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Discussion Paper # 172



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South-South Cooperation in Health and Pharmaceuticals: Emerging Trends in India-Brazil Collaborations

Sachin Chaturvedi*

Abstract: India-Brazil partnership in the health sector is an area in which the two major economies have increasingly collaborated not only bilaterally, but also in several international forums. This has added new thrust to the process of South-South cooperation. At the bilateral level, both the countries have identified common health sector challenges particularly diseases for joint research. They have established new fellowships for supporting research in their respective economies. Besides, the two countries have been developing partnerships for setting the agenda in multilateral forums like the WHO and WTO as well as in the IBSA and the BRICS forums. Apart from facilitating trade negotiating positions at WTO, for export of drugs and pharmaceuticals to the affected countries, India and Brazil have also launched joint R&D projects in biomedicine both at the bilateral level and also under the aegis of IBSA. This emphasis at IBSA on health diplomacy is rather new and it demonstrates that health is emerging as an important area for joint collaboration among emerging economies. The Section II of the paper provides an overview of the trade linkages between the two economies with special reference to pharmaceutical sector while section III presents the recent initiatives at various levels for expansion of ties in the health sector. Section IV looks into research and entrepreneurial linkages. The conclusions are drawn in the last section.

Key words: South-South Cooperation, Health, Pharmaceuticals, India, Brazil, IBSA.

INTRODUCTION

During the past decade the South-South cooperation has emerged as an important mechanism for the collective advancement of developing countries. This mechanism has gathered momentum following the rapid rise of the advanced developing countries on the world stage as a result of which these countries have become the new growth poles of the global economy. What has made South-South cooperation more attractive as a policy option

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is that it brings to the table a fresh perspective on development based on the spirit of partnership. Not surprisingly, therefore, South-South cooperation has become the mainspring of the global engagement of a large majority of developing countries.

Almost all major developing economies have stepped up their support for South-South cooperation.¹ For instance, India has been contributing more than USD1 billion annually for furthering the cause of South-South cooperation, part of which goes to health sector.² These initiatives have developed through both bilateral and plurilateral processes. The latter has taken roots in forums such as the IBSA, where the three participating countries, India, Brazil and South Africa, have initiated several development projects in countries as far flung as Haiti, Guinea-Bissau and Palestine.

However, with contemporary developments groupings such as IBSA (India, Brazil, South Africa) and BRICS (Brazil, Russia, India, China and South Africa) emerged for different purposes. This seems to be effective as in the past, South-South cooperation could not go far due to several impediments like limited availability of resources at the national level, bureaucratic international institutions and limited R&D strategy.³

In order to better understand the content of South-South cooperation, this paper will discuss India-Brazil partnership in the health sector. This is an area in which the two major economies have increasingly collaborated not only bilaterally, but also in several international forums. At the bilateral level, both the countries have identified common diseases for joint research. They have established new fellowships for supporting research in their respective economies. Besides, the two countries have been developing partnerships for setting the agenda in multilateral forums like the WHO and WTO as well as in the IBSA and the BRICS forums. Apart from facilitating trade negotiating positions at WTO, for export of drugs and pharmaceuticals to the affected countries, India and Brazil have also launched joint R&D projects in biomedicine both at the bilateral level and also under the aegis of IBSA. This emphasis at IBSA on health diplomacy is rather new and it demonstrates that health is emerging as an important area for joint collaboration among emerging economies.

Brazil is India's key partner in the Latin American region. This is evidenced by the fact that in the period 1990 to 2008, India signed 23 agreements in the region of which 13 were with Brazil.⁴ The range of issues covered by these agreements signifies the wide ranging partnership that the two countries are engaged in. Besides, the two countries have coordinated amongst themselves to meet the challenges that they have faced; for instance, the incidence involving seizure of generic drugs produced in India by the EU customs authorities when these products were merely transiting through the Dutch ports. A joint complaint was lodged by Brazil and India in the WTO against this action by the EU.

The joint collaboration is likely to be strengthened as both India and Brazil have registered strong growth profile and their firms have shown dynamism. Indian economy has grown at an average rate of 8.7 per cent since the middle of the past decade.⁵ Indian pharmaceutical industry has been one of the top performers and this dynamism was reflected in increasing presence of their products in export markets, particularly in countries like Brazil.

Brazil too has been growing at an impressively, at nearly 9 per cent since 2007.⁶ In another parallel with India, the Brazilian pharmaceutical industry has been performing rather impressively with the local generic industry in Brazil and is consolidating its presence in the industry.⁷ At the R&D level, Brazil has predominant focus on biomedical.⁸ The recent policies of Industrial, Technological and Foreign Trade Policy (PITCE), 2003, and Policy for Productive Development, PDP, 2008, provided major fillip to the growth of this sector.⁹

In this paper, we try to address some of these issues. While comparing India's collaborations with Brazil, in health and pharmaceuticals with a focus on technology for production, we do not intend to cover delivery of these products in this paper. The Conditional Cash Transfer programmes from Latin America as a whole and *Bolsa Familia* of Brazil and *Plan Familias* of Argentina, in particular, offer rich lessons for India for ensuring effective delivery of health services but at this point it would be out of the scope of this paper to bring them in.¹⁰ The Section II provides an overview

of the trade linkages between the two economies with special reference to pharmaceutical sector while section III presents the recent initiatives at various levels for expansion of ties in the health sector. Section IV looks into research and entrepreneurial linkages. The conclusions are drawn in the last section.

II. INDIA-BRAZIL COLLABORATION

The discussion here need not include the details regarding publications, etc. Here you need to mention the dimensions of collaboration – trade, technology, etc. The details included here can be taken to the relevant sections below.

We chose to focus our case study research on India's collaborations with Brazil, which apart from being an emerging economy is also relatively strong in health biotechnology as compared to many other developing countries. India and Brazil both started to promote biotech development when the field was in its infancy in the early 1980s.¹¹ Their research records in the field are strong but Brazil publishes relatively more frequently in high impact international journals compared to other developing countries.¹² According to Gupta and Singh (2004), during 1991-2000 joint publications between Indian and Latin American scientists have doubled. Out of the total 389 joint papers, Brazil-India alone had 229 papers. The major areas covered in these papers were physics, clinical medicine and earth and space sciences. The policy places significant emphasis on developing medical biotechnology. This may provide insights into the dynamics of South-South cooperation. Furthermore, there seems to be governmental emphasis on India's collaboration with these countries as will be discussed below.

The case study on India-Brazil collaborations relied on multiple sources of data, including interviews with experts in the chosen countries (Table 1). The detailed list of interviewees is provided in Appendix 1 and 2. We selected interviewees that could provide varied perspectives on collaborations, such as experts who have been active in either research or entrepreneurial collaborations in the countries of interest, policy makers, directors of R&D institutes, regulatory agency representatives, etc. Furthermore, we relied on background documents, scientometric data, survey of health biotech firms, any statistics of relevance to the topic.

Table 1: Number of interviews for India’s South-South case study research

Countries	Number of Interviewees
India	24
Brazil	18
Total	42

To examine the level and distribution of India’s South-South collaboration we mapped both India’s research and entrepreneurial collaboration. We identified papers co-authored by researchers from India and at least one other developing country then used these as a proxy for collaboration.

We identified papers from Thomson Reuters’ Science Citation Index Expanded™ database (SCI Expanded) for the period between 1994 and 2005. To examine where India’s main entrepreneurial linkages are, we surveyed all health biotech firms we could identify in India and other developing countries active in this field - Brazil, China, Cuba, Egypt, and South Africa, and asked them about their South-South collaborations. We looked at collaboration broadly and included any work contributing to the production or commercialization of knowledge, products, or services in health biotech that was jointly undertaken by firms/organizations in more than one developing country.

Dynamics of pharmaceuticals

India is among world’s leading exporter of pharmaceuticals. With the export of nearly USD 5.8 billion in 2008, India share has gone up from 1 per cent in the global pharmaceutical exports in 2000 to 1.4 per cent in 2009.¹³ The export has grown at the average annual rate of 22 per cent. The size of the current pharmaceutical market in Brazil is around USD 15 billion.¹⁴ With the import of nearly USD 5 billion in 2008, Brazil is among the top 15 importers of pharmaceuticals in the world. Over the years, the share of Brazil in the global imports has declined from 1.6 per cent to 1.2 per cent but it is still nearly 17 per cent of the total imports of Brazil. It is second largest importing item after vehicles, which occupy 19 per cent of total imports.¹⁵

In the Brazilian market, generics have assumed growing importance. In 2008, they had 13.8 per cent market share in value terms and 16.9 per cent in terms of volume.¹⁶ It is interesting to note that the first generic drugs were launched in Brazil only in the year 2000. This was under the first Generic Drug Act 1999. Prior to this, Brazil had original innovation drugs, generics and ‘me-too’ drugs. The Act made bioequivalence tests mandatory for all new introductions in the market. This test was to ascertain therapeutic effects of generics. Table 2 brings out the evolution of drugs, firms and package versions of drugs. As a result of the 1999 Act bioequivalence tests were introduced which actually facilitated substitution for pioneer drugs. The government also ensured that the prices of the generics remain 33 per cent lower than the original drugs.

