

THE FINANCING OF HYDROPOWER, IRRIGATION AND WATER SUPPLY INFRASTRUCTURE IN DEVELOPING COUNTRIES

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John Briscoe, Senior Water Advisor, The World Bank

Caveats and Qualifiers:

This paper is produced as an input into the UN Commission on Sustainable Development's assessment of the water sector. Surprisingly, I could find no recent, credible effort to cover this terrain, some parts of which are changing rapidly. There are formidable conceptual and data problems in attempting to compose a picture of the magnitudes, sources and trends in financing. There are glaring problems with data consistency and definition across countries and across sectors, and many problems of inappropriate inclusions and exclusions from the data. The approach taken in this paper was to make estimates from a variety of different perspectives -- macro estimates based on percentages of GDP; ratios between well-defined numbers, such as World Bank spending, and public spending; private flows from transactions data bases, and "bottoms-up" estimates based on country-level data for specific sectors, etc etc. To my considerable surprise (and even vague suspicion!), there was a remarkable degree of convergence in the aggregate sub-sectoral numbers which emerged!

This paper draws on a wide variety of sources. In many instances I have (shamelessly and often directly) appropriated the material of World Bank colleagues who have addressed specific parts of the problem. The most egregious cases involve the most useful and insightful work -- that of Greg Ingram and his team who produced the Bank's World Development Report on Infrastructure, and Barry Trembath and his internal and external collaborators in the hydro sector, and Mike Garn on the water and sanitation sector.

Even more so than usual, the standard qualifiers apply --the views represented in this paper are attributable solely to the author and are not necessarily the views of those who provided help (including Tor Ziegler and Monica Scatista), of the World Bank (for whom the author works) or the United Nations Commission on Sustainable Development (on whose behalf this paper was produced).

SUMMARY

This paper deals with the financing of major infrastructure in the water-related sectors -- hydropower, water supply and sanitation, irrigation, and overall water resources management (including the environment). The overall level of investment in water-related infrastructure in developing countries is of the order of \$65 billion annually, with the respective shares about \$15 billion for hydro, \$25 billion for water and sanitation and \$25 billion for irrigation and drainage.

These massive investments have been made because water infrastructure plays such a central role in economic and social well-being. It is simply not possible to imagine social and economic well-being without protecting people and property from floods and droughts; without cheap and accessible electricity; without clean and accessible water and adequate sanitation; and without the central contribution which irrigated agriculture makes to global food security. In addition to extending and maintaining this traditional infrastructure, it is also increasingly clear that there has been underinvestment for too long in maintaining the quality of the environment, both terrestrial and aquatic.

With rapid population growth and growing needs for flood protection, clean energy, food security, water and sanitation and environmental quality, there is no question about the need for improved water resource management and no question about the need for continuing large investments in water-related infrastructure. What is in question is what has been bought and how it has been paid for and supplied -- is the infrastructure that which best serves these needs? Are the limited resources used most efficiently? Are environmental impacts adequately addressed? And is it possible to develop a healthier balance between private and public financing, to produce the right services in the right way? This paper assesses these questions in light of current standard practice, and emerging best practice within the water business and in other infrastructure areas.

About 90% of investments in water-related infrastructure comes from domestic sources, and primarily from the public sector. Water-related infrastructure accounts for a large chunk -- about 15% -- of all ^{govt} movement spending. This heavy dependence on the public sector means that the global "winds of change" in perceived roles for government and in what constitutes legitimate government spending have major implications for the financing and structure of the water economy.

There is substantial variation in the culture of the different "water infrastructure industries" -- at one extreme there is a long history of relatively "business-like practices" in the hydro-electric industry; at the other extreme irrigation in most countries has been synonymous with a politicized grab for public subsidies, urban water supply typically falls somewhere in between. The industrial and financing structure for each sub-sector is quite specific, as is the prognosis (and the availability and quality of data).

At first glance, the hydropower industry would appear to face a rosy future in developing countries. Potential in developing countries is huge and only a small fraction (less than 10% in Asia, Latin America and Africa, versus about 70% in Europe and North America) has been tapped. The relatively simple technology is well-suited to operating conditions in many countries, and the technology has major environmental advantages in a "warming world". The dams constructed for hydro purposes also fulfill a number of other vital roles -- in ensuring the water supplies necessary for growing populations and the growing demand for food, in flood protection, etc. The hydropower industry however, faces huge challenges due to changes in the way in which energy supplies are financed, and due to concerns about the environmental and social impacts of dams. Financing of energy supply infrastructure is increasingly being turned over to the private sector. To private investors thermal power plants often look more attractive than hydro plants, for a variety of reasons. For thermal plants, project preparation is cheaper and more predictable, risks are more definable, limited and manageable, export credits provide a ready source of financing for these equipment-intensive plants, and pay-back periods are relatively short. For hydro plants the situation is quite different. The history of hydro construction is replete with the cost overruns and delays deriving, in part, from the public sector domination in this sector. More fundamentally, each and every plant has to be tailored to the particular hydrological, geological, environmental and social conditions; risks are substantial and not always best borne by a private party; financing from official development assistance, which has played a vital role in the

past, is "drying up"; there is well-organized opposition to many dams; and there are frequently substantial infrastructural and institutional costs in linking hydro supplies to their often-distant markets. Between 1990 and 1995, private sector investment in hydro accounted for only about 12% (an average of about \$1 billion annually) of private sector investment in the power sector in developing countries. The prognosis is that the private sector will invest in relatively small hydro plants where risks are low. But large plants are another story. Multilateral and bilateral financiers play a vital role, but appear to be withdrawing from the sector, partially because of the political pressures from those who oppose dams, partially because of the poor performance of many public-dominated hydropower projects and partially because of a (mistaken) view that this is an industry which can simply be turned over to the private sector and is thus "a sunset sector" for external support agencies. There would appear to be a major need for external support agencies to review their (implicit) position, and to formulate a new, more affirmative approach to partnerships with governments and the private sector in the hydropower industry.

The water supply and sanitation industry is also deeply affected by the changing economic paradigm. The sector has long been undergirded by publicly-financed, government-run utilities which have (with some important exceptions) performed poorly in terms of efficiency, quality of services, coverage and environmental impact. Recent years has witnessed a surge in private sector activity in the sector. Where the private sector has been engaged, the results have generally been encouraging -- accountability, efficiency, quality and coverage have improved markedly. As experience has accumulated, one consistent theme emerges -- this is not a sector from which the public sector can "withdraw". Just like hydropower, this should not be considered a "sunset industry" for the public sector (and external support agencies). Rather, the entrance of the private sector means that the public sector has a different, but still vital, complementary role to play, primarily in terms of regulation, but also in terms of financing. The stark reality is that, as currently structured in most developing countries, the water supply sector will attract little private capital. The sector is bedeviled by a long history of underpricing, and by a politicized debate about "basic needs" and the moral imperative of subsidies, by high capital intensity and therefore long payback periods and associated risk. Developments to date show that there are a variety of innovative ways of addressing these problems. But this experience also shows that this takes time, that it requires attention both to long-term vision and to transition processes. And, above all, it shows that it requires innovative new forms of public-private partnership if private expertise and financing are to be attracted into the sector. There is no doubt that the international community has a central role to play in this sector for many years -- in working with governments on developing better legal and regulatory frameworks, in helping to manage the difficult processes of transition from the "old model" to the "new model", and in both direct and indirect (via appropriately-structured guarantees) financing of water and sanitation infrastructure.

The irrigation and drainage sector is a composite of a broad set of different sub-sectors. Most visible are the surface irrigation schemes which have been publicly-financed throughout the world. In industrialized countries and developing countries alike, this is a classic "pork-barrel politics" sector. The results are broad and consistent. The positive effect is that irrigation has been the well-spring of the extraordinary era of food security (and associated low food prices, to the enormous benefit of the urban poor). The negatives, however, have become all too apparent throughout the world -- overbuilding and wasteful use of money, water, fertilizers and pesticides, with serious fiscal, economic and environmental impacts. There are manifest benefits of this system to three principal parties -- the bureaucracies, politicians and private beneficiaries, known as "the iron triangle" in the United States. Rent-seeking behavior is deeply embedded in the social and political fabric of all major irrigating countries and thus changes only slowly and usually because of major exogenous threats. That said, there has been striking change in recent years in a number of major irrigating parts of the world -- Australia, the United States, and much of Latin America -- driven by the idea of the market economy, and by the forces of fiscal austerity, environmental change and participative democracy. Where these forces have matured, the changes have been profound and "the impossible" has happened -- irrigation has become like any other utility, in which accountable agencies provide users the services the users want. In many instances, farmers have become responsible for the costs of operating and maintaining their systems, in some instances they are responsible for meeting the full costs of replacement, rehabilitation and new investments. Where these changes have taken place, there have not only been sharp swings in the relative proportion of private and public spending, but there have been dramatic improvements in the efficiency of investment and operation and, in most cases, major positive environmental impacts. The long-term future is clear; but getting there is not easy, and

is a process which has barely started in many of the major irrigation societies in the developing world. For these societies there is both bad news and good. The "bad news" for those looking to the past is that broader economic forces are going to make a return to "the good old days" of massive public funding impossible. The "good news" is that reforming irrigation systems throughout the world have shown that private investment (mostly farmers investing their own resources) can be mobilized, and that the results can, remarkably, mean better agriculture, better economy and a better environment.

