Indecopi

series

Peruvian women and the Intellectual Property

PERUVIAN WOMEN AND PATENTS: INVENTING THE FUTURE

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In collaboration with the United States Patent and Trademark Office

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PERUVIAN WOMEN AND PATENTS: INVENTING THE FUTURE

Sofía Mimano Suárez

Photo taken by Nelson A. Cruz Tapia - 2019

Chapter I:
Introduction

The purpose of this document is to analyze the relationship between patents and Peruvian women, whose talent and ingenuity as agents of change are not always properly recognized. As a result, we encourage women, who wish to choose a science career, to overcome sexist factors so that, in the future, they can grow professionally in any technological field without gender-based inequalities.

Peruvian women's participation in creative and innovative fields is not comparable to men's because women face more obstacles due to gender stereotypes. This fact is demonstrated in the statistics reported in this document.

Patent applications worldwide are still male-dominated due to various factors. For this reason, it is interesting to pose the following question: why do women are not involved in research? What are the obstacles that impede them to participate in such fields? For instance, last year, three Yale University researchers conducted a study on gender differences in filing and obtaining patents in the United States. They found that applications filed by teams of all women inventors were 21% less likely to obtain the patent, in comparison with similar applications filed by teams of all men. This is a worrisome result because intellectual property rights should be granted regardless of gender.

The objective of this publication is to show the progress of Peruvian women inventors, analyze the trends and characteristics of patent applications filed from 1992 (since Indecopi was created) to 2016 (2018 in some cases), and suggest actions to achieve a gender-based balance in the national patent system, i.e. disseminate the protection of intellectual property rights or provide greater assistance for women inventors filing for a patent. In the medium term, we might achieve gender balance and, thus, women's innovative ideas will contribute to the technological progress in our country.

Photo taken by Nelson A. Cruz Tapia - 2019

Chapter II:
Women in inventive activities

Women have always made important contributions to science through research, knowledge production, inventions, or the production and implementation of technologies. However, throughout history, women's participation in these fields has often been reduced or ignored. For this reason, it is important to encourage a gender-based critical reflection in the field of science.

Women's participation in science has globally increased in recent decades. However, research studies conducted in several countries concluded that there is still a significant gap due to complex factors that influence the access, participation, and development of women in science.

In the book "Why so few? Women in Science, Technology, Engineering and Mathematics"[1], the authors analyzed the factors that influence girls, such as the effects of societal beliefs and the learning environment on girls' achievements and interest in science and math. When teachers and parents told girls that their intelligence can expand with experience and learning, girls outperformed in math tests and were more likely to pursue math in the future. That is, believing in the potential for intellectual growth, in and of itself, improves outcomes. This is helpful for all students, but it is particularly relevant for girls, who tend to be influenced by negative stereotypes about their abilities.

Therefore, when educators (teachers and parents) create an environment that fosters "growth mindsets", they encourage the girls' interest in science and mathematics, disregarding gender stereotypes about girls' performance in these subjects. These beliefs impact women's aspirations to pursue science careers. This showed that changing learning environments can improve girls' performance.

1 Published by AAUW – 2010

According to a study conducted by the United Kingdom Intellectual Property Office, worldwide there is **1** female inventor per every **7** men.

Moreover, the study also found that girls assess their abilities lower than boys with similar science achievements. Girls hold themselves to a higher standard than boys do in subjects like math, believing that they have to be exceptional to succeed in "male" fields. This might discourage girls from pursuing science careers.

Other research studies found that, while girls generally tend to perform better in verbal skill tests, boys perform better in spatial ability tests[2]. The latter is important for engineering careers. However, this ability can improve consistently with training courses. Therefore, if girls grow up in an environment where the development of science skills and spatial abilities is encouraged, they will likely develop the necessary skills and confidence to pursue a science career.

The fact that fewer women are pursuing science careers influences the number of women inventors who file patent applications. For example, women are included as inventors in 13% of patent applications worldwide, according to a study conducted by the Intellectual Property Office of the United Kingdom, i.e. one woman inventor out of seven men inventors[3]. Even though the participation of women in patents has improved, based on such results, gender parity would only be achieved by 2070.

These results confirm that the gap of women inventors is due to the lack of women working in science, technology, engineering, and mathematics (STEM). Penny Gilbert, a partner at Powell & Gilbert IP firm, stated that "If we want to see more women filing patent applications, then we need to see more women studying STEM subjects at universities and pursuing research careers."

Today, women represent nearly one-quarter of the UK's workforce in STEM industries. Fewer girls and women decide to study these subjects in high school and university, despite the efforts to identify and resolve this imbalance.

The same situation occurs in Peru. A study conducted by the Pontifical Catholic University of Peru (PUCP)[4] identified the various factors (individual, family, social, educational, labor, and economic) that influence the access, participation, and growth

2 Introduction to Psychology, Charles G. Morris, Albert A. Maisto – 2005. Spatial skills include mental rotation of an object and estimation of horizontal and vertical dimensions, which are particularly useful in solving certain engineering problems.

3 https://www.bbc.com/news/technology-4984399 by Clara Guibourg and Nassos StylianouData journalists, BBC News.

4 Estudios sobre las mujeres peruanas en la ciencia, octubre 2018 (PUCP).

of women in science, technology, and innovation (STI). The lack of women's participation in science is not due to biological aspects, poor performance or skills, or an "innate preferences", but it is essentially the result of factors and variables that occur at different stages of women's lives. These are socio-cultural factors that impact women's decisions to pursue and grow professionally in a STEM career.

Nevertheless, according to data retrieved from the National Institute of Statistics and Informatics (INEI), from 2005 to 2016, the girls' enrollment rate in kindergarten and primary education is higher; and there is a slight decrease in girls' enrollment rate in secondary education.

Over the years, as reported by the National Superintendency of Higher Education (SUNEDU), there is sustained growth of women's enrollment rate in higher education in comparison with men's during the same period. Nevertheless, in 2016, from the total of students, only 33% pursued STEM careers, and, from that total, 29% were women. Upon graduation, even though the percentage of women who graduate is slightly higher (54%) than men's, only 32% graduate from STEM careers, i.e. men outnumber women in all of these fields. Therefore, the participation of women in science and engineering decreases at the graduate level and, subsequently, in the work environment. This is due to several social and environmental factors that contribute to the lack of women in these fields.

