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Financing for the climate change adaptation of organic export agriculture in Peru

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Financing; climate change; adaptation; agro-exports; organic food

The objective of this research is to analyse financing for the climate change adaptation of organic export agriculture using the methods of correlation and logarithmic regression, as well as exploring the sources of funding. In a context of high international demand, we find that Peruvian organic agro-exports grow in direct relation to the increase in the land area used for organic crops. From 2000 to 2020, exports of organic products achieved a continuous rise, and in 2020 they accounted for 7% of all agro-exports. However, so far little financing has been found internationally for the climate change adaptation of organic agriculture. Among the main financiers at the international level are the Green Climate Fund; IDB Invest, which finances an agro-export fruit and vegetable company in Peru; the FAO, which funds "Yachachiq–Kamayoq" network of women-led bio-businesses in actions to adapt to climate change in Peru; IFAD, which finances the agricultural project "Avanzar Rural" in the Peruvian highlands and Amazonia; and the Peruvian National Institute of Agrarian Innovation, which funds an association of farmers in the Piura region to improve the export of organic bananas to the Netherlands and Germany. It is recommended that policymakers in Peru implement adaptation options – among them, an increase in the land area used for organic production to promote food security, as well as accessible and innovative climate financing for the adaptation of small organic producers.

1. Introduction

Based on International Monetary Fund (IMF) projections of decreasing gross domestic product (GDP), the Food and Agricultural Organization predicted in its report "The State of Food Security and Nutrition in the World" that hunger could grow on a global scale, between 83 and 132 million people – that is, there could be 828 million affected individuals. Although the undernourished population is expected to decline in 2021, the figures are still forecast to be higher than before the pandemic (FAO, IFAD, PAHO, WFP, and UNICEF, 2020).

Agriculture is highly vulnerable to climate change (MINAGRI, 2020). Faced with adverse climate effects such as heat waves, droughts, heavy rainfall, and other extreme weather events, agricultural systems must adapt to negative impacts to ensure resilient food production. In this context, organic farms often maintain greater species diversity and grow locally adapted varieties that enhance the resilience of agro-ecosystems against adverse climatic conditions (FiBL & IFOAM EU, 2016). The Inter-American Institute for Cooperation on Agriculture (2017) supports the planning process for adaptation to climate change in order to

ensure the resilience, productivity, and competitiveness of the agricultural sector in Central and South America.

According to Campos et al. (2017), from 2011 to 2015, Peru's exports grew by 53%, which is a similar rate to other countries with a more significant share in the production sector in terms of land use and producer participation. Exports of agri-food products drive the growth of rural areas, but little is known about the role that exporters play in adapting to climate change; however, it has been noted that they need better information and more financial capital to face the phenomenon in the long term (Kasterine et al., 2015).

Arid desert covers much of Peru's coastal and south-western region, restricting agricultural cultivation to highland areas in the Andean Mountains or humid tropical lowlands. Rain patterns are heavily influenced by the El Niño-Southern Oscillation (ENSO). Although 71% of the world's tropical glaciers – a critical water source for agriculture – are found in Peru, the glacial volume has retreated by 40% since 1970 due to the increase in temperatures associated with climate change. In addition, the increased frequency of El Niño/La Niña events resulting from climate change can lead to a higher incidence of floods, droughts, soil erosion, landslides, and pests/diseases in mountainous and humid lowland areas (Prager et al., 2020).

The international trade in agricultural products is subject to regulations to protect plant variety and take care of human and animal health against pests and risks of additives, toxins, pathogens, or contaminants in food and beverages amid rising global demand for healthy food (MINAGRI, 2020).

Most financial institutions that grant loans to small agricultural producers lend two types of funds: working capital and investment, which have different characteristics relating to criteria such as payback period and the maximum amount that farmers can borrow (Pinzon, 2019). The contribution of the average agricultural credit over the total credit of financial institutions is 4.5% (Table 1).

Climate finance is used chiefly for mitigation actions, with an average of only USD 22 billion per year for adaptation (Tietjen et al., 2019); one of the main discussions in the realm of adaptation finance is the difficulty in distinguishing between adaptation and development projects since climate resilience and development are closely linked.

This study addresses three questions appertaining to the issue of climate change adaptation for organic products, respectively, as follows: What financing

Table 1. Agricultural credit disbursed by different financial institutions

Financial Institution	Total agricultural credit (thousands of USD)	% agricultural credit in total loans
Banks	1,753,076	2.8%
Financial institutions	135,179	4.8%
Municipal savings and credit institutions	249,832	5.0%
Rural savings and credit institutions	29,804	8.5%
Small and micro-enterprise development institutions	8,158	1.6%
Savings and credit co-operatives	NA	
Finance system	**2,562,226**	
% selected financial system	85%	

Source: Pinzon (2019). Appendix 2 (2018).

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contribution has been made to the climate change adaptation of organic export agriculture in Peru? What progress has been made in financing the climate change adaptation of organic export agriculture in Peru? What options are available for Peruvian organic agro exports to adapt to climate change?

