Pilot Project: Integrating freshwater data into sector-wide decision making to improve the protection and restoration of freshwater ecosystems

Marapa – San Francisco River Basin Action Plan

Argentina, 2022

Content

Acronyms

AAPRESID. Asociación Argentina de Productores de Siembra Directa *[Argentine Association of Direct Sowing Producers]*

Arg Cap Net. Red Argentina de Capacitación y Fortalecimiento en Gestión Integrada de los Recursos Hídricos *[Argentine Network for Capacity Development in Integrated Water Resources Management]*

Catamarca. Provincia de Catamarca *[Catamarca Province]*

CCIRS-D. Comité de Cuenca Interjurisdiccional del Río Salí – Dulce *[Interjurisdictional Basin Committee of the Salí – Dulce River]*

CCyC. Código Civil y Comercial *[Civil and Commercial Code]*

CFI. Consejo Federal de Inversiones *[Federal Investment Council]*

CM-SF. Cuenca del río Marapa San Francisco *[Marapa – San Francisco Basin]*

CAN. Constitución de la Nación Argentina *[Constitution of the Argentine Nation]*

COFEMA. Consejo Federal de Medio Ambiente *[Federal Council of the Environment]*

COHIFE. Consejo Hídrico Federal *[Federal Water Council]*

COHINOA. Consejo Hídrico del Noroeste Argentino *[North Western Water Council]*

ConBO-f. Consorcio de Productores de Bañado de Ovanta, en formación *[Bañado de Ovanta Producers' Consortium, in formation]*

ConEA. Consorcio de Productores El Abra *[El Abra Producers' Consortium]*

CONICET. Consejo Nacional de Investigaciones Científicas y Técnicas *[National Council for Scientific and Technical Research]*

CRS-D. Cuenca del río Salí Dulce *[Salí – Dulce River Basin]*

DByANP. Dirección de Biodiversidad y Áreas Naturales Protegidas, Catamarca *[Directorate of Biodiversity and Natural Protected Areas, Catamarca]*

DFFSyS. Dirección de Flora, Fauna Silvestre y Suelos de Tucumán *[Directorate of Flora, Wildlife and Soils, Tucumán]*

DNGAAyEA. Dirección Nacional de Gestión Ambiental de Agua y los Ecosistemas Acuáticos *[National Directorate of Environmental Management of Water and Aquatic Ecosystems]*

DPA. Dirección Provincial del Agua, Tucumán *[Provincial Water Directorate, Tucumán]*

DPSIR. Driver-Pressure-State-Impact-Response Framework

DRRHH. Dirección de Recursos Hídricos, Tucumán *[Directorate of Water Resources, Tucumán]*

FEE. Freshwater Ecosystems Explorer

FAdA. Foro Argentino del Agua (GWP Argentina) *[Argentine Water Forum]*

GTCSF. Grupo de trabajo de la Cuenca del Río Marapa- San Francisco *[Work Group of Marapa - San Francisco River Basin]*

GLC. Grupo Local de Coordinación *[Local Coordination Group]*

GWP: Global Water Partnership

INA. Instituto Nacional del Agua *[National Water Institute]*

MAEyMA. Ministerio de Agua, Energía y Medio Ambiente, Catamarca *[Ministry of Water, Energy and Environment, Catamarca]*

MAyDS. Ministerio de Ambiente y Desarrollo Sostenible de la Nación *[National Ministry of Environment and Sustainable Development, Argentina]*

ORSEP. Organismo de Regulación de Seguridad de Presas *[Regulatory Organization for the Safety of Dams]*

REMAQUA. Red de Evaluación y Monitoreo de Ecosistemas Acuáticos *[Aquatic Ecosystem Monitoring and Assessment Network]*

SDG. Sustaintable Development Goal

Sec.Ag. Secretaría de Agua, Catamarca *[Secretariat of Water, Catamarca]*

SEMA. Secretaría de Estado de Medio Ambiente, Tucumán *[State Secretariat for the Environment, Tucumán]*

SdE. Provincia de Santiago del Estero *[Province of Santiago del Estero]*

SEGPyP. Secretaría de Estado de Gestión y Planeamiento, Tucumán *[State Secretariat for Management and Planning, Tucumán]*

SINARAME. Sistema Nacional de Radares Meteorológicos *[National Meteorological Radar System]*

SIyPH. Secretaría de Infraestructura y Política Hídrica de la Nación *[National Secretariat of Infrastructure and Water Policy]*

SSRRHH. Sub-Secretaría de Recursos Hídricos, Tucumán *[Under Secretariat of Water Resources, Tucumán]*

Tucumán. Provincia de Tucumán *[Province of Tucumán]*

1. Introduction

The pilot project in Argentina is "Integrating freshwater data into sector-wide decision making to improve the protection and restoration of freshwater ecosystems" and is coordinated by FAdA (Argentine Water Forum, GWP Argentina) and Arg Cap-Net (Argentine Network for Training and Strengthening in Integrated Water Resources Management), together with the National Directorate of Environmental Management of Water and Aquatic Ecosystems as Focal Point of SDG 6.6.1 and has the collaboration of the National Directorate of Federal Coordination and Water Policy, as a strategic partner.

Ecosystems possess a great capacity to interact with the surrounding environment and to maintain certain conditions stable, allowing them to provide important ecological services and to resist disturbances and climate change (Lovelock, 1993; Altesor et al., 2011; Jobbagy, 2011).

The "Formulation of the Action Plan for the Marapa - San Francisco River Basin" is a joint interprovincial work involving the Secretariats of Water and Environment (under the Ministry of Water, Energy and Environment of Catamarca), and the State Secretariat of Environment (under the Ministry of Productive Development of Tucumán). Some 120 people from the national, provincial, academic, scientific, social, productive and environmental NGOs participated in the workshops and agreement meetings held during February and March 2022.

The Marapa - San Francisco river basin (almost 7,000 km^2) is part of the Salí - Dulce river basin. The latter has an extension of more than 92,000 km^2, has a special interprovincial Commission (CCIRS-D) and a Basin Master Plan, approved in 2020.

In Argentina, the integration of data for decision-making and action plans is a complex issue, due to the fact that the information is scattered, unpublished and access is often conditioned because a considerable volume of data is in paper format (Lucatelli Gómez, 2017).

1.1. General location of the area

Northwest Argentina is characterized by river basins with extensions of tens of thousands of square kilometers (HydroBasins 5: https://map.sdg661.app/#!; Figure 1a).

One of the basins with the largest extension is the Salí - Dulce River Basin (CRS-D) with 92,809 km2 (Díaz Rueda, 1983; Lucatelli Gómez, 2017; http://dimla.gob.ar/info_cuenca.php?id_cuenca=7) and home to more than 2.5 million people (https://www.argentina.gob.ar/ambiente/agua/cuencas/salidulce) (Figure 1b).

a.

b.

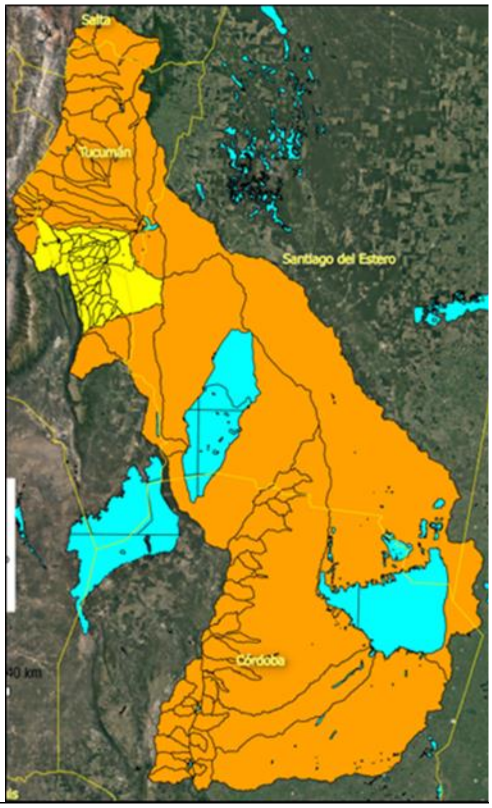


Figure 1. Salí - Dulce river basin (CRS-D). a: distribution and extension of the basins of central and northern Argentina, highlighted in dark light blue CRS-D; b: delimitation of the sub-basins that compose CRS-D (INA, in light blue the natural and artificial permanent and temporary water bodies, in yellow the Marapa - San Francisco sub-basin.

Among the sub-basins that compose it, is that of the Marapa - San Francisco (Figure 1b, in yellow). The Marapa - San Francisco River Basin (CM-SF) reaches 6,793 km^2 (Figure 2) and corresponds to 7.3% of the CRS-D. The contributing flow to the CRS-D is 64.6 Hm^3 annually (Avellaneda et al., 2016, Marapa River; Isuani, 2022, San Francisco River).

The comparison of the extent of the CM-SF defined by Guido et al. (2022; includes field control) differs from that proposed in the Platform Hydrobasin level 7 SDG6.6.1 (https://map.sdg661.app/); fundamentally because the Platform Hydrobasin 6440184 includes within it a microbasin without defined runoff, with slopes towards the Termas de Río Hondo reservoir and located east-southeast of the Marapa river. At a more detailed scale, the differences between the delimitations proposed by Guido et al. (2022) and Platform SDG661 (HydroBasins level 8) are more marked and differ in shape and extension in the plain area.