Table 2: Evolution of generic drugs market in Brazil

	2000	2001	2002	2003	2004	2005	2006	2007
APIs	68	140	203	220	243	271	282	263
Firms	11	25	31	33	36	37	40	37
Drugs	118	295	503	619	818	1040	1169	1099
Package versions	135	490	594	1029	1611	2069	2385	2245

Source: Fiuza and Barbara 2010.

The Brazilian government has launched several initiatives to support the pharmaceutical sector. It established two funds in 2001 which became operational in 2002, they were biotechnology and health funds, for supporting the pharmaceutical sector. These funds provided USD 146.1 million to the pharma firms in the period 2003-2006.¹⁷ They are being administered by the Brazilian Development Bank (BNDES) through its scheme PROFARMA. In this, almost 90 per cent support is extended for R&D and also for production. Interest rates are, as a general rule, based on the long-run interest rate (TJLP) plus a margin for BNDES (between 1 per cent and 1.5 per cent). The programme is set to end on 31 July 2012.¹⁸

According to the government, the scheme is no longer limited to companies under the control of persons residing in Brazil.¹⁹ The idea for this

programme was to build on pharmaceutical production chain for developing health industrial complexes.²⁰ These initiatives are the efforts to overcome historical limitation of the Brazilian pharmaceutical industry where local firms only focussed on marketing requirements and did not do enough for getting into the relevant research.²¹ As a result, Brazilian pharmaceutical industry assumed characteristics of a supplier dominated industry.²² The situation is likely to change with the emergence of biopharmaceutical industry in Brazil where more and more focus is to overcome these limitations by addressing impediments in establishing a viable innovation system.

In Brazil, the Innovation Law (2005/6) is an effort to accelerate technological innovation and facilitate R&D activities across the private sector. In this regard, some states have also come forward to support innovation related activities. The Sao Paulo state has established a programme to support innovation with the fund of USD 29 million.²³ Major push through these projects has supported the growth of biopharmaceuticals, diagnostic kits and related areas in therapeutics. In last few years, four major companies EMS Sigma Pharma, Medley Pharmaceutical Industry, Aché Laboratories and Eurofarma Laboratories have earned a major presence in the Brazilian generic market. They account for almost 75 per cent of the domestic market.²⁴ The Brazilian public sector is a very strong entity in itself. Far-Manguinhos is the leading agency which led the research programme on HIV/AIDS.

Brazil is among India's top five export destinations for pharmaceutical products. Indian exports of pharmaceuticals to Brazil have constantly expanded in the last decade. In 1999 India's total export of pharmaceuticals was just USD 7 million but in 2003, it went up to USD 31 million. The major components of pharmaceutical exports from India in 2009 was of antibiotics (17 per cent), penicillin's and derivatives (8.1 per cent) followed by medicaments containing vitamins (3 per cent) and drugs containing corticosteroid hormones (3 per cent). At various points, vaccines have also been very high on agenda for exports. One also finds growing interest in sterile surgical instruments and blood grouping reagents.

As is clear from Table 3, some of the pharmaceutical products, which are being imported in Brazil, have an important position in the overall import of those products.

Table 3: Average share of major India pharmaceuticals products in the Brazilian import (in US \$ '000)

HS Code	Description	1999-2001	2002-2004	2005-2007	2008
293621	Vitamins A and their derivatives, unmixed	0.00	0.34	2.48	1.22
293623	Vitamin B2 and its derivatives, unmixed	0.00	0.38	0.70	1.12
293626	Vitamin B12 and its derivatives, unmixed	0.16	12.14	21.49	6.01
293627	Vitamin C and its derivatives, unmixed	0.00	0.12	0.21	0.00
293629	Vitamins nes, and their derivatives, unmixed	2.15	3.92	4.02	4.43
293721	Cortisone, hydrocortisone, prednisone and prednisolone, in bulk	0.00	1.36	1.64	0.07
293722	Halogenated derivatives of adrenal cortical hormones, in bulk	2.75	8.05	6.05	8.09
293723	Oestrogens and progestogens		0.71	0.21	0.01
293729	Adrenal cortical hormones, in bulk; deriv of adren cor horm, nes, in bulk	0.77	1.91	3.08	5.77
293739	Catecholamine hormones, derivatives		1.45	3.49	0.00
293890	Glycosides&their salts,ethers,esters& other derivatives,nes,in bulk	0.79	2.52	1.48	1.70
293919	Alkaloids of opium, derivs, salts		5.65	6.92	8.48
293921	Quinine and its salts, in bulk	0.37	10.96	3.23	
293930	Caffeine and its salts, in bulk		0.00	0.17	4.44
293941	Ephedrine and its salts		13.01	36.72	2.00
293942	Pseudoephedrine (INN) and its salts	34.65	31.69	34.23	51.10

Table 3 continued...

Table 3 continued...

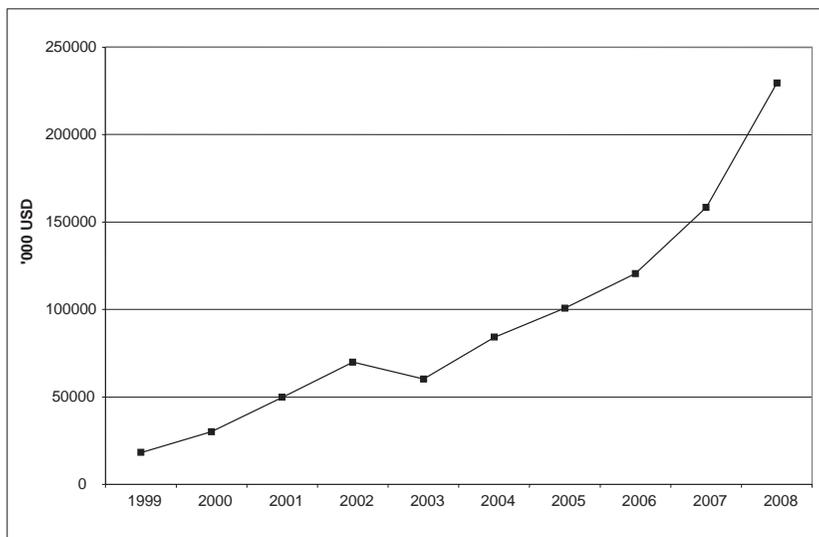
293949	Ephedrine & their salts, nes		30.93	100.00	
293959	Theophylline, aminophylline, etc.		3.08	2.72	1.88
293999	Vegetable alkaloids and salts, nes		24.22	16.07	22.13
294110	Penicillins and their derivatives, in bulk; salts thereof	10.39	22.45	36.37	35.10
294130	Tetracyclines and their derivatives, in bulk; salts thereof	0.06	0.37		0.00
294140	Chloramphenicol and its derivatives, in bulk; salts thereof	3.01	0.80	0.60	2.62
294150	Erythromycin and its derivatives, in bulk; salts thereof	27.64	49.17	53.20	61.81
294190	Antibiotics nes, in bulk	5.82	13.96	16.04	17.53
300190	Heparin&its salts;human/animal substances f therap/prophlct uses,nes	2.08	14.46	40.61	92.26
300220	Vaccines, human use	5.51	3.78	0.95	11.31
300310	Penicillins or streptomycins and their derivatives,formulated,in bulk	5.48	2.20	38.24	49.54
300320	Antibiotics nes, formulated, in bulk	3.83	17.97	47.39	12.98
300390	Medicaments nes, formulated, in bulk	3.67	2.88	7.73	7.14
300410	Penicillins or streptomycins and their derivatives, in dosage	5.49	26.14	34.01	36.70
300420	Antibiotics nes, in dosage	4.24	11.31	16.79	13.96
300432	Adrenal cortex hormones, in dosage	1.52	3.83	5.00	6.76
300439	Hormones nes, not containing antibiotics, in dosage,o/t contraceptive	0.01	0.28	0.48	0.77
300440	Alkaloids or their derivs, not cntg antibiotics or hormones, in dosage	0.28	0.61	1.00	0.98
300450	Vitamins and their derivatives,in dosage	0.16	2.95	3.08	2.41
300490	Medicaments nes, in dosage	0.62	2.39	2.37	3.36

Source: PCTAS,1999-2003,2000-2004 & 2004-2008

Main linkages in India's health biotech

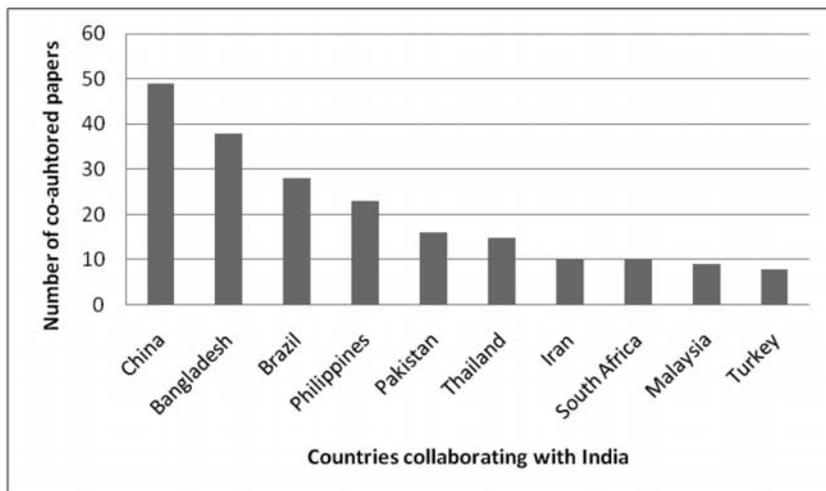
Our mapping of India's South-South health biotech collaboration shows that Indian researchers collaborate to a limited extent with other developing countries (Figure 1). If we compare the number of South-South co-authored papers India publishes in health biotechnology with the numbers for Brazil and China, we can see that Brazil published almost double the number of such papers than India. Also, China is ahead in the number of co-publications with developing countries in the health biotechnology field. This finding is consistent with previous research that shows that India is less engaged in international collaboration than other leading developing countries in this field.²⁵

Figure 1 : India's export of pharmaceuticals products to Brazil



The mapping analysis show that India has a steep increase in South-South co-authored papers, indicating a growing emphasis on collaboration with developing countries. We can also see that China is India's main developing country collaborator in health biotechnology. Another emerging economy, Brazil, also has relatively frequent ties with the country, and is in the third place (Figure 2).