This study is justified because agro exports are the economic activity that generates the second-highest volume of foreign exchange in Peru. Even in these times of recession due to the pandemic, international demand for organic agricultural food continues to drive the industry's growth, provide livelihoods and employment to rural inhabitants, and, in turn, contribute both to the sustainability of Peruvian economic growth and to achieving several sustainable development goals (SDGs 1–3, 8, 12, and 13). Climate adaptation financing is crucial because the agricultural sector is very vulnerable to climate change, and organic agro exports are of particular importance for food security and global environmental security.

The study's objective is to analyse financing for adaptation to climate change in the case of organic export agriculture in Peru. Specifically, we will explore the advances made in providing financing channels for the climate change adaptation of organic agriculture and examine the options available for helping Peruvian organic export agriculture adapt to climate change.

2. Literature review

Nowadays, the world is facing a series of significant political, institutional, and financial changes in the global approach to adapting to climate change. Climate change adaptation and mitigation are essential to achieving the SDGs. The Adaptation Program for Small-Scale Agriculture (ASAP) of the International Fund for Agricultural Development (IFAD) is a multi-donor fund and, since its establishment in 2012, has pioneered resilience-building among highly vulnerable populations. So far, the ASAP has led to improved adaptive capacity for some 5 million smallholders in 41 countries. By 2020, ten countries were scaling up the activities and lessons learned from the original ASAP investments. (International Fund for Agricultural Development (IFAD) (2020).

Organic agriculture is more resistant to the impacts of climate change, partly because organic soils contain higher levels of carbon. As weather and rainfall patterns continue to change, organic farming will be better able to adapt. On the other hand, conventional agriculture is responsible for a significant portion of global and domestic GHG emissions. Opportunities can be created for farmers to transition to organic production through incentives such as carbon credits. Moreover, many organic practices can be incorporated into conventional farming methods to help reduce GHG emissions (Criveanu, & Sperdea, 2014).

Schader et al. (2021) used data from five crops in the seasons from August 2014 to March 2017 to assess the impacts of sub-Saharan African implementation of organic agriculture and smallholder organic management practices on 1,645 farms from five case studies in Ghana and Kenya, which they monitored for 24 months. They found significantly higher farm-level gross margins (144%) on organically managed farms than on conventional farms.

Financial flows are divided between the adaptation and mitigation of small-scale agriculture (Chiriac et al., 2020). Allocation of most small agricultural climate funds for adaptation is also in line with the increased vulnerability of operators in rural areas of Africa, Asia, and the Americas, due to the impacts of climate change on agricultural productivity, income, and food security there.

Using principal component analysis (PCA), Bedoya-Perales et al. (2018) showed that the quinoa boom in Peru resulted in an expansion of quinoa cultivation both in traditional areas and in new regions in the period 1995–2014, in many cases involving changes in land use. This meant that the number of hectares planted with quinoa in 2014 increased by 43% compared to what would have been expected without the boom mentioned above. Meanwhile, Arslan et al. (2020) evaluated sets of indicators related to income, resilience, food security and nutrition, and women's empowerment in a project to strengthen local development in the Altiplano and High Forest Zones of Peru.

The fight against climate change requires billions of dollars in financing to move towards a low-carbon economy and reach the goals of the Paris Agreement by 2050 (EU-LAC Foundation, 2020, p. 21). Accord-

ing to empirical evidence, green bond markets are more prominent in countries with environmental commitments. Reducing information asymmetries is laudable; investors demand transparent information about the fate of green bonds and value sustainable investments in adaptation and mitigation. A green agricultural bond certified by FIRA was issued in Mexico (Fundación EU-LAC, 2020).

According to MINAM (2021), faced with the effects of climate change, adaptation means addressing adjustments to the current or projected climate as well as its impacts on human or natural subsystems to take advantage of the benefits and reduce or avoid the damage. With almost 50% of projects targeting adaptation activities, climate finance for small-scale agriculture has a more balanced distribution between adaptation and mitigation, compared to total climate finance; it is mainly international, 95% comes from the public sector, made up of government donors and multilateral and bilateral development finance institutions at 39%, 32%, and 16%, respectively (Chiriac et al., 2020).

Adaptation to climate change is a public good (Timilsina, 2021), and in this regard, information on financing for climate change adaptation and resilience is distributed among various sources. However, the contributions of developed countries to climate funds remain low. Compared to funding for mitigation, adaptation lacks sufficient financing (Watson & Schalatek, 2021).

Organic agriculture uses fewer inputs than conventional agriculture, has more tremendous potential for carbon sequestration, and is more adaptable to the climate, and is more resistant to extreme weather events (Shaetzen, 2019). On average, because of crop rotation and organic production practices, there is both more biodiversity and crop diversity on organic farms than on traditional farms (Müller & Gattinger, 2012).

Organic agriculture is more respectful of the environment than conventional agriculture and capable of addressing sustainable development goals through its use of ecological technologies, which generate economic, social, and ecological benefits (Cidón et al., 2021). Thus, organic agriculture represents a promising adaptation strategy.

3. Materials and Methods

This non-experimental, expo facto, correlational and explanatory study covers the universe of financing for the climate change adaptation of organic export agriculture in Peru. The unit of analysis is the agro-export of organic products. The study period is annual, from 2000 to 2020 (n = 21).

