

INNOVATION IN CURRENT AND FUTURE SCIENTIFIC COOPERATION: THE SOUTH VIEW

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I. LATIN AMERICAN AND CARIBBEAN: THE STATE OF SCIENCE AND TECHNOLOGY ¹

Worldwide investment in research and development (R&D) increased considerably during the period of 1992-2001 from 400 to 700 billions, representing an increase of 71% to the period. In Latin America investment in R&D for 2001 was 11.5 billions of US\$ representing 1.6% of the worldwide investment, just more than Oceania. The total expenditure amount by North America was twenty times higher than Latin American region; Europe and Asia was eighteen times higher each. This situation is showed in Figure 1.

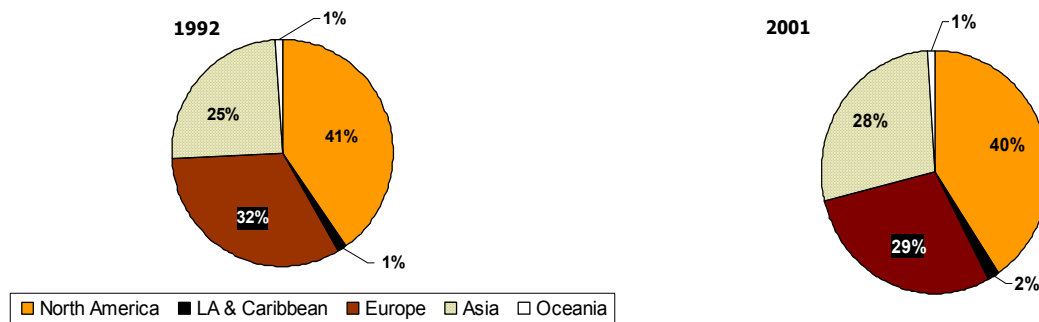


Figure 1. Worldwide investment (percentage of total) in Research & Development by geographic region

Latin American expenditure grew from 1.4% to 1.6%, as same as Asia that grew in a 3%. While North America and Europe decreased in a 1% and 3% each.

Science and Technology (S&T) activities are very important to the improvement and economic development of the countries. Expenditure in S&T represents for many countries a development indicator. Then social welfare can be enhanced in many ways: directly using scientific and technologic improvements in health, environment, and telecommunications among others; and indirectly improving competitiveness of the country and generating better remunerated employments.

Research and development (R&D) is a component of a Science and Technology program, in this component knowledge is generated and implemented to resolve particular requirements.

In figure 1 expenditure in S&T and R&D are showed in a segregated manner

¹ This presentation is based in "El estado de la Ciencia" principales indicadores de Ciencia y tecnología Iberoamericanos/Interamericanos 2002". Do by Red Iberoamericana de Indicadores de Ciencia y Tecnología (RICYT). Argentina 2003. (www.ricyt.edu.ar).