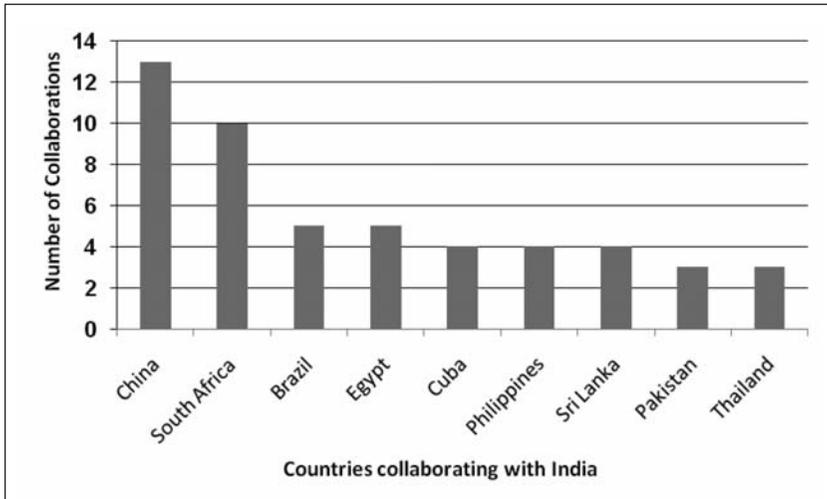
Figure 2: Coauthored Indian papers in health biotechnology (1995-2005)



Looking at the countries that have at least three entrepreneurial collaborations with India, we see that again the emerging economies are India's main partners, with China and South Africa in the primary places (Figure 3). It is notable that South Africa is more prominent in India's entrepreneurial collaborations than among the research collaborators. The two countries only published 10 joint health biotechnology papers from 1995 to 2005. Brazil and Egypt share the next two places as India's most frequent entrepreneurial partners.

Further survey questions revealed that almost all of India's entrepreneurial activities are based around marketing and distribution activities (73 per cent) and almost 21 per cent focus on manufacturing and research and development (R&D). India's South-South collaboration in this field reflects a strong entrepreneurial bent. China is both India's main research and entrepreneurial collaborator. As is clear, Brazil features prominently as India's health biotechnology collaborator and it is interesting to assess and analyse the key drivers, challenges and impacts of various collaborations that have come up in last few years.

Figure 3: The main developing countries India collaborates with in South-South entrepreneurial collaborations in health biotech, based on a survey of firms



Cooperation at the level of government

To explore the policy context of India's South-South collaboration, we explore the emphasis India's government has placed on collaborating with other developing countries. After its independence, India began to gear its foreign policy towards fostering closer ties with developing countries. India's foreign policy has focused on sharing its specialized expertise with other developing countries in lieu of providing traditional grants and aid. India has been focusing extensively on South-South cooperation through training and scholarships, with a structured programme under the Ministry of External Affairs called the Indian Technical Cooperation Programme (ITEC) (<http://itec.nic.in>). As a part of this programme, Indian experts have travelled to other countries to provide training in various technical areas such as telecommunication, transportation, medicine and public health.²⁶ The cooperation has consisted primarily of first generation technologies, but with a few countries, this has been extended to reach high tech sectors

as well. Now India allocates around USD10 million a year to ITEC²⁷, and has supported development in close to 150 countries. As a part of this collaboration agriculture, railways, telecommunication, education, science and technology, atomic energy and space research programmes have been supported across the countries. India also provided an almost 10 per cent support to the UNDP programme on Technical Cooperation among Developing Countries (TCDC).²⁸

Under the Ministry of Science and Technology, the Department of Science & Technology (DST) is also strongly focused on South-South cooperation. The department is guided largely by efforts to strengthen India's own science and technology (S&T) sector while simultaneously promoting international initiatives that are likely to reflect its S&T leadership in empowering other developing countries.²⁹ In total, India currently has 73 bilateral S&T cooperation agreements, including with Brazil, and uses a range of instruments in its collaborations, including: exploratory scientific missions, workshops, joint research projects and development centres, and advanced training fellowships.³⁰ Aside from these bilateral agreements, the DST engages with other countries through a series of multilateral and regional ties. For example, New Delhi is currently home to the Secretariat of the Centre for Science & Technology of the Non-Aligned and Other Developing Countries. Among its other objectives, it strives to “promote the fullest possible and mutually beneficial collaboration among scientists and technologists and scientific organizations from non-aligned and other developing countries”.³¹ In terms of DST, main drivers in international collaboration have been technology diplomacy, technology synergy and technology acquisition. There has been relatively limited emphasis on joint South-South research projects and much stronger focus on capacity building.

We also see a relatively strong capacity building focus in India's multilateral initiatives. For example, it directs 10 per cent of its UNDP support towards fostering South-South activities,³² and also established, in 2007, together with UNESCO, the UNESCO Regional Centre for Biotechnology in New Delhi.³³ This Centre combines research and training in biotechnology, and focuses primarily on capacity building in South

Asia. India has also promoted biotechnology development within the ASEAN (Association of South-East Nations) forum to promote human resource development and sustainable utilization of biodiversity and genetic resources. It established the India-ASEAN Institute of Biotechnology (IAIB) in Jakarta, where R&D is carried out predominantly in plant biotech, but also in pharmaceuticals and bioinformatics. Additionally, the India-ASEAN collaboration places emphasis on collaboration in technology management and intellectual property issues in order to help countries jointly pursue product development and commercialization.³⁴ However, in order to make a strong impact, all the agencies need to follow the same direction and commitment for same philosophy. This does not seem to be the case as this is very much evident from the DBT Annual Reports.³⁵

In the recent years, India seems to have revitalised interest in South-South collaboration largely through the trilateral, India-Brazil-South Africa (IBSA) developmental initiative, which looks forward for promoting cooperation and exchanges between the three countries. IBSA works in several sectors and is strongly focused on developing Southern consensus on international issues to present a more united front at the international fora, and to promote trade between the three countries. Furthermore, collaboration has begun in the areas of health affairs, and science and technology, with IBSA singling out research cooperation in such fields as tuberculosis, malaria, HIV and AIDS, and biotechnology. The future will reveal whether IBSA is successful as a tool for delivering the messages of developing countries, and fortifying their potential to address joint health needs through collaboration.

India's governmental emphasis on collaboration with Brazil is evident, from the establishment of the Indo-Brazil Science Council (IBSC) in 2007 with the goal of promoting joint R&D projects and activities which would bring together both research hubs and entrepreneurial centres within the two countries. Likewise, the IBSA forum serves to focus the countries on joint efforts in health biotechnology research.

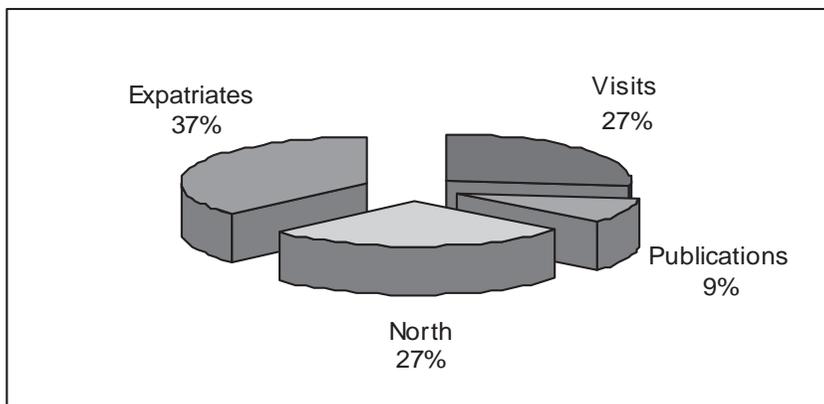
In general, it seems that South-South cooperation in science and technology has emerged as a key constituent in the policy formulation process for external cooperation of independent India. The focus has been

strongly on training programmes, capacity building, and fellowships with very little stress on joint research *per se*. As a result it is not surprising that our research indicates that India's research collaboration with developing countries is relatively small. Still India's political rhetoric emphasises South-South collaboration and the country shares common challenges with other developing countries that lend themselves to be addressed with joint research collaboration. We, therefore, looked at particular India-Brazil research collaborations to study further and see what opportunities and restraints impact the collaborations.

COLLABORATION IN RESEARCH ACTIVITIES

As stated above, Indian researchers have had modest collaboration in health biotechnology with researchers in other developing countries but their South-South collaborations have been increasing in the last few years. In general, India's health biotech collaborations are strongest in the genetics and microbiology subfields of health biotechnology. To identify possible India-Brazil research collaborations we selected papers co-authored by individuals within these countries, as listed in the SCI Expanded database and approached the authors with questions about their specific collaborations.