3.1 Materials

The study draws primarily on statistics from the Ministry of Agrarian Development and Irrigation (MIDAGRI), the Commission for Export Promotion (PROMPEX), the Comprehensive Foreign Trade Information System (SIICEX), and the National Institute for Statistics and Informatics (INEI), analysed using SPSS software.

3.2 Data collection

Secondary information was collected from PROMPEX, in addition to statistics from SIICEX. For the study period, it was necessary to obtain quantitative, objective, and reliable data (volume, monetary value of exports, and financing). First, we reviewed the present financing characteristics for organic agriculture in Peru. Second, we quantified the contribution of the main organic products to Peruvian agro exports as a whole, and then used Pearson's correlation and logarithmic regression for statistical analysis. Third, we analysed the current financing contribution for the climate change adaptation of organic export agriculture. The procedure consisted of comparatively exploring the contribution of financial institutions that finance organic crops, loans for adaptation to climate change of organic export agriculture, and in general, credit support from multilateral financial organizations aimed at farmers in vulnerable areas of Peru (Table 7). So, we examined the progress made in climate financing for organic crops. The information collected on agricultural and climate financing is analysed considering that the beneficiaries are primarily farmers who grow organic products for export. The amount financed in dollars by each financial institution covers partially or totally (in some cases) the projects to improve agricultural production.

Then, we inquired about the available options for cli-

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mate change adaptation of organic export agriculture. Finally, we considered the findings and implications of the pressing need to increase climate adaptation credits for farmers engaged in organic export crops worldwide.

4. Results

4.1 Organic agro-exports and financing

Within the study period, the percentage share of organic products (as certified by Promperú, Peru's export promotion agency) in Peruvian agro-exports peaked in 2007, at 8.2% (Table 2), which represented a 60% increase from 2006.

Peruvian organic agro exports rose by 5186% from 2000 to 2020 (Figure 1). Despite only peaking as a share of overall exports in 2007, in absolute numbers, exports of organic products evolved positively over the period 2000–2020. In the latter year, the composition of organic exports within total agro exports was approximately 7% (Figures 1 and 2, Table 2).

Exports of organic ginger have had a substantial increase of 163% in 2020 despite the pandemic context in relation to 2019. Organic blueberries denote a promising agro export potential for the future (Table 3).

According to Promperú, 70% of the 2020 ginger exports are organic. 80% of organic products are export-

Table 2. Exports of organic products, Peru 2000–2020

Year	Agro-exports of organic products, FOB (Millions of US$)	% agroexports organic products / Total agroexports
2000	9.80	1.52
2001	15.16	2.35
2002	21.90	2.86
2003	33.23	3.92
2004	44.37	3.94
2005	69.87	5.22
2006	100.85	5.62
2007	161.32	8.18
2008	194.22	7.47
2009	162.09	6.58
2010	212.85	6.70
2011	326.05	7.21
2012	250.39	5.99
2013	263.50	6.23
2014	366.25	7.21
2015	384.07	7.48
2016	445.71	7.99
2017	435.58	7.29
2018	400.51	6.00
2019	394.00	5.54
2020	518.00	6.86

Source: PROMPEX (Sector Report, 2009; Annual Reports, 2010, 2013, 2015, 2018, 2020)