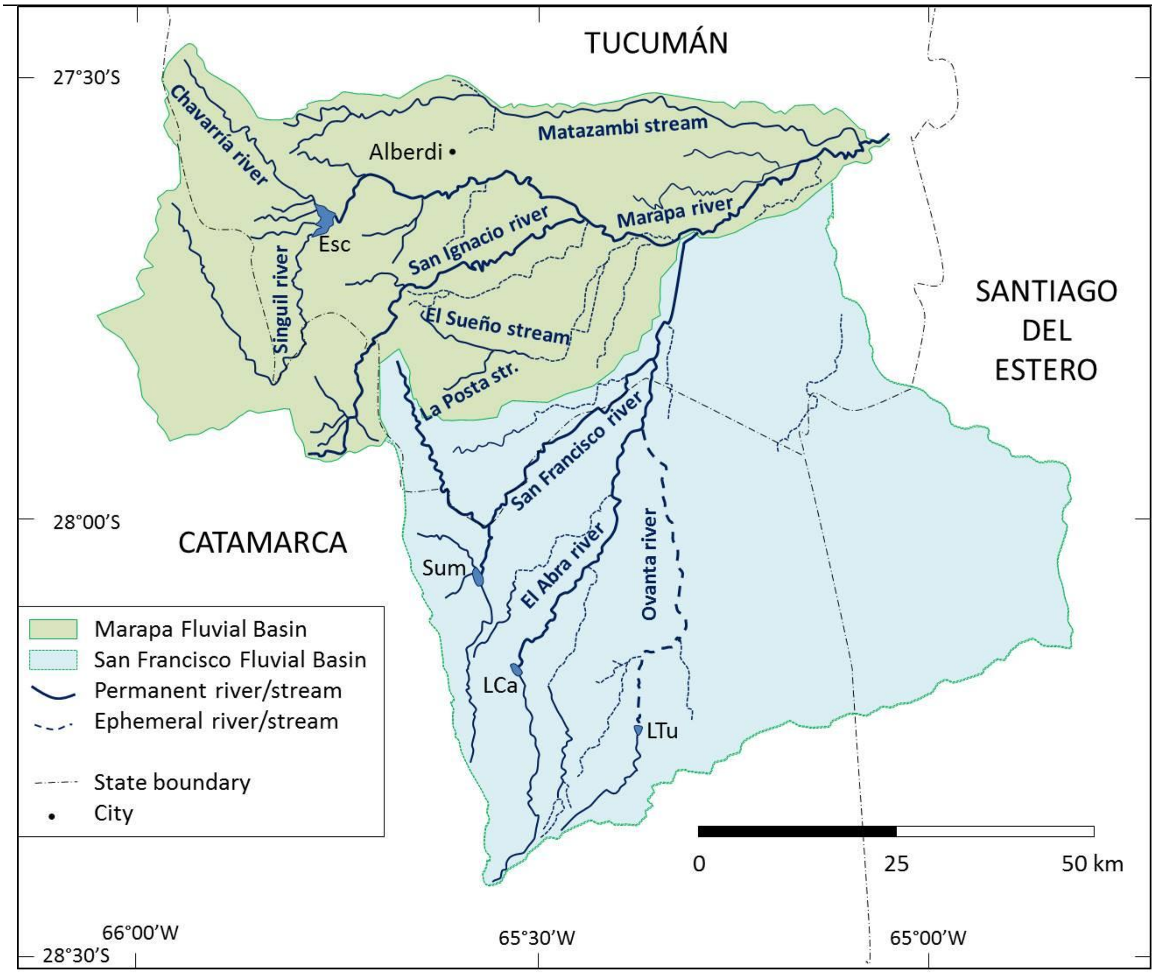


Figure 2. Extension of the Marapa - San Fransisco basin (CM-SF) in 2021 (see text for discussion) and of the main hydrographic network (modified from Guido, 2019). Reservoirs: Esc: Escaba; Sum: Sumampa; LCa: Las Cañas; LTu: Las Tunas.

1.2. Evolution of the Marapa – San Francisco Basin

This hydrological unit is complex and dynamic, mainly due to the expansion of its surface because of the accession of new sub-basins in the last 6 years. This increase in surface area with the consequent increase in liquid and solid flow is due to anthropic modifications: channeling, diversions and connections of river courses that previously infiltrated in wooded wetlands in the middle and lower basin of the CM-SF; product of the change in land use from native forest to agriculture since approximately 1996.

The current hydrographic situation began to be generated in April 2015 when the San Francisco River, previously relict, began to flow as a permanent river in the lower basin of the Marapa River. The El Abra River, also relict, is channeled into the middle basin and in 2017 becomes a permanent tributary of the San Francisco River. Between 2017 and 2019, the excesses of the Ovanta River are channeled to the north-northwest and flow into the El Abra River (mainly during the summer season), abandoning the ephemeral segment that developed to the north-northeast through the Taco Ralo wetlands. Between 2019 and 2020, El Suncho stream flows directly along the left bank of the San Francisco River. Between 2017 and 2020, La Posta and El Sueño creek channels reach the Marapa River on its right (south) bank, Figure 3.

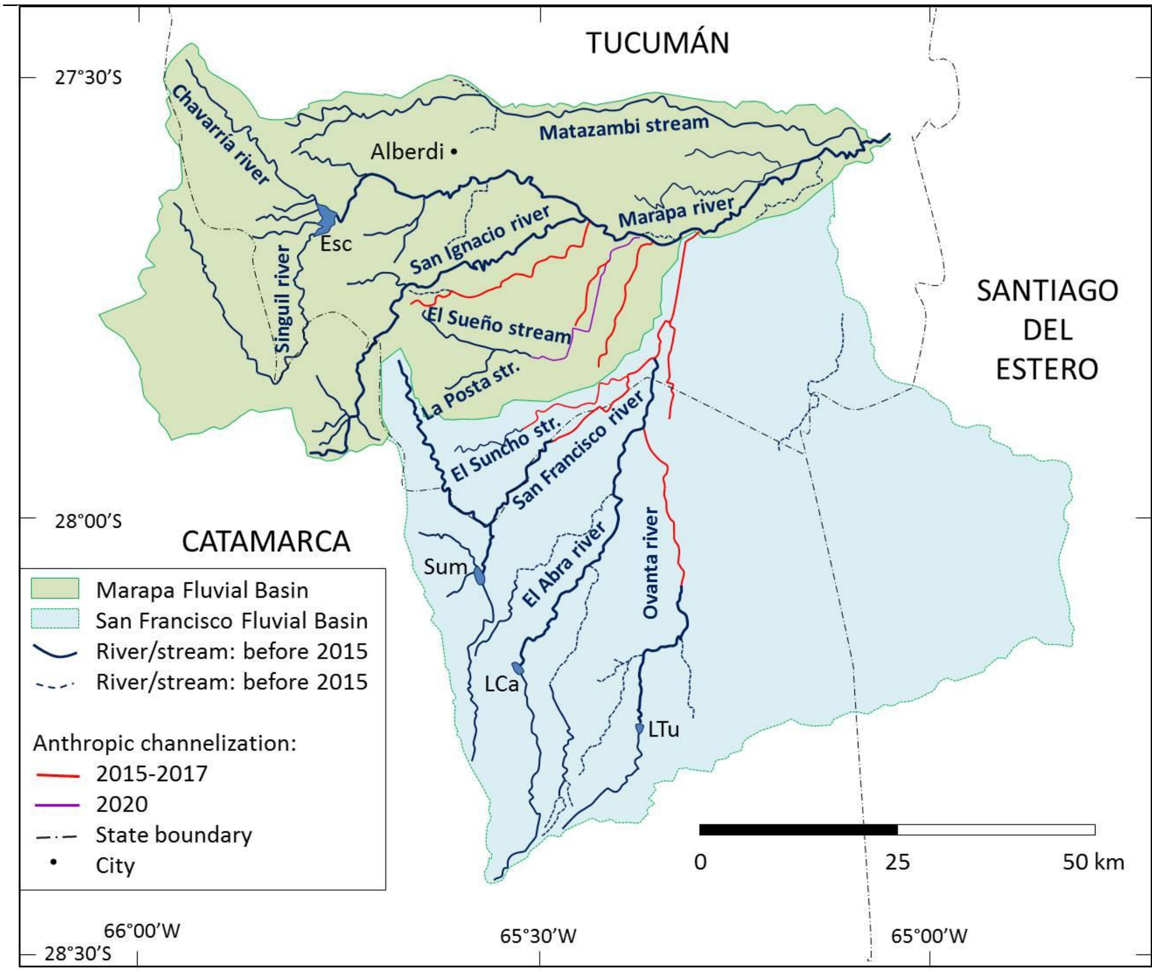


Figure 3. Evolution of the hydrographic network from 1984 to the present. The most significant changes occurred in the San Francisco River Basin in 2015 and 2017, in the Marapa River Basin in 2019 (confluence of the Marapa and San Francisco rivers) and in 2021. In blue line the rivers that had almost no modifications since 1984.

Since the 1970s, there has been an increase in precipitation, mainly in the pedemontane area (increase between 120 and 190 mm/year), recorded both regionally and locally (Toledo et al., 2001, Minetti and González, 2006; Bazzano, 2019).

This new situation produces, as of 2017, an additional discharge flow tributary from the San Francisco River to the lower Marapa River basin, 24 Hm^3/year with about 80,000 tn/year as sediment load (Isuani, 2022; Table 1).

In 1984, forests occupied 62% of the riverbanks (including the Marapa river basin), up to a distance of 500 m from the rivers. By 2010, that area had decreased 40% after approximately

24,000 ha (mainly dry forest) were converted to agricultural land (Díaz Gómez and Gasapari, 2017).

The convergence of natural and anthropogenic causes produced the acceleration of the hydrological process of widening by lateral migration, bank erosion (Table 1), loss of riparian forest and destabilization of ravines.

year	wide (m)	gully height (m)	Sediment transported	water flow rate
2005	12	1	No transport	No flow
2016	62	2.5	No data	No data
2017	169	6	No data	No data
2021	178	8	80.000 tn/year [1]	24 Hm^3/year [1]

Table 1. Morphometric data and flow rates of the San Francisco River, downstream of State Route 334 (27°48'28.42 "S - 65°21'13.83 "W). 1 Water and solid flow rate measurements: May 2020 - April 2021 (Isuani, 2022).

Between 2017 and 2021, the increase in gully height with relative stability of channel widths could be associated with headwater erosion and adaptation of river equilibrium profiles to channels located at lower topographic elevations.

