Action Plan.
 - ✓ Political support for the management of social organisations, especially UNORCAC and its Women's Committee.
- Union of Peasant and Indigenous Organizations of Cotacachi
 - ✓ Plan the programming of projects suggested in this Plan.
 - ✓ Manage political, human, material and economic inputs to achieve the objectives.
 - ✓ Strengthen the organization and create expectations and interest in the community members to take on this plan. Active entities in the development of the plan and main guardians of the intangible heritage of the 'Chakra' production system.

If funding is secured to develop a Strategic Communication Plan, representatives of these organizations should take on this task.

- National Institute for Cultural Heritage
 - ✓ As the institution in charge of directing the declaration of intangible heritage at the national level and requesting the same designation at the international level, as part of its competencies, it could request the declaration of agro-biodiverse intangible heritage for Cotacachi canton, providing the relevant information.
 - ✓ Considering the Institute's analysis of this request and the documentation provided, adjustments are made and an in depth research with institutional and economic support. If the information required by the Institute is available, a deadline will be set for the declaration.
- Ministry of Culture and Heritage

- ✓ Ensure the implementation of the current Ecuadorian Law of Culture. Prior to the analysis of the relevant articles on community law and the continuation of their practices, this Ministry can make resolutions at the national level, similar to a municipal ordinance where the scope changes.
- Ministry of the Environment
 - ✓ Include the Andean zone of Cotacachi canton as a priority in the environmental management of this Ministry.
 - ✓ Include environmental quality and a list of managers of usable inorganic and special waste in flagship projects.
- Ministry of Education
 - ✓ Generate new content or include intercultural information in existing content.
 - ✓ Generate and use the expression identified as the 'Andean Chakra' system at a strategic level, and from its components, spread the knowledge in schools and colleges.
 - ✓ Generate spaces in schools run by this Ministry in Cotacachi, to set up a workshop on Kichwa language, agricultural knowledge, traditional food preparation workshops, among others.
 - ✓ Request a space or visibility of the 'Andean Chakra' production system and its components, in 'The Educational Hour' programme that is broadcasted nationwide.
- Ministry of Agriculture and Livestock - AFC Undersecretary.
 - ✓ Promote the AFC.
 - ✓ Promote agro-ecological production.
 - ✓ To support the short loops for rural marketing.
 - ✓ Strengthen traditional knowledge.
 - ✓ To project agricultural producers - spaces for marketing and exchange of products at national level.
- National Institute of Agricultural Research
 - ✓ Conserving and using ABD.
 - ✓ Improving seed productivity through plant breeding.
 - ✓ Seeds restoration.
 - ✓ Managing the National Germplasm Bank of the Ecuador.
- Ministry of Tourism
 - ✓ To include community service providers from Intag and the Andean area in training and refreshing programmes on tourism.
 - ✓ Include the 'Andean Chakra' in national and global advocacy programmes.
 - ✓ Universidad Técnica del Norte Research and characterize local varieties.
 - ✓ Inventorying ABD and traditional knowledge.
 - ✓ Research on ABD valuation.

5. National and local laws related to the Action Plan

This Plan is aligned with the following national and local laws:

- ✓ Constitution of the Republic of Ecuador.
- ✓ Organic Code of Territorial Organisation, Autonomy and Decentralisation.
- ✓ Organic Code of the Social Economy of Knowledge, Creativity, and Innovation.
- ✓ Organic Law of the Food Sovereignty Regime.
- ✓ Organic Law of Culture.
- ✓ Organic Law of Agrobiodiversity, Seeds and the Promotion of Sustainable Agriculture.
- ✓ Ordinance to Preserve, Maintain and Disseminate the Cultural Heritage of Cotacachi canton.
- ✓ Ordinance that Protects and Promotes Agrobiodiversity, the Knowledge, Know-how and Cultural Manifestations associated with it, of Cotacachi canton.

6. National strategies and policies aligned with the Action Plan

The Plan is aligned with the strategies and policies of the National Biodiversity Strategy 2015-2030:

- Strategic Objectives 3: to distribute the benefits of biodiversity and associated ecosystem services fairly and equitably, considering gender and cross-cultural specificities.
 - ✓ Policy 12.- Promote the management, use and complementary conservation (ex-situ – in-situ) of ABD by promoting sustainable agro biodiverse production systems in Ecuadorian territory.
 - Outcome 9. Ecuador ensures the sustainable management of agricultural, agroforestry and forestry production systems, using clean technologies and energy, ensuring the conservation of biodiversity.
 - Outcome 15: Ecuador makes sustainable use of its genetic resources, which are linked to changes in the production matrix and food sovereignty.
 - Target 15.3: two (2) Bio-knowledge Centres (CBDA) have been implemented in selected provinces for the conservation of local ABD.
 - Target 15.4: increase by 10% in agro-biodiverse production systems that integrate and enhance the knowledge and experience of women and men of all peoples and nationalities.
 - Outcome 18: Ecuador has established a regime for the protection, preservation and promotion of traditional knowledge, ancestral know-how and traditional cultural expressions relevant to the conservation and sustainable use of biodiversity.