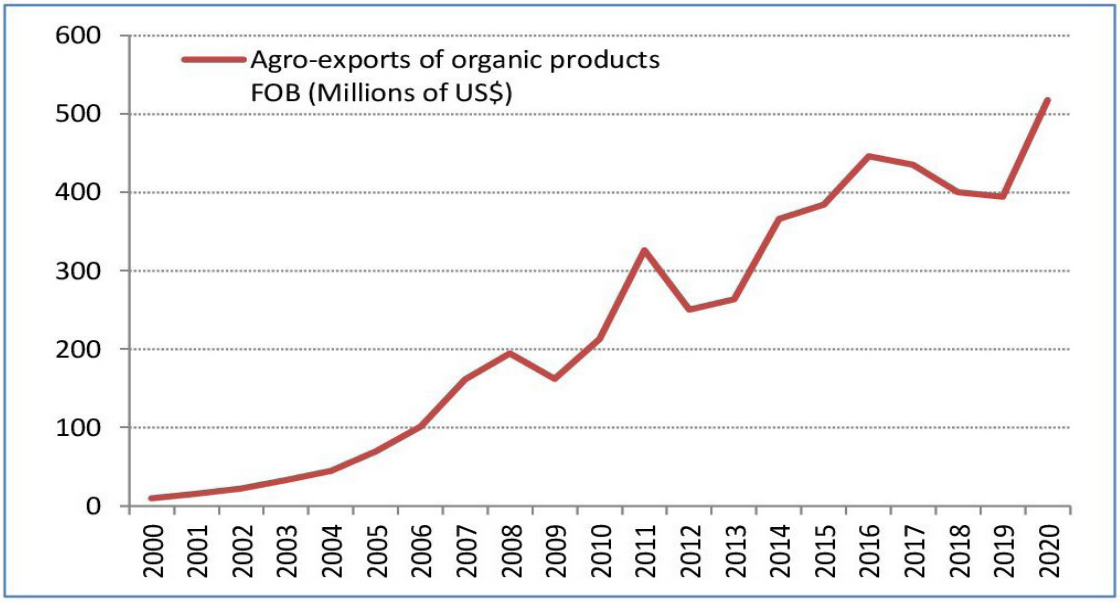

Figure 1. Evolution of agro-exports of organic products, Peru 2000–2020

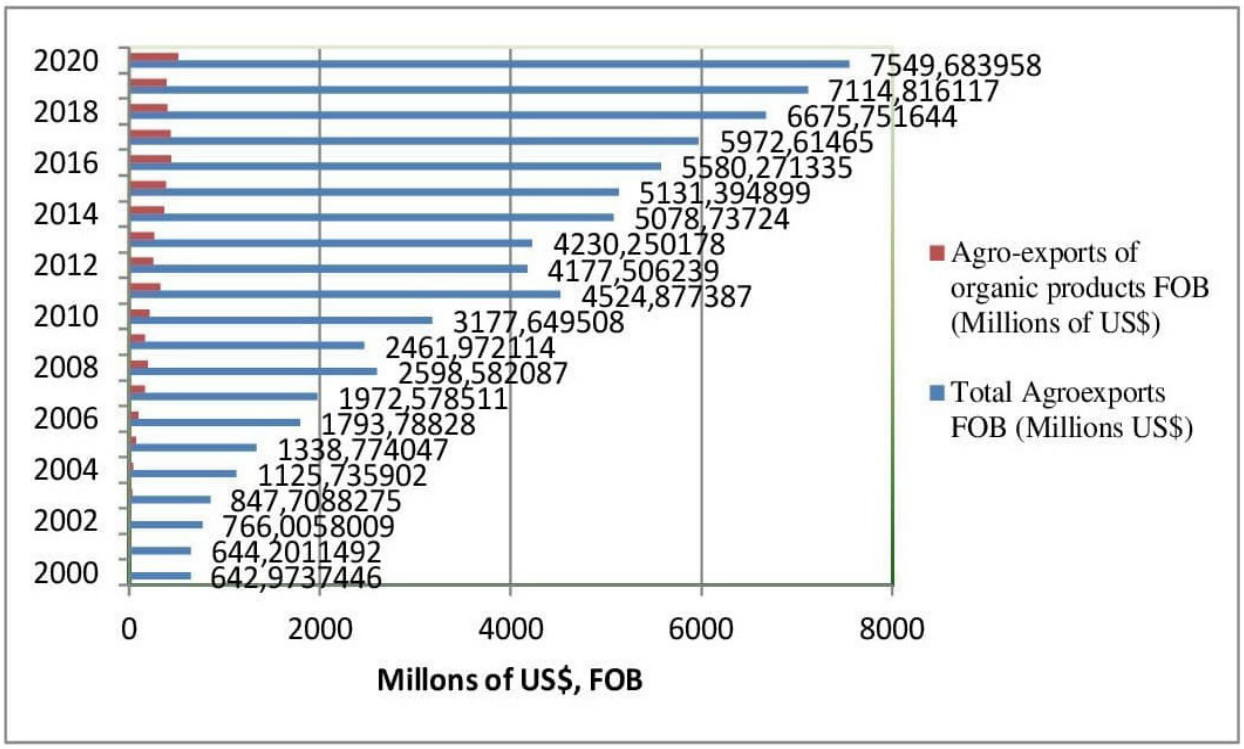

Figure 2. Agro-exports: organic products and overall, Peru 2000–2020

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Table 3. Agro exports of main organic products, Peru, FOB (Millions of US$)

Product	2014	2015	2016	2017	2018	2019	2020	Variation % 2020/2019
Banana	119.40	144.63	152.09	148.50	166.50	153.00	152.00	-0.65
Cacao	77.86	78.97	56.65	48.98	28.05	20.00	20.00	0.00
Quinoa	60.75	49.20	38.78	52.36	55.11	60.00	61.00	1.67
Coffee	54.04	49.58	0.00	0.00	0.00	34.00	53.00	55.88
Maca	13.91	16.00	8.89	8.67	6.96	6.00	11.00	83.33
Ginger	11.08	11.13	12.91	32.67	28.43	27.00	71.00	162.96
Mango	5.25	7.49	7.04	6.99	9.93	12.00	15.00	25.00
Avocado	0.87	1.94	4.10	10.95	12.45	13.00	16.00	23.08
Blueberry						1.00	35.00	3400.00

Source: PROMPEX (Annual reports, 2015, 2018, and 2020). MIDAGRI–PLANAE (2021).

