INSTITUTIONALIZATION OF SCIENCE IN ASIA*

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The primary objectives in this paper are to highlight S&T disparities in Asia and help generate an appreciation of the urgent need there to build a "critical mass" of the most basic scientific and technological resources without which socioeconomic development cannot take place.

First a brief historical perspective on S&T in Asia is provided. Second, the role of S&T for socioeconomic development is highlighted. Third the notion of institutionalization of science is discussed using the leverage of basic S&T indicators in the developmental context. And finally, based on the empirical evidence, some general conclusions are drawn and recommendations made for the growth of modern S&T in Asia.

The focus throughout the paper is on the least developed Asian countries, but a larger comparative framework is used to dramatize certain main points. For this, data from Afghanistan, Bangladesh, Burma, China, India, Indonesia, Pakistan, and Sri Lanka are reflected against the data from a representative group of middle income countries. (Hong Kong, Republic of Korea and Singapore). Japan is used as an example of the most technologically advanced nation in Asia comparable in almost all respects to the advanced industrial societies in the Western hemisphere.

As the economic distribution in Asia indicates, the South Asian countries happen to be low income countries; most of East Asia is officially described as a middle income group, while Japan is the only Asian nation to qualify for the status of a high income country. This classification has been introduced to highlight the existing inequality in Asia as well as to suggest that S&T in the present analysis are appreciated as instruments of much needed socio-economic transformation rather than mere objects of cultural decoration and national pride. S&T have been used either interchangeably or together as one component of culture.

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HISTORICAL PERSPECTIVE

Science in certain parts of Asia flourished in antiquity. India, along with its next door neighbour, China, are noted to have developed institutions for higher learning in mathematics, alchemy, medicine, astronomy, philosophy and logic long before such institutions were developed elsewhere. Technological advances made in India and China travelled far and found widespread applications in different parts of the world. These intellectual, scientific and technological traditions suffered a setback during the past several hundred years due to many internal and external factors, such as feudal exploitation, political disharmony, religious dogma, and the spread of colonialism and imperialism in their midst. Modern science and education began to enter Asia in the 18th century through the European colonizers, traders and missionaries. Large parts of Asia were under the European hegemony for nearly 200 years. The institutional base for this development was, therefore, laid on the European pattern to serve the limited needs of the colonial masters and the colonized elites. The most important characteristics of the emerging institutions were their relatively small size, alienation from the grassroots and the mainstream, and an incapability to provide leadership and influence local and national affairs.

The second phase of modernization began in the wake of political freedom which came to the region in the late 1940s following the end of the Second World War. Science, technology and education were to play a major role in this modernization process. The basic strategy was to expand the infrastructure left behind by the Europeans, modernize it, shed its colonial past and commit it to national reconstruction. The record has been mixed. For instance, India was in the forefront of this new movement, enjoying a stable political structure and supportive leadership, an experienced bureaucracy and abundant natural and cultural resources, including a fairly large number of highly qualified people. Consequently, it ranks today as a major scientific and technological nation in Asia beside Japan and China. Similar developments also took place in Indonesia[1] and what was then called West Pakistan.[2] Others, like Bangladesh, beset by natural and political catastrophes; Afghanistan, Burma and Nepal handicapped by their geography and lack of basic resources for science, technology and development; and Sri Lanka hampered primarily by its small size and rigid social structure, could not fully participate in this Asian movement.

Three main elements characterize the development of S&T in most of Asia during this period: continuation of a centralized system of science, technology and education in the colonial mode; heavy involvement of government bureaucracy in these; separation of scientific research and education from economic activity, particularly the production apparatus. The developments in China occurred on somewhat different lines. Firstly, China was never fully colonized and its bureaucracy, therefore, retained a peculiarly Chinese rather than a Western flavour. Secondly, under a communist regime, a socialistic model of S&T began to emerge early in the post-revolutionary period. And thirdly, Chinese science was delinked from the international S&T system for nearly ten years during the Cultural Revolution (1966-77) and linked more closely with the internal mass movement and production for the masses. Despite many changes since the Cultural Revolution, S&T policy in China continues to lay heavy emphasis on the practical part and the production function of science rather than the development of S&T *per se*. [Editor's note: Professor Bi Dachuan's paper in Chapter 7 of this compendium will shed more light on the current status of S&T policy in the Peoples Republic of China.] The same can be said about Chinese education as well to set it apart from educational developments elsewhere in Asia.[3,4]

NEED FOR MODERN S&T IN ASIA

Tables 1 and 2 provide basic data related to the socio-economic situation, industry and trade in the selected Asian countries through a comparative perspective.

