

The Role of Latin American Women in International Scientific Collaboration

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1. Introduction

Latin America carries out high level scientific research but contributes less than 4% to the total world production of mainstream papers according to the Red de Indicadores de Ciencia y Tecnología – Iberoamericana e Interamericana (RICyT, 2010). Thus, it maintains a relatively low profile in the global arena in spite of the efforts to rectify this situation by the national and regional bodies of some countries and by the scientists themselves. One way in which researchers from the developing world seek to integrate into the global Knowledge Society is through international collaboration.

1.1 International Scientific Collaboration and Gender

This leads us to ask questions such as: What is the participation of women in international scientific projects? Are current international and national public policies promoting the participation of women? What visibility do women scientists from Latin American and other developing countries enjoy? Is this type of information available and when it is, is it organized and easily accessible?

Our experience tells us that information on the way gender issues are affecting participation in international projects is in short supply (Narvaez and Russell, 2001); nonetheless, this is an important issue that could not only shed light on the participation of women in international scientific projects, but also help answer some pressing questions such as the ones posed above.

2. Objectives of Present Study

The present study looks at the role played by women researchers in internationally co-authored mainstream papers from top academic institutions in three Latin American countries: Mexico, Venezuela and Chile, and compares this to their male colleagues at the beginning of this 21st Century (2000–2007). The vision resulting from an analysis of the quantitative scientometric indicators is contrasted with that provided by a qualitative policy analysis to assess if Institutional and national policies that promote international collaboration can be seen to possess gender bias. Greater objectivity in the study is sought by linking scientometric indicators and policy analysis.

2.1 Premises

Our study is based on the following assumptions:

- The number of women in higher education and research has increased; however it is not in proportion to the number of women scientists participating in visible international collaboration.
- There is a loss of human resources for high level S&T research if women are not sufficiently included in international collaboration teams.
- It is to the advantage of Science policy development and programmes to promote the participation of women scientists.

- Information is scattered and incomplete: adequate statistics and other data files that specify gender are still lacking in many S&T fields and in many Latin American countries.

2.2 Methodology

Our approach is twofold, encompassing both quantitative and qualitative procedures. Comparing the results of the two methods will ensure greater objectivity in our effort to assess if national policies are indeed promoting the participation of women scientists in international research teams.

Scientometrics was the quantitative methodology applied; it looks at the production of scientists and their impact. Specific databases such as Web of Science (WoS) containing cited and citing references in mainstream journals, as well as national science statistical data, were searched to construct pertinent indicators for the study.

The purpose of the scientometric indicators was to:

- Look at the role played by women researchers in internationally coauthored mainstream papers from top academic institutions in the three Latin American countries.
- Compare data with that relating to their male colleagues (2000–2007).

This can be achieved by the creation of a local database on international collaboration of Latin America and the Caribbean, using sources such as the Web of Science databases which include in a searchable format the institutional affiliation of all coauthoring scientists,. However, as these sources do not include the gender of the authors, the availability of complete lists of women scientists supplied by national research systems is essential for identifying the gender of collaborating authors. Only in the case of Mexico and Venezuela were we able to access official databases of women scientists through the internet. The availability of these data is linked to the fact that both these countries have implemented a national researcher system. For Chile, in spite of insistent requests for provision of these data, only partial lists of female researchers, those responsible for projects of the National Development Fund for Science and Technology Fund (Fondecyt), were forthcoming. This information was deemed not to be sufficiently representative of the national situation and therefore did not warrant further analysis. Thus the quantitative analysis in this first report of the study refers to Mexico and Venezuela; however the policy analysis also includes Chile.