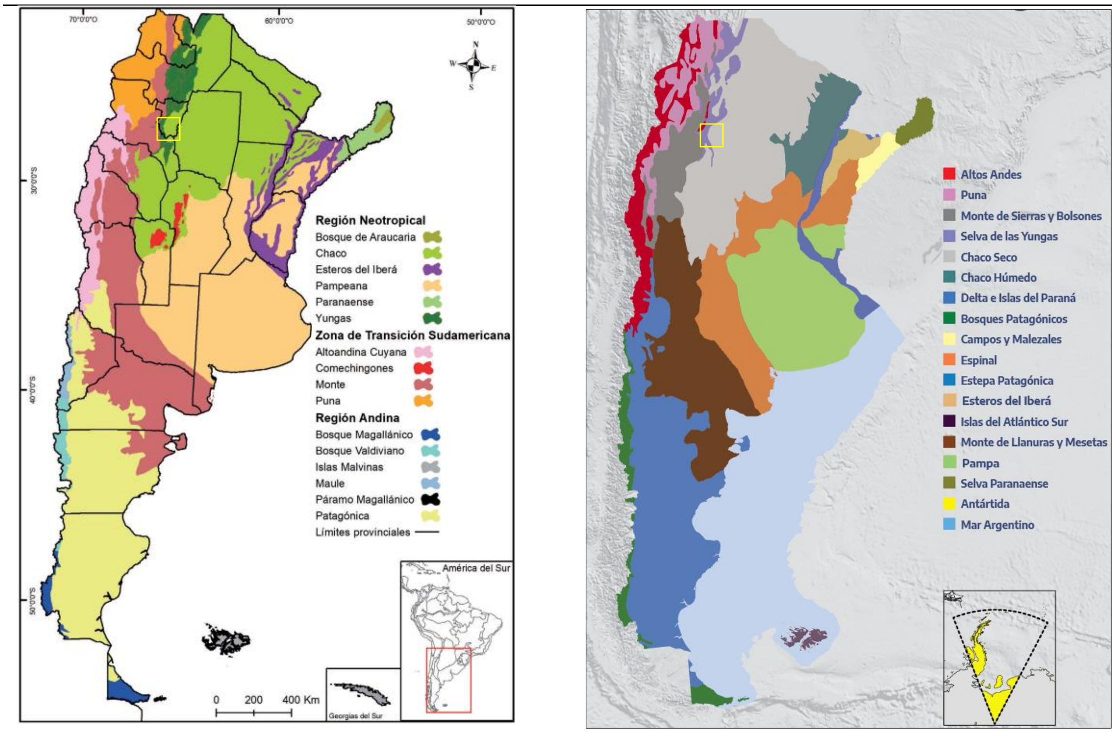
2. Initial analysis

2.1. Biogeographic context

The biogeographic scheme can be characterized by biogeographic provinces that correspond to areas where the distribution of two or more endemic species overlap and have physiographic and ecological identity; or ecoregions (bioregions) that are geographic units with characteristic flora, fauna and ecosystems. Arana et al. (2021) recognize in the Marapa - San Francisco River Basin two biogeographic provinces: Yungas and Chaco; while Pero et al. (2020) identify, with a similar geographic distribution, two ecoregions: Yungas and Chaco Seco. The main difference is that biogeographic provinces consider the identification and evolution of endemic species considering vicariant events (geological or climatic), while ecoregions are based on the identified (present) characteristics of the physical and biological environment.

Figure 4 shows the distribution of the Biogeographic Provinces of Arana et al. (2021, Figure 4a; the yellow box shows the area of the Marapa - San Francisco River Basin) and the Ecoregions (Figure 4b) taken from the page of the Ministry of Environment and Sustainable Development (https://www.argentina.gob.ar/ambiente /parquesnacionales/educacionambiental/ecorregiones; the yellow box shows the study area).

The Yungas Forest (Figure 4a, b and c) is a mountain rainforest belt ranging between 400 and 3000 m; the climate is warm and humid, with mean annual temperatures between 14 and 26°C and precipitation between 1000 and 2500 mm/year. The Chaco Seco (Figure 4b and d) is an extensive plain with mean annual temperatures between 19 and 24°C and mean precipitation varies between 400 and 900 mm/year, with dry forests and segregated grasslands (Pero et al., 2020) and in the Marapa - San Francisco river basin it occupies the plain and the Guasayán mountain range in Santiago del Estero (below 500 m), (Figures 4c, d and 5).



a. b.

Figure 4. Biogeographic context. a. Biogeographic provinces of Arana et al. (2021); b. Ecoregions (Ministry of Environment and Sustainable Development, 2022). The yellow box corresponds to the location of the Marapa - San Francisco River Basin.

General Physiography

From the point of view of the physical environment (Figure 5), the region combines areas of high slopes to the west and south, with areas of very low slopes and even topographic lows to the east and northeast. In the Tucumán sector, Cumbres de Narváez, Santa Ana and sierra de Humaya, the general slope values are usually between 10° and 20° (18 to 37%), while in the piedmont area the values are in the order of 2° (~5%) and gradually decrease to 1% towards the east and east-northeast, with values below 0.5% in the surroundings of the Río Hondo reservoir (Figure 5).

The main climatic types correspond to dry steppe, warm temperate with dry winter and dry high mountain climate (Minetti and González, 2002).

c. d.

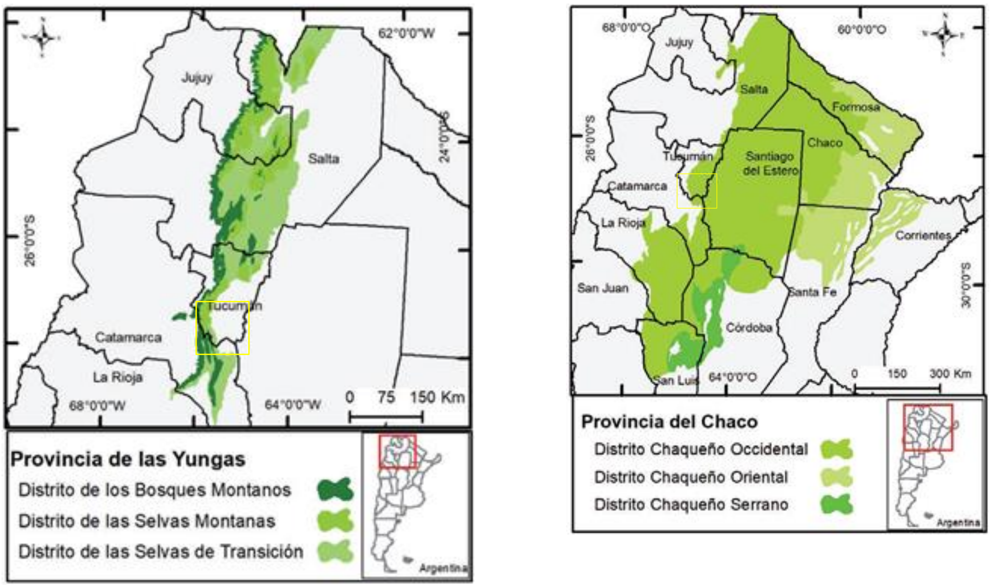


Figure 4 (continued). Biogeographical context. c. Distribution of the Yungas and its different districts; d. distribution of the Chaco province, in this case the Marapa - San Francisco basin area corresponds to the Western Chaco district. The yellow box corresponds to the location of the Marapa - San Francisco River Basin (after Arana et al., 2021).

The rainfall curves for the period 1930-2014, both for Tucumán and Catamarca, show for Tucumán increases from the 1970s between 119 mm and 189 mm per year above the average for the period prior to 1970 (Toledo et al., 2001).

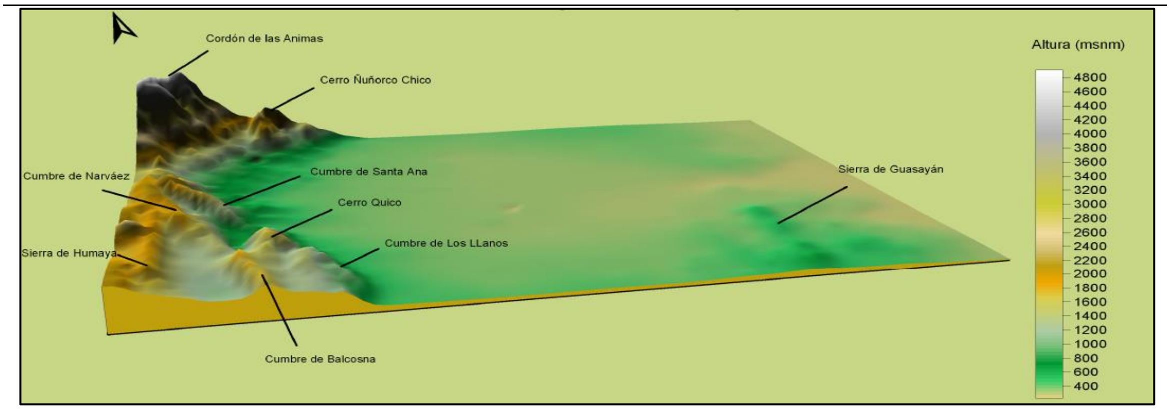


Figure 5. 3D model of the area of the Geological Hazard Map, Concepción - 2766IV (after Fernández and Lutz, 2006). The western sierras form very effective physiographic barriers to the humid Atlantic winds.

2.2. Legal and institutional context

The Argentine Nation adopts for its government the Representative, Republican and Federal form (art. 1: CNA, 1994). It is Representative because the representatives of the people govern; it is Republican because the representatives are elected by the people through suffrage and because there is a division of branches (Executive, Legislative and Judicial) and a written CNA is adopted; it is Federal because the Provincial States retain their autonomy, despite being united under a common government (National Government). The three branches control each other to guarantee decentralization. It has a democratic regime and a presidential system of government (https://www.casarosada.gob.ar/nuestro-pais/organizacion). It follows from the above that the administrative and legal organization in Argentina is decentralized and delegates broad responsibilities and rights to the provincial states.

Legal aspects

Regarding the Pilot Project and the Formulation of the Action Plan, article 41 of the CNA ensures individual rights for human development and productive activities in a healthy, balanced and suitable environment that satisfies current needs without compromising the needs of future generations, and establishes the obligation to preserve the environment. Based on this, and taking into account what has been mentioned about the dominion of the provinces or the Nation over the native natural resources present in their territory (art. 124, see Introduction), there are specific legislations according to the location of the resource, although common general criteria are considered. Figure 6 summarizes the basic legal structure.

Administrative organization

Regarding environmental and water issues, in Argentina there are administrative instances consistent with the decentralized structure of government and the autonomy of the provinces.

According to the Civil and Commercial Code (CCyC) of Argentina, the administrative organization contemplates the possibility of acting as: 1) *a public legal entity* (art. 146 of the CCyC: the national, provincial and municipal states, the City of Buenos Aires, the autarchic entities and organizations to which our law assigns such character, the foreign states and organizations) and 2) *a private legal entities* (art. 148 of the CCyC): corporations, civil associations and simple associations, foundations, churches and religious communities, mutual associations, cooperatives, condominiums, and all others contemplated in our legislation).

In this sense, the administrative organization related to natural resources (environment and water, in this case) is made up of national and provincial state agencies (with different hierarchies: ministries, secretariats, undersecretaries and directorates) and other public legal entities, for example: the Federal Council for the Environment (COFEMA) and the Federal Water Council (COHIFE).

COFEMA was created in 1990 and recognized in 2002 by the General Environmental Law (26,575), addresses environmental problems and solutions throughout the national territory and coordinates the development of environmental policy among the Member States.

The COHIFE, created in 2004, is a federal body for dealing with global, strategic, interjurisdictional and international aspects of water resources. Among other functions, its purpose is to promote the harmonious and comprehensive development of the country in the field of water resources within the framework of the Guiding Principles of Water Policy of the

Argentine Republic, participating in the formulation and strategic monitoring of the National Water Policy for the purpose of an integrated management of water resources, respecting the original domain over these resources held by the Argentine provinces.