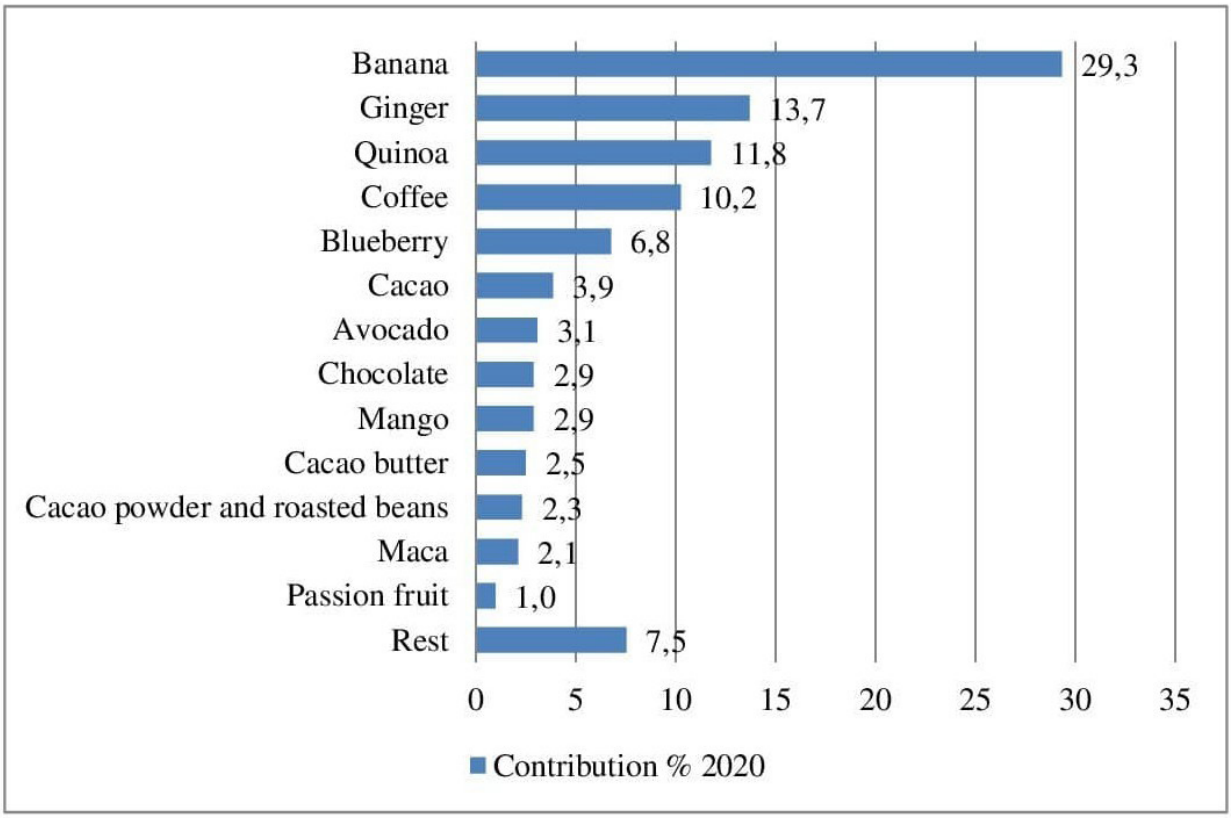

Figure 3. Contribution of main organic products exported Peru 2020, FOB (Millions of US$)

Source: PROMPEX.The organic foods that contributed the most to the FOB value of Peruvian organic agro-exports of organic products in 2020 were bananas, ginger, quinoa, coffee, and blueberries.

ed to the European Union (MIDAGRI, 2021).

The main destination for Peruvian organic blueberries is the United States, which in 2020 amounted to US$ 30.7 million. The export of organic ginger in 2020 increased by 187.6% in FOB value compared to 2019. The main markets for organic ginger that same year were Europe, the United States, and Canada.

The land area under organic crops in 2020 has in-

Table 4. Planted area used for organic production, Peru 2006–2020

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Thousands of Ha	240.17	280.24	257.44	390.95	342.70	302.60	256.84	230.94	331.29	457.04	395.56	537.75	532.66	504.98	559.45

Source: INEI (2020). Peru: Yearbook of Environmental Statistics. SENASA (2021)

Table 5. Correlation: Organic agro exports and hectares of organic production, Peru 2006–2020

		Agro-exports of organic products, FOB (Mill. US$)	Area under organic crops (Thousands of Ha)
Agro-exports of organic products, FOB (US $)	Pearson's correlation	1	0.778**
	Sig. (Bilateral)		0.001
	N	15	15

**. The correlation is significant at the 0.01 level (bilateral).

Table 6. Logarithmic regression: organic agro exports and hectares of organic production, Peru, 2006–2020

	Non-standardised coefficients		Standardised coefficients	T	Sig.
	B	Typical error	Beta		
Ln (Area under organic crops; thousands of Ha)	305.282	70.197	0.770	4.349	0.001
(Constant)	-1487.385	413.316		-3.599	0.003

R^2= 59.3%

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creased by approximately 11% compared to 2019, despite the Covid-19 emergency (Table 4).

According to the Sub-Directorate of Organic Production at the National Agrarian Health Service (SENASA), as of 2020, there were 107,000 producers with certified by SENASA, of which 94% are small farmers organised into 982 groups of operators. The most prominent organic crops certified in Peru are coffee, cocoa, quinoa, and bananas, while 90% of the country's organic production is exported. According to MIDAGRI (2021), the rise in organic production is due to high international demand, mainly from Europe (primarily the Netherlands, Germany, Belgium, France, United Kingdom, Italy, and Spain), United States, Japan, Canada, Russia, Australia, New Zealand, China, Mexico, Chile, South Korea, and Finland, among others.