In summary, the considerable heterogeneity in "the water sector" notwithstanding, there are a number of commonalities—all water sub-sectors (hydro, water and sanitation and irrigation) perform poorly from many perspectives (in terms of returns on investments, of service to customers, and impact on the environment) and all face imminent reductions in public spending and substantial difficulties in attracting private investment. A review of global experience, however, provides both a sense of hope, and a sense that only a few, small steps have been taken down the long and necessary road of reform. This paper describes some of these "beacons of light" — where governments have become partners with communities, businesses and investors in attracting private investment and in producing services accountably and efficiently. What is striking about all of these positive cases (drawn from all water sub-sectors) is that they have made much greater use of private actors and market forces; that issues of environmental quality have been central; and that government attention and capacity has been re-focused away from the direct provision of services, and towards the structuring of an enabling legal and regulatory framework. What is distressing is that movement towards this new approach has been so slow, patchy and uneven. The challenge to people in developing countries, their governments, investors and the private sector is clear. There are terrific examples of progress in all sectors, throughout the developing world. The vision of public-private partnerships which provide quality services to people and which respect the environment is not a utopian dream. But it does require courage and vision, most of all from governments in developing countries. And it requires that the multilateral and bilateral international financing agencies not shy away from the difficult issues involved, and not dream of greener pastures away from the infrastructure sectors, and not declare premature "sunssets" in sectors where they still have such a central role to play.

PART 1: THE CHANGING FACE OF INFRASTRUCTURE FINANCE IN DEVELOPING COUNTRIES

For decades the financing of water-related infrastructure was a sleepy backwater – the financing of hydro-power plants, water supply and irrigation systems all depended heavily on government financing. In recent years, the sweeping changes affecting most economies in the world – changing roles of government, increasing involvement of the private sector, globalization – have had a profound effect on how infrastructure is provided and financed. Since financing of water-related infrastructure is subject to all of the same currents, it is useful to set the stage by providing an overview of the changing face of infrastructure financing in developing countries.

Infrastructure is costly . . .

Even when efficiently provided, infrastructure is costly. About 20% of all investment in developing countries is for new and rehabilitated infrastructure (a total of about \$250 billion a year). Of this, about \$65 billion is for the financing of water sector infrastructure – hydropower (about \$15 billion), water and sanitation (about \$25 billion) and irrigation and drainage (about \$25 billion). All countries—especially those with rapid economic growth— have struggled to meet the infrastructure investment needed to support new economic activities

. . . and often performs poorly

Recent reviews show inefficiencies in the investment and operation of publicly-provided infrastructure services. In the water sector, for instance, half of water leaving a treatment plant is unaccounted for in most developing country cities. Worse, many people are unserved: more than one billion lack access to safe water and two billion to electricity or adequate sanitation. Unreliable services, lack of coverage, and sporadic maintenance reflect inefficiencies, unresponsiveness to demand, and poor management. The underlying causes are many and common: lack of managerial accountability, shortage of hard-budget constraints, and the absence of commercial practices in many public infrastructure agencies.

Most infrastructure financing comes from public domestic sources

Developing countries now spend around \$250 billion a year on infrastructure investment, with some 90% derived from government tax revenues or intermediated by governments. The burden on public finances is enormous, accounting, on average, for about one half of government spending for all infrastructure, and about 30% of this for water-related infrastructure. Governments have relied to varying degrees on foreign financing for infrastructure. Official development financing (including concessional and non-concessional funds from both multilateral and bilateral sources) has remained about constant in recent years, providing about 10% of total resources for investment in infrastructure.

Limitations of the present system:

The logic behind the present system is that in most countries the government is the most creditworthy entity and is able to borrow at the lowest rates, making possible infrastructure projects that might not otherwise be financially viable. Balanced against this advantage has been the difficulty of maintaining accountability, and consequent inflated costs and poor quality of service. Moreover, being creditworthy does not imply that governments have unlimited access to resources. Furthermore, where budgets have been tightened for macroeconomic reasons, the large share that infrastructure represents in government investment has led to proportionately sharper reductions in spending

There has been a dramatic shift in the relative roles of private and public flows to developing countries

As shown in Figure 1, in the 1990s there has been a dramatic shift in the relative roles of private and official capital flows to developing countries. While the current crisis in the East Asian economies makes it clear that there will be many ups and downs (most obviously in foreign private flows, but also in domestic private and public investments), the long-term prognosis remains one of major private financing of infrastructure.

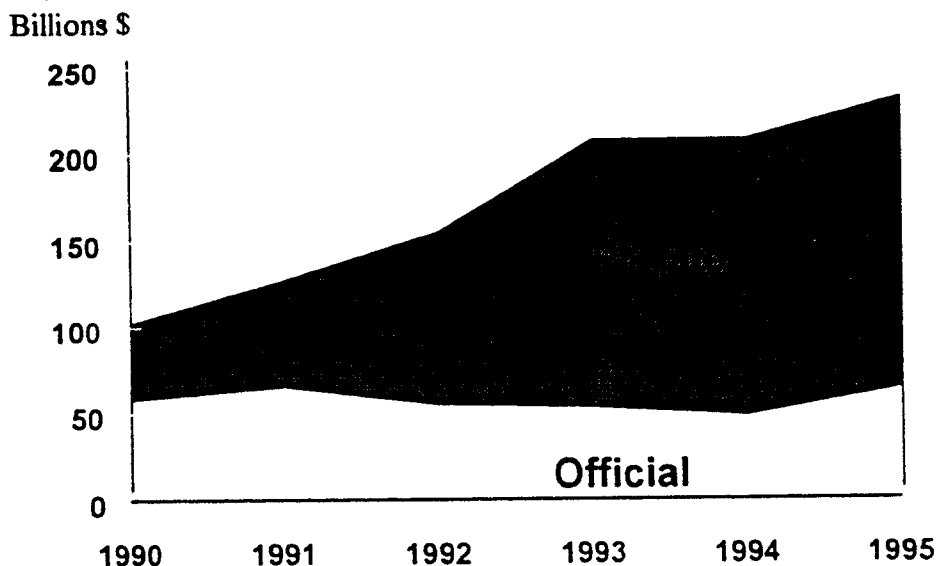


Figure 1: Private capital flows to developing countries have increased dramatically

Private involvement can improve performance and provide financing

The desire for greater efficiency and better service and the need for additional sources of finance have led many developing countries to turn to the private sector. Experience shows that having private providers compete in the market for customers improves service and increases coverage for a range of infrastructure services. A recent study of privatizations of eleven infrastructure enterprises found that divestiture was good for the economy as a whole and led to higher productivity and faster growth in all but one case. Gains stemmed from higher investment to serve unmet demand (the Chilean telephone company doubled its capacity in the four years after its sale), higher productivity from smaller workforces and better management (the Mexican phone company reduced its per-unit labor costs sharply), and prices that covered costs within the context of regulation. Where direct competition for customers is not possible, competition among firms for the right to serve the market is a strong incentive for efficient investment and operation. With the proper policy and regulatory framework, private investors will provide capital for new investment in many infrastructure sectors, reducing the demand for public funds and providing fiscal space for investments in public goods (such as sewage treatment, salinity control and other environmental improvements)

Recent trends in private involvement

One partial measure of global activity based on gross private international financial flows (bank loans, bonds, and portfolio equity, but excluding foreign direct investment) shows rapid growth in flows to infrastructure to developing countries up to 1993 and then a modest increase to \$27 billion in 1996 (Figure 2). Developing countries thus account for about a half of the global private infrastructure industry, a \$60 billion a year industry. The number of

infrastructure privatizations expanded tenfold from 6 in 1988 to 61 in 1992, and then increased to 85 in 1995. Revenues from these privatizations grew from \$800 million in 1988 to \$9.8 billion in 1992, the peak, and then flattened at \$9.4 billion in both 1994 and 1995.

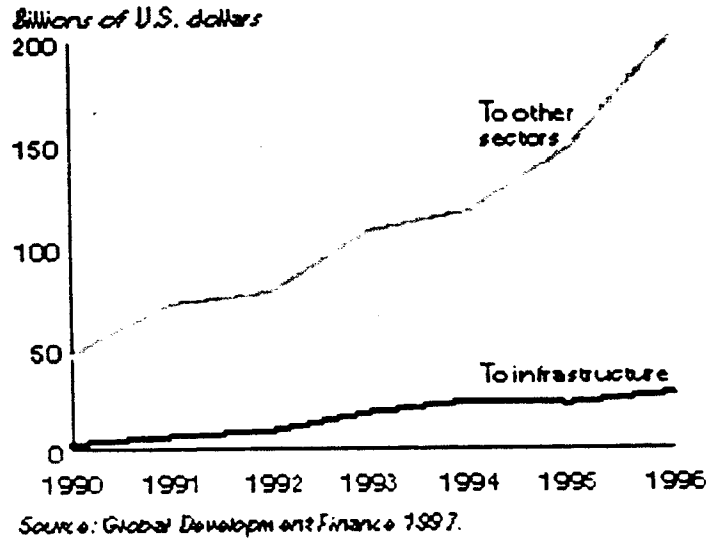


Figure 2 Private international financial flows to infrastructure have grown rapidly

Private participation varies by sector . . .