According to the data retrieved by SUNEDU, from the total number of students enrolled in 2015 (1,317,024), 50% were women; but only 38% of enrolled women chose science-related careers, such as agriculture, forestry, and aquaculture, health sciences, life sciences, physics, chemistry, computer science, construction engineering, computer science, telecommunications, industrial engineering, mathematics, statistics, veterinary medicine, among others[5].

SUNEDU also reported information on the number of undergraduate students who graduated in 2014. Of 89,002 graduates, 53% were women but only 13% graduated from science careers[6]. Therefore, this might be one of the reasons why there is still a gender patenting gap nationwide.

It is important to note that the presence of women professors and/or researchers in Peruvian Universities also shows a significant gender gap in the academic field. According to data retrieved by SUNEDU in 2015, there were 84,774 university professors nationwide; but only 33% were women[7].

Moreover, according to SUNEDU, in 2014 and 2015, the largest amount of R&D resources (30% of total resources) were allocated to the Engineering and Technology schools of Peruvian universities. This resource allocation should have impacted research projects, especially in public universities that mainly invested in equipment and tools. Therefore, this initiative could have led to the increase of women in patent applications in the medium term.

5 Information retrieved from Table 16 of the Biennial report on Peruvian university reality developed by Sunedu. Gender distribution of enrolled students according to type of career, 2015.

6 Information retrieved from Table 17 of the Biennial report on Peruvian university reality developed by Sunedu. Gender distribution of enrolled students according to type of career, 2014.

7 Information retrieved from Table 7 of the Biennial report on Peruvian university reality developed by Sunedu. Gender distribution of faculty in Peruvian universities.

Even though the participation of women in science in our country has increased in recent decades, which significantly reduces gender gaps, the social aspect is still a limiting factor. Family roles, especially motherhood, hinder women's professional growth; consequently, women are at disadvantage in the marketplace in comparison with men.

For this reason, the State must advance public policies that address the current gender gaps and disadvantages faced by women. The Directorate of Inventions and New Technologies at INDECOPI carried out several activities to empower the role of Peruvian women in intellectual property. These will be described in the following chapters. It is worth to point out that, on May 3, 2018, Indecopi became the first and only public entity that signed the "Somos Pares" (We are peers) Pact promoted by Aequales organization. The objective was to reduce gender gaps and empower women in the workplace through the implementation of national policies and good organizational practices that favor gender equity and social inclusion.

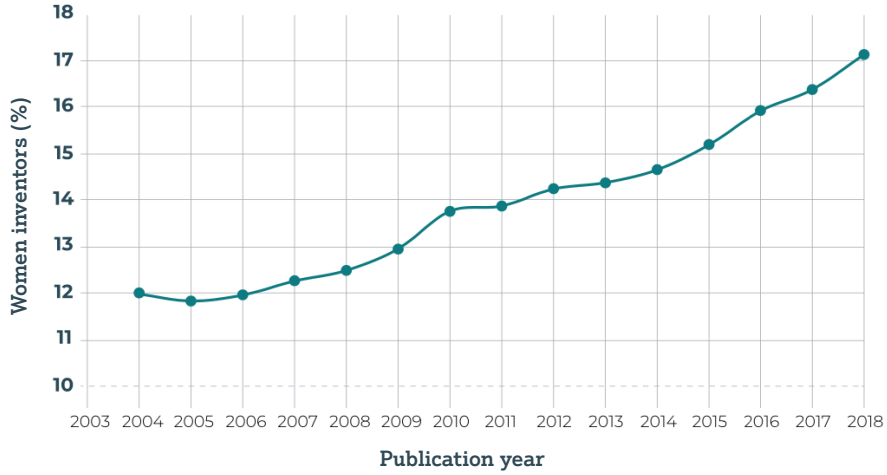
Photo taken by Nelson A. Cruz Tapia - 2019

Chapter III:
Women and patentes

The World Intellectual Property Organization (WIPO) is committed to promote gender equality activities in the field of Intellectual Property and integrate them into daily operations. WIPO developed a worldwide gender-name dictionary that includes information to disambiguate the gender of PCT inventors. The results showed an encouraging trend in recent decades, i.e. an improvement in women's participation in the intellectual property system in all technological fields.

Statistics showed that, in 2018, women accounted for 17.1% of all inventors included in PCT applications worldwide, while men accounted for the remaining 82.9%. It is worth mentioning that, since 2005, women's participation has continuously increased, from 11.8% to 17.1%, as shown in Figure 1.

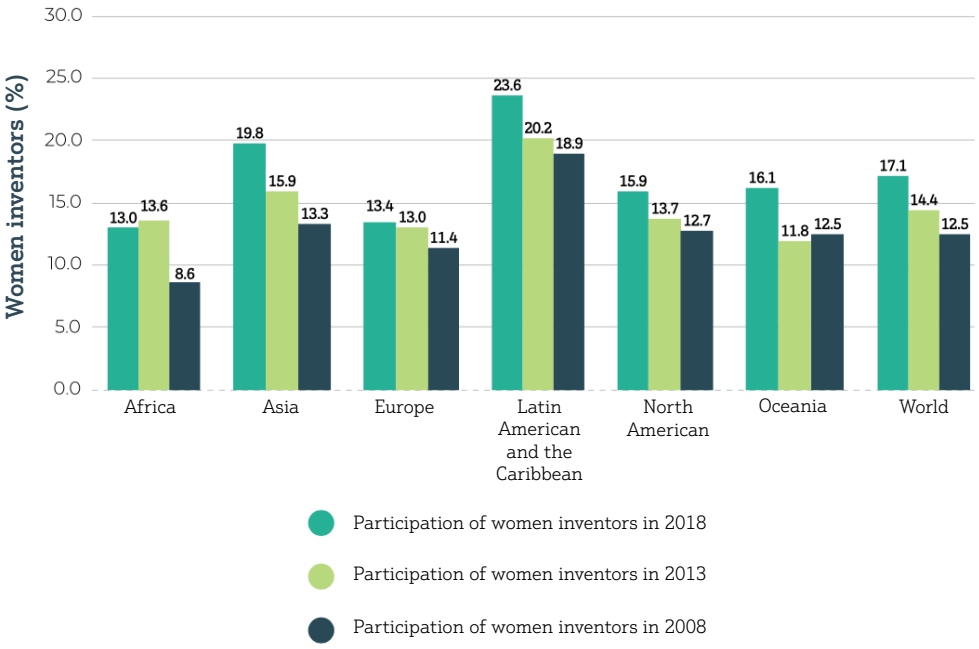
Figure 1:
Participation of women inventors in PCT applications, 2004-2018



Source: Patent Cooperation Treaty Yearly Review 2019 (WIPO Statistics Database, March 2019).