The purpose of Table 7 is to compare the advances in agricultural financing and its adaptation to climate change by financial entities to answer the research questions. Among the financial contributors are the COP 25 Adaptation Fund, the Green Climate Fund, and the FAO which finance the strengthening of the climate resilience of crops and the livelihoods of rural communities. For its part, IDB Invest and the National Institute of Agrarian Innovation of Peru finance some organic crops for agro-export.

The Adaptation for Smallholder Agriculture Programme (ASAP) is IFAD's flagship climate finance program and applies rigorous quality control and monitoring systems. By the end of 2020, only 1.7% of global climate finance went to small-scale farmers in developing countries, despite their being highly vul-

Table 7. Agricultural and climate finance

Financing	Project/ Region	Amount / Entity	Details
Green climate Fund	- Strengthening the resilience of wetlands in the province of Datem del Marañón, Peru. FP001 - Latin America and the Caribbean, Africa. FP128. Arbaro Fund - Sustainable Forest Fund. Seven countries: Peru, Paraguay, Ecuador, Ethiopia, Ghana, Sierra Leone, Uganda. - Laying the Foundations for the Mitigation of GHG Emissions and Increasing the Resilience of Rice Production in the Framework of the NDC in Peru. Code: 5094-03. - Support for the Initiative " Improvement of Sanitary Management for the Implementation of the Agreement on Trade Facilitation " in Peru, Mincetur (Helvetas-IICA). Code: 5053-00.	- USD 6,240,000. 47% disbursed by 2021. PROFONAMPE. Designated National Authority: Ministry of Economy and Finance (MEF) - Total GCF funding: USD 25,000,000 PROFONAMPE, MEF. - Resources: USD N.A. Technical facilitation: Inter-American Institute for Cooperation on Agriculture (IICA) Executing entity: MIDAGRI. - Resources: USD 293,100. Framework: Be Competitive Program of the Swiss Cooperation - SECO. Executing entity: Mincetur.	- Approval Date: 02/27/2017 Start date: 03/10/2017 Duration: 10 years. Underway. Climate resilience and livelihoods of indigenous communities, reduction of GHG emissions due to deforestation (Def. Avoided 4,861 ha). - Approval date: 03/12/2020 Start date: 10/30/2020 Term: 10/30/2034. Underway. - Start: 02/01/2021 Term: 11/30/2021. Underway. Coordination of actors from the public and private sectors of the rice production chain to guarantee food security. - Start: 08/12/2020 Term: 04/30/2022. Underway. Technical Cooperation Project. Reduction in the operational costs of Peru's foreign trade.

Continue table 7. Agricultural and climate finance

Financing	Project/ Region	Amount / Entity	Details
International Fund for Agricultural Development (IFAD)	- Sector: Rural development. Project for the Extension of Public Services for Local Productive Development (Avanzar Rural), Peruvian highlands and Amazonia. Proj. 2000002257 Part of Peru's National Post-COVID 19 Recovery Plan. - Sector: Rural development, Peru. Improvement of public services for Sust. Territorial development in the Apurímac, Ene and Mantaro river basins. Project 2000000897	- Total: USD 71.1 million; IFAD loan: USD 24 million; Peruvian government: USD 41.11 million. Beneficiaries: USD 6.35 million. Implementation: MIDAGRI. - Total project cost: USD 74.51 million; IFAD financing: USD 28.5 million; Backers: national government: USD 38.76 million. Beneficiaries: USD 7.25 million. MIDAGRI.	- Approved: December 23, 2019 Duration: 2019–2025 To improve the productive capacity of family farmers and access to markets in 101 districts in the departments of Amazonas, Ancash, Cajamarca, Lima and San Martín. - Approved: April 13, 2016 Duration 2016–2022. Includes 27 districts in seven provinces in the departments of Apurímac, Ayacucho, Cusco, Huancavelica and Junín, an area that encompasses various ecosystems from the low Amazonian jungle to the high Andean mountain range.
World Bank	- Peru. Adaptation of native Andean crops for food security in the face of climate change. P121136 - Integrated Forest Landscape Management Project in Atalaya, Ucayali Peru. P163023	- MIDAGRI. - USD 12.20 million	- Approved: July 21, 2010 Start date: September 2014 - Approved: January 4, 2019. Underway. Land users who adopt sustainable land management practices.
FAO (in Peru)	- Lima, Junín. Reducing the vulnerability of rural women and their livelihoods for resilient agriculture in a context of climate change in Ecuador and Peru. - Ica, Lambayeque, Piura. Strengthening the cotton sector through South–South cooperation. - Puno (Acora), Arequipa (Atiquipa), Apurímac (Huayana), Cusco (Lares), and Huancavelica (Laria). Sustainable management of agrobiodiversity and restoration of fragile ecosystems in Andean regions of Peru	- USD 240,451 (Peru). MIDAGRI. Agrorural - Financing: USD 1,327,777. MIDAGRI, INIA, APCI, ABC, IBA, Embrapa. - USD 9,369,864 in financing from the Global Environment Facility (GEF). Ministry of the Environment, MIDAGRI, Regional governments of Puno, Arequipa, Cusco, Huancavelica and Apurimac.	- Execution: 2018–2020. Consolidating the "Yachachiq - Kamayoq" network for implementation of climate change adaptation actions and the promotion of resilient local bio-businesses led by women. - Execution 2015–2019. Strengthening technical and institutional capacities to boost the competitiveness of small cotton producers by increasing productivity and income. - Execution 2018–2022. Conservation in situ and sustainable use of agrobiodiversity; conservation of traditional agricultural systems, comprehensive management of forest, water and land resources; and conservation of ecosystem services in the southern Andean region.
Inter-American Development Bank (IDB) Invest	- Sector: Agricultural-Peru.	- IDB Invest, loan USD 25 million over a 10-year term to Agrícola Pampa Baja S.A., a Peruvian agribusiness company. Co-financiers: Entrepeneurial Development Bank (FMO) and DEG Bank.	- IDB Invest partially finances the USD 85 million project. For expansion of the non-traditional production of the fruit and vegetable agro-export industry of Peru.

