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REVIEW



Agriculture and water resources: UNFCCC influence on Peruvian adaptation regulations to increase resilience against climate change

Del Piero R. Arana-Ruedas^{1,2,*} ; Nabil Moggiano² 

¹ Hallym University, Gangwon-do, Chuncheon-si, Hallimdaehak-gil-1. Republic of Korea.

² Universidad Continental, Campus Huancayo, Av. San Carlos 1980, Urb. San Antonio, Huancayo, Junín. Peru.

* Corresponding author: dpiero.arana@gmail.com (D. P. Arana-Ruedas).

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Abstract

Agriculture and water resource are highly threatened due to climate change, increasing the probability of backsliding on almost every aspect of sustainable development worldwide. For instance, water resource distribution throughout the Peruvian territory is not homogeneous. Hydrometeorological phenomena also threaten it, so it is crucial for the agriculture sector and water management to increase resilience against climate change. The study aims to understand the Peruvian conduct under the United Nations Framework Convention on Climate Change (UNFCCC) regime. Its influence in the Peruvian adaptation regulation and public institutions over the years and the interaction with the latest commitment to the UNFCCC related to climate change agriculture - water resources. The methodology used for the study was qualitative, delivered throughout a documentary analysis, and narrative design among scientific papers, UNFCCC documentation, and Peruvian regulation to weave the experience occurred and the sequences of the events to set up a general narrative. The results show that Peru has active participation in the UNFCCC, particularly under a neoliberalism approach. The convention pushed institutional and regulatory development of the Peruvian Government constantly. Also, after the Paris Agreement, one of the most important influences was the implementation of Law N° 30754 on climate change, which articulates all the regulations related to it, providing a national, more substantial legally-binding commitment. Finally, it is important for Peru to analyze the achievement of current adaptation actions and keep studying the impacts of climate change at a local level to develop a bottom-up approach for an effective policy formulation-implementation.

Keywords: Climate Change; UNFCCC; Water Resources; Agriculture; International Regime; Peru.

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1. Introduction

One of the most challenging global issues is climate change, showing its effects through changes in the atmosphere, hydrosphere, biosphere, and geosphere interactions (Mayer, 2018). Also, a threat to human and ecological systems (Mengistu et al., 2021). Furthermore, water represents the critical aspect to guaranteeing food security (Ajjur & Al-Ghamdi, 2022), considering that the agriculture sector is one of the most climate-vulnerable sectors, especially in regions with arid or semi-arid soil (He et al., 2021).

Climate change was strongly analyzed, and its effects on water resources and agriculture still represent a significant duty for policymakers (Shagega et al., 2020; Suresh et al., 2021). Population grows, and rapid development

drastically increases water demand for its consumption and anthropogenic activities (Dias et al., 2020). The supply is threatened by extreme weather conditions that trigger droughts or floods (Zhuang et al., 2018), affecting public health and increasing infectious diseases, vector-borne, heat shock, malnutrition, and hunger (Carter et al., 2021). Regarding food security, it is highly expected to increase irrigation requirements (IRR) due to climate variability, which is impacting several crops (Cooper et al., 2022), and hydro electrical energy is also immersed in water scarcity or abundance effects (Kalair et al., 2019). Also, some countries are predicted to increase international river basin discussions regarding its use right (Dinar et al., 2015), creating hostility toward transboundary water resources (Dinar et al., 2019).

The resource in question indeed represents 70% of the earth's surface (Karunakaran et al., 2021). However, available freshwater for human use represents less than 1% and is still reducing over the years (Schmidt-Kloiber et al., 2019); For instance, springs, rivers, lakes, wetlands, swamps, and lagoons (Kingsford et al., 2020). This small percentage has to satisfy approximately 7.7 billion people around the globe nowadays, with an increasing projection to 10.9 billion people by the end of the current century (Klein & Anderegg, 2021).

International understanding of water resources' importance for human development carried a recognition as a human right by the United Nations General Assembly in 2010, which refers to better quality, enough quantity, safe, and accessible drinking water (Yates & Harris, 2018). Its concern has been shown in the international arena, for example, in the convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) in 1992 and its protocol on Water and Health in 1999 (Ma et al., 2008; UNECE, 2022). Also, under the United Nations Framework Convention on Climate Change (UNFCCC, 2022) or the 2030 Agenda for Sustainable Development in 2015 (Belmonte-Urefia et al., 2021; U.N., 2022).

In that sense, it is essential to take international agriculture and water resources treaties under a climate change approach as national regulation. In order to guarantee its achievement and appropriate climate actions; Long-term climate scenarios related to social, economic, and environmental impacts must be analyzed (Smith & Jenkins, 2013).