Moreover, the information collected by WIPO also showed that there was an increase of women inventors in PCT applications in the last five years worldwide (except in Africa). Asia (19.8%), and Latin America and the Caribbean (23.6%) are above the global average (Figure 2).

Figure 2:
PCT applications worldwide that included women inventors from 2013 to 2018



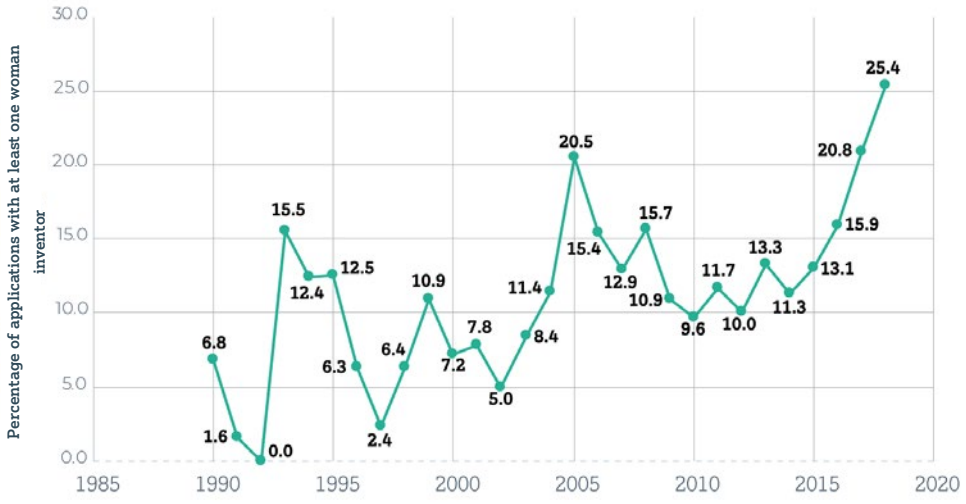
Source: Patent Cooperation Treaty Yearly Review 2019 (WIPO Statistics Database, March 2019).

The gender gap in PCT inventors varies considerably from country to country. For instance, in 2018, the countries that had more women inventors were China (28.9%), the Republic of Korea (26.8%), and Spain (24.4%), while the countries with fewer women inventors were Germany (10.3%), Japan (10.1%), and Austria (9.4%).

It was also identified that the field of life sciences had relatively high proportions of women among PCT inventors. Women accounted for more than 15% of inventors included in PCT applications in the fields of biotechnology (29.9%), pharmaceuticals (29.2%), food chemistry (28.6%), biological material analysis (26.5%), and fine organic chemistry (26.1%).

In Peru, the participation of women in inventive steps is similar to the global situation. For example, in recent decades, the percentage of invention and utility model patent applications with women inventors varies. However, since 2014, this percentage has increased steadily (Figure 3). The unprecedented percentage of applications with at least one woman inventor, compared to the total number of applications filed by nationals, was 25% in 2018.

Figure 3:
National invention and utility model patent applications with the participation of at least one woman inventor in Peru, with respect to the total number of applications filed by nationals from 1990 to 2018

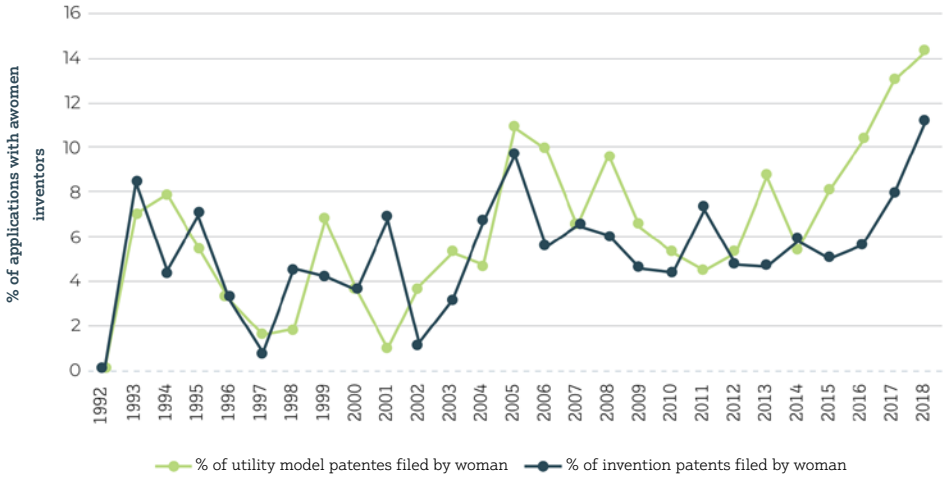


Source: Directorate of Inventions and New Technologies.

Furthermore, from 1992 to 2018, there were more women applicants for utility model patents; however, from 2015, there was sustained growth in invention patent applications with at least one woman inventor, as shown in Figure 4. In 2018, the number of women inventors in patent applications was unprecedented –14% for utility models and 11% for invention patents– in comparison with the total number of applications filed by nationals in that year.

Statistics show that Peruvian female inventors tend to participate in patent applications, in collaboration with other inventors rather than alone, meaning that they are usually part of multidisciplinary teams of several inventors.