In this administrative structure there is a referent that allows an additional link between the national and provincial states, the Interjurisdictional Basin Committees. They are made up of representatives of the autonomous jurisdictions. Their objective is to reach agreements, which must then be endorsed by the provincial governments: the exchange of hydrometeorological information, the prioritization of problems and opportunities of interjurisdictional scope, the design and organization of the implementation of actions related to the prioritized issues (https://www.argentina.gob.ar/obras-publicas/hidricas/comites-de-cuencas).

The Interjurisdictional Basin Committee of the Salí - Dulce River (CCIRS-D; see Figure 1b) was created in 1971; from 2007 it has a new Interjurisdictional Treaty ratified by the five provinces and the Salí - Dulce River Basin Master Plan is being implemented (see 4. Salí - Dulce River Basin Master Plan, in implementation).

Figure 7 shows the basic structure of the administrative organization of the environment and water resources related to the Marapa - San Francisco River Basin.

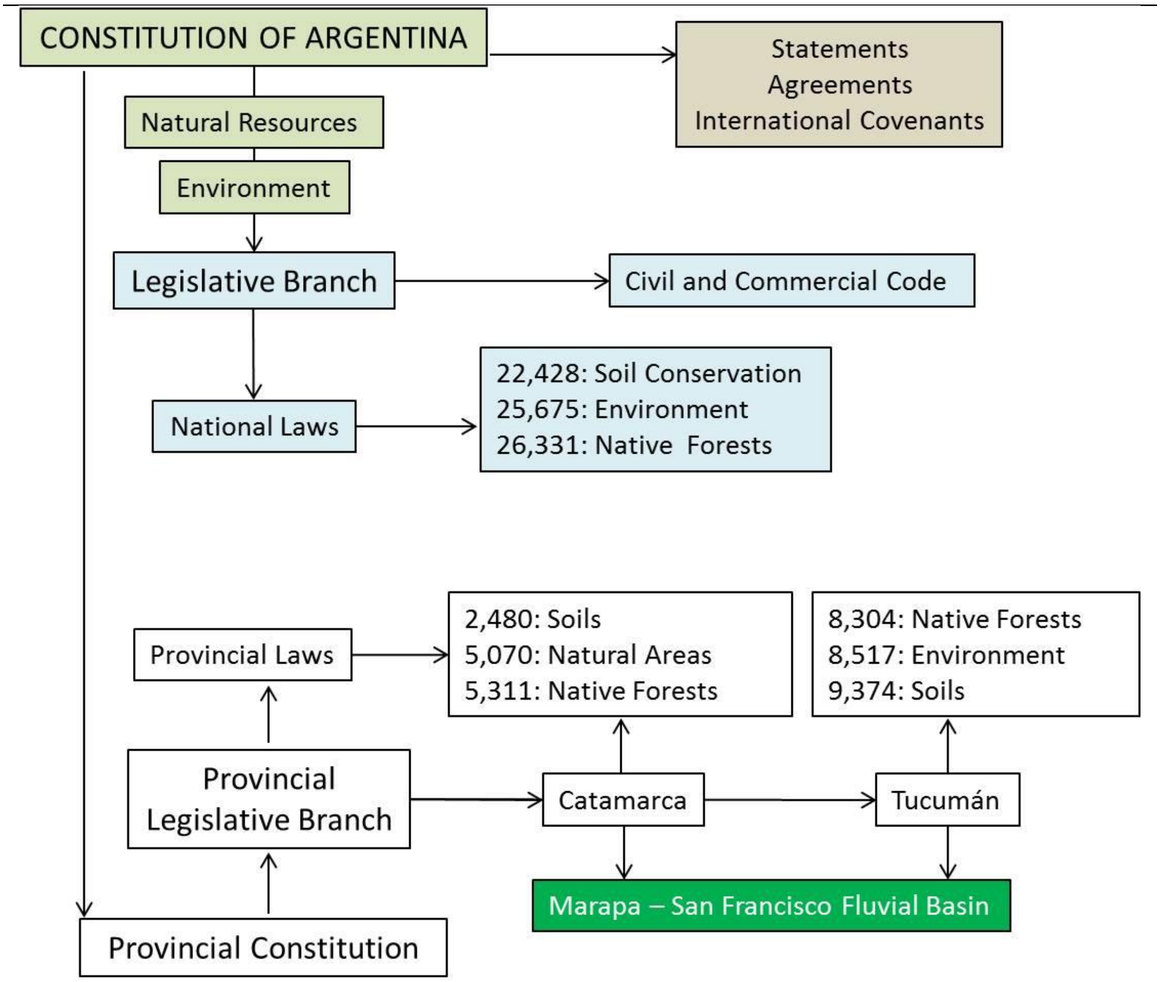


Figure 6. General legal organization of the Argentine Nation and the provinces.

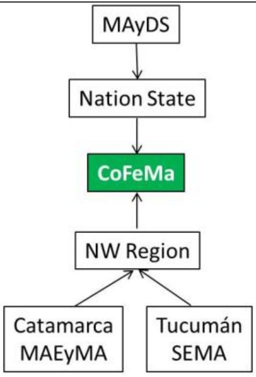


Figure 7a. Administrative structure of the Federal Environmental Committee (COFEMA), adapted for the Marapa - San Francisco Basin.

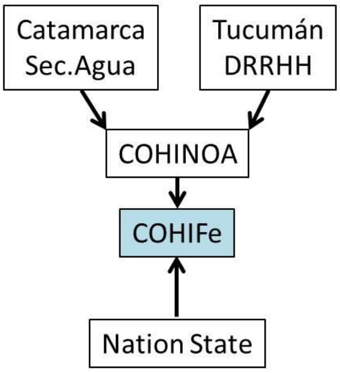


Figure 7b. Administrative structure of the Federal Water Council (COHIFE), adapted for the Marapa-San Francisco Basin.

2.3. Social-economic context

The Marapa River Basin is interprovincial and extends between the provinces of Tucumán (from the high mountains to the plains) and Catamarca (mainly in the mountainous areas toward west). The main activity is extensive agriculture; mainly sugar cane is grown in the middle and lower basin (north and east of the basin) and grain crops (wheat and barley) in the southern sector. In the valleys of the Singuil River (Catamarca) there are forage crops (alfalfa). In the piedmont of Tucumán, blueberries and avocado are grown for export, as well as potatoes and vegetables. There is heavy industry development with the operation of a sugar mill in the north central sector (city of Alberdi). Almost 40,000 people live in the Marapa River Basin, almost 35,000 in cities (24,641 in Alberdi, 5,817 in Graneros and 4,580 in Lamadrid; INDEC, 2010) and about 3,000 people in rural populations from the mountainous area to the plains. The Escaba dam (built in 1967) is located in the upper basin of the Marapa River and is a tourist attraction.

The San Francisco River Basin is also interprovincial, extending mainly in Catamarca and Santiago del Estero, with a strip-like area in the northern zone that corresponds to Tucumán. About 30,000 people live in the basin, distributed between cities (about 15,000) and rural populations. The cities are located mainly in the foothills and the main ones are La Cocha, Los Altos, Bañado de Ovanta and Alijilán. The main activity and generation of direct and indirect employment is soybean, corn and wheat agriculture, corn and soybean seed production and, to a lesser extent, chickpeas, beans, potatoes, peanuts, tobacco, sorghum, barley and rye. In this basin, producers are grouped in consortiums that promote good agricultural practices: farm systematization and direct sowing.

The analysis of the context of equality and inclusive development perspective (Gupta et al., 2020) makes it possible to consider the main causes of changes in ecosystems (direct and indirect drivers), compare them with semi-quantitative and quantitative data (the state of water and ecosystems), associate the causes and quality to determine the impacts, in order to finally and retroactively find answers.

2.4. State of the aquatic ecosystems: drivers and generators

Based on the initial analysis and adopting the DPSIR (Driver-Pressure-State-Impact-Response Framework), the main DPSIR causes acting in the Marapa - San Francisco Basin can be proposed (Figure 8).

The main generator of change in the aquatic ecosystems of the region is the development of intensive agricultural activity and the generation of direct and indirect employment related to this almost exclusive activity. Tourism as a generator of change is present but in low proportion and the climatic changes mentioned previously (e.g., increased rainfall) have become present when the ecosystems had already been transmuted and their flood buffering effect (with 50-year recurrences) had been forgotten.

In this sense, agricultural activity has accelerated urbanization and the growth of cities; 90% of the population lives in cities in the Marapa River Basin and 50% already does so in the San Francisco River Basin, which presupposes an abandonment of the intrinsic benefits of well-being and quality of life related to ecosystems. On the other hand, the pressure on production (change of land use: crops for forests) generates alterations in the hydrological system (previously described in 1.2. Evolution of the Marapa - San Francisco Basin), resulting in the degradation of water status, impoverishment of surviving ecosystems and finally, accelerating the negative impacts that accumulate in very short periods of time: salinized and impoverished soils, floods and serious erosion problems since the beginning of the paradigm shift in the region, less than 30 years ago (Figure 8).

Moreover, the proposals made in the Action Plan based on the Workshops, consultative processes and surveys carried out during formulation coincide with the nature-based solutions proposed by the model generated by REMAQUA (2021) for the CRS-D. This regional model, but with emphasis on the Marapa - San Franisco Basin, poses several hypotheses and scenarios considering an analysis of rainfall (records and predictions), increases in river flows (measured and modeled) and changes in the forested area of the basin.

In this context, the Action Plan formulated is an opportunity to respond with articulated measures, validated by the stakeholders and based mainly on recovering the ecosystems. In this way, it is possible to learn how to use resources sustainably and diversify the activities of the CM-SF.