Developing states had to change their behavior under international treaties from voluntary climate actions to national commitments based on their capabilities to contribute to the international goal (Vázquez-Rowe et al., 2019). Scientific knowledge should get along with systematic social change, which is not impossible (Iglesias, 2022). Peru is one of these developing states where climate change events do not equally affect everybody. Those with an income taking advantage of water resources are a considerable risk to the country's ecological system (Heikkinen, 2021).

Peru's hydrographic structure is integrated by the Amazon, Pacific, and Titicaca, regions with 84, 62, and 13 basins, respectively (ANA, 2022), to supply 33 million 35,304 thousand habitants in 2021 approximately (INEI, 2022). However, the resource distribution throughout the Peruvian territory is not homogeneous (ANA, 2022), so its management and climate commitment to increase resilience are vital.

Taking into account that according to (IPCC, 2014), resilience is the capacity of social, economic, and environmental spheres to handle a hazardous event, replying or reorganizing in ways that allow them to maintain their essential functions and the capacity to adapt, learn and transform. For instance, to be resilient, urban communities worldwide have started to practice urban rooftop agriculture (URTA), applying irrigation techniques to guarantee water availability and food security under climate change scenarios (Begum et al., 2022).

Consequently, this study aims to understand the Peruvian conduct under the UNFCCC regime, the influence on Peruvian regulation and institutions over the years, and the recent commitment to the UNFCCC related to agriculture and water resources based on an exhaustive review of scientific papers, UNFCCC's documents, and Peruvian regulations.

2. Climate Change, agriculture and water resources

Climate change is expressed through the water, affecting its demand and supply. Water use is mainly divided into agriculture, industrial, and domestic activities. Economically speaking, the elasticity refers to that domestic water use will increase from 0.02% to 3.8% by a 1% rise in global temperature and from 0.02% to 0.31% when precipitation is reduced by 1% (Frederick & Major, 1997).

Reducing rainfall frequency and increasing global temperature affects arid and semi-arid areas due to their vulnerability to the potential water resources shortage and the extended renewal capability of the resource (Aliyari et al., 2021).

It is predicted that by 2025, almost 3.5 billion people globally will have problems with freshwater access, or simply it will be impossible. The affected ones, located most of the time in developing countries, used to be marginalized by their geographical location, economically, and socially status; so, it is essential to understand that water is a complex system that involves cultural, social, environmental, and economic spheres (Mukheibir, 2010). Figure 1 mainly explains the water cycle and its interactions with specific sectors, contributing to food security and nutrition.

One of these developing countries is Peru, which has an essential source of fresh water located in the Andes, with 70% of tropical glaciers around the globe and its 4557 lakes surrounding them (Wood et al., 2021), being one of the countries with more fresh water in South America. However, because of global warming, all those glaciers are exposed and tend to disappear by the end of the century (Chevallier et al., 2011; Young & Lipton, 2006). Also, water resources are unequally distributed in the territory (Eda & Chen, 2010), making the vulnerability of ecosystems and communities rise under climate change scenarios (Bury et al., 2011; Lastra et al., 2021; Lynch, 2012). The Peruvian territory is divided into three crucial hydrographic regions: Pacific, Amazonas, and Titicaca (Eda & Chen, 2010), which have a territory distribution of 21%, 74.5%, and 3.8%, respectively to supply 64.9%, 31.6%, and 3.5% of the population in the same order (ANA, 2022). In addition, critical points with the risk of flooding and erosion in rivers and streams have been identified by ANA at the national level due to hydrometeorological phenomena and extreme events increasing water stress (ANA, 2022).

In that sense, Peru has been seeking an Integrated Water Resources Management (IWRM) as part of sustainable development to increase water supply, awareness, and agriculture resilience to environmental problems in a growing population affected by extreme climate events (Flórez Bossio et al., 2021; Salmoral et al., 2020; Ponce, 2020).