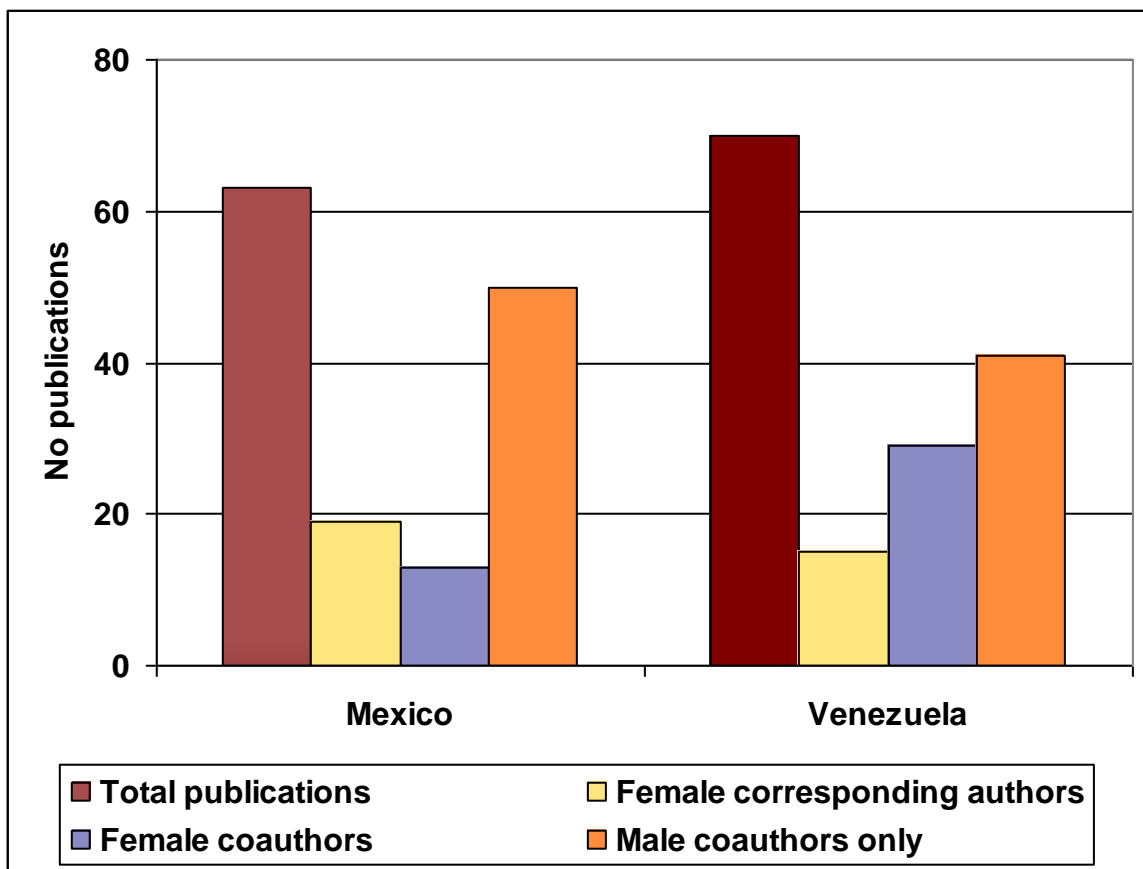
In order to test the feasibility of our proposed scientometric methodology our initial results were directed towards the role of women in mathematical research in both Mexico and Venezuela. Our first task was to develop a method to circumscribe as well as encompass papers as relevant to mathematical research. In the case of Mexico the system of national researchers (SNI) is divided into six main areas, and mathematics is included within area 1, Physics, Maths and Earth Sciences. A researcher was assumed to be a mathematician within this primary classification if the institution, faculty or department was specialized in mathematics. The gender was assigned taking into account the academic title in Spanish Dra, Mtra etc, but as this information presents inconsistencies in the data source, the lists were additionally combed manually for female names, As far as Venezuela is concerned, given that data for the national system PPI are in a searchable database format, mathematics was searched as a discipline and limited to active female researchers as recorded in ONCTI (Observatorio Nacional de Ciencia, Tecnología e Innovación).

After forming the preliminary datasets for Mexico and Venezuela, all coauthors were also coded for gender, a labour intensive procedure given that both the bibliographic database and the actual articles normally use only initials and not full names for the authors. Various tools were employed, including another large international database Scopus, with fairly well developed author identification tools, and in case of doubt, the researcher’s photograph (image) was searched for individually on the internet.