Private provision and financing of infrastructure in developing countries, essentially nonexistent a decade ago, has blossomed. This happened most (see Figure 3) in telecommunications—helped by technological change, few environmental spillovers, and a strong revenue base with some foreign exchange earnings. The power sector has seen more extensive use of concessions and build-operate-transfer arrangements, particularly for the construction and financing of generation plants. Concessions and BOTs (which bring investments) as well as leases and management contracts (which bring only private management skills) are now expanding in water supply, ports, airports, and highways.

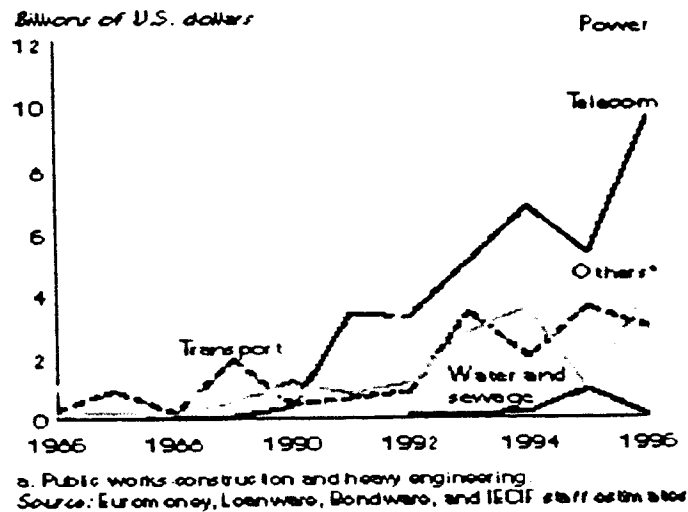


Figure 3: Private investment in different infrastructure in developing countries

... but is broadening

Private activity in infrastructure, previously concentrated in East Asia and Latin America, is now expanding in Eastern Europe and Central Asia, South Asia, and Sub-Saharan Africa (Figure 4). In Latin America, however, countries are privatizing infrastructure enterprises to a much greater extent than are East Asian countries, which tend to rely more on concessions and leases. Private investment also varies with country income and is concentrated in a few countries. Information on net private international flows (including foreign direct investment) to all sectors illustrates this pattern. About three-quarters of net private flows go to middle-income developing. The concentration of financial flows is being diluted as other countries develop attractive environments for private participation. The top twelve recipients of international flows from 1990 through 1996 (the ten top middle-income countries plus India and China) received 80 percent of net flows in 1990 and 71 percent in 1996. Net private flows per capita in 1996 reflect differences in country income level and country policy environments. The top ten middle-income countries receive roughly twice as much per capita as other middle-income countries; India and China receive roughly three times as much per capita as other low-income countries.

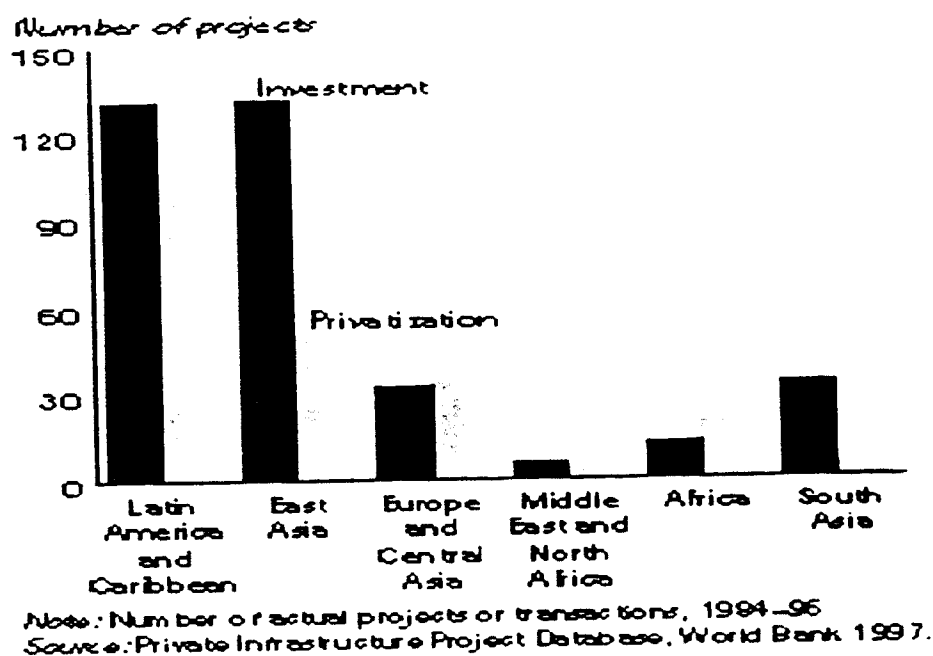


Figure 4: The number of private investment projects and privatizations varies widely by region

The financing mix is changing.

Bank loans predominated through 1990, when both bond financing and portfolio equity flows began to grow (Figure 5). Bond and portfolio equity financing have now emerged as major components of infrastructure finance. Roughly two-thirds of infra-structure bond finance has been issued by Latin American enterprises, much by privatized infrastructure corporations. Thus corporate finance (both bond and equity) is increasing relative to project finance. The sectoral composition of financial flows to infrastructure has also been shifting (Figure 3) Power and transport predominated in the late 1980s; telecommunication began to grow after 1990. Now power and telecommunications absorb three-fourths of private international financial flows to infrastructure. Inadequate availability of long-term debt finance continues to delay many projects, and infrastructure financing must be used to foster the development of domestic capital markets (as it did in industrialized countries)

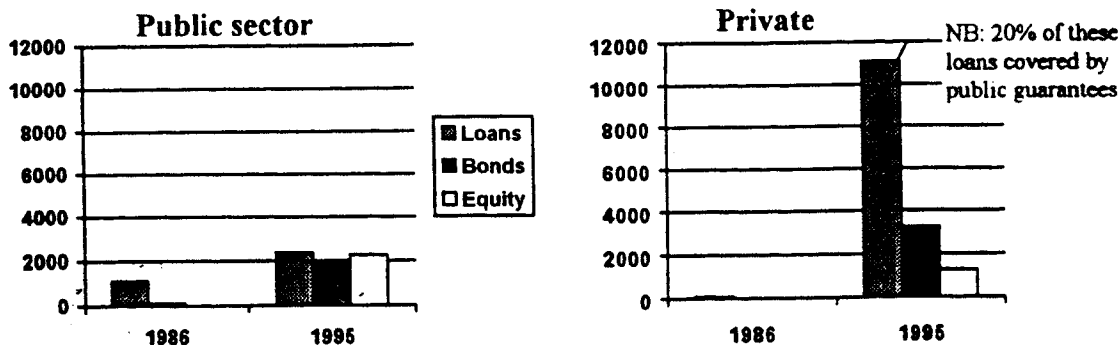


Figure 5: Infrastructure financing raised by developing countries by type of borrower and instrument

The supply side is changing, too

The private infrastructure industry has grown rapidly and become global over the past fifteen years, attracting over 2,000 major companies. The most successful companies have benefited from experience with deregulation and privatization in their home markets and established reputations for expertise within a sector or region—which has helped them increase their market share. Current estimates indicate that the top 20 companies participate in almost one third of all infrastructure projects. Many companies have broadened their scope. Equipment supply companies, engineering companies, and contractors have become project developers, offering financing packages along with their technical expertise.

As the markets mature, the players are changing. The water supply business, for example, was long dominated by a few French companies. While they still play a major role, the privatized British water industry now competes, as increasingly do utilities from Spain, Germany and other European countries. Equally important, there is now evidence of the emergence of domestic private operators in countries such as Brazil and Chile, often lead by large construction companies.

Private infrastructure investment can grow much more

In 1996, private investment accounted for about 15 percent of all investment in infrastructure in developing countries. This is both a lot and a little. Across countries the private share of infrastructure investment varies from less than 10 percent to over 70 per cent (Box 1). As a result of policy choices and budgetary decisions the range will continue to be wide in both developing and industrial countries. But the average for developing countries could easily approach a third. So there is plenty of scope to increase the existing private investment share and to reap substantial benefits from private participation.

And the future will surely not be like the present....

A striking feature of the above picture is the rapid change in virtually every dimension -- in the amount of private investment, in the countries and sectors it goes to, and in the forms in which it becomes available. It is certain that the rapidly-changing economic situation in East Asia will give rise to further substantial changes. What does seem certain, such volatility notwithstanding, is that the fundamental factors underlying the expanded role of the private sector -- the need for services, the inability of governments to finance these, the greater accountability of privately-financed and provided services -- are here to stay.

Box 1: How extensive is private investment in infrastructure?