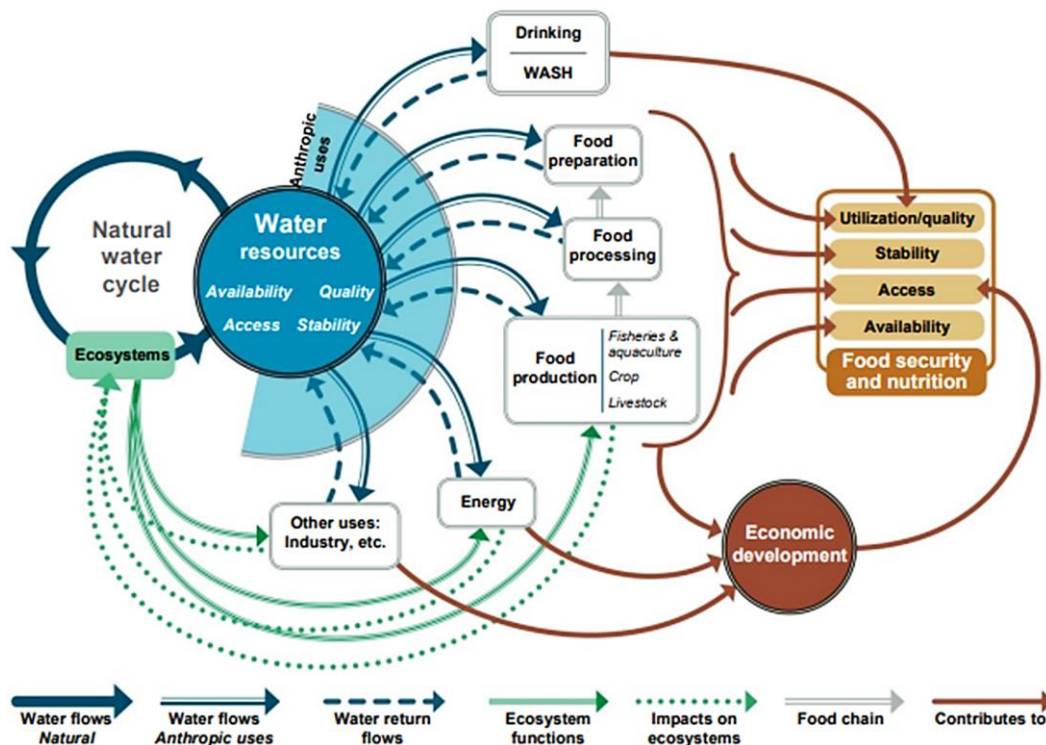


Figure 1. The Multiple Interfaces between Water and Food Security and Nutrition (FSN). Source: HLPE (2015).

3. International regimes

Regimes are sets of implicit or explicit beliefs, behavior regulations defined in norms, specific instructions, and actions to implement collective choice in a specific area in international relations (Krasner, 1983). The main objective is establishing a group of commitments about the area of interest to get expected benefits, such as a rise in social welfare. There are regimes in every international political arena: security, economics, environment (UNFCCC), and human rights. The study of those regimes is under neoliberalism, which privileges interest analysis variables, and realism focuses on the power among states (Hasenclever et al., 1999; Vogler, 2016).

3.1. Realism

The realism approach wants to explain the reality of international regimes' existence and consider that power among nations is crucial. Hence, the capabilities distributions among states influence effective maintenance. In that sense, the regimes promoted by a hegemony are vitally crucial for international goal achievement because of their support, which reduces the uncertainty in international relations (Hasenclever et al., 1999).

Unfortunately, international anarchy fosters competition and conflict among states. It inhibits their willingness to cooperate even when they share common interests, making realism pessimistic about cooperation and capabilities. In effect, this approach emphasizes conflicts; however, it offers a clearer understanding of international issues than others (Grieco, 1988).

Furthermore, regarding adaptation measures, it could be understood that taking that action in developing states is

not a concern for developed ones since it does not provide them any benefits (Khan, 2016).

3.2. Neoliberalism

The neoliberal approach refers to how international regimes promote joint interest achievement, reducing uncertainty, and strengthening cooperation seeking the state's interest (Hasenclever et al., 1999). In that sense, it is understandable that cooperation will maximize the state's gains being indifferent to others' achievements. For instance, if states have similar political, military, economic, or environmental (climate change) interests, individual gains through international cooperation are expected, and states will have the fewest worries about solid conflicts in the long term (Grieco, 1988).

Furthermore, it is referred by Khan (2016) that several developing states will not be viable partners for globalization trade and investment without international cooperation. Nevertheless, the UNFCCC has a neoliberalist approach to promoting international cooperation and recognizing common but differentiated responsibilities and respective capabilities.

4. United Nations Framework Convention on Climate Change

The milestone in international matters regarding climate change was given at the Earth Summit by the United Nations in May 1992 in Rio de Janeiro, adopting the United Nations Framework Convention on Climate Change (UNFCCC) and entering into force in March 1994. Which objective is "stabilizing greenhouse gas concentrations in

the atmosphere at a level that prevents dangerous anthropogenic interference in the climate system" (Kuyper & Schroeder, 2018). Furthermore, article 4^o refers to the fact that all parties, specially developed ones, must cooperate in preparations for adaptation to the impacts of climate change, such as water resources (UNFCCC, 2022).

The Peruvian Government signed the Convention on June 12, 1992, and ratified it on June 7, 1993, as a Non-Annex I party that includes every developing country. Based on the Convention, Peru reported three communications according to the article 12^o of the Convention (UNFCCC, 2022) and two biennial update report submissions based on decision 2/CP.17 (UNFCCC, 2022). The timeline is shown in Figure 2.