3. Preliminary Results of Scientometric Study

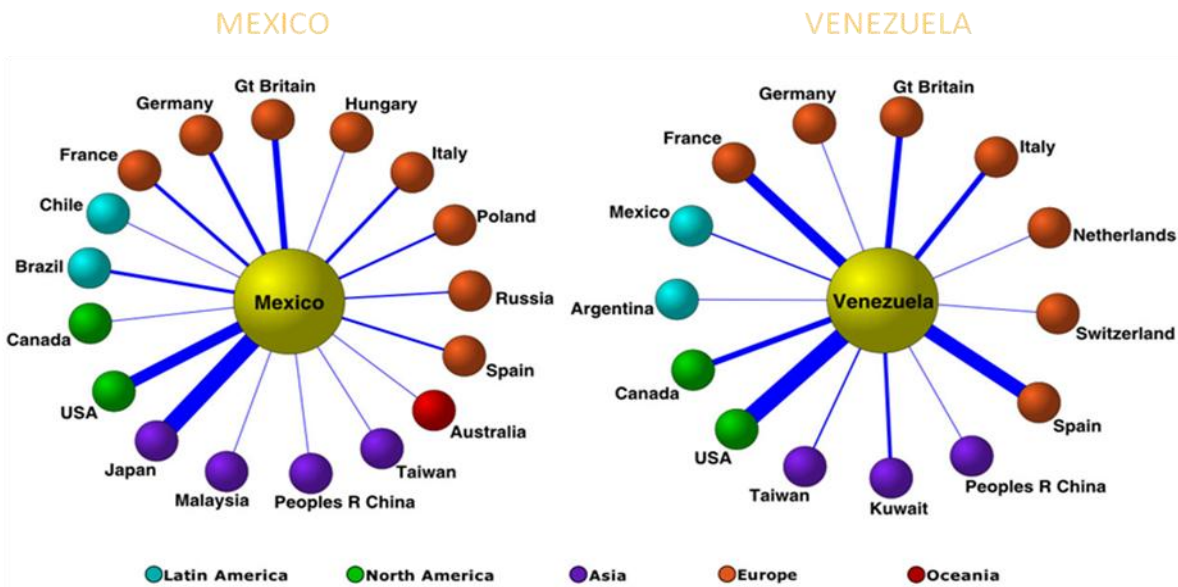
In Mexico, women constitute 34% of national researchers overall, but 18.8% of researchers in Area 1, Physics, Maths and Earth Sciences. In Venezuela, women constitute 54.5% of national researchers overall, but 32.2% of researchers in mathematics.

Figure 1 (below) compares the production of mainstream co-authored papers in Mexico and Venezuela.



This shows that Venezuela has more female co-authorship than Mexico but fewer female corresponding authors. Corresponding authors are often the most senior or experienced member of the group and oftentimes the group leader. In the case of Mexico, however, there are more papers where the coauthors of the woman scientists are all male, which would suggest a greater male presence than with respect to Venezuela and may indicate a greater degree of self-sufficiency in women mathematicians in Venezuela.

Figure 2 (below) compares mainstream publications in international collaboration by Mexican and Venezuelan women mathematicians 2000-2007, by partner country.



Women scientists in Mexico have important collaborations with Japan and the US in Mathematics while in the case of Venezuela, Spain and France figure in addition to the US. Little intraregional collaboration was apparent in either of the two countries. These initial results suggest that women mathematicians in Venezuela and Mexico form part of different international networks beside the strong connections with the US seen in all Latin America research. A more in-depth study including interviews with the women scientists themselves will shed light on the dynamics behind these international links.

4. Policy Analysis

So how do these results link up with policy? The science policies of the past five years in the three countries were reviewed to observe the relation between the gender policies and the mainstreaming of women in Science and Technology in the light of the indicators observed in the first part of this study.

4.1 Mexico

With a total population of 108 555 000 (2008), Mexico had only 16,481 researchers registered in its National Researchers System (SNI) and an average investment of 0.4% of GDP in the past decade, in spite of its national science policy which specifies at least 1% of GDP (UIS UNESCO Statistics 2008, Mexico).

- Total Population: 108 555 000 (2008)
- Researchers per 1 000 000 inhabitants: 460
- Expenditure R&D as % of GDP: 0.50 (2008); 0.79 (2006).

International parameters suggest between 1 and 2%. Developed countries invest an average of 2% of GDP in Science, Technology and Innovation, whereas developing countries spend on average under 1%. Sweden's expenditure in this field is around 4% of GDP (UIS UNESCO Statistics Mexico, 2008).

Investment in science and technology as a percentage of GDP, between 1970 and 2000, increased twofold in Mexico; 4.5 times in Brazil, 5 times in Spain and nine times in Korea. It is interesting to note that the per capita income increased during the same period 3.8 times in Mexico, 6.3 in Brazil, 7.4 in Spain and 25.4 in Korea (Universia Noticias México, 2010).