Table 1: **BASIC INDICATORS IN SELECTED ASIAN COUNTRIES**[9]

	Pop. (mil.)	Pop. Growth ('70-79)	GNP/Cap. (US $)	GNP Growth ('60-79)	Adult Lit.	Life Exp. at Birth	Infant Mort. (1000 b)	Safe Water Access	Daily Caloric Require.
LOW INCOME		(%)		(%)	(%)			(% Pop.)	(%)
Afghanistan	16	2.6	170	0.5	15	41	237	8	110
Bangladesh	92	3.0	90	-0.1	30	49	130	55	91
Burma	34	2.2	160	1.1	70	54	---	19	106
China	965	1.9	260	---	80	64	56	---	104
India	673	2.1	190	1.4	38	52	125	35	91
Indonesia	146	2.3	370	4.1	65	53	120	13	105
Pakistan	82	3.1	260	2.9	28	52	---	31	99
Sri Lanka	15	1.7	230	2.2	87	66	49	22	96
MIDDLE INCOME									
Hong Kong	5	2.6	3760	7.0	92	76	12	---	126
Rep. Korea	38	1.9	1480	7.1	95	63	37	71	119
Singapore	2	1.4	3830	7.4	---	71	13	100	134
HIGH INCOME									
Japan	117	1.1	8880	9.4	99	76	9	---	126

Table 2: INDUSTRIAL AND TRADE INDICATORS--1978-79
(US $ x 000,000)

	Val. Add. Mnfg.	Import	Export	Bal. of Payment	Interest. on Ext. Debt	Debt Svc. (% GNP)
LOW INCOME						
Afghanistan	---	686	494	---	4	1.4
Bangladesh	47	1537	662	-1269	41	-0.9
Burma	402	319	363	-328	31	1.8
China	---	17266	13987	---	---	---
India	15068	9041	6998	1395	375	0.8
Indonesia	3755	7225	15590	1711	772	4.5
Pakistan	1966	4056	2056	-984	213	2.3
Sri Lanka	644	1448	981	-203	28	2.3
MIDDLE INCOME						
Hong Kong	2629	17137	15156	-810	11	0.1
Rep. Korea	2220	20339	15055	-3216	937	4.4
Singapore	1815	17635	14233	-1091	86	2.5
HIGH INCOME						
Japan	190085	110670	103045	-8695	0	0.0

Barring a few notable exceptions, the low income countries are characterized by high population density, high population growth rate (2% and above), low per capita GNP (average U.S. $216), low GNP growth rate (from no growth to 4 percent maximum for Indonesia during 1960-79), very low to moderate levels of adult literacy, low life expectancy at birth (average 53 years), very high infant mortality (100+ per 1000 live births, except in China and Sri Lanka), large populations without access to safe drinking water, and less than the required daily per capita consumption of calories in many countries. All things considered, China and Sri Lanka seem to fare a lot better than others in terms of these basic socio-economic indicators.

In terms of industry and trade, manufacturing seems to be increasing at a moderate rate in India, Indonesia, Pakistan and Sri Lanka, but Afghanistan, Bangladesh and Burma are precariously placed. With the exception of Indonesia as an oil-exporting country, almost all the others in the low income group import a lot more than they export and have, therefore, accumulated huge balance of payment deficits which require large amounts for interest and debt service charges to the international financing institutions.[5] In more productive economies, such as those existing in parts of East Asia and Japan, it is easier to manage balance of payment problems and external debts caused by import of technology, raw materials, consumer goods, etc., because of the availability of large amounts of capital generated through local manufacturing and extensive international trade.

This brief analysis clearly suggests that S&T in large parts of Asia, along with other resources like capital and manpower, must be geared first and foremost toward meeting basic human needs of food, shelter, nutrition, health and education. This would obviously require the productive sector to give top priority to goods and services which are essential to satisfy these needs, and the R&D sector to identify these needs and associated problems and come up with scientific and technological formulas to resolve them. For example, food deficit countries need to modernize their agriculture rapidly through scientific and technological inputs appropriate to their social structure, land and climate. Agriculture is the backbone of Asian economy. But in almost every country in the region productivity gains in manufacturing have exceeded those in agriculture in a 2 to 1 ratio on the average due to national policies, even in those countries where the new agricultural technology has been widely and successfully applied, e.g. India and Pakistan. Productivity aside, it is common knowledge that developing countries lose significant quantities of food-stuff due to lack of proper transportation, storage and preservation (post-harvest) technologies. With due attention to these problems, such losses can be reduced considerably.