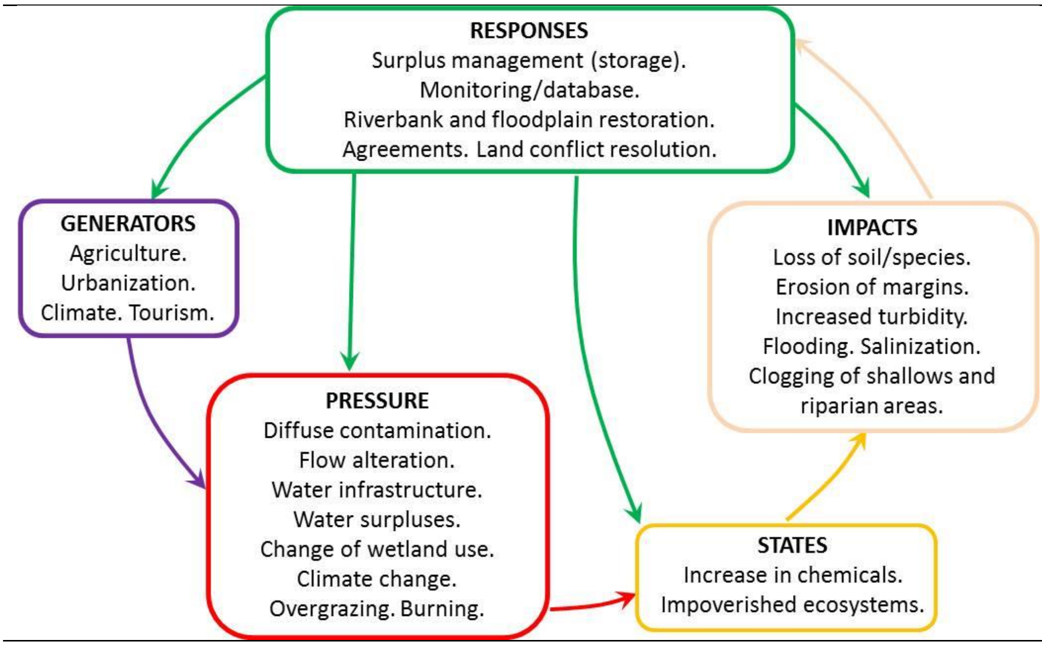


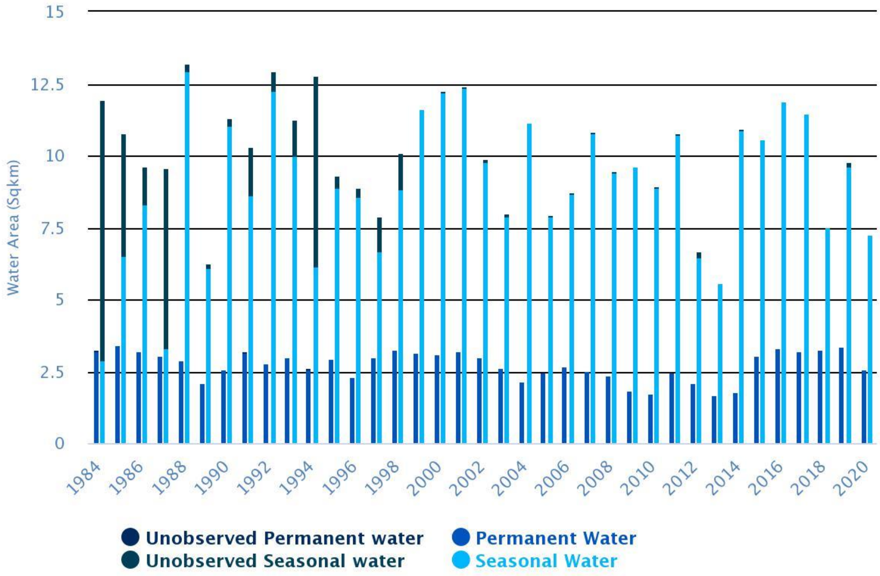
Figure 8. Analysis of the equality context and inclusive development perspective, according to the DPSIR framework (Gupta et al., 2020).

2.5. Ecosystems in relation to the FEE 6.6.1

Freshwater Ecosystems Explorer (EE 6.6.1) presents multiple possibilities for analysis both in terms of water gain or loss (permanent or seasonal), water quality and also contains historical information that allows comparisons with other databases with similar time series (e.g., precipitation and evapotranspiration; https://agromet.eeaoc.gob.ar/index.php).

Among the historical visualizations allowed by FEE 6.6.1 are the cyclic changes of permanent and seasonal waters in the CM-SF (or Argentina/Basin 644018). In this regional context it is very useful to associate the time series of change from FEE 6.6.1 with the rainfall and flood cycles in the basin from meteorological stations and historical data (Figure 9). There is an apparent mismatch in the behavior of permanent water (present during all 12 months) and seasonal water (detectable during 11 months or less) which could be indicating the change in land use (bare soil or soil in transition between crops instead of forest cover) and also the rainfall cyclicity of the basin. The cycles observed in Figure 9.a of seasonal water increases are coincident with cycles of heavy rainfall and flooding in the middle and lower basin of the CM-SF (1988, 1992, 1998, 2000-2002, 2017, 2019) some land remained flooded for more than 6 months.

a.



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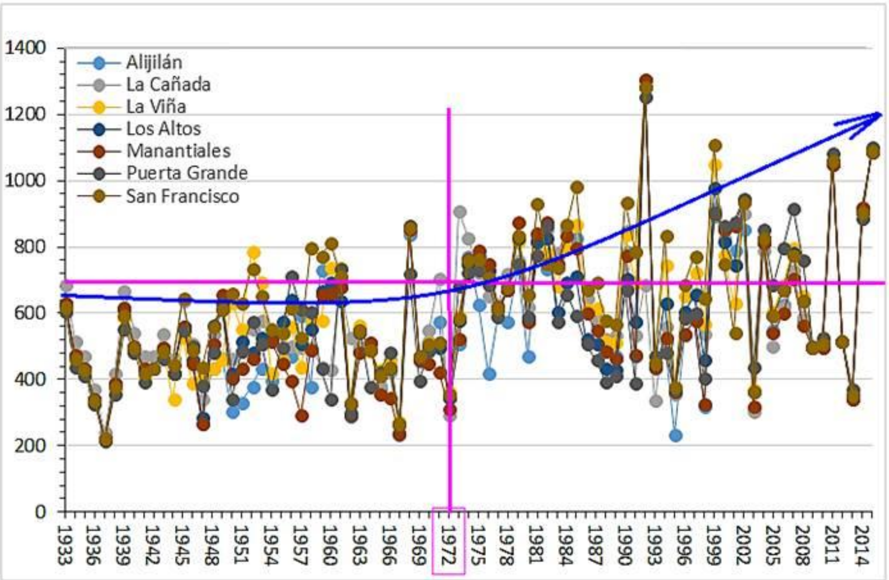

Figure 9.a. Time series of permanent and seasonal waters for the CM-SF recorded in FEE 6.6.1 (see text for comments). b. Historical variation of precipitation measured (1933-2014) at weather stations in middle basin of the El Abra, Ovanta and San Francisco rivers.

The water balance is regionally negative (CM-SF scale or Hydrobasin level 6; Figure 10.a) but is positive when analyzed at the sub-basin scale (El Abra and Ovanta river basin; Hydrobasin level 8; Figure 10.b). This is also the result of the effect of agricultural irrigation for soybean and corn seed production in the piedmont and upper reaches of the lower basin, added to the development of canalizations and subsurface drainage of irrigation water. Finally, the canalizations in the lower basin show a gain in permanent water and losses in seasonal water, since they are draining the wetlands of the lower basin.

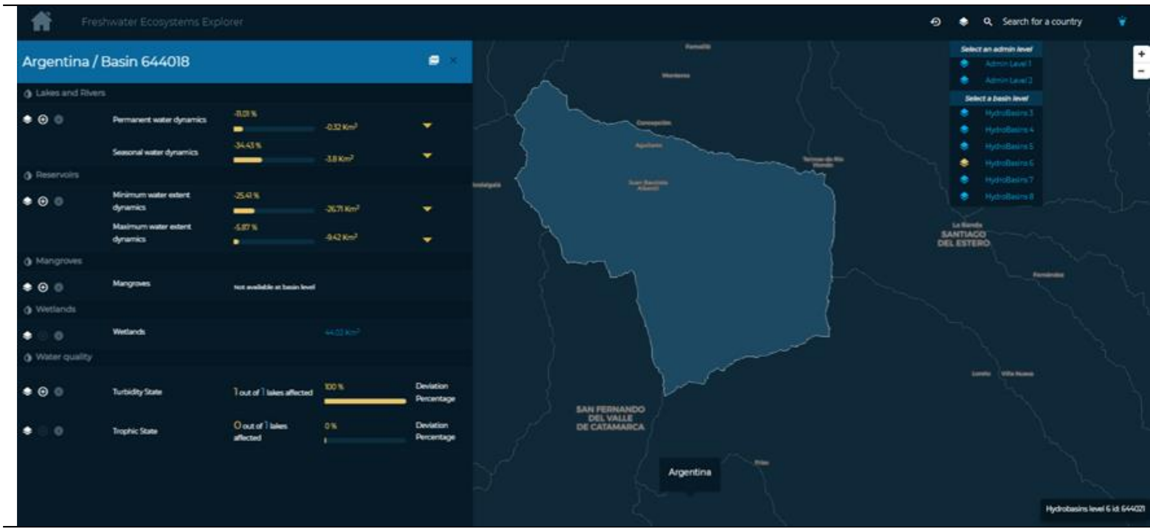

Figure 10.a. Argentina/Basin 644018. The permanent (-0.32 km^2) and seasonal (-3.2 km^2) water balances indicate losses that could be associated with canalizations carried out between 2015 and 2020 (Figure 10.b and c).

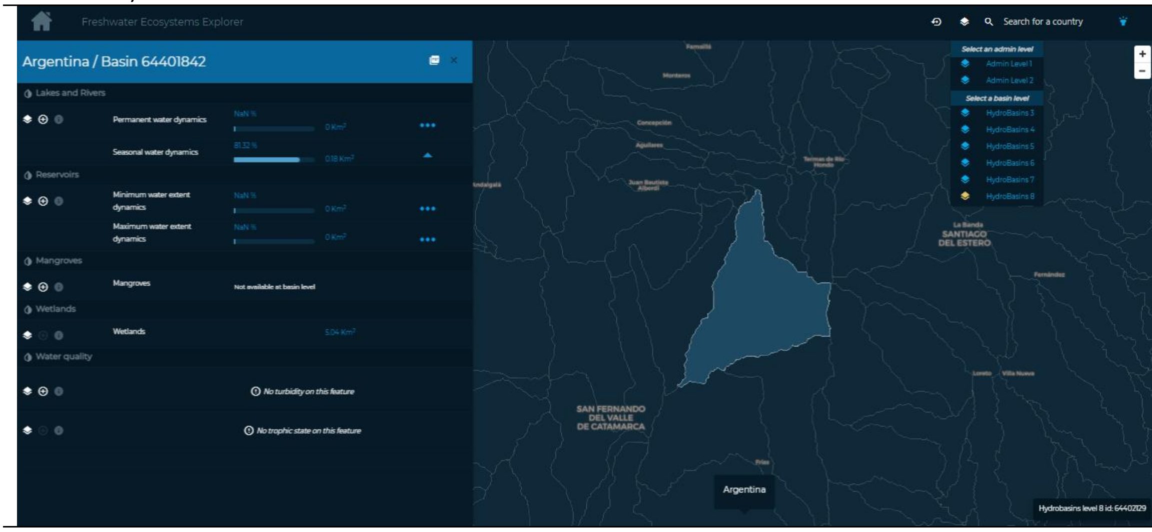

Figure 10.b. Argentina/Basin 64401842. The basin has unchanged cycles in permanent waters and positive ones in seasonal waters. These results may be related to the increase in precipitation in the headwaters and irrigation system in the middle and lower basin in crops that replace the dry forest.