In Mexico, gender mainstreaming has been promoted within the Federal and local governments through the National and some of the State Institutes of Women, especially the Institute for Women of the Federal District. NGOs deserve a special mention as they are paramount in this respect. For example, to mention only a few of the many gender focused organizations, the Instituto de Liderazgo Simone de Beauvoir A.C. (the Leadership Institute Simone de Beauvoir), a not-for-profit organization that promotes democracy and gender equality or the Programa Universitario de Estudios de Género (University Program for Gender Studies of the National Autonomous University of Mexico UNAM), which has an ongoing gender equality and mainstreaming programme aimed at achieving full gender equality and shattering the glass ceiling at the top academic and academic management positions. At the UNAM there are also other groups and associations of women scientists that permanently have programmes and projects to promote more women in the fields of S&T and more women in higher levels. The same occurs at the Autonomous Metropolitan University (UAM) and the National Polytechnic Institute (IPN). The former President of the Mexican Academy of Science is a woman, Dr. Rosaura Ruiz, a biologist and active promoter of women in science and currently Dean of the UNAM Faculty of Science.

Of high importance is FEMU (the Mexican Federation of University Women), an IFUW member which has its own projects, through which it has promoted women in science and technology. To mention just a few: in 1994 FEMU lobbied CONACYT (the Mexican National Council for Science and Technology) to eliminate the age limit for granting scholarships; beginning in the early nineties, FEMU advocated that gender statistics be gathered permanently by the UNAM (the highest ranked university in Spanish and Portuguese speaking countries) and used these statistics to prove that more women than men at UNAM received the highest grades award (premio Gabino Barreda). However, even though the number of women in science has risen, the percentage of men in S&T is significantly higher and especially so at the higher hierarchical levels (Figure 3).

Gender mainstreaming for S&T is promoted at higher education institutions and in academic associations. Public policies include transversal gender mainstreaming in all public offices. Public funding for S&T is mainly through CONACYT. There are several specific funds, such as the INMUJERES–CONACYT Fund (National Institute for Women–National Council for S&T), that have promoted research on gender issues since 1994. However, public policies and legislation have not sufficiently secured adequate funding for S&T nor given sufficient emphasis to gender mainstreaming as a means of achieving equality at all levels of endeavour. This is necessary and crucial for human and social development as well as a means of increasing social and economic efficiency and well being in general.

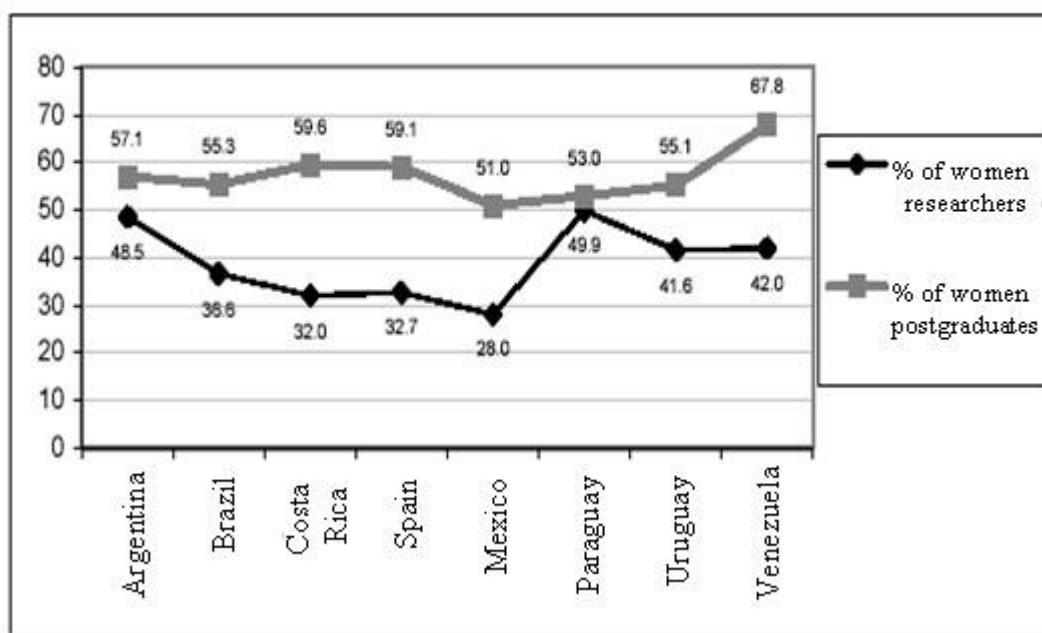
During the decade 1998–2008 there was a twofold increase in women researchers belonging to the Mexican National Researchers System (SNI) and a 146% increase in 12 years. However the current percentage of 34% female researchers is still far short of a balanced 50%, even though there are currently slightly more than 50% female students in higher education: see Table 1 and Figure 3.