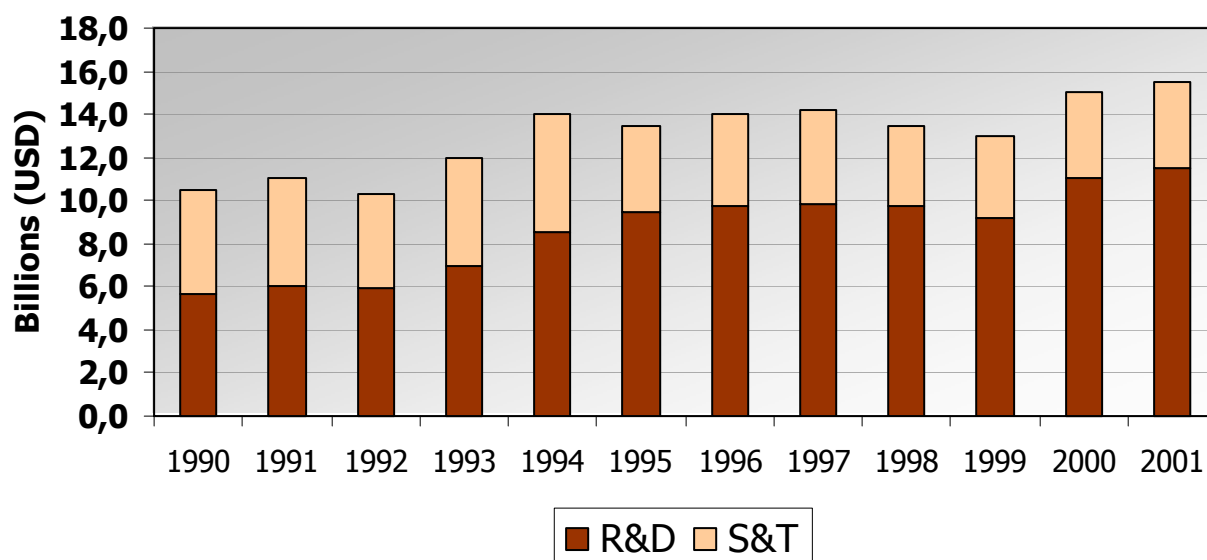


Figure 2. Expenditure in Science & Technology activities and R&D component in LA & Caribbean Countries

Regional expenditure in S&T activities during 2001 was approximately 15.3 billions of US Dollars; this amount represents an historical maximum in the region, besides this amount is greater in a 2.7 % than the expenditure amount of the previous year, confirming an increasing trend after a decrease of approximately 10% in the previous 1997-1999 period. A similar behavior represents the R&D expenditure, in 2001 was of 11.5 billions of USD increasing in a 3.8% related to the previous year (2000). R&D expenditure had a similar trend like S&T, which is logical because the first is a component of the second one. But in Figure 2 looks that R&D expenditure has obtained importance respect to the total expenditure amount, in 1990 R&D expenditure was of 55.8% while in 2001 reached 75.3%.

The trends previously showed led to two possibilities:

- 1) The importance given to R&D by the different countries of the region it's the catalyzer of the investment in S&T, while the rest of components did not show the same importance. This situation can be related with troubles in the collection of information, due to methodological and operative difficulties. That's why can exist a sub-register of the total expenditure quantities.
- 2) In the other way many countries of the region have adopted the UNESCO guideline of addressing a minimum of one percent (1%) of the **Gross Domestic Product** (GDP)

R&D EXPENDITURE RELATED TO GROSS DOMESTIC PRODUCT (GDP)

R&D expenditure for Latin America countries is approximately 0.61% of the Gross Domestic Product (GDP) in 2001. This behaviour it's mainly explained by the Brazilian expenditure increase in the last years. Related to others regions or countries LA & Caribbean region is in a weakness position, because OECD's countries expenditure represents the 2.2 % of GDP, NAFTA countries was 2.5 % of GDP, while European community addressed to this activity the 1.9 % of GDP (see Figure 3)

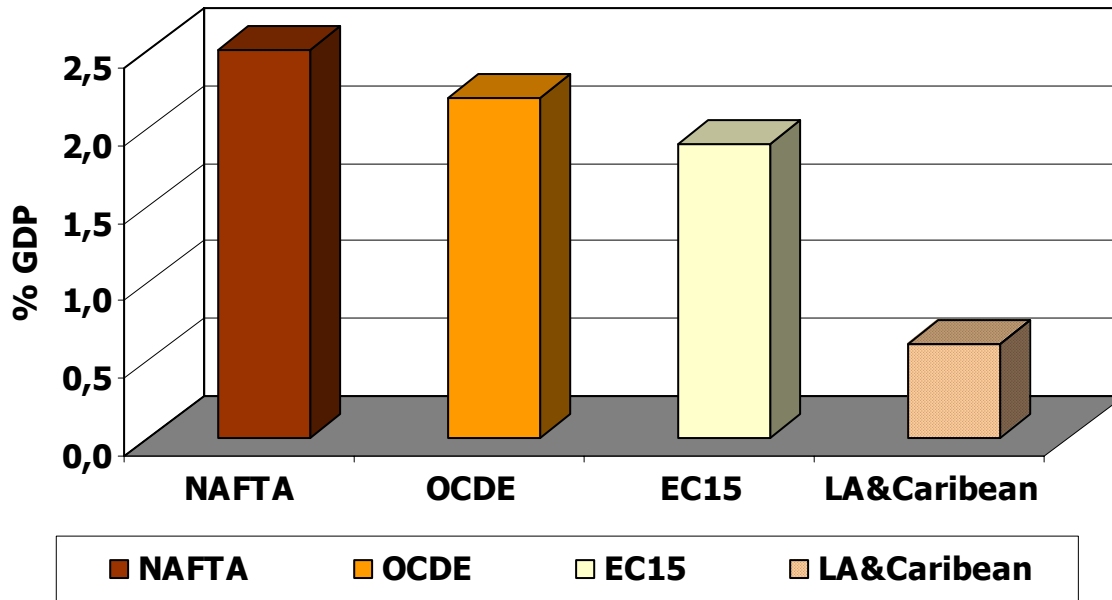


Figure 3. Research and Development (R&D) expenditures by region, as percentage of Gross Domestic Product (% GDP) in 2001.

