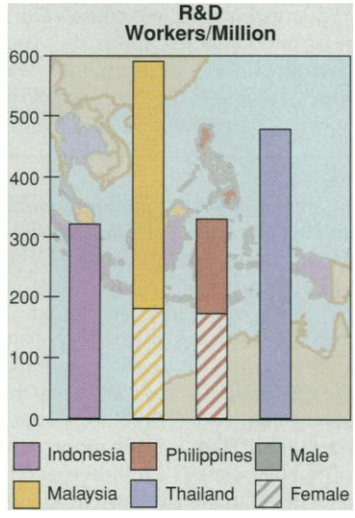
HUMAN RESOURCES

Strengthening Science: First You Need Trained Scientists

BANDUNG, INDONESIA—Indonesian geologist Duddy A.S. Ranawijaya studies the shallow floor of the Java Sea. Some 18,000 years ago, he wouldn't even have needed a boat to get there: The sea level was 125 meters lower then, and the basin was part of a landmass that connected the islands of Java and Borneo. Ranawijaya, a researcher at the Marine Geological Institute (MGI) here, hopes that the sedimentation cores he extracts will provide information about the composition of the ancient atmosphere that could shed light on the factors driving today's changing climate. But first he needs help from the French government.

"I'd like to go back to France" to get a Ph.D., he says, "because I need to learn a lot more about paleoclimate change." [Ranawijaya graduated from the Institute of Technology at Bandung (ITB) and joined MGI in 1992 before going abroad for his master's degree.] "But it's up to the [French] embassy to decide what fellowships it will offer, and the current [science and technology] counselor is less interested in the hard sciences." His plight is a common one for young scientists in Southeast Asia and the rest of the developing world, where educational opportunities are still limited. And the current economic crisis has made matters worse by making overseas training almost prohibitively expensive.

The economic downturn has also made it harder for the region's governments to continue pouring money into training scientists like Ranawijaya and making the best use of existing talent. In the past decade, they have aggressively pursued policies—ranging from improving primary school curricula to changing retirement practices—aimed at creating a critical mass of scientists and engineers to help compete in global markets and raise the standard of living at home. Although most policies have numerical goals attached to them, officials realize that the process may also require a shift in thinking. "I think there is a change in moods about the role of science, although it may take a decade or more to show up," says Teuku Jacob, a physical anthropologist and former rector of the University of Gadjah Mada in Yogyakarta, Indonesia. "Other countries are promoting basic science—in Japan, Korea, and Singapore, for example—and if we do not follow, we will fall behind."



Filling the pipeline. Each country wants more trained workers.

Devaluation and education. A quick way to educate a scientific elite is to send promising students overseas for training. But the recent plunge in the value of local currencies has suddenly increased the costs of that option. "Each year, we send about 600 people abroad for graduate training, at a cost of $30,000 a year" for each of them, says Mohammad Makin Ibnu Hadjar, secretary of the Board of Higher Education within Indonesia's Ministry of Education. "A master's degree takes 2 years, and a Ph.D. longer. For civil servants, the government pays all costs. While we don't want to stop sending them, we would like to train more people here. That would be good for our system of higher education, and it would also reduce costs."

Historically, Malaysia has been even more committed to sending its best students overseas, supporting some 15,000 to 20,000 a year in all fields and levels of higher education. But this year, in response to its currency deflation and the larger economic crisis, it will reduce the number of overseas government scholarships by 80%, saving money by educating students at home.

University administrators are worried about the effect of the new policy, even if it exempts those areas where sufficient local expertise is lacking. "Malaysia's quest for knowledge, skills, and expertise must transcend national boundaries," says Ghazally Ismail, deputy vice chancellor for research at the University of Malaysia at Sarawak (Unimas), which graduated its first class last year. "This is simply not possible if we are prevented from sending people abroad. I fear that Unimas will end up very insular in character."

The rest of the region is facing a similar dilemma. The Philippines' Department of Science and Technology, for example, last year began a program to send students overseas for advanced degrees. But recipients may need a special exemption to get around recently adopted cost-cutting restrictions on government-funded overseas travel. In Thailand, "the government barely has enough money to continue to support those [students] already overseas," says Pornchai Matangkasombut, dean of science at Mahidol University in Bangkok. However, he says that the university will "dip into its own cookie jar" if need be.