Figure 4:
Comparison of the number of women inventors in invention and utility model patent applications filed with the Directorate of Inventions and New Technologies from 1992 to 2018



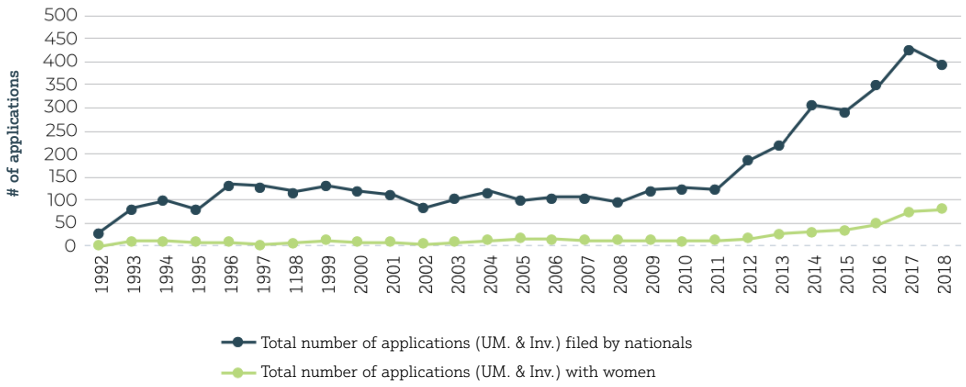
Source: Directorate of Inventions and New Technologies.

The statistics show that there is an increasing and consolidating presence of women in Peruvian inventive step, and, thus, the contribution to society is evident in several technological fields.

In addition, from 1992 to 2018, from the applications with women inventors, 44% were invention patent applications, while 56% were utility model patent applications. In contrast, in the case of men inventors, 31% were invention patent applications and 69% were utility model patent applications. This means that the presence of women encourages a greater inventive step, especially when they are in interdisciplinary teams because it results in a better group performance. Several studies explained that the proportion of women in a group is strongly related to the collective intelligence of the group as a result of their increased ability to read nonverbal cues and make precise inferences about what others think, allowing group members to respond to each other, making better use of their knowledge and skills, and eventually leading to greater innovation and scientific discovery. However, those studies also revealed that, when assessing the gender gap in science, it is not enough to analyze the number of women in a particular group. It would be more beneficial to ensure that women are included in collaborative scientific teams at the same level as men.

However, women's presence in our country's inventive step is still far from achieving gender equality. Figure 4.1 shows that, even though women's presence has been continuously increasing since 2010, there is still a significant gap in invention and utility model patent applications filed by nationals with the Directorate of Inventions and New Technologies, mainly because there are few women choosing science careers, a situation that is expected to be reversed.

Figure 4.1:
Gap between national applications with a female presence (as inventors), with respect to the total number of applications filed by nationals from 1992 to 2018.



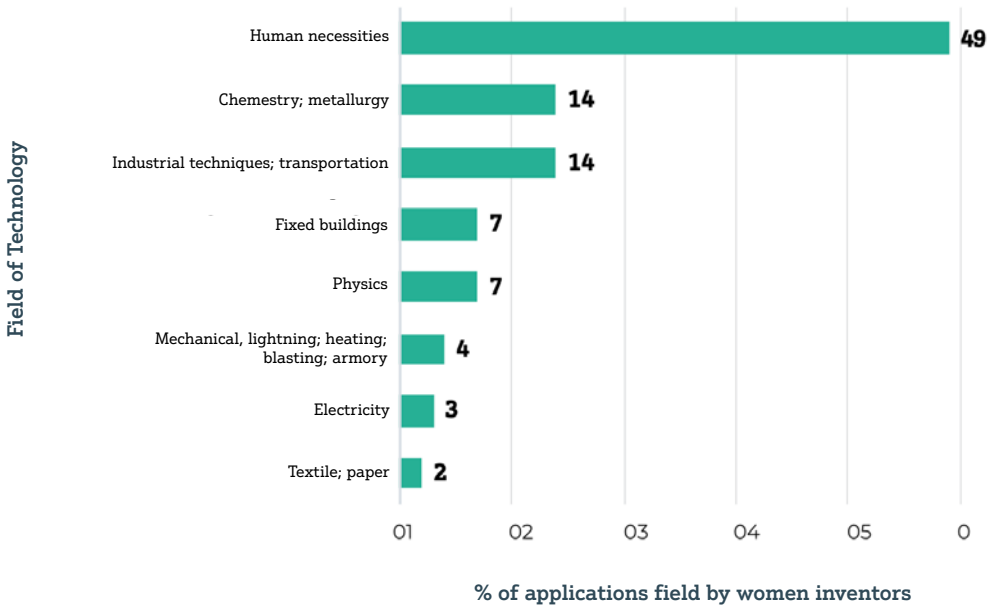
Source: Directorate of Inventions and New Technologies.

Figure 5 shows the fields of technology, according to the International Patent Classification (IPC), with more women inventors from 1992 to 2018. It is worth noting that the human necessities technical field[8] has a relatively high percentage of women among national inventors, followed by chemistry, metallurgy, and various industrial technical fields.

8 Inventions mainly related to agriculture, food, health, entertainment, personal or household objects.

It is important to highlight that trend shows that more and more Peruvian female inventors are specializing in technology fields historically dominated by men, such as mechanics.