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Continue table 7. Agricultural and climate finance

Financing	Project/ Region	Amount / Entity	Details
Inter-American Development Bank (IDB) Lab	- Sector: Agriculture and rural development, Peru. Cajamarca, Amazonas and San Martín regions. EcoMicro–Expansion of financing for adaptation to climate change in the Peruvian coffee production chain. PE-T1423	- IDB Lab, loan USD 800,500. Co-financing of the Nordic Fund, under the framework of the EcoMicro Program (RG-O1649). Counterpart (cash and in kind): US $ 600,700. Executing agency: Perales Huancaruna SAC (PERHUSA). 36 months of execution and 42 months of disbursements are established.	- Approval date: 03/31/2020. Project Stage: Implementation Ecological Financing for MSMEs and Low Income Homes (EcoMicro Program) in Latin America and the Caribbean. Piloting a new line of microcredit, based on precision agriculture and traceability systems, to increase the sustainability and climate resilience of small and medium coffee producers in Peru.
INIA-MIDAGRI	- Sector: Agricultural–Peru. Innovation project for agricultural management by farmers of the Oro Verde del Chira Producers Association, Piura region.	- Financing of PEN 230,000 (USD 60,526) through the National Institute of Agrarian Innovation (INIA) at MIDAGRI. Execution: National Program for Agricultural Innovation.	- Farmers improved the export levels of organic bananas through genetic quality, sending more than 1,400 tons to the markets of Netherlands and Germany. They also increased the commercialisation of this crop to 2,430 tons in the local and national markets.
Agroideas-MIDAGRI	- MIDAGRI/Agroideas Program (to 2021). 145 Business Plans for the technology adaptation for 5,491 small producers in 16 regions of the country, including Ayacucho, Puno, Junín, Apurímac, Huancavelica, La Libertad and Huánuco.	- Investment of PEN 51.7 million in the last 10 years by Agroideas, to promote native potato, quinoa, chia, cañihua, kiwicha, sacha inchi, cat's claw, and tarwi crops. Total investment of PEN 67.4 million. Contribution of agricultural organisations totalling PEN 15.6 million.	- Agroideas has co-financed, for example, the business plan to improve quinoa production of the BOJACI association of agricultural producers. The PEN 360 thousand investment included the acquisition of a tractor with agricultural implements, organic fertilisers, technical assistance, and organic certification.
FEPCMAC - BIOFIN	- The Peruvian Federation of Municipal Savings and Credit Banks (FEPCMAC), with the technical support of the UNDP Biodiversity Finance initiative administered by UNDP, has developed a new green microfinance product called "BioCredito".	- CMAC by 2021: USD 364 million of existing credits in agriculture.	- MINAM, FEPCMAC, the Association of Banks (ASBANC) and the Microfinance Association (ASOMIF) signed the green financing protocol for Peru in 2020. FEPCMAC and UNDP signed an agreement to strengthen the CMAC in the implementation of the Agenda 2030 and the SDGs.

nerable to climate change.

4.2 Adaptation options and implications

The prevailing options available to organic agriculture for adaptation to climate change are as follows:

1. Promotion among peasant communities of organic and agro-ecological crops for export.

2. Increase agricultural productivity and innovation in agro exports with climate-resilient agricultural practices.

3. Promotion of organic agriculture for the sustainable adaptation of ecosystems to the effects of climate change.

4. Increasing the land area used for organic production to favour food security. The production of biofuels using sugar cane, corn, palm oil, and rape competes with scarce natural resources such as land and freshwater required for organic production and hampers food security. Therefore, organic crops should be prioritised and only use marginal land for energy crops.