Table 1. **MEXICO:** % Women in National Researchers' System (SNI)

➤ 1998:	28% Women scientists of 6,742 total members
➤ 2008	33% Women Scientists of 14,681 total members.
➤ 2010	16,598 national researchers of which 5,622 women = 34%
➤ Area 1 (Physics, Maths and Earth Sciences)	18.8% women

In Bonder's (2005) comparative study of women graduates and their participation in research in eight countries, it is interesting to note that both in Mexico and Venezuela there are more women than men graduating from higher education institutions, with over half going into research: 54% in Mexico and 61% in Venezuela. See Figure 3 below, and Estébanez, M.E., 2004, *Estudio comparativo iberoamericano sobre la participación de la mujer en las actividades de investigación y desarrollo*. Los casos de Argentina, Brasil, Costa Rica, España, México, Paraguay, Uruguay y Venezuela. In: *op.cit.* Bonder, Gloria. (2005).

Figure 3. LATIN AMERICA AND SPAIN: Comparison of Women holding postgraduate degrees and Women researchers in the National Science and Technology Systems.



The number of women in science and technology is increasing yet the glass ceiling remains. The percentage of women researchers in the top levels of the national research system is only 18% of the total number of scientists (see Table 2 below).

Some of the issues and challenges that are still pending to achieve a robust development of science, technology and innovation with a solid gender mainstreaming element, in Mexico, are:

- Insufficient investment in S&T; lower than OECD and other international parameters.
- Mostly articulated by Government; insufficient links with productive sectors.

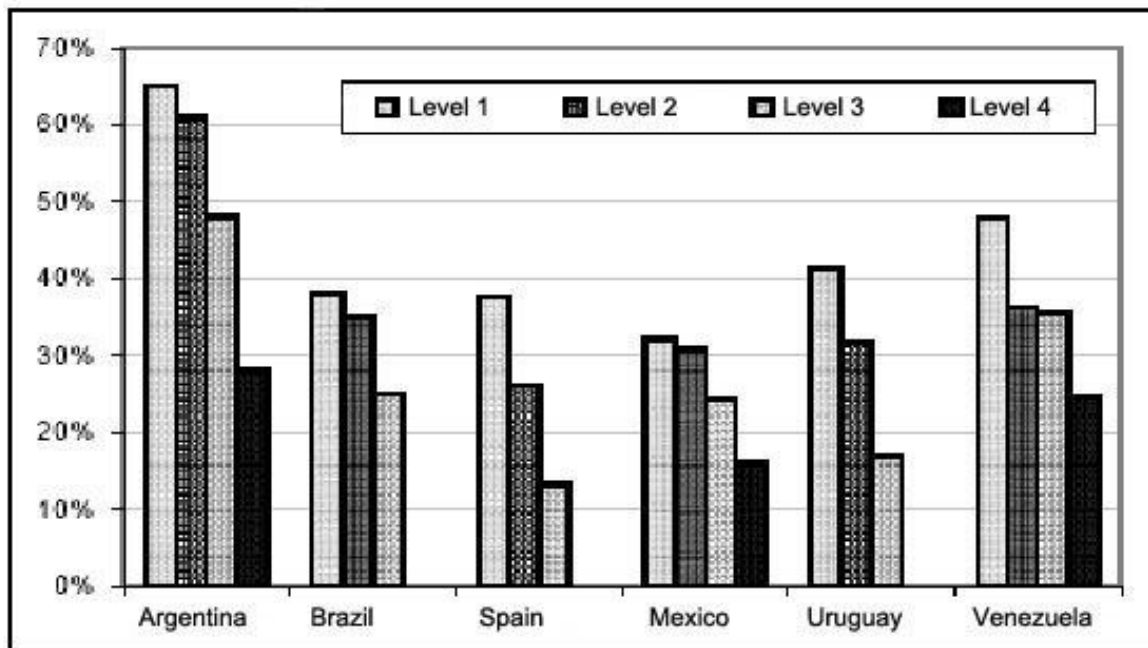
- Public policies should promote S&T in general and include gender mainstreaming, as S&T are crucial for human and social development to increase efficiency and well being.
- Special focus on gender mainstreaming in education, science, technology, innovation, business and industry to increase female participation especially at top levels.