Private investment in infrastructure varies considerably across countries—even among the most industrialized OECD nations (see Table 1 below). The wide range of private interests (from 9 percent to 76 percent) indicates that countries are at very different points on the path to private involvement in infrastructure. Private investment is concentrated in the telecommunication and power sectors. Countries with the highest shares of private investment in infrastructure have managed to widen private investment to include transport and water and sanitation. For example, England and Wales fully privatized the assets and operations of its ten regional water boards in 1989. But the broadening of private investment from telecom and power to transport and water and sanitation normally includes increased involvement with state and local governments. In the United States and Germany state and local governments carry the lion's share of public investments for transportation and water/sewerage infrastructure. In France almost half the public investment in water is from state and local authorities, while in Hungary, municipalities are increasingly responsible for infrastructure services (particularly in urban areas). Shrinking public budgets will force local governments to seek private financing, providing a strong case for improved municipal financing instruments and opportunities. Developing countries can raise private investment in infrastructure from the current 10–15 percent to 25–35 percent of the total by allowing substantial private participation in telecommunications and power generation alone. Hungary, Chile, the Philippines, and others have already seen extensive private investment in both telecommunications and power generation. With some privatization in transport (usually railroads, airports, ports, and toll roads) or water supply, developing countries could reach an average level of 40–50 percent.

	Telecom	Power	Transport	Water/sewer	Weighted private share
OECD-high income countries					
France	0	0	10	36	13
Germany	0	67	0	20	9
Japan	35	96	3	0	14
Netherlands	100	23	8	54	46
United Kingdom	100	100	21	100	71
United States	100	81	13	22	47
Middle- and low income countries					
Chile	100	99	7	4	54
Cote d'Ivoire	0	30	0	25	10
Hungary	98	100	53	0	76
Philippines	87	49	25	0	42
Thailand	31	30	20	0	17
Average	59	61	15	24	36

Source: World Bank staff estimates 1997

Table 1: Private investment in infrastructure, in selected countries as % of total infrastructure investment

PART 2: AN OVERVIEW OF THE FINANCING OF WATER-RELATED INFRASTRUCTURE

Investments in this sector are very large....

It is not a simple task to estimate the overall levels of investment in different water-related infrastructure sectors. There are glaring problems with data consistency and definition across countries and across sectors, and many problems of inappropriate inclusions and exclusions from the data. The approach taken in this paper was to "let a thousand flowers bloom" -- to make estimates from a variety of different directions, including macro estimates based on percentages of GDP; ratios between well-defined numbers, such as World Bank spending and public spending; reviews of private sector transactions data bases; making "bottoms-up" estimates based on country-level data for specific sectors; etc. etc. There was a surprising degree of convergence in the global numbers which emerged, suggesting that the overall level of spending on water-related infrastructure in developing countries amounts to about

\$65 billion a year, with hydropower accounting for about \$15 billion, water and sanitation about \$25 billion, and irrigation and drainage about \$25 billion.

The domestic/external mix for water-related infrastructure is broadly consistent with the overall infrastructure financing pattern described earlier – about 90% of investment is from domestic sources and 10% from external sources. The World Bank, which provides about 50% of this external funding, typically provides about half of the funding for projects it is involved in. The Bank's current portfolio of water-related investments provides about \$20 billion for projects costing a total of about \$50 billion. The World Bank's contribution to current water projects, by sub-sector, is presented in Figure 6. Figure 7 shows how the World Bank's investments in water-related infrastructure have changed in recent years.

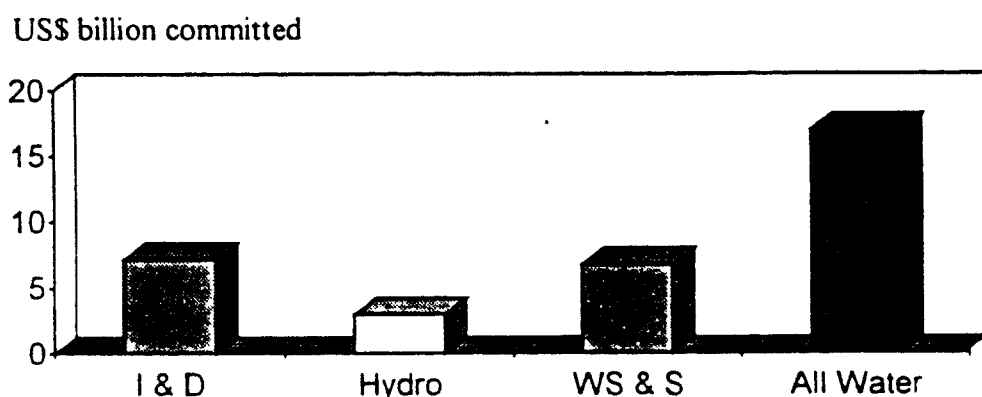


Figure 6. The World Bank's Water Infrastructure Portfolio

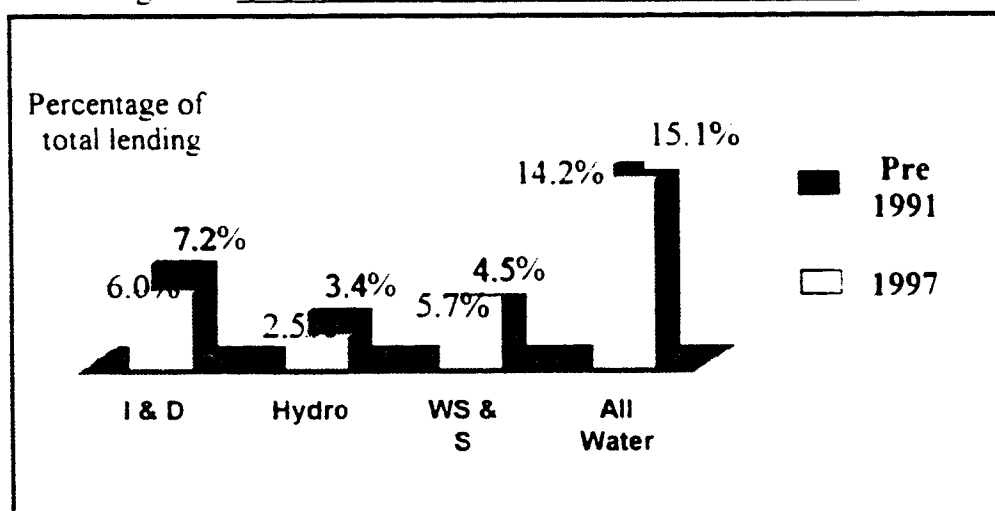


Figure 7: How the World Bank's Water Infrastructure Portfolio is changing

The context is changing rapidly...

In recent years the water-related infrastructure business has been subject to the wave of changes affecting all of infrastructure financing. In some cases this has simply been that the same forces have affected water infrastructure; in other cases major technological changes in other parts of an industry have changed the competitive position (and financing prospects) of a water-related sub-sector. Hydropower is the most dramatic example, where associated technical and institutional changes have been profound. Technical advances in natural gas turbines have opened a field which is attractive to investors. Coupled with deregulation and the emergence of competitive electricity markets, this has meant that investments in long-return, risky hydropower have become less attractive. Concomitant with these

sweeping changes in the role of government have been equally broad concerns about the environment -- in some cases (such as hydropower) making financing more difficult to attract; in other cases (such as sewage treatment) leading to substantially increased levels of investment.

The "water infrastructure sector" comprises quite different sub-sectoral "cultures"...

Before examining the financing trends in each of the major water-related infrastructure sectors (as is done in the following sections) it is also important to note that there are sharply differing "cultures" in each of these infrastructure sectors.

- The power sector is "business-like" (and increasingly so as competitive forces become widespread), with rapid technological change, complex financial engineering and a lot of financial information available.
- Surface irrigation is the classic government-driven public works and rent-seeking operation. The public irrigation sector is characterized by simple financial arrangements, without much demand for, and consequently poor-quality, information;
- Groundwater irrigation is usually "out of sight" in the informal, small-scale private sector. There are some dynamic and modern elements, with changed technology playing an important role in recent decades. The financing arrangements are generally simple and often informal.
- Water and sanitation is historically dominated by public sector financiers and providers. But partial commercialization has meant that it is somewhere in between hydro and irrigation on this spectrum (in terms of "business-like-ness", financing complexity and quality of information available)

PART 3: THE FINANCING OF HYDROPOWER

Participating in the electricity economy is fundamental for the poor...

Increases in the quantity and efficiency of energy used is a sine qua non of development. Electricity, in particular, has a critical role in improving efficiency not only of energy use, but of capital, labor and natural resources. There is a clear relationship between energy and human capacity and an inevitable corollary -- the availability of abundant electricity is a fundamental for development.

The poor pay more for useful energy:

The lives of the poor are unlikely to improve unless they participate in the modern energy economy. Poor urban households in developing countries spend a significant proportion of their limited cash incomes on energy -- often as much as 15 to 22%. The poor often pay higher prices for energy than more wealthy households. This is partly the result of both the heat content of the fuels used and the conversion efficiencies of the technologies used to produce useful energy. Appliances fueled by wood, charcoal, and kerosene are often very inefficient. Conversely, appliances designed for electricity or LPG, purchased mainly by wealthier households, use energy more efficiently. A few examples illustrate the general situation: In the Philippines, where energy prices generally reflect economic costs, the urban poor pay US\$1.80 per kilogram of oil equivalent (KGOE) for their cooking needs, whereas the rich pay only US\$0.70 per mainly because the poor use woodfuels and the rich use LPG. In Cape Verde, the poorest households pay about US\$1.40 per kilolumen hour, compared with US\$0.80 paid by the highest income groups.

Subsidized services do not work, but efficient, commercially-based services do meet the needs of the poor.