Figure 4 shows the proportion of % of GDP by country, it's important to stress the fact that more than 85% is distributed among Brazil, Cuba, Chile and Argentina. Brazil is the country that addressed more funds to R&D activities with a 1.05 % of GDP expenditure higher than 0.61 % of GDP average of the Latin America and Caribbean countries. In a second place Cuba, with 0.6 % of GDP, and Chile in the third place with a 0.57 % of GDP. These three countries are the only ones that in a regular way had reported a R&D/GDP relation more than 0.5%.

Chile is widely recognized as having the most open, stable and liberalized economy in Latin America, with a market based-economic system in which the private sector is the main engine of growth, fuelled by high rates of savings and investment. Argentina devoted 0.4% of its GDP to R&D; this expenditure has not evolved significantly in the last decade. Mexico is the only LA & Caribbean country that is a member of OECD, its R&D expenditure of 0.45% of GDP, is the lowest of the OECD representing just one-seventh of the OECD average.

Central America's countries, with the exception of Costa Rica, have expenditures in R&D activities less of 0.2 % of GDP, compares unfavourably with the 1.0% for Brazil, and similar situation are having South American countries like Peru, Ecuador and Paraguay.

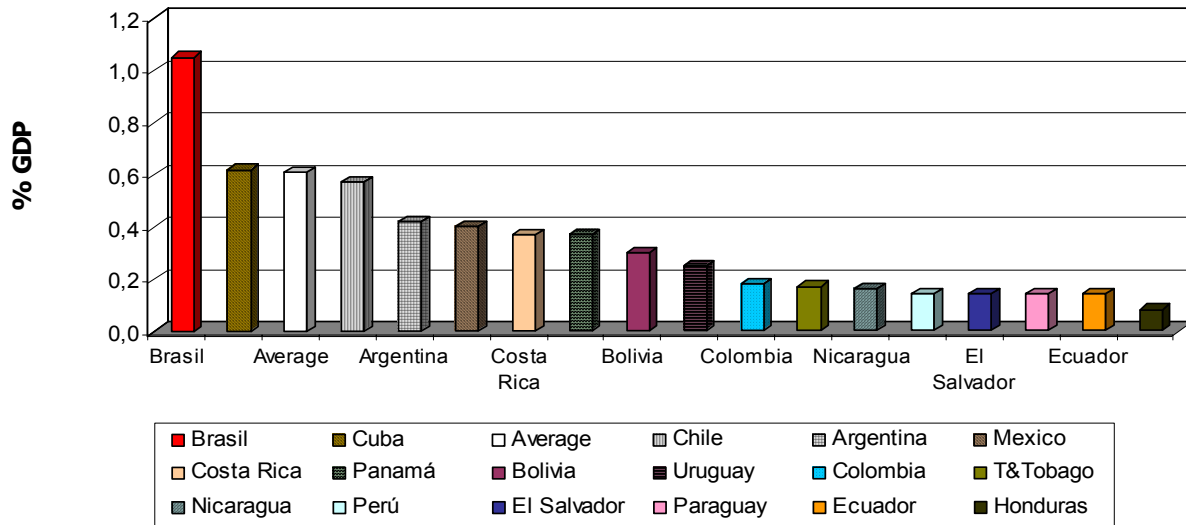


Figure 4. R&D expenditure in % GDP by LA & Caribbean countries

The expenditure by financial sector is an indicator that shows the grade of maturity of the S&T system. In LA & Caribbean Countries the government sector is the main supporter, providing the 54.5 % of the funds addressed to this activity, in the second place is private sector providing 35.8% of total expenditure and the academic sector is in third place with the 7.5%. Cooperation funds just support 1.7%; this situation highlights the fact that is necessary to promote R&D regional cooperation.