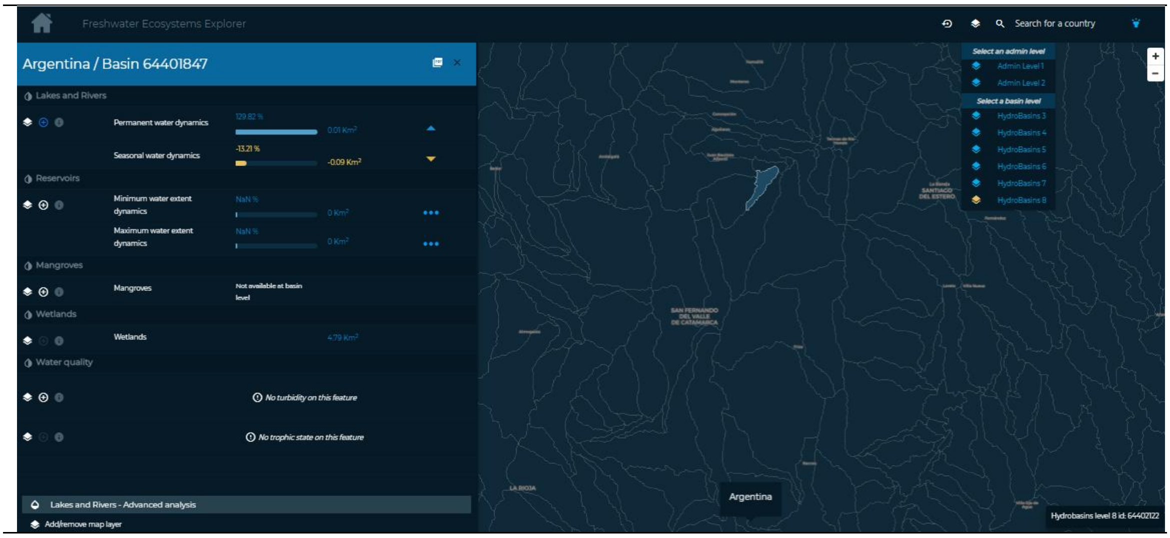

Figure 10.c. Argentina/Basin 64401847. The status of permanent waters is positive (0.01 km2) and negative in seasonal waters (0.09 km2). These variations can be understood by the same process, currently the lower basin has channels that transport water permanently and have drained the surface that previously remained temporarily flooded.

From this point of view, it seems that the ecosystems, although degraded, still have a certain capacity to regenerate and it is necessary to preserve and recover them, especially in the lower part of the basins.

2.6. Ecosystem services

In the participatory workshops, the participants identified the ecosystem services of the Marapa - San Francisco Basin (Table 3).

In this regard, it is noteworthy that the participants identified most of the ecosystem services as available in the upper and middle basin.

In some cases, preservation measures have been taken in advance (Declaration of Priority Native Species for preservation, Provision 024/2012 of the Provincial Directorate of Biodiversity, Catamarca), using as a framework the Provincial Law of Environmental and Territorial Management of Native Forest (Law 5,311/2010). The species protected by this declaration are included in a descriptive annex with photographs of the specimens.

On the other hand, in the middle and lower basin, accelerated erosive processes have been identified, the loss of riparian forest mass with the appearance of opportunistic and invasive exotic species (*Gleditsia triacanthos* or Black Acacia; Sirombra and Ceccotti, 2019). Bravo (2017) has estimated a loss of forest area equivalent to 24,000 ha.

In the case of reservoirs, Silveiro *et al*. (2009) have detected the presence of invasive algae (*Ceratium hirundinella*) in the Sumampa reservoir (Catamarca), while Taboada et al. (2021) have recognized the same invasive species in the Escaba reservoir (Tucumán). In extreme cases of soil salinization, Sirombra and Cecotti (2019) recognized presence of Quinoa (*Chenopodium quinua*) in the lower Marapa river basin.

Regarding the state of river waters, Dos Santos *et al*. (2018) have conducted macroinvertebrate surveys in the middle basin of the Marapa River and provided workshops in elementary and high schools referring to the recognition of these organisms as water quality indicators; they have also developed a cell phone application (Agüita) that allows students to handle basic sampling equipment, capture, recognize species, photograph them and send them to specialists for validation. These activities have proven to be beneficial and aligned with the development of citizen science. This work methodology will be incorporated into the Action Plan in projects related to biomonitoring and hands-on environmental education.

PROVISIONING	**Foodstuffs**: Consumer fish, wild hunting, fruits and grains.
	Water: storage and supply: domestic, agricultural or industrial.
	Raw materials: production of logs, firewood, fodder.
	Medicinal products: extraction of materials from biota.
	Genetic resources: medicine, plant genes, ornamental species.
CULTURAL	**Physical and mental recreation**: for leisure activities.
	Tourism: farms, eco and agritourism.
	Spiritual: personal feelings and well-being; rituals and ceremonies.
	Aesthetics and inspiration: appreciation of the natural landscape.
	Educational: formal and informal education and training opportunities.
REGULATION	**Air quality**: dust and chemical capture.
	Climate: influence of vegetation on rainfall.
	Water flows: water storage: agricultural or industrial.
	Wastewater: treatment and purification.
	Natural hazards: flood, erosion and storm control.
	Soil fertility: includes soil formation.
	Pollination
	Biological control: seed dispersal, pest control, diseases.
HÁBITAT	**Maintenance of species life cycles:** includes nursery services.
	Maintenance of genetic diversity: protection of the gene pool.

Table 3. Ecosystem services recognized by the participants of the February 2022 workshops, mainly in the upper and middle basin.

3. Action plan formulation process

Based on the application conditions, between September 17 and 21, 2021, the Focal Point, through the SIyPH and COHIFE and COFEMA (both federal coordination organizations) issued a call to decision-makers from National Parks and the water and environmental sectors of the provinces. The call proposed to present freshwater ecosystems and/or key basins to be submitted to a prioritization process that would allow the selection, in a concerted manner, of the areas to formulate the action plans.

In addition, on October 1st, a governmental webinar was held, focused on the call, where the criteria for the prioritization and selection of ecosystems were shared.

Between October 15 and 17, the 4 applications were received and -within the framework of the GLC- prioritization was developed based on the degree of compliance with the criteria. As a result, 2 areas with different bio-geographic conditions were selected: the Marapa San Francisco river basin and the Esquel Percy System (Figure 11).

Given the large geographical extension of the country and the ease of holding face-to-face meetings, local consultants were hired to formulate action plans that were proposed by those responsible for water and environmental management in the provinces involved.

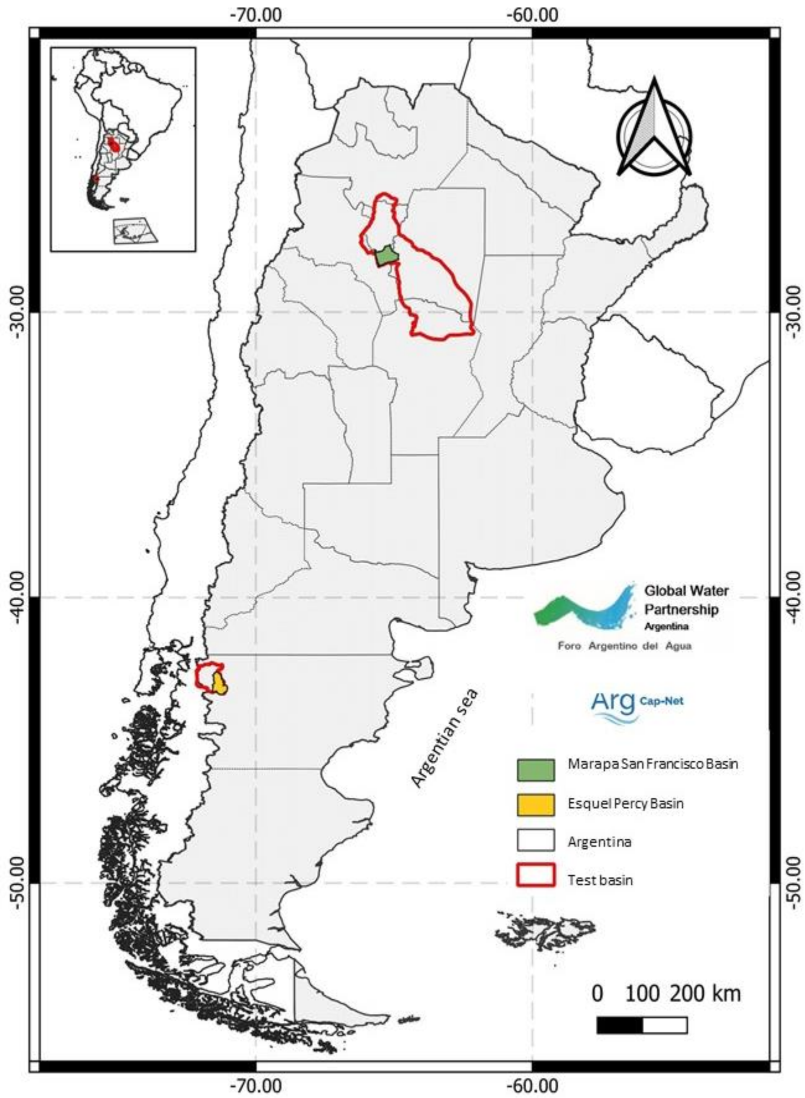

Figure 11. Map showing the location of the sites selected in Argentina for the formulation of action plans within the framework of the pilot project.

3.1. Formation of the Marapa - San Francisco Basin Working Group

On November 26, 2021, the Coordinator and Consultant of the GTCSF Sergio Georgieff, was appointed and started working with the representatives of Tucumán, Aníbal Comba (Deputy Director of Water Resources) and Patricia Grimaldi (Directorate of Water Resources). During January the Secretary of Water of Catamarca, Florencia Zarauz, appointed Patricia Lobo as representative of Catamarca, who formally joined the work of the Group on February 4, 2022, although she had already participated in a general meeting in early December 2021. Also, during January 2022, it was agreed that the participation of a representative of the Environment of the province of Catamarca was necessary. On February 17, Carlos Barrionuevo, Director of Biodiversity and Natural Protected Areas, joined the GTCSF.