However, it would be naive to suggest that Asia does not need improved industrial technologies for local needs and international trade. For these, large numbers of options ranging from small-scale, rural technologies to the most advanced technologies, e.g. electronics and biotechnology must be pursued in view of their appropriateness to the purpose they are supposed to serve. For instance, a country like Afghanistan can benefit as much from improvements in its primitive leather and metalware technologies as from an improved system of communication based on electronics. In Nepal, where some useful work is currently under way on rural technologies at the Research Centre for Applied Science and Technology in Kathmandu, the need for large scale power generation and telecommunications is also urgent. These decisions can never be taken lightly though. Every technological intervention in the social and natural environment has some costs and some benefits. It is up to the policy makers to weigh these costs and benefits carefully and make appropriate choices.[6,7]

INSTITUTIONALIZATION OF S&T

An activity is considered institutionalized when it can proceed on its own momentum, when it becomes self-balancing and self-corrective, when people and institutions in society develop "vested interests" in its survival and sustenance, when it evolves a code of conduct, a value system of its own to which the participants willingly subscribe and derive some emotional as well as economic satisfaction from their participation. An institutionalized system of S&T must display these features or else it would neither be viable nor useful to society.

The extent to which S&T in society have been institutionalized is not easy to measure. Yet we do need certain quantitative measures to determine the nature and extent of national investment in the growth of S&T and arrive at some reasonable estimate of what has been done, and what remains to be done, to build the critical mass. Intangibles like momentum, quality, and cultural correlates of S&T are equally important but harder to measure. I am, therefore, inclined to estimate institutionalization of S&T in Asia through a simple head-count on the generally acceptable quantitative indicators like the following:

1. National investment on R&D and scientific and technical education
2. Number and size of institutions engaged in these activities
3. Number of scientists, engineers and technicians engaged in R&D, scientific and technical education, and production and services
4. Productivity levels of these professionals by way of publications, patents, etc.
5. Number and activity levels of professional associations
6. Enrollment in science and engineering education

In the present analysis, only some of these indicators have been used due to paucity of comparative data on the others. Although some of the data is old, it was the latest available at the time of compilation and from all indications remains fairly representative of the current comparative situation.

This methodology has been used in other contexts, but never exclusively for comparative purposes within Asia. It must also be qualified. For instance, such measures can only be suggestive and relative, not absolute. There are other more difficult quantifiable measures as well, such as the extent of linkages that scientific and technological efforts develop with other elements in society, like production, value systems, and human behaviour in general. The scientific and technological dimension may not be the only dimension of wisdom, knowledge, innovation, and creativity in society.

Tables 3 through 13 present a comparative estimate of S&T in a selected group of Asian countries. Table 3 indicates that Europe, North America and the USSR account for over 80 percent of the world R&D expenditure; Asia accounts for only 15 percent.

Table 3: **REGIONAL DISTRIBUTION OF R&D EXPENDITURE**[8]

	Percent (%) of Wld. Total ($207,801 mil. US)	Percent (%) of National GNP
REGION		
Europe	34.0	1.79
North America	32.5	2.18
USSR	15.6	4.67
Asia*	14.8	1.18
Latin America	1.4	0.53
Oceania	0.9	1.11
Arab States	0.5	0.27
Africa	0.3	0.36

*Japan's share in Asia is approximately 90%.

However, approximately 90 percent of the Asian expenditure is incurred in Japan, leaving only ten percent for the rest of Asia where India and China are the major spenders. As a percentage of their GNP, the Asian countries spend as little or as much as 0.2 to 0.7 percent on R&D, with the exception of China (1% of GNP) and Japan (2.4%). Science in South Asia is heavily funded by the government, as much as 100 percent in the case of Pakistan whose economy, otherwise, is not totally controlled by the government. In contrast, South Korea and Singapore seem to rely rather substantially on the private sector for R&D funds, suggesting that this sector plays a critical role in technology development there (Table 4).