Figure 4: Factors contributing towards origin of collaborations



The India-Brazil collaboration has evolved at different levels since 1999-2000 when cooperation at WTO started in a major way, which led to

a political emphasis on renewed commitment for South-South cooperation which in any case was obvious in the foreign policies pursued by these two big economies of the South. The current process led by the governments of these two countries with a philosophy of South-South Cooperation, provided an impetus to the evolution engagements in the areas of medical biotechnology.

The process is influenced by several factors; for instance, international events, publications, expatriate linkages and of course, government supported research and development projects. As is clear from Figure 4, 27 per cent of the collaborations being analysed in this study have occurred due to linkages with the North, 37 per cent have come up due to linkages with expatriates and 27 per cent due to contacts developed during international conferences, seminars or visits of the scientists. There is another important factor whereby the presence of a northern partner in an earlier joint publication might have led to a new joint study. Almost nine per cent collaborations have come up due to such joint publications.

Drivers for research collaboration

During our interviews we found the following drivers playing an important role in India-Brazil cooperation:

Common Challenges

Our interviews revealed that the most pervasive driver of India's South-South collaborations is the desire to work with other developing countries towards finding realistic solutions for common health threats. A good example of a common health threat between India and Brazil is HIV/AIDS. Most research in the world has been carried out on sub-type B of the HIV virus but in India and Brazil there is a heavier prevalence of sub-type C virus and as a result an impetus for India and Brazil to research that sub-type together. Shared health concerns are reflected in the prioritisation of India's governmental collaboration programmes with Brazil, where the focus seems to be heavily on communicable diseases. Under the Indo-Brazil Science Council (IBSC), the foreign ministers of India and Brazil, at their joint meeting in April, 2007 in New Delhi, have set forth prioritisation, with both India and Brazil

contributing USD 1 million each for joint research projects. Out of some 200 proposals, received in response to a call, nearly 20 projects are approved and majority are in the health technology sector. Both sides have identified malaria, leishmaniasis, HIV, tuberculosis, and leprosy as target diseases for joint research. Since leishmaniasis is a shared health problem between India and Brazil several groups in the two countries have focused on researching this health issue and they have joint publications on this topic. The strains of leishmaniasis are, however, quite different in the two countries which limits further potential for collaboration. The work in the area of HIV is in preliminary stage of joint research. These projects are being coordinated by the two governments, from Indian side it is the Department of Science and Technology and from Brazil it is the National Council for Scientific and Technological Development (CNPq).

India's collaborations with Brazil for dealing with common challenges also has regional context to it (Box1) for instance Cholera is a significant health problem in South Asia, particularly in Bangladesh and Eastern India, and as a result the two countries have collaborated on health biotech research on this health problem, such as the genome of Cholera. In fact this is one health concern in which researchers from Bangladesh, India and Brazil have developed informal research networks. As Bangladesh happens to have an international organization for advanced research viz., The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B, Dhaka) and the country is generally new to biotech research it is not altogether surprising that the Indian collaboration almost solely involves experts from this centre instead of domestic institutes.

Box 1. India-Brazil Cooperation and Its South Asian Context

The cooperation between India and Brazil has its regional linkages as well. The National Institute of Cholera and Enteric Diseases (Kolkata, India) and the International Centre for Diarrheal Diseases Research (Dhaka, Bangladesh) are internationally recognized centers of excellence in the field of diarrhoeal diseases. Diarrhoeal diseases are the second most common cause of death among young children in developing countries. The two institutions collaborate closely with each other and

Box 1 continued...

work with international partners in studying molecular pathogenesis of enteric disease agents such as *Escherichia coli*, *Vibrio cholerae*, *Shigella dysenteriae*, rotavirus strains. In addition to collaborating on world class academic research on tropical pathogens, they are also involved in developing locally relevant health technologies to serve their populations. *Helicobacter pylori* is a gastric pathogen implicated in gastric cancer and is prevalent in south Asian populations. In 2004, collaborating researchers from the Indian and Bangladeshi institutions, along with US scientists, developed a simple but novel multiplex PCR assay for rapid detection of *Helicobacter pylori* infection and virulence genes. As the assay does not require the culturing of strains, the pathogen genotypes can be obtained directly from gastric biopsy specimens. This can save time as well as expensive reagents and instrumentation which is a feature of particular value for laboratories in developing countries.

Our interviewees for this study stressed that complementary expertise was an important reason for their collaboration. As summarised by an Indian researcher: “The major reason to collaborate is complementing expertise and commonality in scientific thrust”. Together, scientists from both India and Brazil were said to be strengthening their ability to carry through with projects that otherwise might have stalled due to a lack of knowledge. In an example from the work between India and Brazil, one Indian scientist explains, “I was looking for a thermodynamic explanation, [while] the collaborator did work on hydrocarbons and [was] looking for applications, which I provided. He had a solution in search of an application, and I had an application in search of a solution, and we just matched [them]”. Our research did not necessarily indicate that India searched for specific health biotech knowledge from Brazil or vice versa but rather allowed each partner to draw upon their own specific strengths and experiences to contribute towards a common goal.

Access to samples

Another driver for collaboration is access to clinical samples or strains. This has led to the formation of several collaborations between the two countries, focused on the need to access these samples for research purposes. Regarding the collaboration between the Bose Institute (Kolkata) and Fiocruz (Rio de

Janeiro), a Brazilian interviewee explains: “Since there was no repository kept for strains or isolates, there was no way work related to identification of strains could be initiated in Brazil. Meanwhile, scientists in working in India on Cholera were exploring gene sequencing of various strains.... This led me to contact them for partnership”.

India has access to some genetic strains unavailable elsewhere and as such, it has become an attractive partner for other countries seeking to gain access to them. Brazil is also providing samples to Indian investigators in malaria research. The Amazon people of Brazil have resistance to malaria which is not found in India. Indian researchers are interested in knowing what strains in the body are different and can these be linked to the causes of the disease. Access to samples both of the parasites, as well as of the human population, to know the factors that are responsible for resistance is important for research. Malaria is yet another example of a shared health problem in India and Brazil that encourage collaboration.

Role of international meetings and publications

During our study, we came across several instances in which international meetings, publications and such other international opportunities for interaction played a key role in getting various researchers together to eventually launch joint research studies. It was interesting to find that a US university based initiative could get Indian and Brazilian scientists together to work on leishmaniasis. Later these two scientists continued to work together through their respective institutions and even promoted further exchange of researchers in the subsequent years and much detailed collaboration on genomics studies on leishmaniasis.

Challenges of the research collaborations

A challenge for India’s health biotech collaboration with Brazil seems to be the perception that collaboration with the North is much more valuable than South-South collaboration. In the health biotech field we would expect a heavier emphasis on collaboration with developed countries as there is more research taking place in the North than the South and the north possess more of the needed resources to conduct research in this field. Still some

of the comments seem to suggest an exaggerated emphasis on North-South collaboration. One Indian researcher stated, for example: “All Indians have Western fixation and so do the institutes made of them.” This sentiment also seems to be echoed by Brazilian researchers. In speaking with some of our interviewees, we found out that many of the South-South collaborations were spin-offs from previous studies led by the North. In other cases, a Northern party was involved in bringing the two Southern groups together on paper only, and the two groups from developing countries did not even have the chance to communicate with each other. Funding was also more accessible for collaboration with the North than the South. Joint research at times started between India and Brazil but could not continue due to lack of dedicated funding. For example, research on cholera between the Bose Institute (Kolkata, India) and Fiocruz (Rio de Janeiro, Brazil) was confined to couple of joint papers due to lack of resources.

Another challenge identified by our study was that new governmental initiatives to promote South-South collaboration did not seem to align well with existing South-South collaborations. An Indian researcher explained that new initiatives geared towards strengthening the South-South collaborations did not favour researchers that have a track record in carrying out collaborations with developing countries but rather more established researchers. Those established researchers generally have extensive research funding from developed countries and collaboration with Southern countries are in no way their priority.

A further challenge pointed out by our interviewees was lack of post doctoral fellowships. There are, for example, only a few fellowships planned as a part of the India-Brazil joint research programmes. Governments need to pay more attention to include fellowships, especially at the junior research level, as a part of their support programmes. Related to lack of fellowships was a lack of research networks that connected the countries we studied. The researchers in these countries don't generally seem to form an informal or formal network, or establish a trustworthy and comfortable relationship with one another. There are various reasons for this, such as language challenges and lack of direct airline flights, which make it difficult for researchers to travel to their collaborators' sites.

Impacts of the research collaborations

India-Brazil cooperation and medical biotechnology has a promising start with some very encouraging results in hand. However, in terms of precise product development there is much more to be desired. The collaboration for precise practical applicability of scientific advancement is an area which has moved further. For instance, the leishmaniasis kit, developed at Prof. Soccol's centre, was ready in 2003 and the technology was transferred to the Brazilian for Centre for Research in Immunological Products, CPPI, Parana State Government. However, nothing moved after that. Similarly, a tuberculosis diagnostic kit was also developed which also met with similar consequences. These kits have now been improvised for necessary adaptation for India. It is likely that CNPq would fund a joint team from CPPI and Jamanlal Bajaj Tropical Disease Research Centre (JBTDR) at Mahatma Gandhi Institute of Medical Sciences, Sevagram, India.