3.2. Most relevant tasks

On December 12, the Consultant-Coordinator presented the roadmap and work plan for the Formulation of the Action Plan. At the same time, working meetings were held with the GLC: Ana Mugetti (who prepared the ToR) and Leandro Díaz from FAdA, Marcos Cipponeri and Fernanda Gaspari (Arg Cap-Net), Francisco Firpo Lacoste and Laura Benzaquen (DNGAAyEA), its Director Gabriela González Trilla and Silvia De Simone (SIyPH). During January, work was carried out on the Initial Analysis and the definition of the methodology for the consultative and participatory processes. Considering distances, time, and situations (disease outbreaks), it was decided to hold virtual workshops with online questionnaires for the participatory workshops and virtual and/or face-to-face meetings for the consultative process.

During February, 2 participatory workshops were held, and the surveys also proved to be opportunities for open consultation with specialists. The dynamics of the activities proved to be profitable due to the active participation of the attendees and the number of comments, suggestions and contributions that were reflected in the surveys.

At the beginning of March, two meetings were held to reach agreements on the actions, those responsible for their execution and also for the management of funds from possible financing sources, with the participation of the Secretaries of Environment and Water of Catamarca and Tucumán, the managers of the Producers' Consortiums, GLC, the president of ORSEP and members of the GTCSF. Work was then carried out on the preparation of the first summary document of the Action Plan Formulation to be reviewed by the GTM-SF, the GLC and external peer reviewers.

Finally, a workshop was held in April to present the revised Action Plan.

4. Salí Dulce River Basin Master Plan, under implementation

The Salí Dulce River Basin Master Plan (2020, approved and implemented by the CCIRS-D) responds to SDG 6.5.1 (IWRM) and the guiding principles of Argentina's water policy.

The structure of this Master Plan considers Axes and includes the environmental assessment of the measures to be adopted. The main Axes are:

- A. Conservation and Improvement of the Environment,

- B. Water Quality Protection and Improvement,
- C. Water and Production,
- D. Water and Society,
- E. Education and Training, and,
- F. Institutional Strengthening and Regulatory Aspects.

Table 4 summarizes the Axes, objectives and programs related to those proposed in the Formulation of the Marapa - San Francisco Basin Action Plan.

AXIS and OBJECTIVE	PROGRAMS
A. Protect the environmental values of the basin by conserving and restoring strategic water-related environmental sites.	A.1. Conservation and restoration of strategic environments A.2. Erosion and sedimentation control A.4. Land Use Planning
B. Improve water quality and also protect those waters that do not have significant impacts, based on the knowledge of their chemical and biological quality and their ecological status in natural and artificial watercourses and bodies.	B.1. Periodic monitoring of contamination in water and other related compartments (biotic and abiotic). B.2. Recovery of water quality. B.4. Integral management of urban solid waste.
E. Support activities for the protection and development of the basin through the knowledge, awareness and education of the population for the care of water and the environment.	E.1. Formal and non-formal education E.2. Training for innovation
F. Strengthen and harmonize governmental response capacity to efficiently and effectively fulfill its mandate.	F.2. Improvement in basin management. IAS 22. Harmonization of the regulatory framework for water resources.

Table 4. Axes, objectives and programs of the Salí-Dulce River Basin Master Plan, approved by the CCIRS-D (2020).

5. Objectives

Sustainable Development Goal 6.6.1 is to protect and restore freshwater aquatic ecosystems with actions to increase spatial extent, water quantity and quality and ecosystem health.

The objectives of the Action Plan for the Marapa - San Francisco Basin are the evolutionary restoration and/or protection of the functionality of aquatic ecosystems (rivers, floodplains, marshes and lakes), the management of surface water increase and the improvement of water quality in the Marapa - San Francisco Basin.

In the agreement meetings between provincial and national officials and socio-productive sectors, were defines the actions to be carried out and those responsible for their execution.

6. Actions for the conservation and restoration of aquatic ecosystems

The participatory/consultative workshops carried out made it possible to define 36 short-term (2022 to 2025), medium-term (2026 to 2032) and long-term (2033 to 2042) actions that can be summarized in the following objectives:

1. Restore the balance of solid flows transported by watercourses,
2. Protect and restore riverbank ecosystems,
3. Restore forested wetlands,
4. Improve decision making through a uniform and accessible network and database,
5. Develop inter-jurisdictional coordinated legislation/regulations where appropriate (supported by specific technical advisory teams),
6. Promote environmental education through the social involvement of schools and the training of producers in new technologies, and
7. Define a monitoring, coordination and follow-up of actions system.

7. Action Plan

The proposed action plan is mainly on nature-based solutions (green infrastructure) and measures to raise awareness of the importance of ecosystems (environmental education and training in new technologies). However, the situation of almost extreme deforestation in the middle and lower basin, added to the anthropic modifications of the drainage lines (canalizations to drain the wetlands, canalizations within the farms and an extensive network of additional canals that transfer surface surpluses from one sub-basin to another) force the implementation of gray infrastructure for the restoration and stabilization of river slopes (with heights between 6 and 12 meters and slopes between 70° and 90°), combined with riparian revegetation, allows for the recovery and conservation of the impacted ecosystems.

7.1. Actions for the conservation and restoration of aquatic ecosystems

Based on the Initial Analysis, the opinion of the specialists at the Workshops, and the surveys of the nearly 100 workshop participants, were identified actions that should be implemented to restore and protect the aquatic ecosystems of the Marapa - San Francisco Basin.

These activities were considered as actions that would produce measurable effects in improving the quality and health of the ecosystems.

According to the characteristics identified, these actions were grouped into 7 programs, 12 projects that contain 39 actions with common objectives and are likely to show comparable results.

Finally, according to the type of action, their complexity and/or need for execution, they were classified to be implemented in the short, medium and/or long term.

Short-term actions have an implementation period between 2022 and 2025; it should be considered that actions implemented in this period should show measurable results as of 2030. Medium-term actions should be implemented between 2026 and 2032 and long-term actions between 2033 and 2042.

The following table summarizes the programs, general objectives, projects, actions, expected results and the proposed implementation period.

PROGRAM 1: RECOVERY OF ECOSYSTEM FUNCTIONALITY				
Objectives	**Action**	**Projects**	**Expected results**	**Completion deadlines**
Protect ecosystems, improve the water balance, increase the extent and restore the functionality of aquatic ecosystems.		**Project 1.1: Protection and recovery of riparian ecosystems.**	Protection and recovery of the structure and functionality of soils in ecosystems. Buffering of runoff and flood flows. Control surface erosion. Reducing soil salinization. Raising awareness among producers, social perception of the problem. Improvement in the hydrological balance. Carbon sequestration. Creation of nurseries.	
	1.1.1	Survey and update of the condition of riparian forests (native species) and prioritization of impacted areas. Quantitative evaluation of the necessary revegetation.		Short
	1.1.2	Planting of native species (seedlings and seeds) in pilot areas and temporary closure of the property for cattle ranching.		Short
	1.1.3	Increased planting of native species (seedlings) from pilot areas.		Short to Long
	1.1.4	Recovery of biodiversity and generation of connections between riparian ecological corridors.		Medium to Long
		Project 1.2: Recovery of forested wetlands.		
	1.2.1	Survey, update of ecosystem status and ranking of impacted wetlands. Identification of native species of better adaptation and quantitative evaluation of implantation.		Short
	1.2.2	Planting of native species (seedlings and seeds) in pilot areas and temporary closure of the property for cattle ranching.		Short
	1.2.3	Increased planting of native species (seedlings) from pilot areas.		Short to Long
	1.2.4	Biodiversity recovery and generation of ecological corridors between wetlands.		Medium to Long

PROGRAM 2: IMPROVEMENT OF ECOSYSTEMS AND RESTORATION OF THE BALANCE OF SOLIDS FLOWS				
Objectives	**Action**	**Projects**	**Expected results**	**Completion deadlines**
Evaluate and protect the areas according to the dominant process: erosion - deposition		**Project 2.1: Definition of fluvial dynamics and quantification of erosion-deposition processes.**	Knowledge of the state of the ecosystem. Acquisition of data for decision making.	
	2.1.1	Measurement of solid and liquid flows: systematic field monitoring.		Short
	2.1.2	Survey of the general condition and control of erosion and sedimentation processes of the San Ignacio river, lower basin.		Short
	2.1.2	Survey of the general condition and control of erosion and sedimentation processes of La Posta and El Sueño streams, middle and lower basin.		Short
	2.1.3	Survey of the general condition and control of erosion and sedimentation processes of the San Francisco river, lower basin.		Short
	2.1.4	Survey of the general condition and control of erosion and sedimentation processes of the El Abra river, middle and lower basin.		Short
	2.1.5	Survey of the general condition and control of erosion and sedimentation processes of the Ovanta River, middle and lower basin.		Short
To recover ecosystems as flow regulators. Mitigate anthropic modifications.		**Project 2.2: Restoration of longitudinal river profiles and balancing erosion-deposition processes**	Mitigation of anthropic modification of drainage. Recovery of wetlands as regulating ecosystems of the hydrological cycle. Reduction of channel clogging and sediment erosion.	
	2.2.1	Evaluation of the restoration of the flow conditions of the San Francisco river, in the lower basin towards the eastern marshes.		Short
	2.2.2	Evaluation of the restoration of the flow conditions of the San Francisco River at the mouth of the Marapa River.		Short
	2.2.3	Evaluation of the restoration of the flow conditions of the San Ignacio River towards the original marshes, at the mouth of the Marapa River.		Short to Medium
	2.2.4	Evaluation of the restoration of the flow conditions of the El Sueño stream (lower basin) towards the marshes.		Short
	2.2.5	Evaluation of the restoration of the flow conditions of the Ovanta River, in the middle basin towards the original northeastern marshes.		Short to Medium

PROGRAM 2: IMPROVEMENT OF ECOSYSTEMS AND RESTORATION OF THE BALANCE OF SOLIDS FLOWS				
Objectives	**Action**	**Projects**	**Expected results**	**Completion deadlines**
		Project 2.3: Slope stabilization, revegetation and systematization	Restoration and long-term protection of recovered ecosystems. Cost evaluation between green and gray infrastructure implementation versus production losses.	
Protect the existence of riparian ecosystems and forested wetlands.	2.3.1	Implementation of green and gray infrastructure actions for the conservation of riparian zones (protection and stabilization of slopes and revegetation): a. First stage: pilot projects b. Second stage: extension of lessons learned		Short to Long
	2.3.2	Systematization of farms, incorporation of good agricultural practices.		Short to Medium