Attempts to make energy services more accessible and affordable to the urban poor by targeting subsidies for certain fuels have largely failed, resulting in restricted access by the poor and diversion of subsidies to other economic groups. Furthermore, the benefits of taxing modern fuels to conserve energy, raise government revenues, and lower foreign exchange expenditures are often offset by the indirect harm that they cause the urban poor.

This does not mean that governments should abandon efforts to assist the urban poor through energy policies. Many studies, including an extensive recent global survey, confirm that the urban poor are better served by pricing energy along commercial lines and facilitating access to fuels. Energy that is neither heavily subsidized nor heavily taxed, and that is free of import restrictions, has the best chance of reaching the urban poor. Such policies help households that can afford electricity, LPG and kerosene; they also help the poor by keeping the prices of traditional fuels, used mainly by the poor, at affordable levels.

Hydroelectric potential is unevenly distributed, but there is vast untapped potential in many developing countries

As shown in Figure 8 below: developing countries have more than double the hydropower potential of industrialized countries. But whereas about 70% of that potential has been tapped in industrialized countries, only about 10% of that potential has been tapped in the developing world.

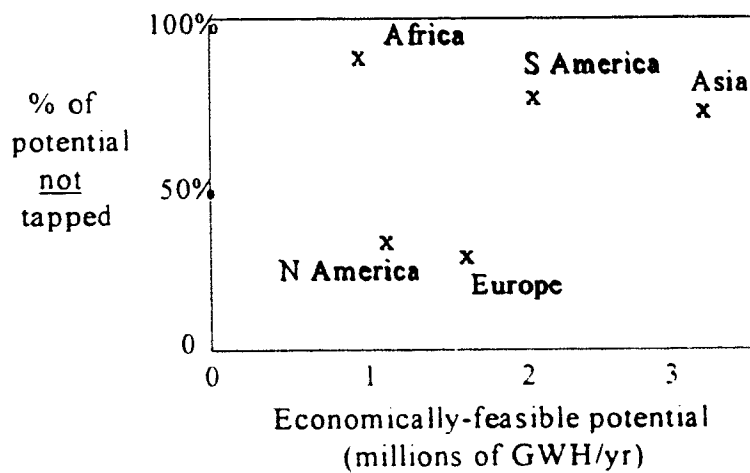


Figure 8: Potential and actual hydropower generation in different regions

Since the demand for electricity in developing countries is expected to triple over the next 30 years, the outlook for hydropower would appear to be rosy. Most estimates agree that by 2020, installed hydro capacity will also triple, from about the current 10% of technical usable potential to some 30%. A closer look at the industry, however, unearths deep problems, and many challenges.

How much, and how, is hydro currently financed?

Historically, hydroelectricity in the developing world has been financed predominantly from public or guaranteed funding. For instance, during the last three decades, the World Bank has financed about 110 hydroelectric power projects in 50 developing countries. These projects range from 6.6 MW to 2,460 MW, with a combined generating capacity of about 35,000 MW. Between 1990 and 1995 the Bank approved 12 hydropower projects, accounting for about \$600 million a year of the total estimated investment in hydropower in developing countries of about \$15 billion a year.

Reliable global data on trends in hydro financing are not available. As usual, World Bank data provide some pointers. As shown earlier, there has been a marked decline in World Bank lending for hydro – over the course of the 1990s, hydro has fallen by about 25% as a share of (approximately constant) Bank lending – from 3.4% to 2.5% of the approximately \$20 billion lent annually. There is no doubt that environmental pressures on the Bank (and other multilateral agencies) account for some of this decline; accordingly, it is not clear whether this decline mirrors a

parallel shift in spending on hydro by developing countries. What seems more likely (and for which there is ample anecdotal evidence) is that, since money is fungible, developing countries have simply taken "the path of least resistance", using their own resources for these controversial investments, and submitting projects to the World Bank (and other external support agencies) which are more politically palatable in the West.

Whatever the actual numbers on current (mostly public) spending on hydro, it is obvious that capacity expansion will require the mobilization of both public and private finance and the forging of new partnerships between the two.

The private sector has shown some interest in funding hydroelectricity. The International Finance Corporation (the private sector arm of the World Bank) approved financing for 7 private hydroelectric power projects, between 1990 and early 1995; 6 of these were relatively small (10 MW to 73 MW), and one was a large (450 MW) run-of-river project. Besides development of new capacity, the private sector has also shown considerable interest in buying, retrofitting, rehabilitating, and operating existing hydroelectric plant, with this process particularly active in Brazil and other Latin American countries. Between 1990 and 1995, about \$25 billion a year (see Figure 16 later in this paper) was invested by the private sector in infrastructure in developing countries. About 35% of this (or about \$9 billion a year) was in the power sector, and about 12% of this (about \$1 billion a year) in hydro. This implies that the private sector has financed only about 7% of the \$15 billion invested in hydro in developing countries each year.

Hydro projects have frequently suffered from delays and cost overruns

World Bank data show that power generation projects have not always performed well -- schedule slippage has averaged about 38% for thermal projects and 35% for hydroelectric projects. Cost overruns have averaged about 11% for thermal plants but 30% for hydroelectric projects.

Some of this poor performance can be attributed to the generic "public works hazard", in which there is little sanction for high costs and poor performance. But as the difference between public thermal and hydro plants suggests, there are also a much larger variety of risk factors -- hydrologic, geologic and environmental -- associated with hydro plants. The allocation and assignment of risk is a central topic to which we return later; here it is only pertinent to note that it is possible to structure private sector projects to specifically address the problems of cost overruns and delays. In recent independent hydropower projects in Colombia, India and Guatemala, for example, a major portion of the project developers' return on equity comes from delivering the project on time and within budget.

The characteristics of "the new energy economy", and the consequences for hydro financing

Hydropower advocates (reasonably) portray hydropower as an indigenous, renewable, non-polluting and long-lived peak energy resource more deserving of foreign investment than many thermal projects which, in the words of one observer, "when based on imported equipment and fuel... are no more than a long-term contract for the import of electricity".

The reality, however, is that hydro, in the words of an influential energy analyst "stands at a cross roads" -- "On the one hand, project owners face increasing economic, environmental and financial challenges. There are the vocal and visible attacks by environmental interest groups on hydro projects, particularly those with large dams. There is competition from alternative energy sources. In only a few years, the natural gas-fueled combustion engine has become a dominant technology for producing electricity. Its physical and economic characteristics are almost the opposite of those of hydro -- project capital costs are relatively low and predictable with a high degree of accuracy; construction times are short; and fuel/operating costs are high. And there is the drying up of inexpensive public financing for energy projects."

Financing from the private sector

There is no doubt that private financing will play a major role in the future of the power sector -- Percy Barnevik, a leading energy thinker, suggests that in the future 90% of power financing will come from the private sector.

How does the private sector view investments in hydro? The short answer is "warily", because of a number of substantial risks, many of which are inherent in the degree to which each and every hydro project has (unlike thermal projects) to be tailored to specific hydrological, geographical and geological conditions. When a private financier looks at hydro, he sees the following:

- substantial market growth, in contrast to the situation in industrialized countries; but
- a wide variety of legal and regulatory environments, with some markets better structured and less risky than others;
- there is a lot of work (and associated high costs) in preparing a project to the stage where it can be costed by a prospective developer within a reasonable degree of certainty;
- a necessity (see Figure 9) below, for a complex set of partnerships, even in relatively simple projects;
- even at the bid stage there is typically considerable cost estimate risk from geological and hydrological uncertainties, as well as uncertainties (and often shifting goalposts) due to costs of environmental mitigation and resettlement;
- costs are recovered from these capital-intensive projects over a design life typically two or three times longer than a thermal plant, with consequent exposure to greater uncertainty (not least due to political changes);
- a dearth of the long-maturity financial instruments which are necessary for hydro;
- little ability to attract export credits, the major source of financing for thermal plants, which have about four times more dollars of equipment than a hydro plant per megawatt of capacity and, therefore, greater dependence on multilateral agencies sources, who are subject to a variety of political pressures and have become less than reliable partners, for financing or guarantees;
- the considerable hydro resources located in poorer countries or regions are often far in excess of their needs. While there is often demand in adjacent countries or regions, there is considerable friction in cross-border marketing due to both lack of infrastructure and lack of well-established purchase rules

The net effect is that the private sector correctly sees hydro projects, relative to thermal power projects, as fraught with risks. With countries and utilities increasingly turning to the private sector to fund and build such projects, that perceived high financial risk will discourage investment.

An important reality is that these risks are typically quite different in smaller and larger projects. It is relatively easy to involve the private sector in smaller projects, specifically chosen to have minimal geological, hydrological and environmental risks. Consequently, the typical private sector hydropower plant is an environmentally benign, high head, run-of-river plant between 40 and 400 MW located on the tributaries to the big rivers. For larger projects there has been, and will be, little private sector financing unless there is substantial involvement of governments and bilateral and multilateral agencies in co-financing such projects and in assuming some of the risks (by, for instance, funding upstream sector planning and project preparation activities, and by providing partial risk guarantees). It should be noted that traditional financing by governments and through bilateral and multilateral banks addressed most of these difficulties. Development costs were financed through technical assistance loans and credits and through project preparation facilities. Construction uncertainties were addressed by the "schedule of rates" form of contract and price variation clauses which passed as much as possible of the risk of unknown conditions to the project owner. Owners, usually with the backing of their governments, shouldered the responsibility for cost overruns. While there were certainly moral hazards abounding in such arrangements, in many cases this made sense since the risks were borne by the party best able to diversify the risk, which in the case of hydro development was the (usually public) owner. Grace periods and maturities accommodated the longer construction period and pay-back periods.