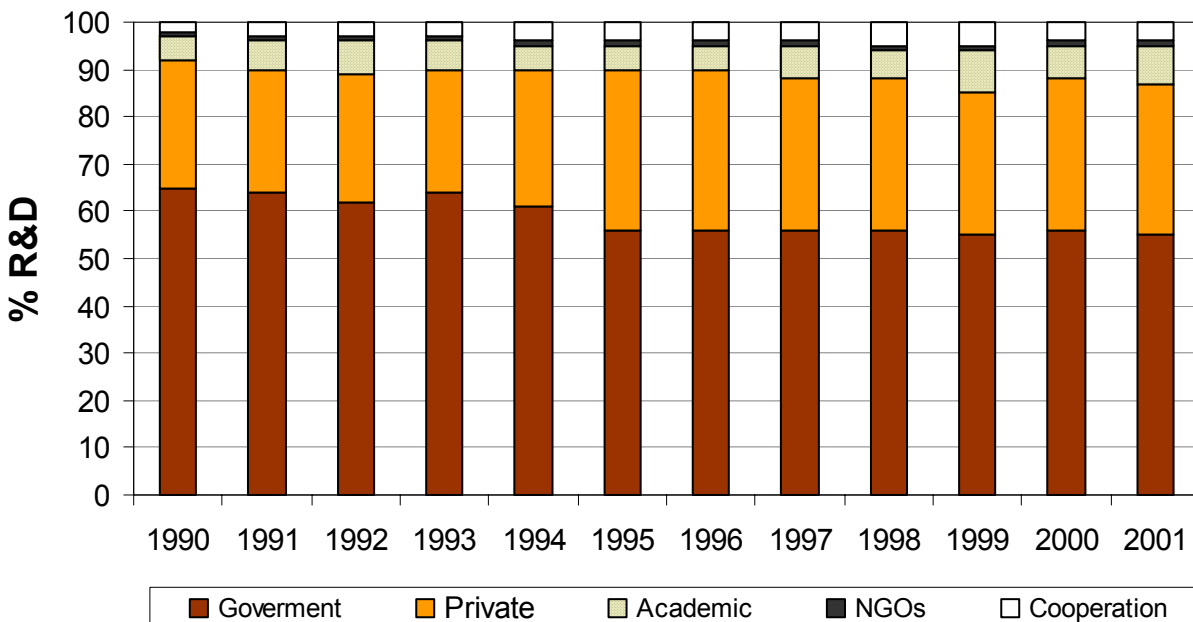


Figure 5. Percentage of R&D expenditure by financial sector in LA& Caribbean region

Although government is the main supporting of R&D, its contribution decreases in time, as it is shown in Figure 5. In the beginning of the new decade support was already 55%. In other regions or

developed countries main supporter for R&D activities is the private sector. In OECD countries, private sector support 64% of R&D expenditures, in European community was 65%, and NAFTA Countries were 63%.

HUMAN RESOURCES FORMATION IN SCIENCE AND TECHNOLOGY

Human Resources in science and technology are the central element to generate and promote knowledge. In LA & Caribbean region studies about human resources in S&T are scarce, this can be due because of the little importance given to S&T in the government's policies or the little importance in the work plans of the national statistics institutes.

Considering the OECD definition (Canberra Manual, OECD 1995) human resources working in S&T activities are persons with university studies, or persons who have been working in S&T activities for a long time. There are two important guidelines in this definition: academic level and professional qualification.

A special characteristic in LA & Caribbean countries is the high concentration of researchers in the academic sector; this proportion varies from 62% in Mexico to 82% in Uruguay. In the other hand, researchers in private sector are scarce; furthermore there are a small proportion of researchers doing engineering or technologic research. Brazil is an exceptional case. This situation contrasts with North America where only a 19% of researchers are in the academic sector.

This is an important fact because this limits the possibilities of technological development and the competitiveness of its productive sector;