PROGRAM 3: GENERATION OF A UNIFIED DATABASE FOR DECISION MAKING				
Objectives	**Action**	**Projects**	**Expected results**	**Completion deadlines**
Make decisions based on agreed and objective criteria.		**Project 3.1: Creation and operation of a standardized secure-access database**	Improvement in the integrated management of ecosystems. Unification of existing technical data in the different organizations. Coordinated and consensual water and environmental solutions. Tool for decision making. Strengthening of the information system in a collaborative manner.	
	3.1.1	Define server location, access links, links to other databases and remote data loading.		Short
	3.1.2	Database maintenance and administration of authorizations for access to reserved data.		Short
	3.1.3	Spatial data monitoring of water quality, water quantity, meteorological data.		Short
	3.1.4	Uploading user data from mobile applications.		Short to Long

PROGRAM 4: DEVELOPMENT OF COORDINATED LEGISLATION AMONG THE PROVINCES				
Objectivs	**Action**	**Project**	**Expected results**	**Completion deadlines**
Coordinating legal actions to improve ecosystem health		**Project 4.1: Legal Coordination between the Provinces of Tucumán and Catamarca**	Improved long-term environmental decision making.	
	4.1.1	Review of current legislation and development of standards agreed upon by the jurisdictions, considering the interactions of water, soil, vegetation cover and fauna of the ecosystems.		Short to Medium

PROGRAM 5: ENVIRONMENTAL MANAGEMENT AND PROJECTION OF ENVIRONMENTAL SERVICES				
Objectives	**Action**	**Projects**	**Expected results**	**Completion deadlines**
To take advantage of the environmental services provided by ecosystem restoration.		**Project 5.1: Environmental Planning**	Improved ecosystem health and use of ecosystem services.	
	5.1.1	MSW treatment and recycling.		Medium to Long
	5.1.2	Regulation of aggregate extraction		Medium
		Project 5.2: Recovery, use and promotion of ecosystem services		
	5.2.1	Fishing: regulation and control of species.		Medium to Long
	5.2.2	Promotion of aquaculture.		Long

PROGRAM 6: ENVIRONMENTAL EDUCATION AND TRAINING ON WATER MANAGEMENT				
Objectives	**Action**	**Projects**	**Expected results**	**Completion deadlines**
		Project 6.1: Environmental education	Practical environmental education and social involvement	Short and Medium
Promote and raise awareness of ecosystems and sustainable water use	6.1.1	Design and implementation of formal and non-formal environmental education programs in schools near riparian ecosystems, including field visits and practices related to ecosystem health and functionality.		
	6.1.2	Design and implementation of environmental education programs related to biomonitoring using a cell phone application for macroinvertebrates of freshwater aquatic ecosystems.	Citizen science development	Short and Medium
		Project 6.2: Training in new technologies and optimization of water use	Adoption of new irrigation and soil conservation techniques aimed at optimizing water resources.	Short and Medium
	6.2.1.	Training in technologies, science-based answers and water management applied to production.		

PROGRAM 7: ECOSYSTEM MONITORING AND FOLLOW-UP OF IMPLEMENTED ACTIONS				
Objectives	**Action**	**Projects**	**Expected results**	**Completion deadlines**
Determine spatial and temporal variations of water (quality, depth), sediments and biota to evaluate the evolution of the actions implemented to improve their quality.		**Project 7.1: Periodic monitoring of aquatic ecosystem: abiotic and bioindicators**		
	7.1.1	Monitoring and control of water quality in rivers and reservoirs (including bacteriological): 10 sampling sites (20 parameters): 7,600 analyses in the period October 2022 to December 2025.	Improved understanding of the hydrological balance of ecosystems. Decrease in soil loss. Improved decision making.	Short to Long
	7.1.2	Bioindicator monitoring: macroinvertebrates, cover and birds.		Short to Long
	7.1.3	Monitoring of success indicators quantification of restoration cost-benefits.		Medium to Long
	7.1.4	Meteorological monitoring of the productive sector (agriculture): precipitation, temperature, wind direction and intensity, radiation. National Meteorological Radar System (SINARAME), state-owned.		Short to Long
	7.1.5	Water table monitoring of the agricultural production sector.		Short to Long
Evaluate spatial variations of pilot projects.		**Project 7.2: Monitoring the evolution of restored ecosystems**	Evaluation of the evolution of the ecosystem. Learning from implemented actions.	Short to Long
	7.1.6	Monitoring of pilot projects (see 1.1.3; 1.2.3; 2.3.1, 2.3.2)		

7.2. Short-term action plan implementation roadmap

The Short-Term Action Plan proposed for the Marapa - San Francisco River Basin can be considered as an extension of the environmental aspects of the Salí - Dulce River Basin Master Plan and includes specific actions that complement it (Table 5).

Action plan Marapa - San Francisco	Salí - Dulce River Basin Master Plan
Program 1: Recovery of ecosystem functionality	**Program A.1**: Conservation and Restoration of Strategic Environments (very high priority)
Program 2: Improvement of ecosystems and restoration of the balance of solids flows.	**Program A.3**: Erosion and Sedimentation Control (high priority)
Program 3: Generation of a unified database for decision making	
Program 4: Development of coordinated legislation among the provinces	**Program F.2:** Improvement in basin management Harmonization of water resources regulatory framework
Program 5: Environmental management and projection of environmental services	**Program A.4**: Land management (very high priority). **Program B.4**: Integrated MSW Management.
Program 6: Environmental education and training on water management	**Program E.1** : Formal and non-formal education **Program E.2** : Training for innovation (high priority)
Program 7: Ecosystem monitoring and follow-up of implemented actions	**Program B.1**: Periodic Monitoring of Contamination in Water and Other Compartments (high priority)

In this way, the implementation of the Action Plan can be made feasible and expedited through the CCIRS-D, where the Marapa - San Francisco River area is included.

The actions planned to be carried out until 2025 involve investments of USD 2,455,000, the funds come from the institution's own budgets and others that will be managed through the institutions responsible for the execution of the action.

The stages of implementation of the actions involve:

a) Pre-investment, management of funds for the execution of the action.

b) Investment/implementation, funds available to execute the action, and

c) monitoring and evaluation of the results.

Program	Project	Results		Implementation stages	Responsible for execution	Indicator	Schedule 2022	2023	2024	2025	Approximate cost (USD)	Funding Sources: Available (USD)	Potential
1	1.1. Revegetation, protection and recovery of riparian ecosystems.	Recover the functionality of the ecosystem.	160,000 native species planted	Preinvestment / Implementation	SEMA DByANP ConEA	Implanted area (ha). Decrease in water turbidity.					200,000	SEMA, 120,000	Native Forest Law Funds (N°26,331)
	1.2. Revegetation, recovery of forested wetlands.	Decrease erosion and prevent soil salinization.		Preinvestment / Implementation	SEMA. DByANP ConEA	Implanted area (ha). Decrease in water turbidity.					200,000	SEMA, 120,000	Native Forest Law Funds (N°26,331)
2	2.1. Definition of fluvial dynamics and quantification of erosion - deposition processes.	Allow programmed reforestation. Recovery of wetlands as regulating ecosystems of the hydrological cycle.		Preinvestment	DRRHH Sec.Agua	Parameter quantification					250,000		Nation State and other national and international credit organizations. CFI.
	2.2. Recovery of river equilibrium profiles and balancing of erosion-deposition processes.	Control of anthropic modification of drainage. Control of surplus consumptive water use: agricultural and urban. Recovery of wetlands as regulating ecosystems of the hydrological cycle.		Preinvestment	DRRHH Sec.Agua	Decrease in turbidity of river water.					250,000		Nation State and other national and international credit organizations. CFI.
	2.3. Stabilization of river banks, reduction of the slope of river banks and stabilization with planted vegetation.	Long-term ecosystem restoration.		Preinvestment / Implementation	DRRHH Sec.Agua SEMA DByANP ConEA	Hectares of riverbank restored and conserved.					1,000,000		Nation State and other national and international credit organizations. CFI.
3	3.1. Creation and operation	Coordinated and consensual		Implementation	SEGPyP	Reduction of					50,000	SEGPyP , 30,000	Nation State and

Program	Project	Results	Implementation stages	Responsible for execution	Indicator	Schedule				Approximate cost (USD)	Funding Sources	
						2022	2023	2024	2025		Available (USD)	Potential
	of a standardized secure access database.	water and environmental solutions. Tool for decision making. Strengthening of the information system in a collaborative manner.		DRRHH Sec.Agua	socio-economic losses.							other national and international credit organizations.
4	4.1. Legal coordination between the provinces of Tucumán and Catamarca	Improved long-term environmental decision making.	Implementation	Legislatures Tucumán - Catamarca	Agreed regulations					50,000	Legislatures, 50,000	
6	6.1. Environmental education	Practical environmental education. Social involvement. Development of citizen science.	Preinvestment	SEMA DByANP	Population involved					60,000		Nation and Provincial State and other national and international credit organizations.
	6.2. Training in new technologies and water use optimization	Adoption by producers of new irrigation and soil conservation techniques aimed at optimizing water resources.	Preinvestment	SEMA DByANP ConEA ConBO-f	Number of producers involved					20,000		Nation and Provincial State and other credit organizations.
7	7.1. Periodic monitoring of the aquatic ecosystem: abiotic and bioindicators	Improved understanding of the hydrological balance of ecosystems. Decrease in soil loss. Improved decision making.	Implementation Investment Monitoring	SEMA DByANP	General improvement of water quality and recovery of ecosystem services.					350,000	SEMA, 240,000	Nation and Provincial State and other national and international credit organizations.
	7.2. Monitoring the evolution of restored ecosystems.	Evaluation of the evolution of the ecosystem. Learning from implemented actions.	Preinvestment / Implementation	SEMA DByANP	Increase in ecosystem area (ha)					25,000		Nation and Provincial State and other national and international credit organizations.

7.3. Coordination and follow up mechanisms for implementation

Two members of the CCIRS-D (one for each province) actively participated in the specific Working Group of the Marapa - San Francisco basin during the formulation process of this Action Plan.

Coordination and follow-up of the Action Plan can result from the formation of a CCIRS-D Sub-Working Group.

The additional advantages of this coordination are related to the complementarity between the Salí-Dulce River Basin Master Plan and the formulation of proposed actions for the restoration of aquatic ecosystems.

A presentation of the preliminary results of this Action Plan was made to the CCIRS-D during March 2022, the general conclusions were coincident and complemented with additional data from other CCIRS-D members.

The actions proposed in this Plan were considered by CCIRS-D as adequate for the restoration of pre-2017 environmental (ecosystem) conditions.

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