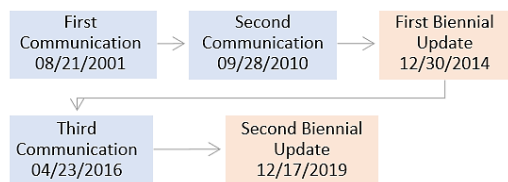


Figure 2. Peruvian Submissions to the UNFCCC Timeline.

5. Agreements under the United Nations Framework Convention on Climate Change

The Kyoto Protocol was established at the third Conference of the Parties (COP3) held in Japan in 1997 and entered into force in 2005 to reduce Greenhouse Gasses (GhG) by 5% versus the levels of 1990 between 2008-2012, considering the sewage treatment as a source of GhG (UNFCCC, 2022). It was signed on November 13, 1998, and ratified by Peru on September 12, 2002 (UNTC, 2022). Then, it was amended in Qatar on December 8, 2012, at the 18th Conference of the Parties (COP18) "Doha Amendment" for a second period between 2013-2020, increasing the target to 18% (UNFCCC, 2022), accepted by Peru on September 24, 2014, and entering into force on December 31, 2020 (UNTC, 2022).

The Kyoto Protocol was considered a failure and an exclusive mitigation action (Mayer, 2018). The Copenhagen Accord took place in 2009 at the 15th Conference of the Parties (COP15) in Denmark regarding adaptation measures to increase resilience in vulnerable populations and provide the objective to hold the temperature rise below 2 °C and pursue the effort to limit it to 1.5°C (UNFCCC, 2022).

In consequence, under a better structure argument (Mayer, 2018). The Cancun Agreement occurred at Mexico's 16th Conference of the Parties (COP16) in 2010. It secured those arguments in 2009, recognizing the effects of climate change on human rights, ratifying the importance of adaptative measures in diverse spheres like water resources, and establishing the Green Climate Fund (GCF) (UNFCCC, 2022).

Furthermore, the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) took place in December 2015 at the 21st Conference of the Parties (COP21) in France. On November 4, 2016, the agreement entered into force for periods posthumous to 2020. The main objective is holding the increase in the global average temperature to well below 2°C and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels by the year 2050, among mitigation and adaptation actions. Every party under the UNFCCC should present their Nationally Determined Contributions (NDC) (UNFCCC, 2022).

The Peruvian Government signed the agreement on April 22, 2016, and ratified it on July 25, 2016 (UNTC, 2022). The same day, Peru reported its first Nationally Determined Contributions (NDC) and updated it on December 18, 2020 (UNFCCC, 2022) with 62 mitigation and 92 adaptation measures, of which 31 are strictly related to water resources and 17 to agriculture (Peruvian Government, 2022). The agreements timeline is detailed in Figure 3.

6. Peruvian institutions concerning climate change, agriculture and water resources

Public institutions are vital actors in climate change regulations. In that sense, those head institutions related to the compliance of the Peruvian commitments under the UNFCCC related to agriculture-water resources were considered.

Peru has 18 ministries; one of them is the Ministry of Environment, created by Legislative Decree N° 1013 on May 13, 2008 (Peruvian Government, 2022b), which nowadays is the focal point for the United Nations Framework Convention on Climate Change (UNFCCC) and it has a directive, technical-normative functions in environmental aspects. Therefore, compliance with regulations implemented by the legislative branch in climate change will be in charge (Peruvian Government, 2022c). The central departments related to climate change are shown in Figure 4.

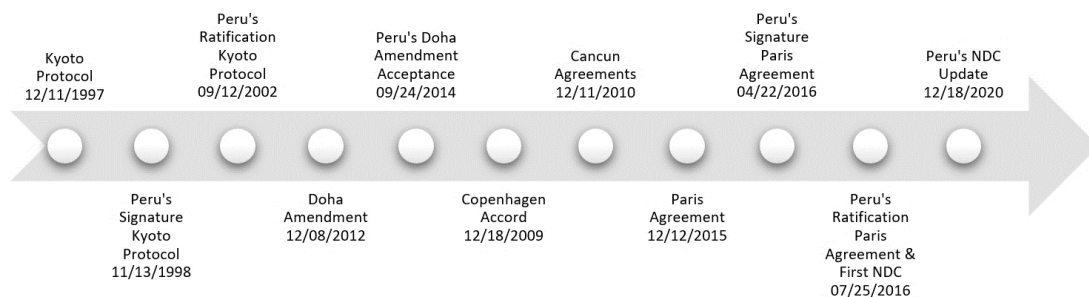


Figure 3. Agreements Under the UNFCCC and Peruvian Participation Timeline.