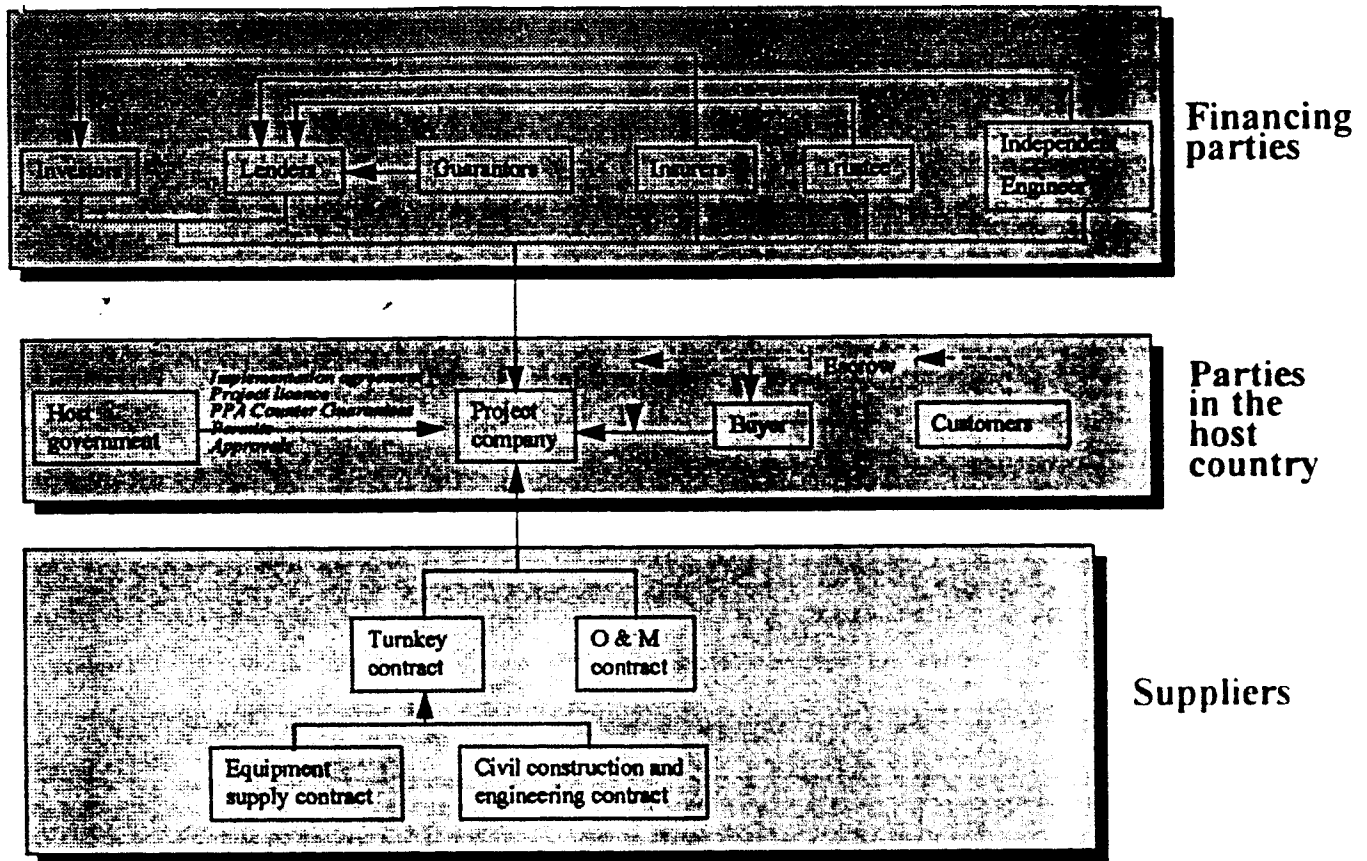


Figure 9: Structure of parties in a typical project- financed power project

What, then, needs to be done to harness the immense potential for hydropower as a source of socially-sensitive and environmentally-benign electricity generation in developing countries? The development of hydropower will, to be sure, require much greater participation of the private sector in project development, management and operation. But it will also require substantial, continued involvement of official development assistance -- in helping set internationally-accepted standards on when dams are appropriate investments and how to plan, design, build and operate them (as is being done through the World Conservation Union/World Bank sponsored "World Commission on Dams"); in financing construction-intensive plants; in providing private investors comfort with regard to political risk through partial-risk guarantees; in facilitating cross-border power sharing and sale agreements. Although official development assistance still provides substantial financing to the power sector, the prognosis is not good. The World Bank's lending -- often a "leading indicator" in the development business -- shows hydropower's share declining by 25% over the past five years. And agencies like the UK's Department for International Development has a policy of "avoiding large capital projects". There is a general perception that official development assistance for power generation is a "sunset sector", and that responsibility can be handed over to the private sector. The realities of global environmental politics (to which development agencies are highly susceptible) also play an important role. There is an effective and vociferous "anti-dam lobby", which focuses only on the environmental and social costs of dam-related projects. And there is a curious absence of environmental defenders of what, in many circumstances, can (relative to the realistic current alternatives of thermal and nuclear power) an environmentally-benign source of power. For this combination of reasons there is an implicit belief that a "phased withdrawal" of official development assistance from the hydropower sector has started. If this trend is sustained, then the private sector of its own volition will confine its activities primarily to the small, low-risk niche of the hydro spectrum and will concentrate of "private-sector-friendly" thermal power instead. This will mean that the overall low level of development of hydro potential in developing countries will persist.

PART 3: THE FINANCING OF WATER SUPPLY AND SANITATION

There have been huge increases in coverage...

A great deal has been accomplished since the start of the UN International Drinking Water Supply and Sanitation Decade. Between 1980 and 1994, about 2,000 million more people have obtained access to an improved water supply, and 400 million more urban people have access to sanitation facilities. The glass is, however, also half empty – about 1 billion people still do not have access to an adequate supply of water, and 2 billion do not have access to sanitation facilities. In fact sanitation coverage has actually declined over this period, from 67% to 63% in urban areas, and from 33% to 18% in rural areas.

But the costs of supplying raw water are rising...

This challenge is made more daunting by the fact that the cost of raw water is rising, due to three main factors. First is the Malthusian arithmetic, which pits growing populations and increasing economic activity against a finite water resource base. Second, in all countries it is taking time and political will to change existing allocation patterns in the face of rising scarcity and, in particular, to re-allocating water from irrigation to urban uses. And third, as cities grow, so do the “pollution halos” around the city. This often requires relocating water intakes at substantial costs (over \$350 million in the case of Shanghai, for instance). The net effect of these factors is substantial, with the cost of raw water increasing by a factor of 2 to 3 each time a new water source is tapped (as shown in Figure 10)

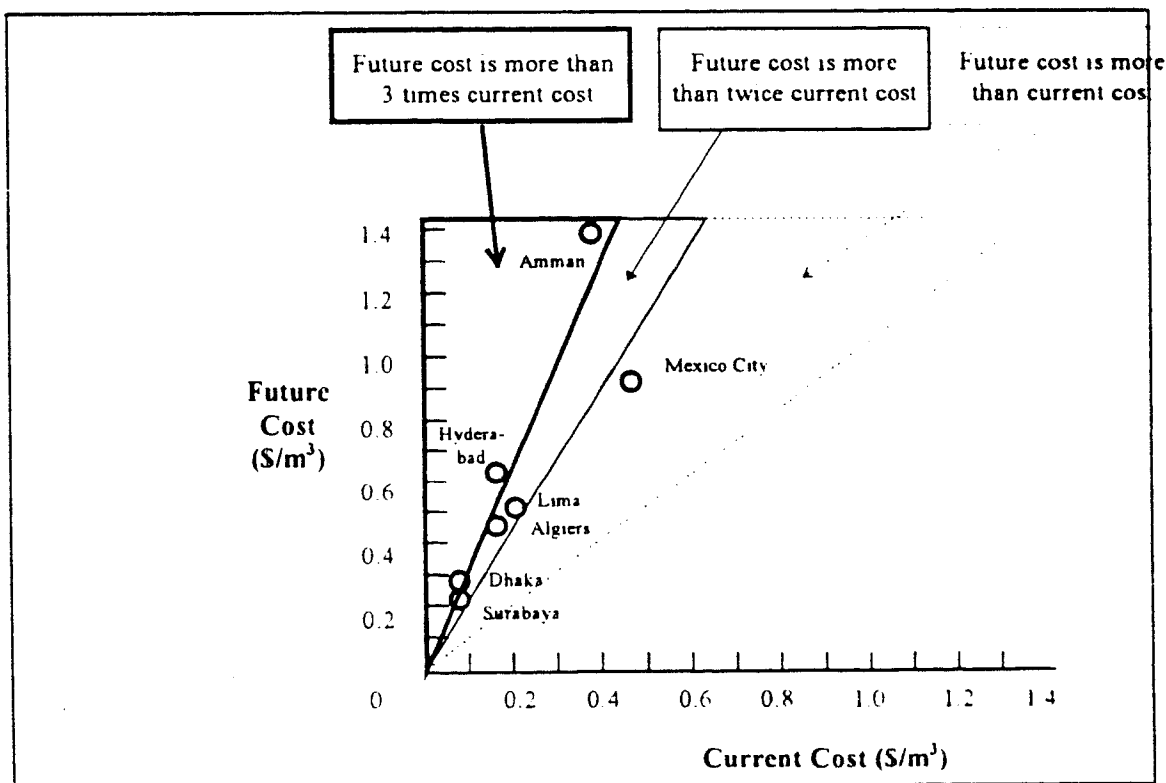


Figure 10: The rising cost of raw water for cities

Most water utilities in developing countries are inefficient..