J. MERVIS

Setting sail. Marine geologists Duddy Ranawijaya, left, and Rina Zuraida hope to build research careers.

Rising enrollments. An alternative to educating students abroad is to beef up domestic universities and attract more students into higher education. Malaysia faces the biggest challenge: It has the lowest portion of its student-age population (age 19 to 24) enrolled in some type of higher education, a bare 3.5%. (Figures for the rest of the region range from 10% in Indonesia to 26% for the Philippines. By contrast, rates for European countries typically run from 30% to 50%, while the U.S. figure is 81%.) Under Malaysia's current 5-year development plan, the level of participation would rise to 5% by 2000. Government officials also hope that a majority—60%, compared with less than 40% at present—will decide to major in technical fields, although a new study by SRI International advises that such a ratio is neither achievable nor, in the long run, desirable, because it would shrink the eligible talent pool for other fields.

Other countries are also pursuing a variety of strategies to prime the talent pump for science and technology. Last year, the University of the Philippines at Diliman doubled the size of its freshman engineering class as one step in raising by half the nation's annual number of new engineering graduates. Emil Javier, president of the six-school University of the Philippines system, also sees this growing student body, and their parents, as a potent lobbying force. "That's the kind of thing our legislature will listen to," he says. In Indonesia, the government hopes to boost science

PROFILE

Making a Splash in Marine Science

MANILA, THE PHILIPPINES—Every new Ph.D. wants a challenge, but few get the kind of task handed to marine biologist Edgardo Gomez. Shortly after Gomez joined the University of the Philippines, Diliman, in 1974 after studying at the Scripps Institution of Oceanography in La Jolla, California, the school's vice president of academic affairs handed him a two-page charter for a new marine science center and told him to make it happen. "There was no space, no money, nothing," says Gomez, now 59. He set up labs in an abandoned botanic culture house and, as an early staffer recalls, "begged on his knees" for money to buy equipment.

ALBERTO GARCIA

Making it happen. Edgardo Gomez has built up marine lab from scratch by focusing on research.

The venture has come a long way since that inauspicious start. The Marine Science Institute (MSI) now has a 10,000-square-meter lab at Diliman, 100 staffers, and a research station on the South China Sea coast north of Manila. And its publication rate is the highest of any Philippine academic institute, averaging one international publication per faculty member per year. "He knows the science, and he has both the people skills and the political acumen to get the resources he needs," says Edward Murdy, a marine biologist at the U.S. National Science Foundation who worked at MSI in the late 1970s.

Gomez showed that savvy in 1995, when China built some observation structures on a few of the Spratly Islands, a group of coral reefs and rocky outcroppings in the South China Sea that are claimed by five nations, including the Philippines. Gomez used that territorial spat to gain government funding for a study of the links between the aquatic life on the reefs and the fisheries of the surrounding sea. "The most obvious thing that should be happening out there is marine scientific research," he told officials.

Those kinds of opportunities, he says, "provide an environment where [young researchers] can work." Helen Yap, for example, got her start at the institute in 1980 working on a coral reef study for her master's degree. At the time, says Yap, few department or institute heads in the Philippines could provide both a paying job and advanced training. And the institute preserved her slot when she went to Germany for her doctorate.

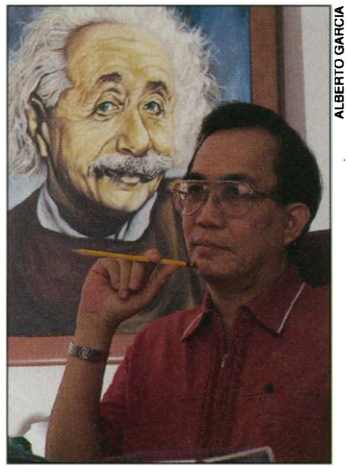
Gomez nearly missed his chance to start MSI. Unaware of the university's plans to start a marine science center, he was preparing to apply for an overseas postdoc until government sponsors urged him to come home. "In retrospect, [it's a] good thing that I did return," he says. "The planets and stars get aligned a certain way only once in a lifetime."