Table 4: **R&D EXPENDITURE IN SELECTED ASIAN COUNTRIES**[8]

	Percent (%) of GNP	Percent (%) Fund. by Govt.	Percent (%) Fund.by Priv. Indst.
LOW INCOME			
India	0.6	86.2	13.8
Indonesia	0.6	---	---
Pakistan	0.2	100.0	---
Sri Lanka	0.2	53.5	44.2
MIDDLE INCOME			
Rep. Korea	0.7	41.5	56.4
Singapore	0.2	37.6	55.9
HIGH INCOME			
Japan	2.4	27.0	72.9

Ironically, expenditure on defense is fairly heavy (3 to 5% of GNP and 15 to 26% of government expenditure) in all the low income Asian countries, with the exception of Sri Lanka (Table 5). Generally, defense consumes more of their national budget than S&T, health and education put together. Pakistan offers the best example of this type of public policy.

Table 5: **DEFENSE AND SOCIAL EXPENDITURE, 1978**[9]

	Defense Expend. As percent of		Govt. Expend. (per cap. '75 US $)		
	GNP	Govt. Exp.	Defense	Education	Health
LOW INCOME					
Burma	3.7	26.3	5	2	1
China	4.8	15.1	9	6	---
India	2.8	18.7	4	---	---
Pakistan	5.3	31.4	10	1	1
Sri Lanka	0.7	1.9	2	8	5
MIDDLE INCOME					
Rep. Korea	6.3	38.0	49	21	2
Singapore	5.4	26.8	164	88	52
OECD COUNTRIES (Average)	3.0	9.0	262	206	191
OECD RANGE (from highest to lowest)		(US 21.0 Austria 3.1)	(US 375 Austria 67)	(Neth 520, FRG 21)	(FRG 433) Neth 19)

Public expenditure on education, like the expenditure on R&D, is generally low in the low income Asian countries, with the exception of India, Sri Lanka and Indonesia (2-3% of GNP). The middle income countries represented here spend a larger proportion of their national resources on education (3% of GNP and above). Japan spends close to six percent of its GNP on education which compares well with the amounts spent in advanced industrial societies in Europe and America (Table 6).

Table 6: **PUBLIC EXPENDITURE ON EDUCATION, 1980-81**[8]

	Percent (%) of GNP	Percent (%) of Govt. Exp.
LOW INCOME		
Afghanistan	1.8	8.8
Bangladesh	1.7	8.2
Burma (1977)	1.6	12.2
India	3.0	10.2
Indonesia	2.2	9.3
Pakistan	1.8	5.0
Sri Lanka	3.0	8.7
MIDDLE INCOME		
Hong Kong	3.0	14.6
Rep. Korea	3.4	---
Singapore	3.8	8.5
HIGH INCOME		
Japan	5.8	19.6

Field-wise distribution of enrolment in college and university education is depicted in Table 7, below.

Table 7: **ENROLLMENT IN COLLEGE AND UNIVERSITY EDUCATION**[8]

				Percentage of students in each field					
	Year	Total Students	Percent of Pop.	Natural Science	Engin.	Math & Comput.	Medic.	Agric.	Social Science
LOW INCOME									
Afghanistan	1978	21,118	0.3	7.5	20.2	---	13.3	9.1	51.6
Bangladesh	1980	240,181	0.3	40.6	1.5	2.2	3.5	1.6	23.5
Burma	1978	121,609	0.3	53.3	2.4	---	3.5	1.6	41.2
China	1981	1,295,047	0.1	6.0	33.6	28.2	12.4	7.2	---
India	1978	4,456,198	0.6	17.4	7.5	---	3.2	1.0	46.7
Indonesia	1978	296,326	0.2	3.3	11.0	---	5.3	6.6	56.1
Pakistan	1978	148,451	0.2	14.3	13.4	---	15.3	5.2	54.4
Sri Lanka	1978	17,485	0.1	12.2	19.6	---	9.7	3.3	57.5
MIDDLE INCOME									
Hong Kong	1981	63,971	1.3	4.4	32.2	2.6	2.8	---	6.1
Korea	1981	786,354	2.1	8.4	19.7	1.4	6.3	6.0	10.0
Singapore	1980	23,256	1.2	7.0	46.0	---	4.0	---	---
HIGH INCOME									
Japan	1980	2,412,117	2.1	1.9	16.4	0.6	5.6	2.5	32.7

The picture is highly mixed throughout Asia but China is an exception with clear emphasis on applied disciplines, such as engineering, mathematics and computer science, medicine, and agriculture. Medical and agricultural sciences seem to be the least popular subjects of study. Social sciences are generally the most popular.