7. Action Plan

STRATEGIC PILLAR	AREAS OF THE GIAHS TO BE STRENGTHENED	ACTIONS	INDICATORS	IMPLEMENTATION UNTIL 2022	TIME FRAME	BUDGET USD	STAKEHOLDERS INVOLVED
Conservation of Agrobiodiversity - ABD	Food security Agrobiodiversity	1. Establish a baseline of the state of conservation of ABD. Definition of a list of varieties at risk.	A database on the state of conservation of ABD. A list of varieties at risk.	The state of conservation of ABD has been documented. There is a list of varieties at risk.	Until 2022	50.000	Subnational autonomous decentralized government (GAD, in Spanish) of Cotacachi Ministry of Agriculture - MAG (in Spanish) INIAP UTN FAO UNORCAC
		2. Restoration of the ABD in the "chakras" through the restitution of native seeds.	500 farmers from the Indigenous communities of Cotacachi reconstitute 10 seed varieties of native crops	Seed restitution of 10 varieties at risk of maize and beans has been made to 1,000 farmers in the 2019-2020-2021 agricultural cycles.	Until 2026		
		3. Strengthening of the local seed system: seed fair, conservationist farmers.	An annual regional native seed fair is held	The seed fair has been held in the years 2019, 2021, 2022.	Until 2027		
		4. Strengthen the community seed bank.	A community seed bank is working	Bioknowledge Center and seed bank are running	Until 2027		
		5. Establish an ABD monitoring system.	An established monitoring program.	Not implemented	Until 2025		
		6. Promote complementary <i>in situ</i> – <i>ex situ</i> conservation.	A UNORCAC- National Germplasm Bank cooperation agreement	Not implemented	Until 2027		

Protection and reaffirmation of ancestral knowledge linked to the <i>Andean Chakra</i> .	Agrobiodiversity Local and traditional knowledge systems Cultures, value systems and social organizations	1. Research, systematization, and dissemination of traditional knowledge.	An inventory of traditional knowledge carried out	Inventory was carried out	Until 2023	25.000	UNORCAC INIAP Subnational autonomous decentralized government (GAD, in Spanish) of Cotacachi GAD Imbabura Ministry of Culture Ministry of Agriculture - MAG (in Spanish) FAO
		2. Strengthen the traditional knowledge transmission systems.	An implemented traditional knowledge dissemination plan		Until 2024		
		3. Strengthen traditional practices and cultural manifestations related to the " <i>Andean Chakra</i> ": Agricultural techniques, festivals, celebrations, rituals, stories, and others.	At least 6 events that recover annual cultural manifestations carried out	Seed festival, Inty Raymi, take place every year	Until 2027		
		4. Implementation of the Bioknowledge Center of the Cotacachi canton.	A running bioknowledge center	Bioknowledge center is running	Until 2023		
		5. Holding the meeting of cultural manifestations.	An annual meeting	Not implemented	Until 2027		
		6. Training in the regulations for the protection of ancestral knowledge.	An annual workshop	Not implemented	Until 2027		
		7. Promote the development of biocultural protocols.	At least one protocol	Not implemented	Until 2025		
		Sustainable use	Agrobiodiversity Food security and livelihoods	1. Characterization of local varieties and creation of an information data base.	A database with information on local varieties		

	Local and traditional knowledge systems Cultures, value systems and social organizations	2. Promote short commercialization circuits for the production of the " <i>Andean Chakra</i> ".	An agro-diverse peasant fair running weekly	Peasant fair is running	Until 2027		UTN Subnational autonomous decentralized government (GAD, in Spanish) of Cotacachi MIPRO Ministry of Tourism GAD Imbabura FAO
		3. Promote gastronomic fairs.	Two annual gastronomic events	Gastronomic fairs are held every year	Until 2027		
		4. Support value-added bio-enterprises.	Two peasant companies with good manufacturing practice (GMP) certification	Not implemented	Until 2025		
		5. Research the development of new value-added products in the " <i>chakra</i> " production	Two new value-added products developed	Not implemented	Until 2025		
		6. Support agrotourism initiatives linked to the " <i>Andean Chakra</i> ".	A rural tourism operator is running	Is being developed	Until 2023		
		7. Research and assess ABD and traditional knowledge in the biological, social, cultural and landscape spheres.	Research was carried out	Not implemented	Until 2023		
Education, Training and Awareness-raising.	Cultures, value systems and social organizations	1. Implementation of school projects with the " <i>Andean Chakra</i> " theme.	At least 10 school projects implemented	School projects were implemented	Until 2026	20.000	