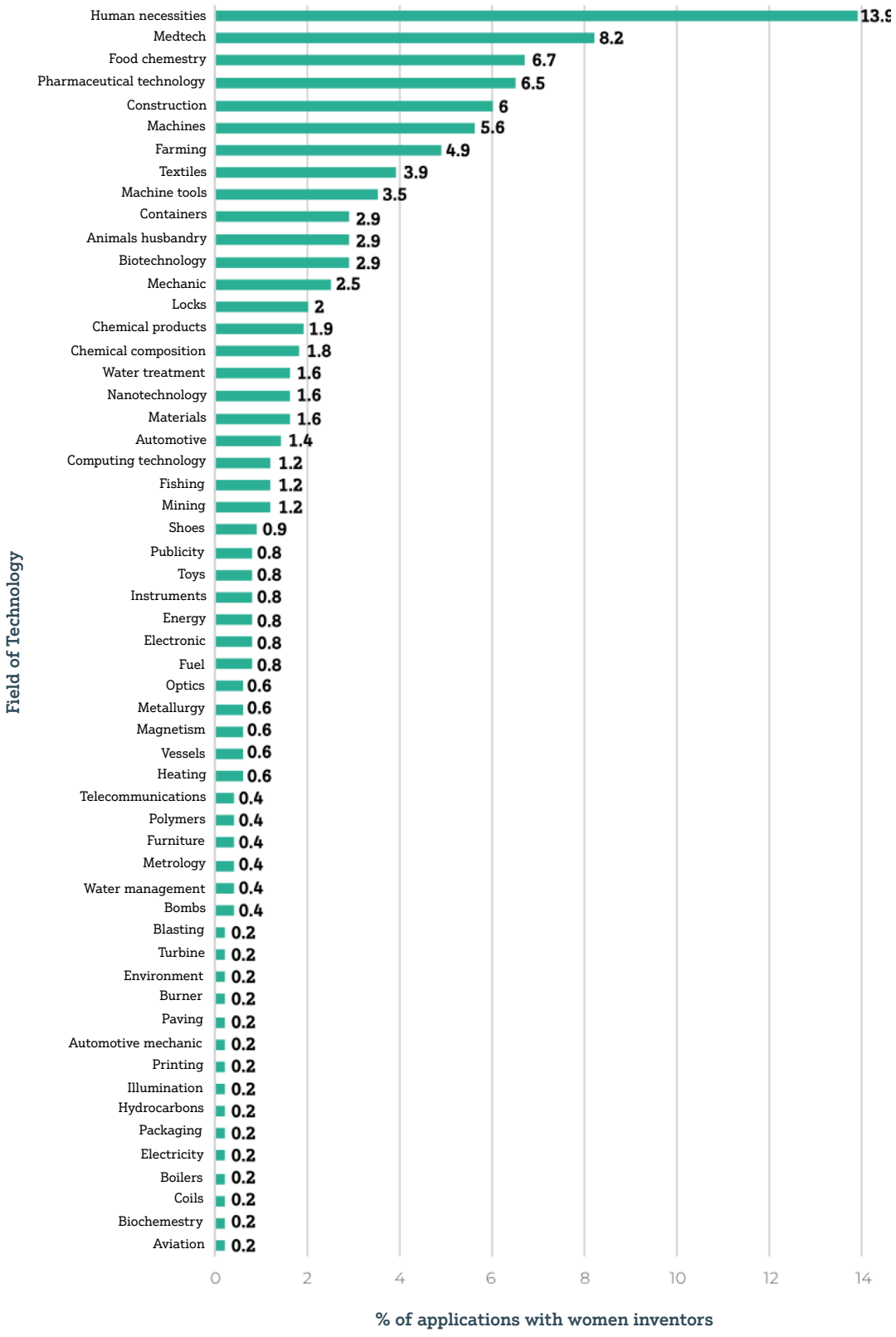
Figure 5:
Participation of women inventors in the different technological fields from 1992 to 2018.



Source: Directorate of Inventions and New Technologies.

Figure 6 shows an analysis of the technological fields where there are more women, i.e. the construction, pharmaceutical technology, food chemistry, medical technology, and utilitarian products sectors.

Figure 6:
Distribution of the technological fields of applications with women inventors from 1992 to 2018

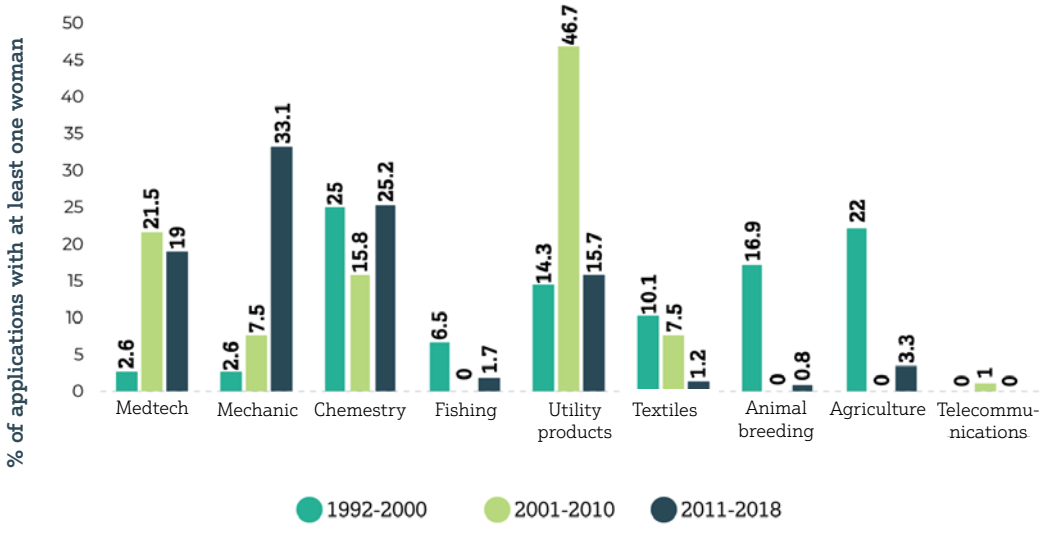


Source: Directorate of Inventions and New Technologies.

TREND OF PERUVIAN WOMEN INVENTORS' PARTICIPATION IN SPECIFIC TECHNOLOGICAL FIELDS

Figure 7 shows the variation of Peruvian women inventors' participation in different technological fields in three different periods, from 1990 to 2000, from 2001 to 2010, and from 2011 to 2018. There is no constant variation trend in all technological fields; however, it is important to emphasize that women's participation in the inventive step has improved in some fields, such as mechanics and chemistry, and decreased in the field of utilitarian products over the past decade. From the 1990s to 2000, 2.6% of the applications in the mechanical field included, at least, one woman inventor and, from 2011 to 2018, the percentage increased to 33.1%. In contrast, from the 1990s to 2000, 46.7% of the applications in the utilitarian products field included, at least, one woman inventor and, from 2011 to 2018, the percentage decreased to 15.7%. This shows us that Peruvian women inventors changed their professional career path, which is also evident in their participation in technological fields. It is important to mention that within the field of chemistry, the applications were related to biotechnology, nanotechnology, organic chemistry, food chemistry, and material chemistry. Finally, in the last decade, there has been a greater presence of Peruvian women in patent applications related to emerging sectors, such as construction, energy, mining, and electronics.