Keeping in line with the pattern of R&D expenditure, 77 percent of the world's R&D scientists and engineers work in the USSR, Europe and North America; 18.5 percent work in Asia, over 70 percent of the Asian total in Japan alone (Table 8).

Table 8:: REGIONAL DISTRIBUTION OF R&D SCIENTISTS AND ENGINEERS[8]

REGION	Percent (%) of World Total (Approx. 4 Mil.)	No. per Mil. Pop.
USSR	36.6	5172
Europe	22.4	1743
North America	18.5	1862
Asia*	18.5	284
Latin America	1.8	287
Oceania	0.9	1502
Arab States	0.9	207
Africa	0.4	52

*Japan's share in Asia is over 70% of the Asian total.

The largest number of R&D scientists and engineers in the low and middle income Asia are located in India (approx. 60,000) and Indonesia (17,287). Chinese figures are not available, but we estimate the number to be equal to or slightly more than in India. The number of scientists and engineers in R&D per million of population is a better indicator of the extent of R&D in a society than the total numbers. As far as this measure goes, the low income Asian countries (except Indonesia) are very poorly staffed next to the situation in the middle income group and Japan (Table 9-a).

Table 9 (a): NUMBER OF SCIENTISTS AND ENGINEERS ENGAGED IN R&D[8]

	Number	No. per mil. Pop.
LOW INCOME		
Burma	1,720	57
India	60,000	89
Indonesia	17,287	115
Pakistan	5,144	61
Sri Lanka	604	43
MIDDLE INCOME		
Rep. Korea	20,718	536
Singapore	461	198
HIGH INCOME		
Japan	463,062	3,936

The picture looks pretty much the same for the number of physicians and nurses available to serve the people. China, once again, scores high with one physician per 1,160 people and one nurse to service a population of only 480, placing China well alongside the more advanced nations in Asia and elsewhere (Table 9-b).

Table 9(b): POPULATION PER PHYSICIAN AND NURSE--1977[9]

	Physician	Nurse
LOW INCOME		
Afghanistan	20,550	25,920
Bangladesh	8,780	56,880
Burma	5,120	6,120
China	1,160	480
India	3,620	6,430
Indonesia	13,640	8,850
Pakistan	3,760	9,980
Sri Lanka	6,750	2,050
MIDDLE INCOME		
Hong Kong	1,180	1,090
Rep. Korea	1,990	550
Singapore	1,250	380
HIGH INCOME		
Japan	850	290

Data in Tables 10 and 11 are interesting. India with 8,498 publishing scientists has 2.8 percent of the world's total; Japan has five percent.

Table 10: NUMBER OF PUBLISHING SCIENTISTS--1978[10]

	Number	Percent (%) of World Total
World Total	298,231	
LOW INCOME		
Afghanistan	4	---
Bangladesh	58	---
Burma	16	---
China	137	---
India	8,498	2.8
Indonesia	53	---
Pakistan	133	---
Sri Lanka	76	---
MIDDLE INCOME		
Hong Kong	0	---
Rep. Korea	85	---
Singapore	119	---
HIGH INCOME		
Japan	14,783	5.0

*Based on articles published in European languages and indexed in European and North American sources.

Table 11: COUNTRIES WHOSE AUTHORS PRODUCED 50 OR MORE SCIENTIFIC ARTICLES[11]

	No. Articles	Citations	Impact on World Science*
COUNTRY			
Japan**	15,569	64,160	4.1
India**	7,888	15,515	2.0
Singapore	139	305	2.2
Pakistan	111	197	1.8
Sri Lanka	58	123	2.1

*Based on average number of citations per article, 1973-78.
**Among the top 25 producers in the world.

No other Asian country has numbers significant enough to be counted as percentages of the world total. Obviously 92 percent of the publishing scientists are in Europe and North America. We are talking about scientists who publish in European languages, particularly English, French and German. Russian, Chinese and Japanese scientists generally publish in their own languages, with only marginal contributions to European-language journals. But even if these local publications are fully counted, the world picture would not change substantially. India's publication record in these sources is exceptional, being the only low income country among the top 25 producers of scientific articles in the world. However, when the number of citations per article is counted, the impact on world science of this "research superpower of the Third World" is not very high.[12]

India publishes the largest number of journals in Asia (7,542), larger than the numbers published in Japan (1,412), although the percentage of journals devoted to S&T subjects is significantly larger in the Republic of Korea (30% of the total), Japan (25%), and Afghanistan (21%) than India. Japan tops the list in book production (42,217 during 1980-81) followed by the Republic of Korea (25,747), China (22,920), and India (11,560). Interestingly, 45 percent of the small number of books published in Afghanistan in 1980-81 were in basic and applied sciences, more than the percentage in any other Asian country including China and Japan (Tables 12 and 13).