The Ministry of Agrarian Development and Irrigation was created by Law N° 9711 on December 31, 1942 (Peruvian Government, 2022b). It is concerned with pursuing integral, social, efficient, sustainable, and modern water resources management and agriculture resilience (Peruvian Government, 2022d). The central departments related to climate change are shown in Figure 4.

The Water National Authority (WNA) is a specialized technical body attached to the Ministry of Agrarian Development and Irrigation and was created on March 13, 2008, through Legislative Decree N° 997 (Peruvian Government, 2022b). Some of its functions related to climate change are to promote the implementation of adaptation measures, promoting actions, and projects that will increase water availability during hydrological events under the harm prevention and mitigation approach (Peruvian Government, 2022e).

The Ministry of Housing, Construction, and Sanitation was created by Law N° 27779 on July 11, 2002 (Peruvian Government, 2022b). It is focused on infrastructural planning in the national territory, evaluation of construction and sanitation policies, comply with norms, plans, and procedures related to climate change actions under their functions (Peruvian Government, 2022f) under their departments evidenced in Figure 4.

Furthermore, the Ministry of Energy and Mines was created by Law N° 17271 on December 3, 1968 (Peruvian Government, 2022b). Its functions are related to the concern for the integrated and sustainable development of mining and energy, which involves hydroelectric ones respecting the environment (Peruvian Government, 2022g).

7. Peruvian normativity concerning climate change, agriculture and water resources

Several regulations related to the environment were implemented in Peru during the last decades. However,

those essential milestones for significant changes in the Peruvian regulations related to climate change, agriculture, and water resources were considered.

7.1. Progress Reported in the First National Communication to the UNFCCC

The Peruvian Political Constitution is the most crucial regulation in Peru, signed in 1993 and expressed in its second article that everyone has the right to enjoy a balanced and appropriate environment in their life development (Peruvian Government, 2022b).

In the same year, through Supreme Resolution N° 359-93-RE was created the National Commission on Climate Change (NCCC) to guide the implementation of the commitments assumed under the United Nations Framework on Climate Change (UNFCCC). Then, the National Commission on Environment was created in 1994 by Law N° 26410 to implement a governing body in environmental matters (Peruvian Government, 2022b).

Finally, in 1997 Law N° 26821 for sustainable use of natural resources was created where the water and atmosphere are considered natural resources as well as the soil for their susceptibility to being exploited by humans (Peruvian Government, 2022b).

7.2. Progress reported in the Second National Communication to the UNFCCC

The Law N° 27867 of Regional Governments was created in 2002 and includes formulating, coordinating, leading, and supervising the regional strategies related to climate change, agriculture, and water resources. Which one complements the National Strategy on Climate Change (NSCC) established in 2003 through Supreme Decree N° 086-2003-PCM, which includes the national program with mitigation and adaptation measures (Peruvian Government, 2022b).

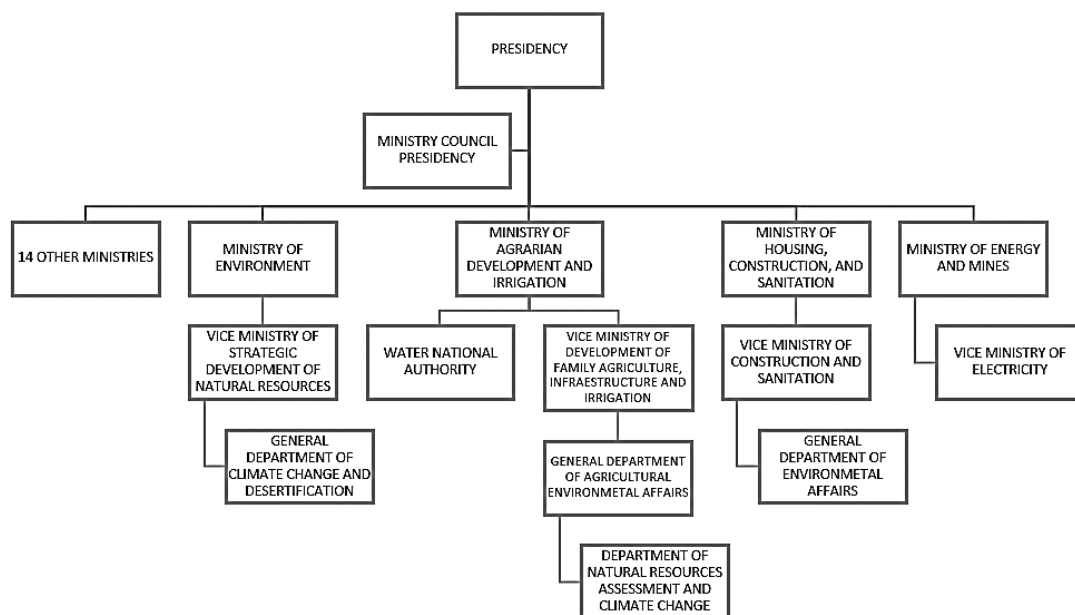


Figure 4. Main Peruvian Public Institutions concerning climate change, agriculture, and water resource.