Product development

Research initiated in certain areas needs to be targeted towards innovation for product development. For instance, excellent papers have been published in the field of Cholera but it remained as a potential area, which could have explored further research for vaccine development. A new forum of scientists was formed in 2005, which was called the Association of *Vibrio* Biologists (AVIB). The main goals of the Association were to promote collaboration on *Vibrio* research and to disseminate information on the latest breakthroughs and insights through biannual meetings. Though Brazilian scientists and some Indian scientists were active in this forum, the concerted effort for product development really misses the mark. Professor Ana Paulo Vincente observes that in this context Northern countries should also be involved as they have made sufficient advances in molecular science which may eventually help in product development.³⁶

Product adaptation

In Brazil, significant improvement has been achieved in the area of diagnostic kit development at various national and regional institutions. India still needs to link up with these research groups, which have gone beyond the proof of concept so that the advances achieved may be translated into

commercial products. Apart from supporting and funding Indian research institutes, the DST would have to look at bringing in firms for facilitating wider availability of these kits at cost effective prices.

Table 4: Unit cost comparison for diagnostic kits

	India	Brazil
AIDS Diagnostic Kit		
- ELISA Produced by only one company	Rs. 108	Rs. 36
- RAPID Produced by three companies	Rs. 50	Rs. 17
Leishmaniasis	Rs. 180	Rs. 60

Source: Compiled by Author.

In Brazil, AIDS diagnostic kits and leishmaniasis diagnostic kits are available at a 60-70 per cent lesser price than in India (Table 4).³⁷ Adaptation of products developed in Brazil by local scientists but not commercialised so far require specific institutional mechanisms for establishing contacts between such scientists and the Indian private companies. During our discussion with Prof. V. T. Soccol, we came to know that Prof. Vanete has been working on developing diagnostic kits for leishmaniasis and tuberculosis as an assignment from the Parana State Government but once the product was ready the local government never thought of its commercialisation.

COLLABORATION IN ENTREPRENEURIAL ACTIVITIES

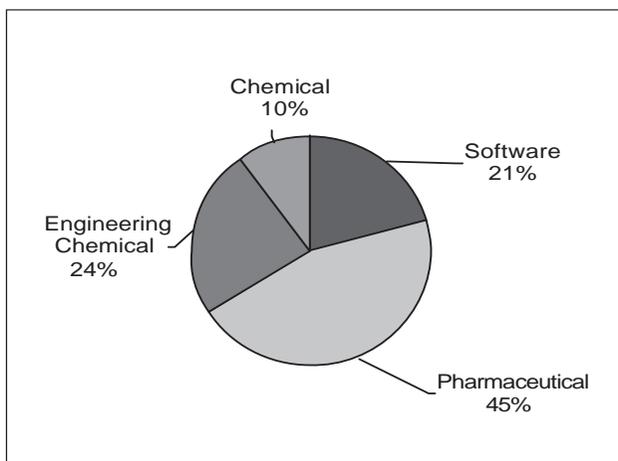
India's entrepreneurial collaboration in the health biotech field with Brazil also has turned out to be limited in scope. Our survey identified 22 entrepreneurial collaborations in the pharmaceutical sector between India and Brazil. The entry of Indian firms may easily be divided in to two distinct phases. The first phase is from 1994-99, when few firms entered in, without much preparation and had to face several challenges. According to an interviewee: "It was not until 1994 that linkages between Brazil and India began to take-off. Indian companies neglected Latin America completely and when they started in 1994 with Dr. Reddy's Laboratory, the strategy was not well suited to the Latin American markets."

A major turn around came in 1997 when the Brazilian Health Minister Jose Serra invited Indian generic companies to invest in Brazil and use Brazil as a production hub for pharmaceuticals rather than as a mere export destination.³⁸ The Indian investment in Brazil has multiplied in the recent years and has expanded to USD 470 million between 1996 and 2006.³⁹ A large chunk of this investment is led by Indian pharmaceutical companies. The facilitating factors as explained by an entrepreneur are as follows:

One of the catalytic factor was the promulgation of rules for generics, which were intended to debureaucratise the process as much as possible without altering the technical requirements that guarantee the effectiveness and security of the drugs – a responsibility entrusted with National Agency of Sanitary Vigilance (ANVISA).⁴⁰

Several leading generic companies responded and over the years, the number of companies present has multiplied to almost 22. As Figure 5 shows, the pharmaceutical sector occupies almost 45 per cent of the total Indian operations followed by engineering activities (24 per cent), software (21 per cent) and chemicals (10 per cent).⁴¹

Figure 5: Indian operations in Brazil by sector



Indian drug and pharmaceutical exports to Brazil were around USD 165 million in the fiscal year 2006-07. This is about three per cent of total pharma exports of USD 5.51 billion. In 2010, India's export of pharmaceutical products is likely to touch USD 800 million.⁴² There are several companies which are getting into the marketing of drugs developed through biotechnology. With a focus on the sales and marketing of biotech drugs, for oncology as well as plasma products, Intas Biopharmaceuticals Limited (IBPL) has launched three new sales divisions aimed at catering to solid tumours, haematology and supportive therapies, respectively. As is clear from Table 5 almost all the firms initially enter through marketing tie-ups and gain a foothold in production-related activities only after this.

Table 5: Leading Indian pharmaceutical companies in Brazil and their operations

Company	Brazilian Affiliate	Entry Year	Ownership (USD)	% of Interest	Activities
Aurobindo	AB Farma Quimica	2000	Subsidiary	99.80	M&M
Dr. Reddy's	Dr. Reddy's Farmaceutica do Brasil Aurantus Farmaceutica	1998	Subsidiary	100	Marketing
Glenmark	Glenmark Farmaceutica Laboratorios	1999	Subsidiary	100	Marketing
	Laboratories Klinger	2004	Took over for 5.2 million	-	Produces solid orals, semi-solids and liquid orals
	Uno-Ciclo	2005	Bought for 4.6 million		
Ipca	Ipca do Brasil	1999	Subsidiary	100	Marketing
Orchid Chemicals	-	1998	-	-	-
Ranbaxy	Ranbaxy Farmaceutica	1999	Subsidiary	80	M&M

Table 5 continued...

Table 5 continued...

Strides Arcolab	Strides Latina	2000	Subsidiary	100	Marketing
	Cellofarm Farmaceutica				
Torrent	Torrent do Brasil	2000	Subsidiary	100	Registration and Marketing
Unichem	Unichem Farmaceutica do Brasil	2002	Subsidiary	100	Registration and Marketing
Wockhardt	Wockhardt Farmaceutica do Brasil	2000	Subsidiary	100	Marketing
Zydus Cadila	Zydus Cadila	2000	Subsidiary	100	Marketing and Registration
	Quimica e Farmaceutica Nikkho do Brasil Ltda (Nikkho)	2006	Took over for 26 mn.		-
Claris Lifesciences	Clariss Produtos Farmaceutica Brazil Ltda	2002	Subsidiary	100	Marketing
Intas Pharma	Accord Health care Limited	-	Subsidiary	100	Marketing

Source: Compiled by the Author based on several sources including Sweet (2007); Pradhan (2008). www.glenmarkpharma.com; www.zyduscadila.com

Note: M&M = Marketing and Manufacturing; - = Unknown

The policy initiated by Brazilian Health Minister Jose Serra also had a negative response due to some of the major local pharmaceuticals companies that were probably not prepared for competition from other developing countries firms. They formed small cartels and gave submissions to ANVISA for tougher standards, particularly for government procurement, which gave a popular impression that ‘ANVISA has a dual policy one, for foreigners and one for locals’.⁴³ However, this impediment soon withered away as firms adopted standards very fast and quite a few Indian companies got clearance from ANVISA.

Initially, linkages were centred heavily on the importation of Indian health products into the Brazilian market. However, with specific

encouragement from the Brazilian Government in 1999, the firms were encouraged to take a long view and invest in Brazil. This had its impact. Ties gradually became deeper, and by 2002 the companies started investing in local production in a major way. In this phase, almost all the major Indian companies like Ranbaxy Laboratories, Strides Acrolab, Dr Reddy's Laboratories, Cadila Healthcare, Wockhardt Ltd, Orchid Chemicals & Pharmaceuticals, Torrent Pharma, Glenmark Pharmaceuticals, Unichem Laboratories, IPCA, etc. have already established subsidiaries for manufacturing or marketing in Brazil. Riche (2006) captures the strategic mistakes by Ranbaxy to demonstrate how tough the Brazilian market is. This was the time when Ranbaxy already had manufacturing units in more than seven countries, including in China, Ireland, Malaysia, Nigeria and the US. He says, "the Brazilian market is harsh, and international players can make mistakes, as did Ranbaxy of India. The company entered the Brazilian market in 2000 and was supposed to start operations at a USD10 million plant located in Rio de Janeiro by the end of 2005. Ranbaxy was expected to increase its product offering with its new plant and was already standing third in the generics market in Brazil in 2002. After five years, failing to start its plant, results are poor and sales dropped by 26 per cent in 2005. Since 2003, Ranbaxy has been losing shares for several national laboratories that increased their production capabilities exponentially and started producing generics against AIDS. Today, the company has a production line equal to half of that of its major competitors and its market share fell from 14 per cent to 4 per cent in about three years."⁴⁴

Their entry-strategies ranged from manufacturing plants to joint venture alliances to acquisitions and mergers. For example, the Indian company Glenmark acquired the Brazilian firm Laboratories Klinger in 2004, and set up a subsidiary in Brazil to capture that country's generics markets. Most of the Indian companies have their subsidiaries in Brazil. One of them, Cellofarm is among the fastest growing pharma companies in the generics space in Brazil. With two production units and a business of about USD 98 million, the company has a growth of almost over 30 per cent annually.