4.2 Venezuela

- Total Population: 28 121 000
 - Researchers per 1 000 000 inhabitants: data not available
 - Expenditure R&D as % of GDP: Not available
- (UIS Statistics 2008, Venezuela).

Science Indicators: In 2008 there were 6,831 national researchers; 3,724 women meaning 54.5% of the total research population. It is noteworthy that in Venezuela, where there are more women researchers than men, the Minister for Science and Technology has been a woman, Yadira Cordova, since 2003. In Mathematics women represent 32.2%, which is high, as it is a discipline that in most countries is largely represented by men. The percentage of women scientists in the highest level of the national research system is around 25%, which is higher than the 18% of women scientists in that same level in Mexico. Figure 4 shows the participation of women at the four hierarchical levels with respect to all scientific categories of the national research systems of Spain and Latin America (Source: Estébanez, M.E., 2004)

Figure 4. Female participation related to Total of each Science category



Source: Estébanez, María Elena. Ibero American comparative study of the participation of Women in Research and Development. The case of Argentina, Brazil, Spain, Mexico, Uruguay and Venezuela. April 2004. In: Bonder, Gloria (1994). *Mujer y Educación en América Latina: hacia la igualdad de oportunidades*. Revista Iberoamericana de Educación. No. 6 Género y Educación. Septiembre – diciembre. <http://www.irieoei.org/oeivirt/rie06a01.htm>

4.3 Chile

This South American country, with a total population of 16 804 000, has 833 researchers per 1 000 000 inhabitants and an expenditure in research and development (R&D) of 0.67 % of GDP, (UNESCO UIS 2008, Chile).

The strategic pillars for its policies to promote high level science and technology education include gender focused strategies such as:

- a) Provide grants, scholarships and programmes for the insertion of women in academia and industry.
- b) Improve and strengthen science and technology infrastructure. For example, budgets have increased over 100% between 2005 and 2009.
- c) Specific policies aimed at strengthening science and technology information availability and international linkages.
- d) Media dissemination of female participation in science and technology.

These measures have afforded a higher visibility for women in science and technology in the Chilean Science and Technology national sphere and mass media, and are expected to render a steady increase of women in these fields. However there are still challenges to meet such as:

- a) There is a salary gap close to 30% between men and women; in postgraduate employment the gap can reach 50%.
- b) Few women have access to higher hierarchical positions in all economic sectors including academia.
- c) Even though Chilean women generally have a higher level of education than their male counterparts (more years of study) only 42% of the total female population are employed, of which 80% work in domestic labor or social services – an extension of what have been considered “socially or culturally” female roles.

There is still an under-representation of women in politics, notwithstanding that the former President of Chile, Michelle Bachelet, and the President of CONICYT (National Commission for Science and Technology Research) are women.

The gender policies seek to meet the challenges and in the words of Vivian Heyl, President of CONICYT, in a speech to the Inter-American Development Bank (Banco Interamericano de Desarrollo, 2007): “the Commission is actively promoting the incorporation and access of women to science and technology through the development of an S&T culture favoring gender equality. This is done by promoting good practices and recognition – by the science community and society in general – of the relevant role that women perform in such a sensitive and decisive field for the future development of Chile.”

5. Conclusions

Although more women are entering and graduating from higher education institutions, the percentage of women entering fields of science, except in Venezuela, is still below 50%. Moreover, women who do enter the sciences do not achieve higher positions in the same proportion as their male counterparts.

To understand and effect changes in this situation requires both better data and better policies.

5.1 Quantitative indicator challenges

- National research systems need to publish more reliable gender-based statistics and indicators.
- While the existence of a national researchers' system is positive in this respect, it does not as yet produce adequate and comprehensive lists of female researchers.
- Production data needs to be linked to the lists of national researchers but the highly labour intensive process involved means that here is a scarcity of gender-based production data.
- Bibliographic data bases do not author code for gender, making accurate identification difficult.

5.2 Policy Challenges

- Gender mainstreaming principles are beginning to penetrate public policies in Latin America, through the work of government and other public and private institutions. However, stronger initiatives, actions and programmes for gender mainstreaming should be part of the higher investment in Science and Technology required from both government and private institutions.

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