Law N° 28245 implemented the National Environmental Management System (NEMS) in 2004 as a national strategy designed to implement commitments under the UNFCCC and other international commitments. Then, in 2005 a regulatory framework for environmental management to improve life quality and encourage sustainable development was established by Law N° 28611, General Environmental Law (**Peruvian Government, 2022b**).

Also, in 2006 through Supreme Decree N° 001-2006-ED, the National Strategic Plan of Science, Technology, and Innovation for Competitiveness and Human Development was established to articulate the national priority areas as agriculture, water security, and climate change with international treaties like the UNFCCC. Furthermore, the Ministry of Environment was created in 2008 through Legislative Decree N° 1013 to replace the National Commission on Environment. It became the new governing body in environmental matters in Peru and the new focal point for the UNFCCC (**Peruvian Government, 2022b**).

Strictly related to water, the Peruvian Government created the National Water Authority (NWA) by Legislative Decree N° 997 in 2008 to manage water resources. This regulation came with the Legislative Decree N° 1081 and Legislative Decree N° 1083, creating the National Water Resources System (NWRs), and promoting the efficient use and conservation of the resource, respectively. To regulate the water resources management intentions, the Water Recourses Law was created in 2009 by Law N° 29338 (**Peruvian Government, 2022b**).

7.3. Progress reported in the Third National Communication to the UNFCCC

Once the national involvement in environmental matters was taking place, the National Environmental Policy was defined in 2009 through Supreme Decree N° 012-2009-MINAM, having a vision for the achievement of adaptation to climate change impacts as well as the integrated management of water resources and natural resources as soil. Later, in 2011 Law N° 29664 created the National Disaster Risk Management System (NDRMS) to prevent or reduce the risk of various factors as climate change effects (**Peruvian Government, 2022b**).

Through Supreme Decree N° 054-2011-PCM, the National Development Plan Strategy (NDPS) was established in 2011 for long-term development, considering climate change as a megatrend of worldwide changes. Also, to operationalize the National Environmental Policy with specific water resources, agriculture, and climate change objectives, the National Environmental Action Plan was established in 2011 through Supreme Decree N° 014-2011-MINAM (**Peruvian Government, 2022b**).

The National Commission on Climate Change (NCCC) was modified in 2013, considering the Ministry of Environment functions through Supreme Decree N° 015-2013-MINAM (**Peruvian Government, 2022b**). Then the National Strategy on Climate Change (NSCC) was updated until 2021 to increase awareness and adaptive capacity to maintain water resources and agriculture resilience as a priority in 2015 through Supreme Decree N° 011-2015-MINAM (**Peruvian Government, 2022b**).

7.4. Progress after the Third National Communication to the UNFCCC

The Peruvian Government, according to the Paris Agreement, reported its first Nationally Determined Contribution (NDC) in 2016, approved by the National Commission on Climate Change (NCCC) to pursue and contribute with adaptation and mitigation measures by 2030 (**UNFCCC, 2022**). However, to take the international commitment into a national legally-binding obligation; the Framework Law on climate change was created in 2018 by Law N° 30754 to articulate public policies and their comprehensive management of climate change, taking into account different approaches: intergenerational, intercultural, equality, human rights, indigenous knowledge, hydrographic basis, and ecosystems (**Peruvian Government, 2022b**).

Then, in 2020 through Supreme Decree N° 006-2020-MINAM, the High-Level Commission on Climate Change was created to propose adaptation and mitigation measures for the Nationally Determined Contribution (NDC) and report its advance every five years (**Peruvian Government, 2022b**). In that sense, the update of the first Nationally Determined Contribution (NDC) by 2030 and 2050 was given in 2020 and approved by the High-Level Commission on Climate Change, including 92 adaptations (31 related to water resources and 17 to agriculture) and 62 mitigation measures (**UNFCCC, 2022**).

Furthermore, the National Adaptation Plan for climate change by 2030 was established in 2021 through Ministerial Resolution N° 096-2021-MINAM. It operationalized all those 92 adaptive measures presented in the latest NDC (**Peruvian Government, 2022b**).

On the other hand, the update of the National Environmental Policy by 2030 within its thematic axes to increase resilience in the agriculture sector to climate change or the integrated management of water resources was established through Supreme Decree N° 023-2021-MINAM in 2021 (**Peruvian Government, 2022b**).

7.5. Objectives related to climate change, agriculture and water resources based on Peruvian actions - Regulations

Table 1 lists the objectives related to climate change, agriculture and water resources.