Further aggravating the cost problem is the fact that most water and sewerage supply organizations in developing countries are very inefficient. For example, whereas the level of unaccounted-for-water is about 8% in Singapore, it is 45% in Bogota, Colombia, and 58% in Manila. Throughout the Indian sub-continent the situation is so bad that

losses are “controlled” by having water in the distribution system for only a couple of hours a day, and for keeping pressures very low. In Madras, for example, it is estimated that if supply was to increase from the current levels (of about 2 hours supply a day at 2 meters of pressure) to a reasonable level (say 12 hours a day at 10 meters of pressure) leaks would account for about 900 MLD, which is about 3 times the current supply in the city!

Should public spending be increased?

An obvious response to the supply deficit is that public spending on the water and sanitation sector should be increased. It is also frequently asserted that spending on the sector has declined in recent decades. In fact, this is not true. A World Bank review of public expenditures in developing countries shows that public investment in the water and sanitation sector increased from under 0.3% of GDP in the 1960s and 1970s, to over 0.4% of GDP in the 1980s.

There is a lot of private financing in the informal water economy

Whatever the state of public facilities, people have to have water to live, and have to deal with their sanitation needs. Accordingly, where there are deficits in formal supplies, households have to devise other ways of meeting these needs, generally at very high costs. Water vendors are ubiquitous in developing countries, and typically charge around \$3 per cubic meter of water, which is ten or more times the cost of water through the formal system. The magnitude of this “black economy” is huge. In the city of Onitsha in Nigeria, for example, aggregate annual payments to water vendors are 10 times the annual revenues of the water utility. In Jakarta, 54% of households rely on private wells and 32% on street vendors, and household investments in septic tanks are estimated at about \$400 million. Throughout the developing world this “hidden water economy” represents an immense source of financing which could be “attracted in” if the formal systems were available to all and of reasonable quality.

What do users pay and what are the implications?

Few developing countries charge users the cost of the water services provided. Figure 11 shows the sources of financing for World Bank-financed water projects, and shows that payments from users are particularly low in the poorer parts of the developing world.

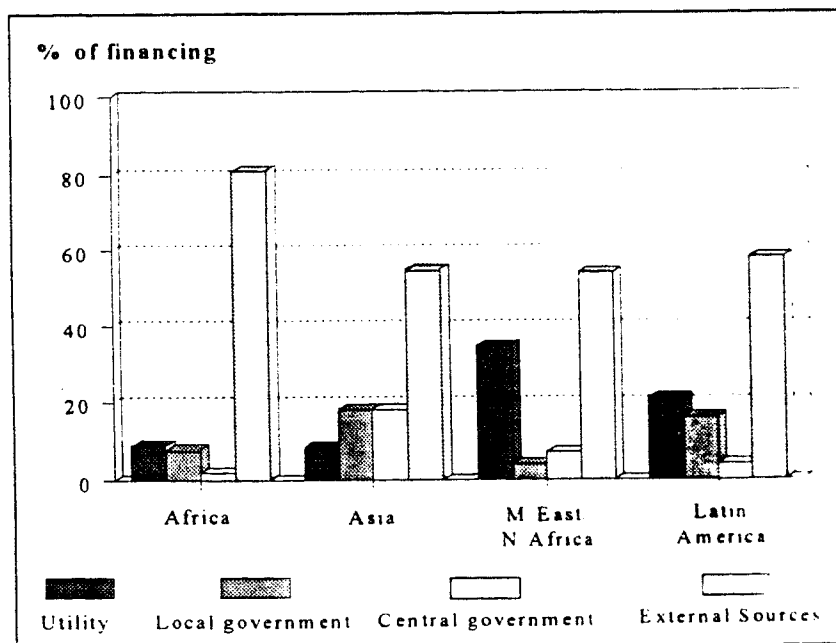


Figure 11: How World Bank-supported water utilities in developing countries are financed

The implications of current financing arrangements

There are many pernicious results from this distorted financing picture. First, fine-sounding statements notwithstanding, he who pays the piper will always call the tune. Consequently, utility managers correctly see government as their most important stakeholder – there is little accountability to the users of the services. Second, because government is a fickle client, there is seldom sufficient reliable financing to cover the costs of maintenance and to extend coverage. For some the result is no services at all, for others the services are of poor quality. Third is the vital and paradoxical issue of equity. The universal stated rationale for subsidizing services is that “water is a basic human need, for which the poor cannot afford to pay”. In virtually every situation, however, the story is the same – when services are rationed, it is always those with access to political power, namely the rich and middle classes – who get served, and it is always the poor who do not get services and who have to rely on the “black market”. In city after city in the developing world the consequence of “social tariffs” is that the rich are heavily subsidized, while the poor pay very high prices for “black market” water. The “hydraulic law of subsidies” always pertains – water flows towards influence and power, which the poor never have. Figure 12, which shows who benefits from public sanitation subsidies, illustrates another general point – the poorer the country, the greater the rationing and the greater the negative impact of “social subsidies” on the poor. The bottom line is clear – what the poor need is not charity, but opportunity, inclusion and even-handedness.

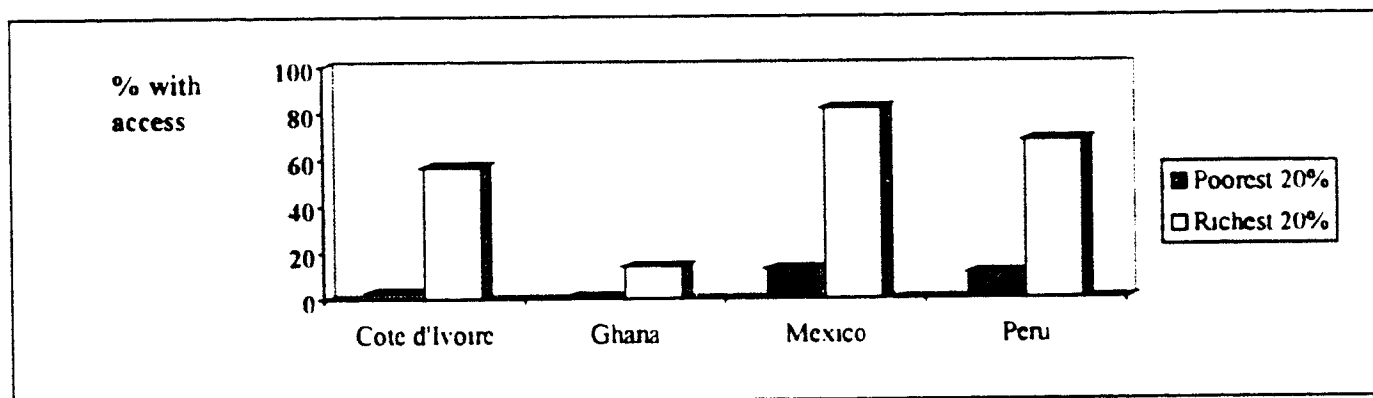


Figure 12: Who benefits when services are rationed?

Innovative, equitable, approaches to financing of water and sanitation services

In recent years a number of innovative approaches to dealing with the issue of cost recovery have emerged. In rural Bangladesh, the renowned Grameen Bank makes unsubsidized loans available to groups of organized poor women. While the bulk of such loans have been used for directly economically-productive activities, in recent years about \$15 million a year is lent for private tubewells and handpumps. As with all other Grameen projects, repayment rates are high (98%).

At the other end of the development spectrum, Chile has developed an equally innovative and effective approach. Until the late 1980s water utilities in Chile (like most developing countries) used cross-subsidies to address the needs of the poor. What was observed was that this introduced several distortions. First, it meant that each poor person served meant a financial loss for the utility, which, consequently, had a disincentive to actually serve the poor. Second, it meant that utility managers were diverted from their primary focus, which was running their company efficiently. The essence of the new approach was to separate the welfare and business functions, by introducing the idea of “water stamps”, which are provided by the government to means-tested poor people, and which are used by the recipients to pay part of their water bills. This has worked very well for the past five years. It has meant that utility managers are now out of the welfare business, and it has meant that subsidies are visible and transparent.