Scientists elsewhere have also benefited from that alignment. In the mid-1970s, Gomez and his team worked out a strategy to assess the condition of a coral reef, based on the percentage of cover that was living coral, that remains a major tool for coral reef assessment in the region. And William Newman, his thesis adviser at Scripps, credits Gomez for stimulating programs throughout the Pacific to rebuild giant clam stocks endangered by overfishing. "He's been a key person in getting that going," Newman says.

Gomez readily shares the spotlight with his staff. And he thinks they have only begun to make their mark. Tropical marine science is still a "wide-open field," he says. "If you have the right people with the right attitude, there is a lot you can do." –D.N.

and technology's share of undergraduates from a quarter to a third by 2000, as part of a near-doubling of overall enrollment in higher education in the next decade. Toward that end, it has opened 150 polytechnic institutions in the past 25 years.

Of course, the quality of that education is also a major concern. In Indonesia, nearly three-quarters of students in higher education attend private universities, which generally offer a less rigorous curriculum despite higher fees and better faculty salaries (see p. 1474). Officials in the Philippines are proud of the country's high rate of participation in tertiary education, but admit the level of instruction is uneven. "There are 100 engineering schools in the country graduating 20,000 engineers, but 90% of those would be only glorified technicians," says Roger Posadas, a physicist and the former head of the Diliman campus.



ALBERTO GARCIA

No quick solutions. Roger Posadas wants higher standards for teachers.

The problem starts with poor secondary-level instruction, Posadas notes, particularly in science. A recent survey found only 4% of high school physics teachers had taken university-level physics. And there are no quick solutions. In-service training "is just a Band-Aid. The right approach would be to require a B.S. in physics for teaching high school physics," he says. "Unless we raise the standards for teachers, we can never raise the standards of education."

Linking up with research. The World Bank is funding a cluster of programs in Indonesia and elsewhere to improve the links between education and research. One, called DUE (Development of Undergraduate Education), is aimed at 17 second-tier Indonesian universities, says Makin, while a second, called QUE (Quality in Undergraduate Education), "is trying to meet the same goal for the top tier of universities." The oldest program, URGE (Unifying Research and Graduate Education), is a 5-year, multifaceted effort to beef up graduate education.

In addition to offering small and large grants based on rigorous peer review, URGE provides young scientists with starter grants, pays a bonus to first-time authors for publishing in international journals, and encourages student participation in research. Although the program runs for another year, World Bank and Indonesian government officials are already hatching plans for a successor that's likely to combine successful elements from all three programs.

"We're trying to change the system," admits Chris Smith, an educational consultant in the World Bank's Jakarta office. "We want to give young faculty, often returning from

overseas, the incentive to stay at the university and to work with students, as well as to continue their contacts with overseas scientists. ... We also want to see the results of that improved training—a reduced time to degree for students, for example, or a shorter wait between graduation and employment."


J. MERVIS

Money matters. B.A.K. Khalid makes case for clinical research.

The Philippines is also in the midst of an $85 million program, funded by the World Bank, to upgrade facilities—from 110 new science lab buildings for selected high schools to new equipment for universities—and support more than 4000 science, engineering, and science education graduate students. And Thailand has stitched together support from several sources for a major reform of higher education that includes boosting science and engineering enrollments. The country has coupled a $143 million World Bank loan to equip science and engineering labs with a $14 million grant from Australia to improve its management practices and help to update curricula and teaching methods.

But even with more students receiving advanced training, governments face an uphill battle in convincing talented young people to pursue research careers. Indonesia's Ranawijaya confesses that his fellow ITB graduates "thought it was a mistake" for him to join MGI and instead went to work for mining and natural resources companies. Ruud Valyasevi, a researcher at Thailand's National Center for Genetic Engineering and Biotechnology, says that many of his university friends chose private-sector jobs because "they couldn't see a career path [for themselves] in science."