The budding India-Brazil linkages cover various high tech areas. Brazil, for example, has emerged as a major centre for organ transplants

that require immunosuppressants, which Indian companies like Biocon have readily supplied. Based on our interviewee data, the future collaborations in high tech areas are likely to be in areas such as oncology, particularly blood cancer. Intas Biopharmaceuticals is an example of a firm eyeing the opportunities of India-Brazil collaboration in oncology through its Brazilian subsidiary.

Reasons for the entrepreneurial collaborations

Our case study research showed that the India-Brazil linkages have been growing because of various reasons that include:

1. Access to markets: Tapping into the Brazilian and Latin American markets has been the main focus of Indian firms in this sector. This was supported by our survey which showed consensus between the Indian and Brazilian firms that access to the Brazilian markets was a reason for their collaborations. Aiding India's success in this has been its ability to provide high quality drugs and intermediates at very cost-effective prices. Our interviewee indicated that future phases of collaboration would be likely to include more R&D ties, but for now, the country seems highly focused on the importing and marketing as activities of the collaboration. It was also clear that the Indian firms set up subsidiaries or ties with Brazilian firms not just to access the Brazilian market but, more generally, Latin American markets.

2. Governmental push: As mentioned earlier, the major push to increase India-Brazil biopharmaceutical collaborations came in 1997 when the Brazilian Health Minister, Jose Serra, invited Indian companies to invest in Brazil and use Brazil as a production hub for pharmaceuticals, rather than a mere export destination. This was an attempt to increase Brazil's local pharmaceutical sector. In 2007, Brazil increased import duties on pharmaceutical products that made it difficult for Indian firms to rely solely on exporting their products to Brazil and pushed them to rather set up a Brazilian operation or collaboration.⁴⁵ The total Indian investment in Brazil has multiplied in recent years, and has expanded to USD 470 million between 1996 and 2006. A large share of this investment has been made by the Indian pharmaceutical companies. As described by one Indian entrepreneur: "One of the catalytic

factor[s] was the promulgation of rules for generics, which were intended to de-bureaucratise the process as much as possible”. Several leading generic companies responded and, with time, the number of companies present has multiplied. In our survey, we found that this number currently is around 22. Many of these companies have local partnership, which may help in building capacity of the local firms. In the generics market, India’s share is around 3.6 per cent of the total capital invested, which is much higher than Germany (1.8 per cent), US (1.1 per cent) and Canada (0.3 per cent).⁴⁶

3. *The role of expatriates:* Several Indian companies have been recruiting the Indian scientific diaspora from developed countries. Many of these individuals have experience working in firms in northern countries that have had close ties with emerging markets, such as multinational pharmaceutical firms, and are keen to establish ties with other emerging countries as a part of their work with Indian firms. Indian companies, such as Dr. Reddy’s Laboratory, Wockhardt, and others, are luring these Indian scientists in to head their R&D units. Interviewees suggest that this has brought a completely different approach to the entrepreneurial canvas. Firms are now more open to the unconventional markets of Latin America, and the experience of the Indian scientific diaspora can, therefore, be put to good use in establishing closer India-Brazil ties.

Challenges of the entrepreneurial collaborations

Our interviewees indicated that changes in the Brazilian regulatory system have posed the following challenges to India-Brazil collaboration.

Regulatory approvals

ANVISA, the Brazilian regulatory agency, adopted new bio-equivalence standards in 2003. The new regulation made it mandatory that contract research organizations undertaking bio-equivalence studies need to be approved and certified by ANVISA. These were applied across the board, including to products that had already been approved by the regulatory body. The new set of standards did not stop there – they also shortened the period of validity for registered products, and increased the registration fees for medical and pharmaceutical product imports. These changes have increased the financial burden on Indian companies and are far more time consuming.

In our interview with ANVISA, when we raised this point their response was that they have a defined time line and to make the process predictable and transparent they place all details on their site.

Delays in granting of patents

Delays in patenting in Brazil have also posed a challenge for India-Brazil collaborations. These delays were compounded in 2003 when a new requirement was made for all applications to be sent to, and approved by the Brazilian Patent Office, INPI, and ANVISA. There is a serious registration backlog within the Brazilian Patent and Trademark Office (INPI). According to recent INPI information, the backlog is estimated at 70,000 patents. The situation is even more negative in the case of pharmaceutical applications (close to 20,000 out of the total 70,000).⁴⁷ Pharmaceutical companies need to wait on average for eight years to get a patent in Brazil. The nature of the situation has caused great frustration among Indian entrepreneurs who are engaged in collaborations with Brazilian groups, but it needs to be appreciated that in Brazil the granting of pharmaceutical patents with the participation of the ANVISA is a part of a complex administrative act of the executive branch, which relies on the combined expertises of ANVISA and INPI and very often it is this coordination that takes a long time, particularly when both the agencies have severe crunch of trained staff.

Growing focus on locals

Though when compulsory license was instituted by President da Silva in May 2007 for Merck's efavirenz, the Indian firm Aurobindo was selected as the key supplier for the APIs but still several firms, whom we interviewed, expressed concerns about the growing urge, especially among the public sector agencies, to source drugs from local generic companies. As one of them said "Brazilian public sector has moved towards national restrictions for purchasing as is very clear from a growing discrimination from API purchases of Far Manguinhos." This is important in light of the fact that in the value terms the share of government purchases in overall drug market of nearly USD 14 billion is roughly 32 per cent. In our discussion with Far Manguinhos, it came out that some Asian API consignments were not of the quality expected hence change in policy.

Scope for cooperation with Brazilian public sector

A further challenge for the India-Brazil collaboration in health biotech has been difficulties in establishing collaboration between Indian firms and the public research institutions in Brazil. As the latter are the main performers of biotech research in the country, the lack of linkages has quenched the innovation potential of the collaborations. Indian companies have not been aware of the expertise within these centres, and vice versa.

Granting of visa

Most of our interviewees emphasised the problems they face in getting their staff from India, due to growing restrictions on visas for staff of the same company. In accordance with the 1997 bilateral arrangement between India and Brazil, Indian get visas valid for up to 5 (five) years, for business purposes, which allows for a period of stay in Brazil not exceeding ninety (90) days, renewable for an additional period of up to ninety (90) days, provided the total length of stay does not exceed one hundred and eighty (180) days per year, from first entry. However, when India raised this issue at the Trade Policy Review meeting with Brazil in 2009 at the WTO, India was informed that, “it is important to underline that in past few years, there has been a significant increase of the work permit authorizations issued to Indian citizens. For example, in 2006, 766 authorizations were granted, in 2007, 1292 authorizations were issued and in 2008, 1981 authorizations were granted.”⁴⁸

Impacts of the entrepreneurial collaborations

The main impacts of the India-Brazil collaborations are increased market access of Indian firms in Brazil as well as in other Latin American countries. The Brazilian pharmaceutical market has been growing in recent years and is forecast to increase by a 7.1 per cent average annual growth rate, reaching a value of USD18.3bn in 2012.⁴⁹ This steep growth rate has attracted firms from various countries, including developing countries, to Brazil and has led to their market expansion and increased economic revenues.

A significant impact of the India-Brazil health biotech collaboration has been increased availability of cost effective health products. Indian health biotech firms have proven ability in process innovation that has lowered the price of health products such as the Hepatitis B vaccine. Brazilian firms can also contribute cost effective health products to the Indian market. In Brazil, for example, AIDS and leishmaniasis diagnostic kits are available at prices 30-40 per cent less than the cost that they are in India. By using research collaboration between the two countries, there is the potential – and desire – to make these technologies available to the public in a way that would increase accessibility through affordability.

BY WAY OF CONCLUSION

The next few years will show if India, with the aggregate increase in the size of the economy and related economic clout, will contribute to a new dawn of South-South collaboration or would it further enhance the knowledge divide among the developing countries, much at the cost of Nehru’s cosmopolitanism which in all these years has emerged as key component of India’s foreign policy. Our study shows that India certainly values South-South collaboration and has the intention to increasingly invest in the collaboration with fellow developing countries. Both its bi-lateral and multi-lateral ties reflect renewed emphasis on collaboration with developing countries. There is a great scope for India to contribute to health biotech development in other countries and for all parties to gain mutual benefits provided other developing countries also see this and do not allow narrow nationalist agenda to prevail. In that context, India also has to put its money where its mouth is in order for the collaborations to gain more fillip and flourish. This requires line ministries and key agencies to genuinely attempt to “de-west” themselves and start looking for potential of South-South cooperation. In this context, it is the Department of Biotechnology (DBT), which should seriously absorb this message.