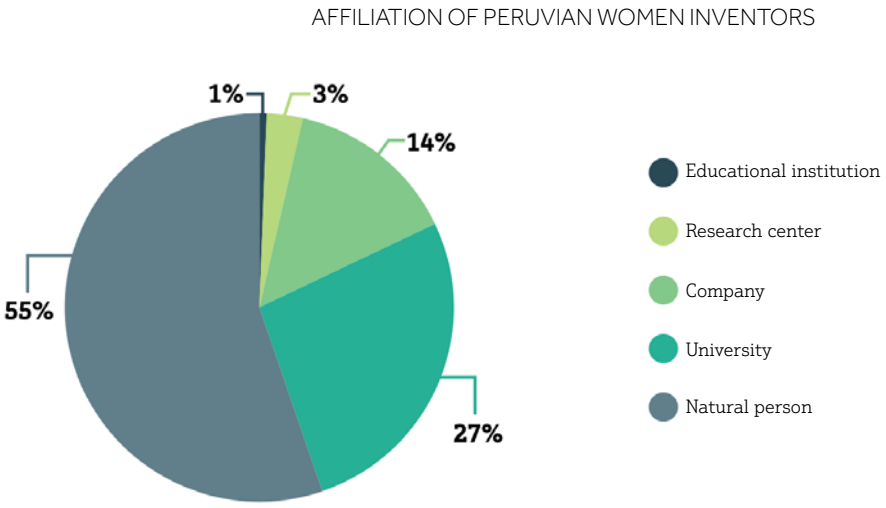
Figure 7:
Percentage of applications with at least one woman inventor in the different technological fields from 1992 to 2018



Source: Directorate of Inventions and New Technologies.

It should also be noted that a high percentage of Peruvian women inventors who decide to file invention and utility model patent applications are natural persons, followed by women inventors from universities and companies, as shown in Figure 8.

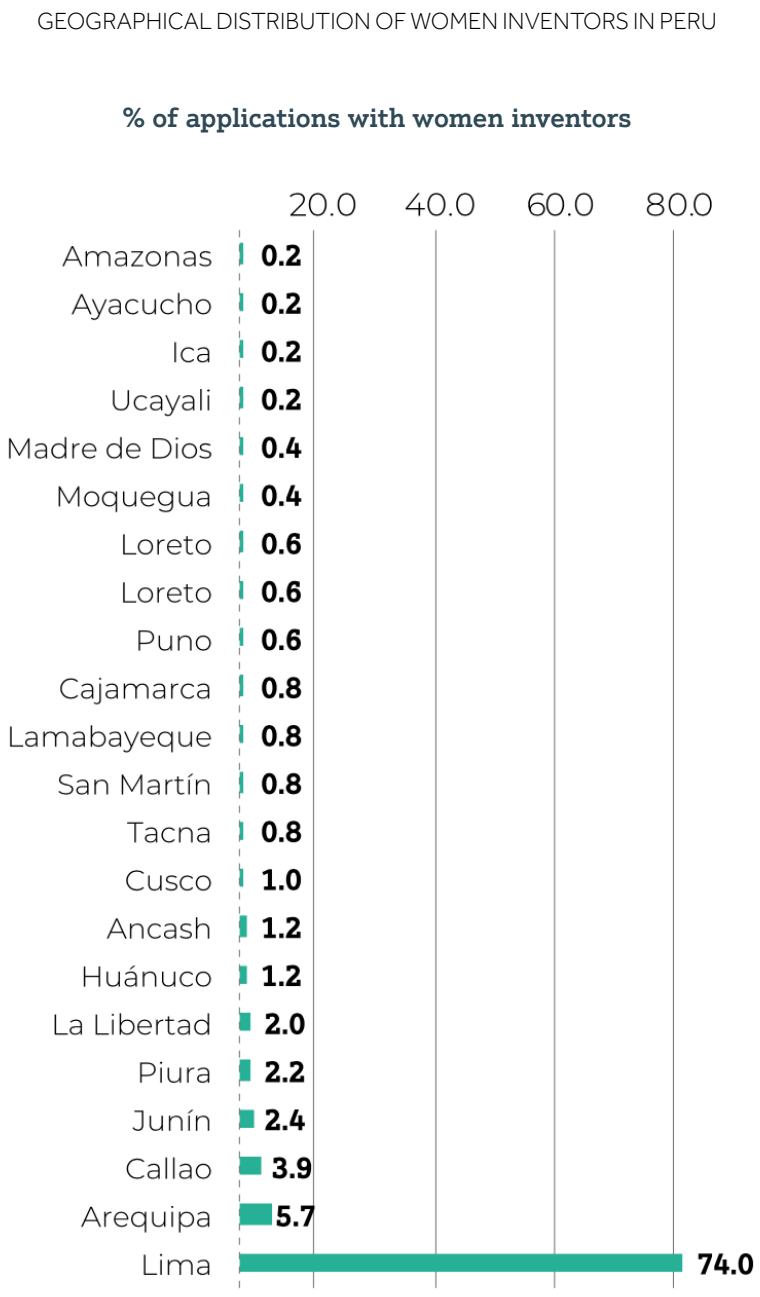
Figure 8:
Distribution of the type of affiliation of women inventors from 1992 to 2018.



Source: Directorate of Inventions and New Technologies.