Administrators throughout the region have launched programs to lower the entry barriers for young researchers. Outstanding young Filipino scientists, for example, can compete for generous grants by making presentations to a committee of senior researchers. And the Thailand Research Fund, one of the country's major funding agencies, established a special category for postdoctoral-level researchers, says deputy director Vudhipong Techadamrongsin, after officials realized that its mainstream awards favored researchers with a long list of successful publications.

Gender equity. By most accounts, women planning to enter science face few hurdles, although some researchers say they have bumped against a glass ceiling on their way up the career ladder. For example, women make up two-thirds of the student body throughout the six universities of the University of the Philippines system, considered the country's top schools. And they head up five of the six programs at the Philippines' National Institute of Molecular Biology and Biotechnology (Biotech) in Los Baños.

Some suggest that Filipino culture actually steers women into intellectual areas, while men aim for more macho fields or at least higher paying positions in the private sector. Universities also provide free or subsidized housing for faculty families and schooling for faculty children near or on campus. "You can combine a career and household responsibilities without too much guilt," says Mariechel Navarro, a science communications specialist at Biotech.

Not every field is as open to women as the life sciences, however. "Men don't realize that women can work and think and do geology just as well as a man, and there is definitely still a bias against women doing fieldwork," says ITB petrologist Emmy Suparka. In 1988, she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Bias breaker. Emmy Suparka has pushed through gender boundaries.

was the first Indonesian woman to obtain a Ph.D. in geology, and in 1992 she became the country's first female chair of an academic geology department. Although she believes her country has an open attitude toward women—nearly half of the fellowships in one graduate-level training program go to women, for example—she admits that a gender bias exists within her discipline and throughout the university. "I found it difficult to advance professionally," she says. "Our faculty senate is still a bit old-fashioned."

Clinical neglect. Another traditional barrier to a research career—low salaries—has hurt efforts to build up clinical research programs. "I was the first M.D. to return to Malaysia with a Ph.D.," says Malaysian endocrinologist B.A.K. Khalid, who last fall was a co-recipient of the country's Scientist of the Year award. Khalid, a professor of medicine and director of the hospital at the National University of Malaysia (UKM), points to the disincentives for physicians to do science. "They would rather be cardiologists or surgeons because they can make more money that way," he says. "Who cares about compiling a résumé with 200 papers on it when you could have 2 million ringgit [US$500,000] in the bank?"

The 49-year-old Khalid, who returned to Malaysia in 1982 after extensive training in Australia, has been a pioneer in developing less expensive, domestic immunoassays for measuring basic metabolic functioning and for clinical use in the treatment of diabetes and other endocrine disorders. Last year, he stepped down as dean of the medical school, and he hopes within a few years to relinquish his other administrative duties and concentrate on clinical research. But the financial pressure to practice medicine is also strong. The father of three admits that he'd also like to have enough money to send his children overseas for the same high-quality education that he received. And he'll be at retirement age—55 in Malaysia—when his youngest is ready to go to university.

The end of the pipeline. Indeed, retirement policies play a big role in shaping a country's scientific infrastructure. To cope with a shortage of trained personnel in senior positions, Indonesia recently raised the retirement age for civil servants from 65 to 70. In contrast, Malaysia's policy is a holdover from British colonial days, when the goal was to ensure opportunities for younger workers. But faced with the same lack of experience in the upper ranks, the government in recent years has given those who want to remain a chance to apply for a 5-year extension.

For science administrators, the choice is a tough one. "The staff generally wants the retirement age to be increased, because they feel that they are still productive," says A. H. Zakri, a plant ecologist and UKM's deputy vice chancellor for academic affairs. "After all, 55 is a very young age, and retirement is a scary thought for many people. At the same time, [the current age limit] allows us to weed out the deadwood."

Retirement is a long way off for Ranawijaya. His goal is to be as productive as possible over the next quarter-century and to justify his decision to pursue a career in research. "One of my friends has a nice car, a nice house, and his salary is many times what I make," he admits. "But his time is not his own. For me, time means a chance to improve my knowledge, or write a paper, or supervise students. It's a question of motivation. I like to be able to explore a subject and to seek answers."

–Jeffrey Mervis and Dennis Normile