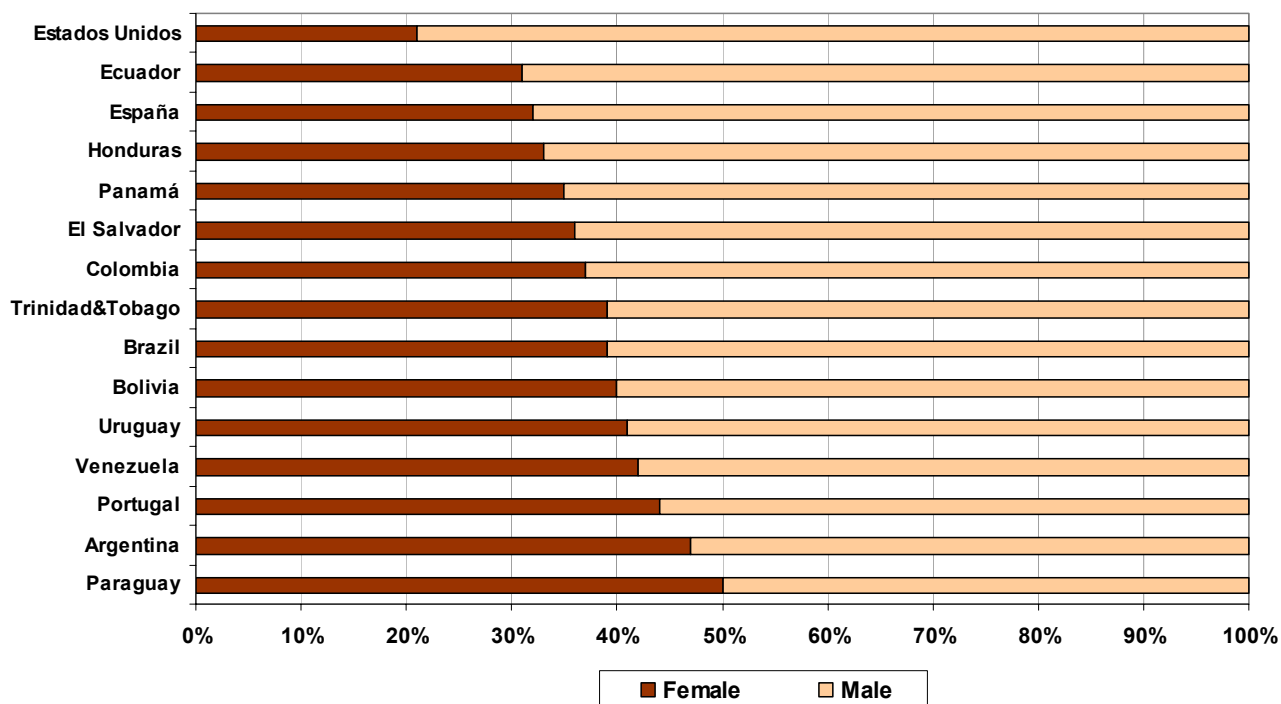
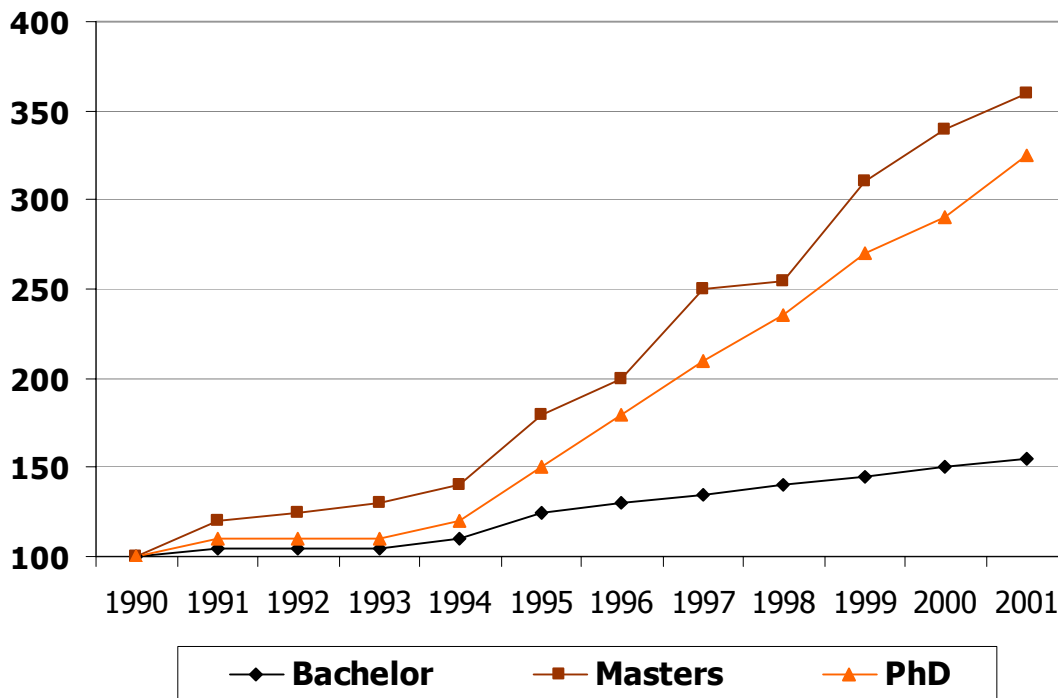


Figure 6. Distribution of researchers by gender doing S&T activities, 2001

Figure 6 shows distribution by gender of human resources doing S&T activities, female participation registered a maximum of 40% in South American countries like Paraguay, Argentina, Venezuela and Uruguay while in a developed country like United States female participation is just a 20%.