Table 12: **PERCENTAGE OF PROFESSIONAL JOURNALS DEDICATED TO SCIENCE AND TECHNOLOGY**[13]

	Year	No. Prof. Journals	Percent (%) for S&T
COUNTRY			
Afghanistan	1977	23	21.7
India	1975	7542	17.6
Sri Lanka	1977	432	16.0
Rep. Korea	1976	814	30.0
Japan	1977	1412	25.2

Table 13: **BOOK PRODUCTION BY SUBJECT, 1980-81**[8]

	Total	Basic and App. Sciences (%)	Soc. Sc. (%)	Others (%)
LOW INCOME				
Afghanistan	451	45.3	5.0	49.7
Bangladesh	542	15.1	18.0	66.9
China	22,920	25.5	17.0	57.5
India	11,562	14.0	34.2	51.8
Indonesia	1,836	23.6	25.3	51.1
Pakistan	1,279	6.8	18.7	74.5
Sri Lanka	2,352	9.6	54.7	35.7
MIDDLE INCOME				
Hong Kong	4,851	22.3	14.5	63.2
Rep. Korea	25,747	13.0	21.8	65.2
Singapore	1,783	12.1	34.3	53.6
HIGH INCOME				
Japan	42,217	21.0	18.0	61.0

According to reasonable estimates, India and China each have several thousand big and small institutions devoted to scientific research and education. Proportionate to their size, these numbers are substantially larger than the numbers found anywhere else in Asia, including Japan.

CONCLUSIONS

Several conclusions can be drawn from this brief analysis. For one thing, wide variations are visible in Asia in terms of socio-economic and S&T indicators. In terms of economy, industry and trade, most of South Asia can be classified as the least developed region in Asia. Some of the smaller East Asian nations seem to be doing relatively well, with high economic growth and well-developed manufacturing systems built through technology imports and geared toward export markets. In the low income group, China, India and Indonesia have built impressive manufacturing capabilities and engage in a good bit of international trade. China and Sri Lanka also score quite high on the Physical Quality of Life Index (PQLI), suggesting that nations need not necessarily be rich in order to live well if they choose to do so by diverting national resources, including S&T inputs, toward meeting basic human needs. On the other hand, economically poor and backward India is the world's tenth largest industrial nation, having one of the largest scientific and technological establishments and the third or fourth largest stocks of qualified scientists and engineers in the world, with advanced capabilities in nuclear and space technologies. China also enjoys many of these distinctions plus a good record of resource applications for social and economic development, suggesting that while S&T may be necessary, they do not in themselves constitute sufficient conditions for development by virtue of just being there. In Afghanistan, Indonesia, Bangladesh, Burma, Pakistan, Sri Lanka, (and apparently, Nepal) those necessary ingredients of social transformation, that is, S&T, remain relatively small, undeveloped, and not fully institutionalized.

There are many barriers to development in Asia, including the barriers against the development of S&T. Some of these barriers are purely economic and environmental, such as lack of capital and natural resources. Some are political barriers, such as lack of stability, honesty, and competence of political institutions and actors. Others are organizational and administrative barriers, such as the problems connected with the way developmental functions, including S&T and education, are organized and administered. Still others are social and cultural barriers, such as lack of skills and education among the common people, their attitudes and values. In the least developed countries of the region, all these barriers have combined to produce an unwelcome situation for the development of science, technology and society. S&T institutions and manpower in Asia should be built on two major considerations:

1. National needs, which first and foremost happen to be basic human needs

2. Natural endowments which means mobilization of existing resources and building further capabilities based upon them

Most of the Asian countries are endowed with large populations, fertile land, mineral reserves, forests and water resources, and a great deal of traditional and modern skills. Mobilization of these valuable resources is the primary responsibility of national, political and administrative machinery. A critical mass of scientific and technological capability for this purpose should be built using local expertise and borrowed know-how on favourable terms. The alternative would be continuing backwardness and dependency.

NOTES

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