5. Designing ecosystem-based adaptation (EbA) strategies for small organic producers.

6. Developing accessible climate finance innovation to adapt small organic producers dedicated to agro exports.

About three billion people worldwide have lost purchasing power to afford a healthy diet and the COVID-19 pandemic has pushed 115 million people into extreme poverty – the most vulnerable being the inhabitants of rural areas in developing countries, who are also essential contributors to food security. The global commitment to eradicating hunger (SDG 2: zero hunger) in the framework of the 2030 Agenda requires an inclusive rethink of new financing mechanisms, especially for those who grow, process, and distribute food (IFAD, 2021).

Countries must develop support plans for rural producers and build sustainable food systems, linking local needs with national development paths and international coordination; rural people in developing countries need affordable financing to introduce new crops and apply novel techniques to enhance their livelihoods (IFAD, 2021). Small-scale organic producers in Peru need accessible credit to adapt to climate change while contributing to global food security. As organic agriculture improves the climate resilience of small farmers, there is a great need for financial institutions to provide more loans aimed at climate adaptation of organic export crops globally.

5. Discussion

Within the 2000–2020 study period, the growth of Peruvian organic agro exports by 60% from 2006 to 2007 coincided with economic growth of 8.3% at the country level, in a context of the international financial crisis (2007–2008) and a global contraction of 2.9%. In 2020, despite the worldwide Covid-19 crisis, organic food exports continued to rise (by 31% compared to 2019). Indeed, even though the pandemic caused a global contraction of approximately 6.2% in 2020, following a 9.56% growth in Peruvian non-traditional agro exports between March 2019 and 2020 (Zhilkin et al., 2021). Therefore, organic agriculture improves the ability to adapt to the climate even in crises. Faced with shocks from the pandemic, Perrin & Martin (2021) showed that French farmers were more concerned about the risks of climate change on their farms than about health risks; they also confirmed the relevance of organic agriculture to improving the resilience of systems agricultural and food. Decentralised adaptation empowers the leaders or heads of local or communal farmers, and could therefore yield better results than top-down climate adaptation carried out by policymakers. According to DAR (2015, p.28), in Peru over the 2010–2014 period, 75% of international climate finance was loans aimed mainly at mitigation.

Schader et al. (2021) found that organic agriculture generated higher profit margins than conventional agriculture by monitoring the cultivation process for two years in sub-Saharan Africa. Consequently, the implementation and financing of organic crops ensure both farmers' livelihoods and healthy food for consumers around the world.

In July 2021, the Green Climate Fund accredited the Inter-American Institute for Cooperation on Agriculture (IICA) to compete in projects of a maximum value of USD 50 million in favour of climate adaptation and resilience initiatives in agriculture and rurality in the Americas. The "Increasing Resilience in Rice Production" project is part of the contribution that the IICA is making in Peru, in addition to projects in other Andean countries such as "Good Agricultural Practices for Quality Assurance" and "Safety of Corn" in Colombia and "Promotion of the Cultivation and Commercialisation of Sacha Inchi for the Economic improvement of Family Agriculture" in Bolivia.

Roberts et al. (2021) analysed the bilateral and multilateral financing flows using different methods to determine whether they are directed at climate objectives, estimating an average allocation of about US USD 100 billion per year to each commitment. In Peru, however, there is little climate financing targeted at the adaptation of organic crops or for the agro exports of organic products, despite the importance of organic food for food security, for a low-carbon or carbon-neutral economy, and for achieving various sustainable development goals.

6. Conclusions

In a context of growing international demand for or-

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ganic food, Peruvian organic exports are increasing in close and significant correlation to the increase in land area used for organic crops. In the period 2000–2020, exports of organic products rose continuously. The share of organic products in Peruvian agro exports in 2007 was 8.2% during the international financial crisis, and 7% in 2020 in the context of a global health crisis. The organic products that contributed the most to exports, in FOB value, in 2020 were bananas, ginger, quinoa, coffee, and blueberries. In this study, little financing was found for adaptation to climate change of Peruvian agro-exports of organic products. Peru participates in the Green Climate Fund in projects to mitigate GHG emissions and develop resilience in rice production to guarantee food security. IDB Invest partially finances (USD 25 million) the expansion of a Peruvian fruit and vegetable agro-export company valued at USD 85 million, co-financed by Entrepreneurial Development Bank (FMO) and DEG Bank. FAO finances the "Yachachiq - Kamayoq" network for actions to adapt to climate change and promote resilient local bio-businesses led by women. In Peru, MIDAGRI's National Institute for Agrarian Innovation (INIA) finances PEN 230,000 (USD 60,526) for farmers from the Oro Verde producers association in Chira, Piura region, who improved the levels of organic banana exports to the Netherlands and Germany. For its part, FIDA granted a loan of USD 24 million to the project for the expansion of public services for local productive development (Avanzar Rural) in the Peruvian highlands and Amazonia to improve production capacity. At the global level, IFAD is also exploring the potential for public development banks to concede affordable financing for rural producers while helping shift investments to fairer and more environmentally sustainable systems.

It is recommended that policymakers in Peru implement adaptation options – among them, continue increasing the land area used for organic production to promote food security and innovative, accessible climate financing for the adaptation of small organic producers engaged in agro exports. There is an urgent need for financial institutions to provide more loans to improve the climate resilience of farmers engaged in organic export crops globally.

Conflict of interest

The authors declare no conflict of interest.

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