With respect to education degree of human resources, LA & Caribbean countries show a high increase in number of university students as well as in diversification of careers, for example in 1950 it was registered approximately 260,000 students, in 1970 increased to 1,640,000 and for 2000 student's number were already 9,000,000.

Figure 7 shows the trend of graduates in LA & Caribbean students. Taking like a base line 1990, bachelor's degree had a notable increase close to 50%; a significant increase had master and PhD degrees. Master is the most considering post graduate preparation having an increase more than 200% since 1990 to 2001.



MIGRATION OF S&T HUMAN RESOURCES

In the last 15 years there has been an important world-wide migratory flux, furthermore a change in the composition and destination has been observed. United Nation's Population Division registered in 1990, 130 millions of migrants representing a 2.9 % of world-wide population and in 2002, 175 millions representing a 2.9%. Main destination for this migration flux had been developed countries due to multiple and complex factors.

In the United States of America, more than half of immigrants are Latin Americans, generally with a few years of academic formation and doing low qualified jobs. Some South American countries like Argentina, Brazil, Chile, Venezuela and Uruguay shows different migration behaviour, with a high representation of professionals and technicians. It's important to stress the fact that most of the LA & Caribbean countries do not have an actualized data base of qualified professionals, and also the numbers of professionals that migrates to other countries is not registered.

II. SUGGESTIONS TO INNOVATE IN SCIENTIFIC COOPERATION

By Latin American & Caribbean Governments

The behaviour of expenditures in science and technology in Latin America and Caribbean region has been irregular. Although government efforts, is not possible ensure an enhancing in funds. It's necessary to promote a general compromise of countries to increase investment in R&D at least to 1.0 % of GDP.

To implement a flexible and stimulating program of financial incentives to industries that made research and development in a systematic way, or maybe establishing concurrent funds in a way to stimulate S&T in that sector.

To define and implement a government policy about Science and technology, increasing the responsibilities of the Sciences and technologies Ministers/Councils to promote and rising funds to collaborate with universities in scientific projects.

Science and Technology Ministers/Councils, especially in Central American and Caribbean countries, have to be strengthened with a specific law to establish them like a main promoter of S&T in the country.

Promote the country participation in international scientific cooperation networks by means of S&T Ministers/Councils, trough the participation of national universities, procuring to do joint R&D projects exchange of technology and qualified human resources.

Promote and maintain a S&T research career, also stimulating the promotion of human resources that support S&T activities. Governments have to try to guarantee a reincorporation of researchers formed by cooperation funds avoiding the migration of qualified researchers to other countries. Also Private sector can play an important rol developing more R&D activities where these professionals can found an opportunity.

Promote the participation of foreign capital in research activities, with the opportunity of the international globalization of markets and the facilities of information technologies.

Make a review of the methodologies used by each country to obtain S&T data, standardizing with the OECD's methodologies, for the reason that data does not look consistent in the relation in expenditures among S&T/R&D. Then actualize the S&T indicators to using them like instruments to design the S&T government policies.

BY THE COOPERATION AGENCIES

Promote scientific cooperation with LA & Caribbean countries procuring that South governments implement a S&T policy and strengthening the role of S&T Ministers/Councils.

Cooperation to Latin American & Caribbean countries has to be done considering the different levels of scientific development, like % of GDP addressed to S&T, human resources formation, productivity of research existing among the countries. This cooperation can be focussed by themes or scientific or technological areas of interest, such as:

- Environment and climate
- Agricultural, forestry and aquaculture
- Industrial and manufacturing technologies
- Sustainable transport
- Sustainable energy
- Economic and social development

Cooperation funds addressed to LA & Caribbean countries have to be systematically monitored and evaluated in a basis of an established program.

Promote special support to LA & Caribbean countries, especially countries with less S&T investment capacity, to subscribe to scientific journals data base.