8. Institutions, regulations, and Peruvian commitment to the UNFCCC

According to the regulations previously cited, the Peruvian Government had updated their Nationally Determined Contributions (NDC) to the UNFCCC, including 92 adaptation measures among priority spheres (water, agriculture, fishing-aquaculture, forest, and health). The water and agriculture sector involves 31 and 17 out of 92 measures participating at the central four institutions related to climate change, agriculture and water resources shown in **Table 2** operationalized by the National Adaptation Plan to Climate Change by 2030 (**Peruvian Government, 2022**).

Table 1
Operational climate change, agriculture and water resources objectives

Regulation	Title	Date	Objectives
Supreme Decree N° 086-2003-PCM	National Strategy on Climate Change (NSCC) to 2012	10/24/2003	Strategic Line N° 06: Promote projects to alleviate poverty, reduce vulnerability, and mitigate GhG. Target N° 6.3.1.: Projects in vulnerable sectors of Climate Change a) hydrology and aquatic resources, b) agriculture and security of food supply, c) terrestrial and freshwater ecosystems, d) marine and coastal ecosystems, e) human health, f) human settlements, energy, and industry, g) insurance and other financial services.
Supreme Decree N° 001-2006-ED	National Strategic Plan of Science, Technology, and Innovation for Competitiveness and Human Development	01/17/2010	Strategy N° 1.2.: Promote transference and adoption of technology national policy to increase companies' competitiveness and generate national capabilities. Action Line N° 1.2.5.: Articulate national policies with international instruments linked to sustainable development like the UNFCCC.
Supreme Decree N° 012-2009-MINAM	National Environmental Policy	06/22/2009	Policy Axis N° 01: Conservation and sustainable use of natural resources and biological diversity. Objective N° 03: Achieve the integrated management of the country's water resources. Policy Axis N° 2: Quality Environmental Management Objective N° 01: Achieve sustainable development regarding productive, extractive, and transformation to guarantee good environmental quality in the country.
Supreme Decree N° 054-2011-PCM	Strategic National Development Plan to 2021	06/22/2011	Strategic Axis N° 06: Natural resources and environment. Specific objective N° 03: Integrated and efficient management of water and basins at the national level. Specific objective N° 4: Vulnerable population and productive systems adapted to climate change.
Supreme Decree N° 014-2011-MINAM	National Environmental Action Plan to 2021	07/09/2011	Priority Goal N° 01: 100% of urban domestic wastewater and 50% of these are reused.
Supreme Decree N° 011-2015-MINAM	National Strategy on Climate Change Strategy to 2021	09/23/2015	Strategic Objective N° 01: The population, economic agents, and the state increase awareness and adaptive capacity for action in the face of climate change's adverse effects and opportunities. Product N° 08: Evaluation of the impact and effects of the condition of climate change in watersheds and ecosystems, including protected natural areas.
High-Level Commission on Climate Change report	NDC Update Report to 2030	12/18/2020	Adaptation objectives and measures are established in five prioritized thematic areas: i) Agriculture; ii) Forests; iii) Fishing and aquaculture; iv) Health, and v) Water (Water Resources) to reduce the vulnerability of people and ecosystems.
Ministerial Resolution N° 096-2021-MINAM	National Plan for Adaptation to Climate Change by 2030	06/07/2021	Annex N° 05: Adaptive measures sheets. 31 of the 92 adaptive measures related to climate change correspond to the priority thematic area of water resources and 17 to agriculture.
Supreme Decree N° 023-2021-MINAM	National Environmental Policy to 2030	07/22/2021	Direct cause N° 03: Increased risks and impacts from natural and man-made hazards in the context of climate change. Priority objective N° 05: Increase adaptation to the country's climatic effects under four operational guidelines to reduce damages, alterations, and losses due to climate change by 20%.

Table 2
Peruvian agriculture-water adaptation measures

Thematic area	Component	Measures	Synergistic Institution
Water	Water for Energetic Use	Target: 02 No Target: 04	Ministry of Energy and Mines
	Water for Agriculture Use	Target: 05 No Target: 02	Ministry of Agrarian Development and Irrigation
	Water for Population Use	Target: 07 No Target: 01	Water National Authority
	Water for Multisectoral Use	Target: 08 No Target: 02	Ministry of Housing, Construction, and Sanitation
Agriculture	Soil	Target: 03 No Target: 01	Ministry of Agrarian Development and Irrigation
	Agricultural Value Chain	Target: 04	
	Agricultural/Livestock System	Production Target: 08 No Target: 01	

The table above shows Peru's 31 water and 17 agriculture adaptation measures for Climate Change by 2030-2050, its target status, and synergistic institution. The National Adaptation Plan (NAP) reveals that 29% of its water measures do not have specific targets for the two long-term scales, while almost 12% of agriculture measures lack specific targets (2030 & 2050). Furthermore, it is essential to emphasize that the main responsible for the NAP implementation is the Ministry of Environment; however, the horizontal cooperation among ministers is essential based on their responsibilities and adaptation components. In that sense, four institutions are also responsible for the appropriate planning, implementation, monitoring, and evaluation.