The case study research on India’s health biotech collaborations with Brazil has identified several important findings that highlight the potential for South-South collaboration and shed light on approaches to strengthen it. India emphasizes collaboration with developing countries for

political reasons as a way of becoming less reliant on the North. Recent years have seen renewed emphasis on India's South-South collaboration, for example, with the establishment of the IBSA programme. In the health biotech field, India's collaboration with advanced developing countries has expanded but the governmental emphasis on collaboration with rest of the developing countries conveys a message that is not in the tune with the wider foreign policy emphasis. There is need to enhance more joint research and development activities generally in science and technology and, more specifically, in health biotech with larger Third World.

As India's economy has strengthened in recent years, we have started to observe increased Indian contributions to capacity building in fellow developing countries. India has been strengthening its capacity in health biotech and has started to share it with other developing countries. These are welcome developments and reflect the powerful potential of South-South learning in the health biotech field. Still, the limited Indian research and development collaboration with developing countries shows how underutilized the South-South collaboration is as a tool for addressing joint health problems. We discussed fate of Cholera programme. As India's economy grows, and the country allocates increased funding for research, it should put increased emphasis on joint research and development with other developing countries to tap on complementarities for addressing global health challenges.

Almost all the India-Brazil entrepreneurial collaborations reviewed in this study are found to be focused on gaining market access for Indian firms in Brazil. This has led to increased revenues for Indian firms and at the same time also increased availability of affordable health products in the Brazilian market. Still, the collaboration so far has been rather one-sided and the Brazilian side has not contributed much to it, apart from their market. The Brazilian firms already have increasing share in local generics productions but Indian firms may further supplement each other's efforts on reengineering skills and new drug discovery skills.

As the Brazilian entrepreneurial activities in the health biotech sector are strengthened, they can contribute more fully to the collaboration and,

through it, gain access to the important Indian market. We have identified case for Brazilian investment in the area of diagnostic kits. There is a growing market in India and this may provide major support to Brazilian public sector companies active in this area. The collaboration between Indian firms and Brazilian public sector research institutions should be encouraged to tap on the expertise of the latter and capital of the former. But this partnership would not be sustainable on generics alone. Given the tough competition from the multinationals these two economies would have to explore other options. One of them could be reverting back to their rich base of biodiversity. Using it for drug development would be an excellent initiative. In this context the specific leads by the Brazilian companies in this filed, particularly Ache and Biositetica, offers possibilities for joint collaboration by the firms and public sector institutes. The joint position at the WTO, when both the countries together criticized the EU over the seizure of the Indian generic drug heading for Brazil and joint position on IP issues at the WTO and WIPO has also provided a fillip to the South-South cooperation for ensuring facilitating international regimes, when access to medicine is an issue.

**Appendix 1: List of organizations/research institutes
interviewed for the study**

Date	Name	Organisations/Research Institutes	City/Country
January 30, 2008	Dr. A. Mithal	Indraprastha Apollo Hospital	New Delhi, India
January 30, 2008	Prof. Rentala Madhubala,	Jawaharlal Nehru University	New Delhi, India
January 31, 2008	Dr. Purnima Rupal	Council of Scientific and Industrial Research (CSIR)	New Delhi, India
January 31, 2008	Dr. B. K. Ramprasad	Council of Scientific and Industrial Research (CSIR)	New Delhi, India
January 31, 2008	Dr. B. K. Jain	Department of Science and Technology (DST)	New Delhi, India
Feb 29, 2008	Prof. M. R. S. Rao	Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)	Bangalore, India
Feb 29, 2008	Dr. Namita Surolia	Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)	Bangalore, India
Feb 29, 2008	Dr. Udaykumar Ranga	Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)	Bangalore, India
Feb 29, 2008	Dr. P. Satishchandra	National Institute of Mental Health and Neuro Sciences (NIMHANS)	Bangalore, India
Feb 29, 2008	Dr. Sanjeev Jain	National Institute of Mental Health and Neuro Sciences (NIMHANS)	Bangalore, India
March 1, 2008	Dr. Ashok Pandey	Council of Scientific and Industrial Research (CSIR)	Thiruvanthapuram, India
March 1, 2008	Dr. V. V. Radhakrishnan	Sree Chitra Tirunal Institute for Medical Sciences and Technology	Thiruvananthapuram, Kerala, India

Appendix 1 continued...

April 9, 2008	Mr. S. S. Agarwal	Vivekanada Hospital	Lucknow, India
April 9, 2008	Dr. Ms. Neena Goyal	Central Drug Research Institute	Lucknow, India
April 9, 2008	Prof. S K Mishra	Sanjay Gandhi Post Graduate Institute of Medical Sciences	Lucknow, India
April 9, 2008	Dr. Gaurav Agarwal	Sanjay Gandhi Post Graduate Institute of Medical Sciences	Lucknow, India
January 24, 2008	Dr. Iddya Karunasaga,	Karnataka Veterinary, Animal & Fisheries Sciences University	Mangalore, India
January 25, 2008	Prof. V. Sitaramam	University of Pune	Pune, India
June 9, 2008	Dr. Carlos Morel	Fiocruz	Rio de Janeiro, Brazil
June 9, 2008	Dr. Akira Homma	Fiocruz	Rio de Janeiro, Brazil
June 9	Dr. M F Feitosa	Fiocruz	Rio de Janeiro, Brazil
June 9	Dr. ACP Vicente	Fiocruz	Rio de Janeiro, Brazil
June 9	Dr. F. Birjandi	Fiocruz	Rio de Janeiro, Brazil
June 9	Prof. Enrique Saravia	FGV / EBAPE	Rio de Janeiro, Brazil
June 12, 2008	Mr. Reinaldo Guimaraes	Ministry of Health	Brasilia, Brazil
June 12, 2008	Mr. Leandro Viegas	Ministry of Health	Brasilia, Brazil
June 12, 2008	Prof. Isaac Roitman	Ministry of Science and Technology	Brasilia, Brazil
June 13, 2008	Prof. Carlos Ricardo Soccol	Federal University of Parana	Curitiba, Brazil
June 13, 2008	Prof. Vanete Soccol	Departamento de Patologia Básica, Universidade Federal do Paraná	Curitiba, Brazil

Appendix 1 continued...

Appendix 1 continued...

June 13, 2008	Prof. Sandra Aparecida Furlan	UNIVILLE - Universidade da Região de Joinville	Curitiba, Brazil
September 24, 2008	Prof. G. B Nair	National Institute of cholera and Enteric Diseases (NICED)	Calcutta, India

Appendix 2: List of private enterprises interviewed for the study

Date	Name	Private Firms	City/Country
April 8, 2008	Mr. H. Balakrishna	Torrent Pharmaceuticals Ltd	Ahmedabad, India
April 8, 2008	Mr. Nayan Rao	Claris Lifesciences Ltd.	Ahmedabad, India
April 8, 2008	Mr. Binish Chudgar	Intas Pharmaceuticals Limited	Ahmedabad, India
April 8, 2008	Mr. P. R. Patel	Cadila Healthcare Ltd.	Ahmedabad, India
June 9	Mr. Amit Dave	Zydus Cadila	Sao Paulo, India
June 9	Mr. Madhusudhan	Cellofarm	Rio de Janerio, Brazil
June 16, 2008	Mr. R. L. Keshwani	Bilcare	Sao Paulo, Brazil
June 16, 2008	Mr. Pinaki Trivedi	UNICHEM	Sao Paulo, Brazil
June 16, 2008	Mr. Balaji C. Subramanian	Aurobindo Pharam Ltd	Sao Paulo, Brazil
June 16, 2008	Mr. Abhishek Banerjee	Glenmark Pharmaceuticals	Sao Paulo, Brazil
June 17, 2008	Mr. Alok Kapoor	Ranbaxy	Sao Paulo, Brazil

Appendix 3 :Developing country cooperation programme in select years at DBT

Year	Country	Level of Programme
1987-88	China	Exploratory delegation
	Indonesia	Exploratory delegation
	Vietnam	Exploratory delegation
1988-89	Cuba	Exploratory delegation

Appendix 3 continued...

Appendix 3 continued...

	Vietnam	Exploratory delegation
1991-92	Vietnam	Joint Rice research
	Brazil	Exploratory delegation
	Mongolia	Exploratory delegation
	Cuba	Exploratory delegation
1992-93	Cuba	Exploratory delegation
	Mongolia	Exploratory delegation
	China	Exploratory delegation
	Vietnam	Exploratory delegation
1993-94	China	<ul style="list-style-type: none"> · Identified areas for cooperation: Hepatitis A, B, C & E – diagnostics in vaccines · Development and evaluation of new methods of fertility control · Joint venture on production by recombinant DNA technology products like EGF, gamma and alpha interferon, interleukin-2 with high yield in bacterial and yeast systems
	Cuba	Exploratory delegation
	Vietnam	Exploratory delegation
1994-95	Sri Lanka	Exploratory delegation
1997-98	Sri Lanka	Ten joint research projects using recombinant DNA technology for plant genetic engineering
	Tunisia	<ul style="list-style-type: none"> - Provision for Post doctoral training - Project on biopesticides
2002-03	Brazil	MoU signed for collaboration in agriculture and medical biotechnology
	Sri Lanka	Project on treatment of waste water from textile units
	Sudan	Exploratory delegation
	ASEAN	<ul style="list-style-type: none"> - Capacity building for CLMV countries - India-ASEAN biotechnology network
2003-04	Nepal	Training on vermicomposting
	Vietnam	Project on plant genome
	Thailand	Exploratory delegation
	Syria	India helping Syria to establish Syrian biotechnology centre.
	Malaysia	Exploratory delegation
	South Africa	Exploratory delegation
2004-05	Sri Lanka	Filing of patents out of the project on waste water treatment
2005-06		No Developing Country mentioned

Appendix 3 continued...