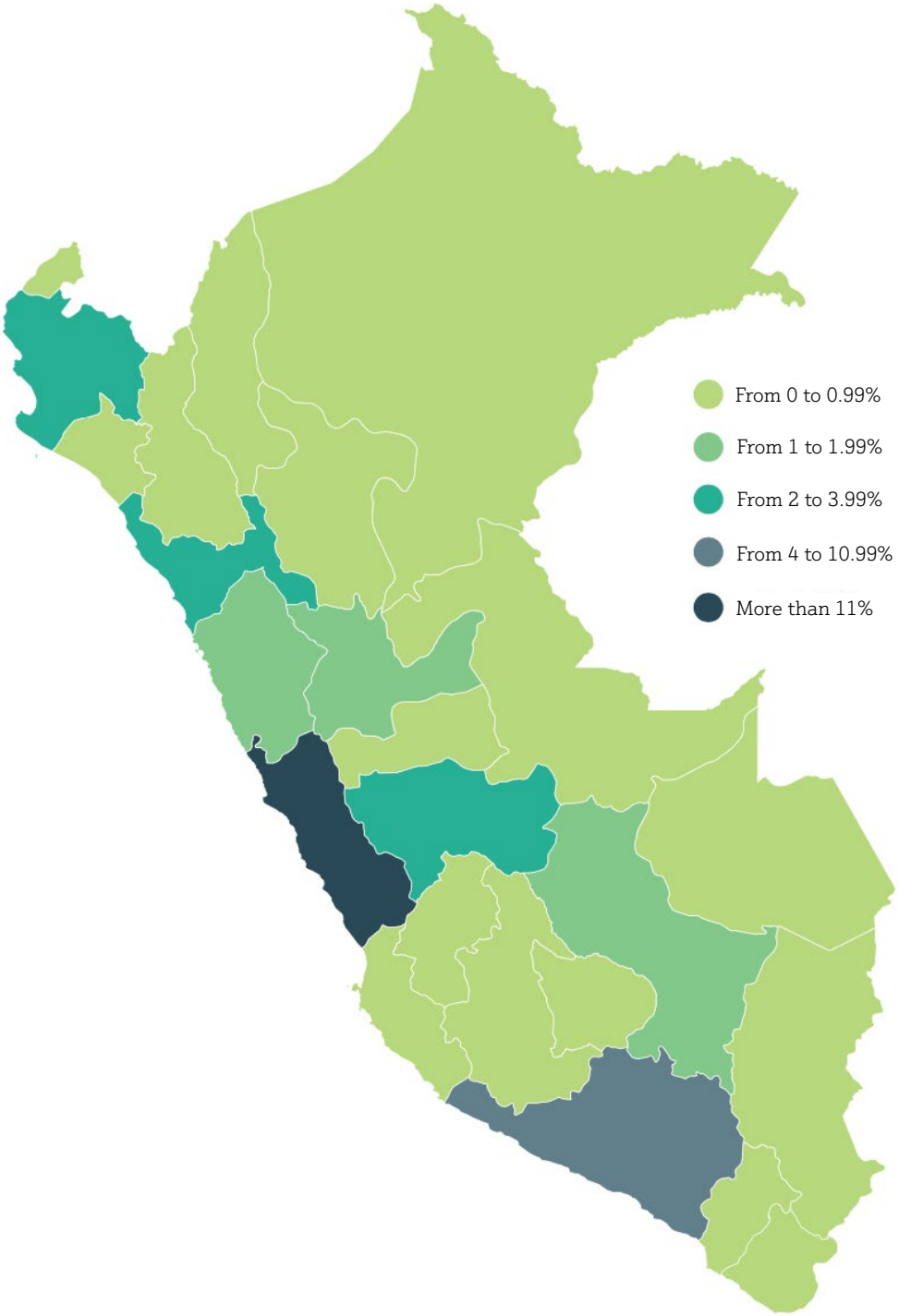
Furthermore, it is important to show the geographical distribution of Peruvian women inventors (Figure 9). Lima is the department with the largest number of women inventors. The factors that negatively influence women's access to science in other departments of Peru could explain this situation.

Figure 9:
Geographical distribution of women inventors in Peru from 1992 to 2018



Source: Directorate of Inventions and New Technologies.

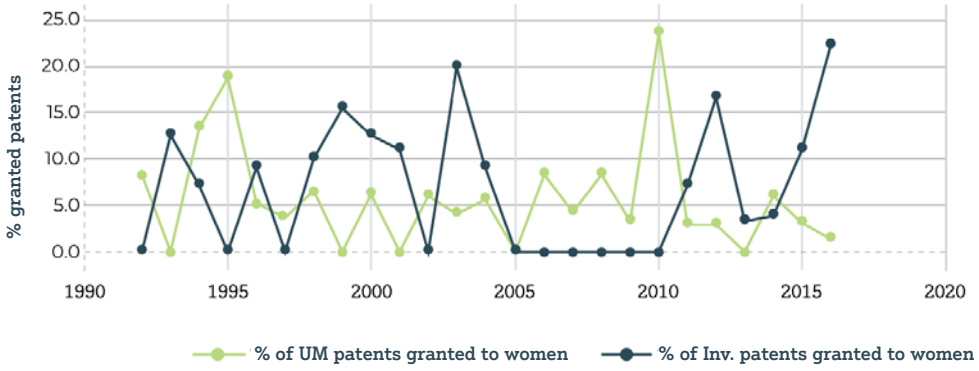
Figure 10:
Map of Peru showing the percentage distribution of women inventors who file invention and utility model patent applications.



Source: Adapted map of Peru retrieving information from "Progress and Potential, a profile of women inventors on U.S. patents" report and using data from the Directorate of Inventions and New Technologies. The map shows the percentage of applications with at least one woman inventor according to the percentage distribution in the different departments of Peru.

Figure 11 shows women holders of intellectual property rights in the field of invention patents and utility models. This is the percentage of patent applications with at least one woman as the IP right holder, in contrast with the total number of patents granted to nationals from 1992 to 2016. In 2015 and 2016, the presence of women as intellectual property rights holders tends to become more visible in invention patents, i.e. more women are obtaining exclusive rights for inventions whose technical solutions have greater inventiveness and fewer women obtain exclusive rights for inventions that provide minor technical solutions.

Figure 11:
Percentage of invention and utility model patents granted with at least one woman holder of the intellectual property rights, with respect to the total invention and utility model patents granted from 1992 to 2016



Source: Directorate of Inventions and New Technologies.

Empowerment activities supported by **the Directorate of Inventions and New Technologies**

Institutional Videos:
Indecopi, through the Directorate of Inventions and New Technologies, produced two institutional videos that show how women find solutions to problems that improve living conditions and, thus, become inventors. For instance, Gaby and Zulma Quispe Anaya invented the "self-generating heat garment" to mitigate the negative impact that frosts cause to animals in high Andean areas, and Ruth Quispe invented the "aerospace minilab for microbial survival" to test the resistance of cyanobacteria in outer space conditions.