9. Critical appraisal

The Peruvian Government, as a developing state, had acted under a neoliberalism approach, seeking a common objective and strengthening international cooperation to increase the resilience to climate change. However, the United Nations Framework Convention on Climate Change (UNFCCC) tends to have a realistic approach because the states' capability distributions affect the achievement, despite its intentions led by a neoliberalism approach.

Also, the result shows four seasons related to the Peruvian regulation evolution related to climate change, agriculture, and water resources. Three of them have been reported to the United Nations Framework Convention on Climate Change (UNFCCC), considering scientific, economic, and moral components that, according to (Mayer, 2018), should be considered in government actions to contribute to the fulfillment of international objectives.

Some regulations were updating their previous ones. The latest has been shown a roadmap with goals in terms of climate change, agriculture, and water resources by 2030 as the Paris Agreement request based on the learning obtained representing one of the high-level goals that (Gates, 2021) suggests. However, it should be analyzed and defined if it is specific, measurable, and realistic because, according to (Young, 1989), it increases the effectiveness of fulfilling the responsibilities assumed internationally.

On the other hand, Integrated Water Resources Management (IWRM) started a policy discourse supported by international organizations like the United Nations in 1990 (Benson & Lorenzoni, 2017). Throughout the years, it has been part of adaptation measures (Kamperman & Biesbroek, 2017). The water management programs are oriented primarily to infrastructure, technology development, and public awareness. Which one goes accord Table 2, having 18 adaptation measures among the same areas belonging to the Water National Authority and the Ministry of Housing, Construction, and Sanitation. Furthermore, (Schattman et al., 2021) express that the efficacy of measures to tackle climate change will depend on a balance of water demand among different sectors, as is shown in figure 04 among four Peruvian head institutions concerning adaptation actions, agriculture, and water recourses.

Unfortunately, the Peruvian critical points, water inequity distribution, and weather change could threaten all those adaptation measures related to water resources and agriculture reported in the Nationally Determined Contributions (NDC). According to (Dias et al., 2020), the hydrological modeling, agriculture sector management, and climate scenario occurrence still represent much uncertainty for policymakers. In that sense, (Mertz et al., 2009; Mumme, 2020) suggest that environmental strategies related to agriculture-water management should develop forward international treaties, identify risks, and promote values and international cooperation. In addition, the Peruvian Government has been running the National Strategic Plan of Science, Technology, and Innovation for Competitiveness and Human Development to increase climate change, natural resources, and water resources research. According to (Carraro et al., 2012), which substantially increases the probability of efficiency in public policies and is referred by (Eroğlu & Erbil, 2021) that cooperation among policy and knowledge makers is essential to tackle climate change.

10 Conclusions

The Peruvian Government actively participates in the United Nations Framework Convention on Climate Change (UNFCCC). They take a neoliberalism approach to increase the adaptive capacity and contribute to the global interest in reducing Greenhouse Gases (GhG) emissions. Furthermore, as a developing country, it does not have the power to implement adaptation measures by itself, making international cooperation a very strong component in the Peruvian funding strategy to reduce climate vulnerability.

The freshwater availability among the Peruvian territory is very inequity. One of the biggest challenges for the national Government is to ensure its distribution across the country that is also threatened by hydrometeorological events and to increase agriculture resilience to ensure food security. However, the climate change convention represented an excellent opportunity to achieve integrated agriculture-water management. It pushed to develop specific public institutions related to agriculture-water and programs, policies, and laws under a sustainable development approach since the ratification of the Peruvian Government on the convention.

Furthermore, one of the most important influences of the United Nations Framework Convention on Climate Change (UNFCCC) in the Peruvian regulation was given after the Paris Agreement. Law N° 30754 on climate change articulate regulations providing a more substantial legally-binding commitment under the international convention.

Recently, the Peruvian Government submitted its updated Nationally Determined Contributions (NDC) as the Paris Agreement requested. Among its 154 measures reported, almost 60% of them are related to adaptation actions. The half part of it is directed to water resources and agriculture, understanding their priority under the international convention.

Finally, it is recommended to analyze the compliance of the latest programs, policies, and laws related to

adaptation-mitigation actions, as well as keep studying climate change impacts at a local level to develop a bottom-up approach for an effective policy formulation, implementation and monitoring.

ORCID

D. P. Arana-Ruedas  <https://orcid.org/0000-0002-3682-5405>
N. Moggiano  <https://orcid.org/0000-0002-5642-3833>

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