2006-07		No Developing Country mentioned
2007-08		No Developing Country mentioned
2008-09		No Developing Country mentioned
2009-10		Not available
<i>Source:</i> DBT Annual Report (respective years).		

Endnotes

- 1 See Chaturvedi (2008) for further details.
- 2 Chaturvedi (2011).
- 3 Thorsteinsdóttir H., Kapoor A. K., Aly S. , Chaturvedi , S. *et al* (forthcoming).
- 4 IDB (2010).
- 5 Economic Survey (2010-11). Government of India, Ministry of Finance. February, Oxford Press, New Delhi.
- 6 IMF (2010).
- 7 Personal meeting with Cellofarm.
- 8 Chamas (2005).
- 9 Caliarí (2010).
- 10 See IDB (2010) for further details.
- 11 Ferrer, M., Thorsteinsdóttir, H., Quach, U., Singer, P. A. & Daar, A. S. (2004).
- 12 Thorsteinsdóttir, H., Daar, A. S., Singer, P. A. & Archambault, E. (2006).
- 13 WTO (2010).
- 14 Sweet *et. al* (2010).
- 15 *ibid.*
- 16 Fiuza and Barbara (2010).
- 17 Hasenclever *et. al.* (2008).
- 18 WTO (2009).
- 19 *ibid.*
- 20 Hasenclever *et. al.* (2008).
- 21 Between 1958 and 1972, 43 national companies were incorporated by foreign capital firms and removal of scientists from these companies which adversely affected the R&D linkage of the local Brazilian industry (Urias 2010).
- 22 Urias (2010).
- 23 Rezaie *et. al.* (2008).
- 24 Urias and Furtado (2009).
- 25 Thorsteinsdóttir *et al* (2006).
- 26 Chaturvedi (2008).
- 27 <http://itec.nic.in>
- 28 Parthasarathi, Ashok (2000).
- 29 <http://www.dst.gov.in>
- 30 <http://www.stic-dst.org>
- 31 <http://www.namstct.org/aboutnam.htm>
- 32 Parthasarathi, A. (2000).
- 33 <http://www.stic-dst.org>
- 34 Padma, T. V. (2005).
- 35 See Appendix 3 for details of various DBT initiatives.

36 Personal communication with Prof. Vicente June 9, 2008.
37 Personal communication with Dr. Udayakumar Ranga at Bangalore, February 29, 2008.
38 This process was further accelerated by the announcement from Jose Serra of breaking the
patent of the drug Nelfinavir used in the treatment of people with AIDS and thereby bringing
in compulsory licensing provisions in the Brazilian economy.
39 ibid
40 Personal communication with Mr. Madhusudan, June 9, 2008.
41 Sweet (2007).
42 Khorakiwala (2007).
43 Personal communication with one of the Indian firms in Sao Paulo.
44 Maxime (2006).
45 <http://www.business-standard.com/india/news/export-barriers-hit-pharma-firms/294713/>
46 Urias (2010).
47 WTO (2009).
48 WTO (2009).
49 www.researchandmarkets.com/reports/c85337

References

- Caliari Thiago and Ricardo Ruiz. 2010. Structure and Innovation in Pharmaceutical Industry in Brazil: The Impact of Generic Drugs, Paper presented at the DRUID_DIME Academy Winter 2010 PHDE Conference, Aalborg, Denmark.
- Chamas Claudia Ines. 2005. Developing Innovative Capacity in Brazil to Meet Health Needs, Oswaldo Cruz Institute, FIOCRUZ, Ministry of Health, Paper Prepared for CIPIH, WHO, Geneva
- Chaturvedi, Sachin. 2011. "Emerging Dynamics of Development Cooperation and Economic Partnership: Challenges and Policy Inferences for India" in Chaturvedi, Sachin; Thomas Fues and Elizabeth Sidiropoulos (eds.) *Development Cooperation and Emerging Powers: New Partners or Old Patterns*. London: Zed Books Publication, (Forthcoming)
- Chaturvedi, Sachin. 2005. "Dynamics of Biotechnology Research and Industry in India: Statistics, Perspectives and Key Policy Issues". *STI Working Paper 2005/6*, OECD, Paris.
- Chaturvedi, Sachin. 2008. "Emerging Patterns in Architecture for Management of Economic Assistance and Development Cooperation: Implications and Challenges for India." *RIS Discussion Paper #139*, New Delhi.
- Ferrer, M., Thorsteinsdóttir, H., Quach, U., Singer, P. A. & Daar, A. S. 2004. "The Scientific Muscle of Brazil's Health Biotechnology". *Nat. Biotechnol.* 22, 12.
- Fiuza Eduardo P. S. and Barbara Caballero. 2010. Estimation of Generic Drug Entry in Brazil Using count versus Ordered Models. Directorate of Industrial Studies and Policies, Innovation and Infrastructure, DISET/IPEA, Rio de Janeiro, Brazil, October

- Gupta B.M. and Mohinder Singh. 2004. "India's Collaboration with Latin America as Reflected in Co-Authored Papers." *DESIDOC Bulletin of Information Technology*, Vol. 24, No.3, May 2004, pp. 9-21
- Hasenclever Lia and Julia Paranhos. 2008. "The Development of the Pharmaceutical Industry in Brazil and India: Technological Capability and Industrial Development". Working Paper, ESOPE Network, University of Bordeaux, France.
- IDB. 2010. India: Latin America's Next Big Thing? Special Report on Integration and Trade, Inter-American Development Bank, Washington D.C.
- IMF. 2010. Larger Latin American Economies Recovering Faster than Expected. IMF Survey, October 8.
- Khorakiwala Habil. 2007. "Pharma keeps Indo-Brazilian Trade in Shape." *Financial Express*, August 07.
- Kumar, Nandini K. *et al.* 2004. "Indian Biotechnology--Rapidly Evolving and Industry Led". *Nature Biotechnology*. 22, DC31-DC36.
- MEA. 2005. *Bandung Meeting*. Ministry of External Affairs, Government of India, New Delhi.
- Maxime Riche. 2006. *Opportunities for UK Companies in Biopharmaceuticals and Biotechnology in Brazil: Brazil as a Strategic Partner for Generics and Vaccines*. UK: University of Cambridge.
- Padma, T. V. 2005. Asian Nations Plan Technological Cooperation.
- Parthasarathi, Ashok. 2000. "India's Experience with TCDC." *Cooperation South*.
- Pradhan, J.P., 2008. *Transnationalization of Indian Pharmaceutical SMEs*. New Delhi: Bookwell.
- Rezaie, R., Frew, S. E., Sammut S. M., Maliakkal M. R., Daar, A. S., Singer, P. A. 2008. "Brazilian Health Biotech--Fostering Crosstalk between Public and Private Sectors." *Nat Biotechnol* 26(6): 627-644.
- Riche, Maxime. 2006. Opportunities for UK Companies in Biopharmaceuticals and Biotechnology in Brazil - Brazil as a Strategic partner for Generics and Vaccines. UK Trade and Investment Board, London.
- RIS. 2008. *Trinity of the South: Potential of India-Brazil-South Africa (IBSA) Partnership*. Delhi: Academic Foundation.
- Shaw, H. W. (ed.) 2001. *International Development Cooperation – Selected Essays by H. W. Singer on Aid and the United Nations System*. Palgrave: NY.
- Sweet Cassandra and Andrea Laplane. 2010. The Latin American Pharmaceutical Sector, Presentation made at the ICTSD/UNCTAD meeting on Legal and Commercial Trends in the Post-TRIPs Environment, Buenos Aires, March.
- Sweet Cassandra M. 2007. Regulating the Tigers: The Institutional Dynamics of Indo-Brazilian Trade – Reflections from the Pharmaceutical Sector, ELSNIT Conference, Barcelona, October.
- Thorsteinsdottir, H., Daar, A. S., Singer, P. A. & Archambault, E. 2006. "Health Biotechnology Publishing Takes-off in Developing Countries". *Int. J. Biotechnol.* 8, 23-42.

- Thorsteinsdóttir H., Kapoor A. K., Aly S. , Chaturvedi , S. *et al.* “ Introduction” in H. Thorsteinsdóttir (ed) *Building Bridges: A Study on South-South Collaboration in Health Biotechnology*. IDRC & Academic Foundation . (Forthcoming).
- Urias, Eduardo. 2010. “Making Innovation Work for Society: Linking, Leveraging and Learning”. Paper presented at Globelics 2010, Kuala Lumpur, November 1-3.
- Urias, Eduardo and Joao Furtado. 2009. “Institutional Changes and Their Impacts on the Brazilian Pharmaceutical Industry: Is there an Innovation System on the Way?” Paper presented at Globelics 2009, Senegal, October 6-8.
- WHO. 2005. “Regional Strategic Framework for Elimination of Kala-azar from the South-East Asia Region (2005-2015)”. WHO Project No.: IND CRD 714, New Delhi.
- WTO. 2009. Trade Policy Review: Record of the Meeting, March 9th and 11th, WT/TPR/M/212/Add.1, 30 June, World Trade Organisation, Geneva
- WTO. 2010. “International Trade Statistics-2009”. World Trade Organization, Geneva.

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