Expositions: Peru participated in the 2019 Korea International Women's Invention Exposition (KIWIE) from June 20 to 23, 2019 in Seoul, South Korea. The Korea Women Inventors Association (KWIA) invited Indecopi to participate in this event. The 2019 KIWIE aimed to show protected inventions and designs developed by women who contribute to their countries' growth. 100 inventors from various countries of the world participated in the event and Peru was the only country in the Americas. The inventions of the Peruvian delegation were "Disinfectant made with natural compounds and its elaboration process - Biosanit" invented by Ysabel Koga Yanagui, "Self-heating container - Smart Container" invented by Pamela Casimiro and the "Self-generating heat garment for Andean animals - CALORINA" co-invented by sisters Gaby and Zulma Quispe Anaya. Two of the aforementioned inventions received a gold and a silver medal, in addition to the special recognition awarded to inventor Pamela Casimiro for her contribution to society.

I Women's Industrial Designs Workshop: This workshop was held on April 15 and 16, 2019 at Indecopi facilities. The event targeted women involved in industrial designs to value national production, promote women's empowerment and creativity for the economic, social, and cultural development of the country through the use of intellectual property. Five women officials from the Directorate of Inventions and New Technologies were the speakers in this event.

Experiences of **peruvian women inventors**

Ysabel Koga Yanagui

Ysabel Koga Yanagui is a Peruvian inventor who, from a very young age, cared about animals. She liked science and was an outstanding student during her school years. During high school, biology was one of her favorite subjects. This might have influenced her decision to pursue veterinary medicine at the National University of San Marcos, despite family struggles and her relatives' suggestions to choose other traditional careers for women. She managed to graduate with honors and was the first woman in the veterinary medicine school to rank first in her class. She is also proficient in five languages.

After a successful career, she decided to make her way and founded the company "Bioservice S.R.L." with other partners. She filed nine patent applications as a result of her research work. She obtained the exclusive rights for four of them. According to Ysabel, the greatest difficulty as an inventor was to find funds for her research projects, because these are self-managed. Nonetheless, she got great satisfaction from her job. Her greatest achievement was to contribute to the creation of environmentally friendly products that will help to have a better planet for future generations.

Photo taken by Nelson A. Cruz Tapia - 2019

She believes that patents lent credibility to "Bioservice S.R.L" company and customers relied on the properties of the offered products. She thus learned that the patent system could boost the company's competitiveness. Even though the first approach to the patent world was not entirely satisfactory, she then discovered that patents helped to prove that her work was serious, since these supported the company's credibility.

As a final reflection, she advised women that, despite economic, gender, or opportunity-related adversities, they should remember that it all comes down to their self-confidence and drive to achieve their goals. Finally, she recommended that women should not be influenced by adverse comments from third parties. They must pursue what they like because there are no careers "for men or women". It is possible to thrive in any professional field.

Estela Assureira Espinoza

Estela is a Peruvian inventor who, from a very young age, loved to learn and was a prominent student during primary and secondary school. Her father was a mining engineer, so she familiarized herself with his professional activities, and he constantly motivated her daughter to pursue a science career. When she was a kid, she had the opportunity to see hydraulic power plants, turbines, and other technological equipment.

An important milestone in her life, which motivated her to pursue science, was her participation in a national competition organized by NASA at the age of 15. Among other 80 teenagers from different countries, she witnessed the launch of Apollo XVII, the last manned moon landing in Kennedy Space Center in Florida, United States. She also had the opportunity to visit NASA's main research centers and share experiences with other young people of different nationalities, which changed her worldview. When she returned from NASA, she decided to undertake her first project: start a school science club. She didn't succeed because she failed to catch the attention and interest of her schoolmates. Nevertheless, her dream to pursue a career in science remained intact.

She got into the Pontifical Catholic University of Peru (PUCP) and studied mechanical engineering. Despite the difficulties when starting her career, she prevailed and proved that she had the necessary skills to achieve her goals. She converted the challenges faced during university life into opportunities, demonstrating to have the same abilities as her male peers. She achieved this as a result of her father's constant support and her dedication to her undergraduate studies.

After graduating, she pursued a career in research and worked on major research projects. The first one was related to coal briquettes. Then, one of her projects resulted in ***Peru's first residual biomass map***, which provides information on the location of energy crops and biomedical resources in the departments of Peru. This project led her to obtain her second patent. She appears as the inventor of three invention patents to date, affiliated with PUCP. Two have already been granted, and the last application is still pending.

Estela believes that one of the most difficult challenges she faced throughout her career as an inventor was to obtain funds to finance her research projects, and the lack of appreciation of some of her projects because they were considered to be too simple. However, her commitment to knowledge and to discover how things work motivated her to continue conducting research. She got great satisfaction from pursuing this path. She won second place in the X National Inventors Competition with the invention "Procedure for transforming biomass into solid biofuels". It consisted of transforming biomass residues –generated in agricultural, agro-industrial, and forestry activities– into a solid fuel called "bio-briquette" that can be used in heating, water heating, drying, and cooking of food, both domestically and commercially. It is therefore demonstrated that her effort was worth it. In 2017, she was the first Peruvian speaker to participate in the European Biomass Conference.

Finally, Estela advises girls and women who want to pursue science and patents to never stop dreaming, since it is the driving force to achieve our goals. She also recommended to always be honest and never stop believing in themselves so as not to be influenced by false stereotypes

Photo taken by Nelson A. Cruz Tapia - 2019

Conclusions

Chapter IV: Conclusions

- The development of proposals to eliminate misconceptions or stereotypes, which often start at home and school, should be a joint effort because these stereotypes have a negative impact on young women's choice to pursue science careers.

- The number of patents with at least one woman inventor has increased steadily in recent decades, as a result of the promotion of the patent system.

- Peruvian women inventors have been specializing in emerging technologies such as energy, biotechnology, and mining over the past decade.

- Peruvian women inventors are breaking stereotypes; they are conducting research in male-dominated fields, such as the mechanical sector.

- The highest percentage of women inventors is located in Lima, Arequipa, and Callao. For this reason, policymakers should encourage women inventors from other provinces to file invention or utility model patent applications.

- Women are increasingly filing patent applications in mixed-gender teams; therefore, it is worth highlighting the importance of gender balance and collaboration in multidisciplinary teams.

- Gender disparity among inventors is still very prevalent in our country, so all-female research teams are almost non-existent.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