	Food security and livelihoods	2. Training institutional technicians in the "Andean Chakra" as a GIAHS	At least 20 trained technicians	Not implemented	Until 2024		Subnational autonomous decentralized government (GAD, in Spanish) of Cotacachi INIAP UTN FAO
		3. Design and implement awareness-raising campaigns and collective awareness on the value of ABD, rational water management and solid waste management.	A campaign in media and social media.	Not implemented	Until 2025		
		4. Promotion of the nutritional and medicinal benefits of local ABD through publications and promotional campaigns in the media, social media and other alternative means.	A promotional campaign	An annual campaign implemented	Until 2027		
		5. Promotion of the consumption of products based on local ABD.	A promotional campaign	Promotion implemented every year	Until 2027		
		6. Training in the production of bio-inputs from organic waste.		Not implemented	Until 2024		
Public policy advocacy	Agrobiodiversity Food security and livelihoods	1. Incorporate GIAHS criteria into the Cotacachi Canton Land Use Management Plan.	Land use plan updated.	Not implemented	Until 2024	5.000	UNORCAC Subnational autonomous decentralized

	Local and traditional knowledge systems	2. Put into practice the ordinance of the municipality of Cotacachi for the conservation and promotion of ABD and traditional knowledge.	Cotacachi municipal ordinance implemented	Not implemented	Until 2024		government (GAD, in Spanish) of Cotacachi INIAP Ministry of Agriculture - MAG (in Spanish)
	Cultures, value systems and social organizations	3. Promote the recognition of ABD as a conservation zone and its financing of the "Andean Chakra" of Cotacachi	A declared conservation zone.	Not implemented	Until 2026		
	Landscape	4. Search for strategies to provide access to land for Indigenous communities and manage the enforcement of the land use ordinance of the Cotacachi canton	An established strategy	Not implemented	Until 2027		
		5 Manage the enforcement of the solid waste management ordinance in rural communities.	Cotacachi municipal ordinance implemented and with social monitoring	Implemented	Until 2027		
		6. Manage the creation of an authority within the Ministry of Agriculture that is responsible for the support and management of the GIAHS in Ecuador.	Ministerial agreement	Not implemented	Until 2027		

This conservation plan is the result of a projection of the work already carried out by the communities, organisations, and community enterprises of Cotacachi that, in the conservation of the 'Andean Chakra' system, identified the vital space for the environmental, social and economic sustainability of families, while representing a living and dynamic expression of the Andean cultural identity of the Kichwa people in Cotacachi.

8. Plan monitoring and control

The Plan will be monitored and controlled by MAG, INIAP, the Municipality of Cotacachi, in the actions that are within their competence. The supervision will be carried out in a participatory manner with the social actors in the territory.



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ANNEX



Annex 1. Local process to generate a policy for the conservation of ABD and traditional knowledge of the Kichwas communities of Cotacachi.

UNORCAC, in special, its Women's Central Committee, on its own initiative, has carried out practical actions to conserve and value ABD and the traditional knowledge, by promoting native crops, seed fairs, identification of conservation farmers, traditional food fairs, school awareness activities, indigenous medicine, systematisation of ABD and gastronomy. The municipality of Cotacachi has supported some of these activities; however, there is no public policy to support these actions.

This set of actions carried out by UNORCAC, together with the communities and organized groups, was recognized by the UNDP in September 2008, awarding the Equator Prize that recognizes community actions that illustrate the extraordinary achievements in poverty reduction through the conservation and sustainable use of ABD. UNORCAC's proposal was selected from over 300 initiatives submitted from five continents and the recognition was presented at the 2008 World Conservation Congress held in Barcelona, Spain.

In its strategic plan 2008–2018, UNORCAC has proposed, as a strategy to conserve and value the expressions of heritage, the declaration of cultural heritage of ABD to the territory of their communities, as a mechanism to conserve and enhance tangible and intangible natural assets, related to agriculture and ABD.

In 2013, the Provincial Government of Imbabura, together with UNORCAC, developed the *knowledge route* for tourism. UNORCAC is responsible for developing the attraction linked to traditional knowledge related to agriculture, indigenous medicine, gastronomy and ABD, as a recognition of the work of Cotacachi communities.

In August 2015, the peasant communities of UNORCAC, especially the organized women supported by the rural parish councils of the Andean zone of Cotacachi, presented a community manifesto to the mayor of Cotacachi asking that the municipality declare its territory a cultural heritage of ABD.

In October 2015, the Assembly of Cotacachi Cantonal Unity, at its annual summit, issued a resolution to *Support the declaration of the indigenous and peasant community's territories of UNORCAC as cultural heritage of ABD, being a strategy for the conservation and related ancestral knowledge.*

In November 2015, the territory of the UNORCAC communities is recognized by the Ministry of Heritage of Ecuador and FAO as a National Ingenious Agricultural Heritage System.

In this context, UNORCAC gathered available information on the subject and handed it over the municipality of Cotacachi to support the declaration request.

In the participatory construction of the Cotacachi Land Management and Development Plan 2015-2030, UNORCAC proposed that the declaration of cultural heritage of ABD be incorporated into the municipal management planning. This request was accepted and is now part of the municipality's regulatory agenda that has to be promulgated.

On 19 May 2019, the DAG of Cotacachi canton promulgated the Ordinance that protects and promotes ABD, knowledge, know-how and cultural expressions associated with it.