A very common problem for water utilities in developing countries (including Eastern Europe and the former Soviet Union) is that of how to make a transition out of a “low-level equilibrium trap”, in which the quantity and quality of

services are poor, which means willingness to pay is low, which means revenues are low, which means services are poor, and so on. An innovative approach in the city of Conakry in the West African state of Guinea shows how creative financing can help break out of this vicious cycle. In 1987, the government water utility functioned very poorly, and the quality of services in Conakry was abysmal. The government of Guinea decided that they wanted to attract the private sector in, an approach which had worked well in the Ivory Coast and other countries in the region. The problem was an obvious one – no private company would be interested in a contract when revenues were only a fraction of the costs! The solution which was devised is illustrated in Figure 13. The private operator was assured of sufficient revenues by a combination of (initially low, but rising) revenues from users and (initially high, but declining) subsidies from the government (largely paid out of a World Bank credit). The trick was to use a time-bound, transparent “transition subsidy” to improve services, and then raising tariffs for the improved service. The vicious cycle was replaced by a virtuous cycle of good service and reliable revenues

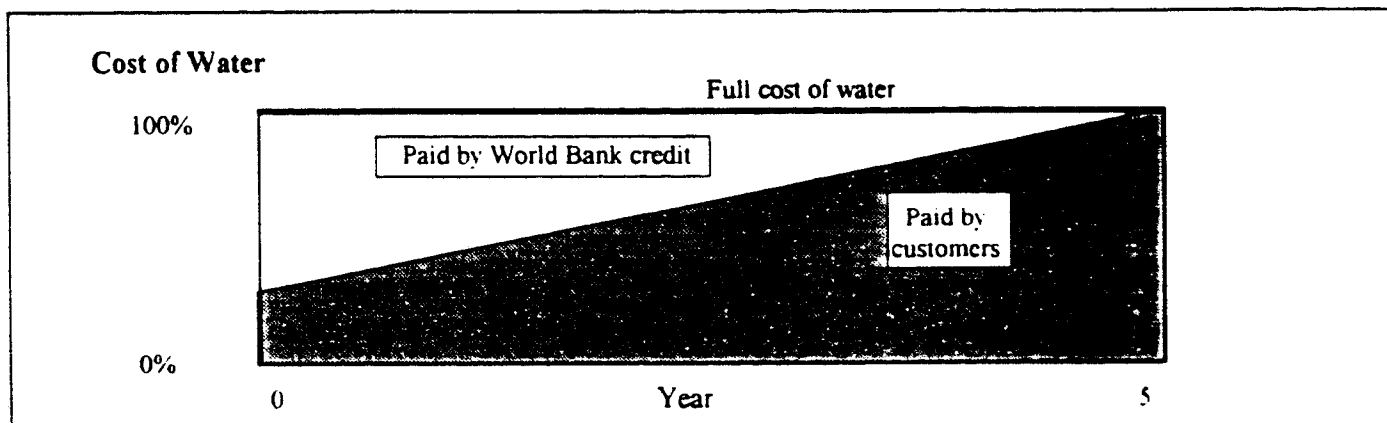


Figure 13: Breaking the “vicious cycle” in Guinea, Conakry

Serving the poor – the Orangi Pilot Project example

These general lessons on how to provide services to poor people in developing countries are well illustrated by the Orangi Pilot Project in Karachi. In the early 1980s, Akhter Hameed Khan, a renowned community organizer, began working in the slums of Karachi. He asked what problem he could help resolve. People in this area had a relatively satisfactory supply of water but now faced “streets that were filled with excreta and waste water, making movement difficult and creating enormous health hazards”. What did the people want, and how did they intend to get it, he asked. What they wanted was clear – “people aspired to a traditional sewerage system. It would be difficult to get them to pay for anything else.” And how they would get it, too, was clear to them – they would have Dr. Khan persuade the Karachi Development Authority (KDA) to provide it for free as it did (or so they perceived) to the richer areas of the city.

Dr. Khan then spent months going with representatives from the community petitioning the KDA to provide the service. Once it was clear that this would never happen, Dr. Khan was ready to work with the community in finding alternatives. (He would later describe this first step as the most important thing he did in Orangi – liberating, as he put it, the people from the demobilizing myths of government promises.)

With a small amount of core external funding the Orangi Pilot Project (OPP) was started. The services that people wanted were clear: the task was to reduce the costs so that these were affordable and to develop organizations that could provide and operate the systems. On the technical side, the achievements of the OPP architects and engineers were remarkable and innovative. Coupled with an elimination of corruption, and the provision of labor by community members, the costs (in-house sanitary latrine and house sewer on the plot, and underground sewers in the lanes and streets) are less than \$100 per household.

The (related) organizational achievements are equally impressive. The OPP staff has played a catalytic role -- they explain the benefits of sanitation and the technical possibilities to residents and conduct research and provide technical assistance. The OPP staff never handled the community's money. (The total costs of OPP's operations amounted, even in the project's early years, to less than 15 percent of the amount invested by the community.) The households' responsibilities include financing their share of the costs, participating in construction, and election of a "lane manager" (who typically represents about fifteen households). The lane committees, in turn, elect members of neighborhood committees (typically around 600 houses) who manage the secondary sewers. The early successes achieved by the Project created a "snowball" effect, in part because of increases in the value of property where lanes had installed a sewerage system. As the power of the OPP-related organizations increased, so they were able to bring pressure on the municipality to provide municipal funds for the construction of secondary and primary sewers.

The Orangi Pilot Project has led to the provision of sewerage to over 600,000 poor people in Karachi and to attempts by at least one progressive municipal development authority in Pakistan to follow the OPP method and, in the words of the project director Arif Hasan "to have government behave like an NGO." Even in Karachi, the mayor has now formally accepted the principle of "internal" development by the residents and "external" development (including the trunk sewers and treatment) by the municipality.

Developing efficient formal institutions

It is obvious that there can never be good services for people in developing countries unless the formal utilities which serve them function well. The ingredients for successful utility performance are universal, simple and clear -- managerial autonomy, a commercial orientation and a strong voice for consumers. Throughout the developing world (and substantial parts of the developed world!) water and sewerage utilities are run as a direct agent of government. As a rule, these utilities are politicized, bureaucratic and inefficient, with the result that coverage is low, and services are costly and of poor quality.

Many approaches have been tried in developing more efficient and accountable water utilities. "Corporatization" describes an approach in which service delivery remains public, but in which managers are given greater responsibility and an arms'-length relationship to government. In many cases (Indian "Water Boards" are a good case in point) the independence is paper-thin. In some cases -- New Zealand and Chile are two examples -- this model has been implemented with conviction. While substantial efficiency gains are possible (and have been achieved) these gains turn out to be difficult to sustain over time. (In the face of these difficulties, Chile is now starting to divest its public utilities.)

Many utilities (water and other) are involving the private sector to an increasing extent. The simplest form of private sector participation (PSP) is for a utility to subcontract out various activities (such as billing and collecting). Once again, efficiency gains are possible, but only if the contracting utility is well run (which is often the real cause for concern!). Another drawback is that this form of private sector participation does not stimulate private investment.

Somewhat greater private sector involvement can be obtained via a management contract, whereby a private company is paid a fee for operating water and sewerage services (typically for about a five-year period). Such contracts are being implemented in Gdansk in Poland, and Mexico City. This is an obvious approach when public agencies are performing very poorly, and can be a first step in initiating a process of deeper private sector involvement. However, the arrangement offers few incentives for the private sector. Furthermore, administrative demands are substantial, and the city remains responsible for investment.

Throughout the world there is now much greater use of "stronger" instruments for involving the private sector. A common approach is the lease or "affermage" contract, in which a private company leases the water and sewerage assets for a period of 10 - 15 years, and operates them in return for the right to revenues from the customers. These contracts are common in France (as the name implies!). In recent years affermage contracts have been concluded in Guinea, Senegal and Australia (Adelaide). The two main advantages of the approach are that the private operator

has clear performance incentives and that the operator provides the necessary working capital. The arrangement remains administratively demanding for the public sector, which also remains responsible for investments.

The second common "French" approach is the concession contract. As in the affermage contract, the city owns the assets, and a private operator operates and maintains the facilities. In this case, however, the private operator is also responsible for new investments. Accordingly, these contracts are much longer, typically 25 to 30 years. This is a popular model in France. The city of Abidjan in the Ivory Coast has moved gradually from an affermage to a concession contract. Macao, Limeira in Brazil, and Buenos Aires are other well-known recent cases of concession contracts. These contracts offer potential for high, sustainable efficiency gains in both operations and investment. The case of Buenos Aires illustrates what is possible. In the three years following the concession contract, water production increased by 27%, coverage for water supply and sewerage increased by 9% and 6% respectively, response time was down by 73%, and labor productivity increased by 43%. However, sustaining these improvements and providing incentives for new investment by the private sector depends on the public sector's ability to establish good regulatory frameworks and to implement adequate tariff regimes and subsidy mechanisms

Build-operate-transfer (BOT) contracts are similar in some respects to concession contracts. Here the private sector is given a contract to build and operate bulk facilities. This form of private sector participation is particularly popular in Asia, with major recent contracts in Malaysia, China and Australia (Sydney). This is a good way of getting efficient construction and delivery of bulk services, and of mobilizing private financing for this purpose. But it is not a good solution in the situation where distribution systems and operating companies are in bad shape, a situation which is, unfortunately, both the norm and the fundamental problem in many developing countries

Finally, the most complete form of private sector involvement is that of asset sale. The best-known case of this approach is England and Wales. Chile has now decided to sell the assets of several of its corporatized water utilities. While the potential for efficiency gains is high with this approach, it requires sophisticated regulatory capacity and great commitment from the government.

It is instructive -- Figure 14 -- to depict the various forms of private sector participation in terms of increasing levels of deregulation, private sector investment, and contract duration.

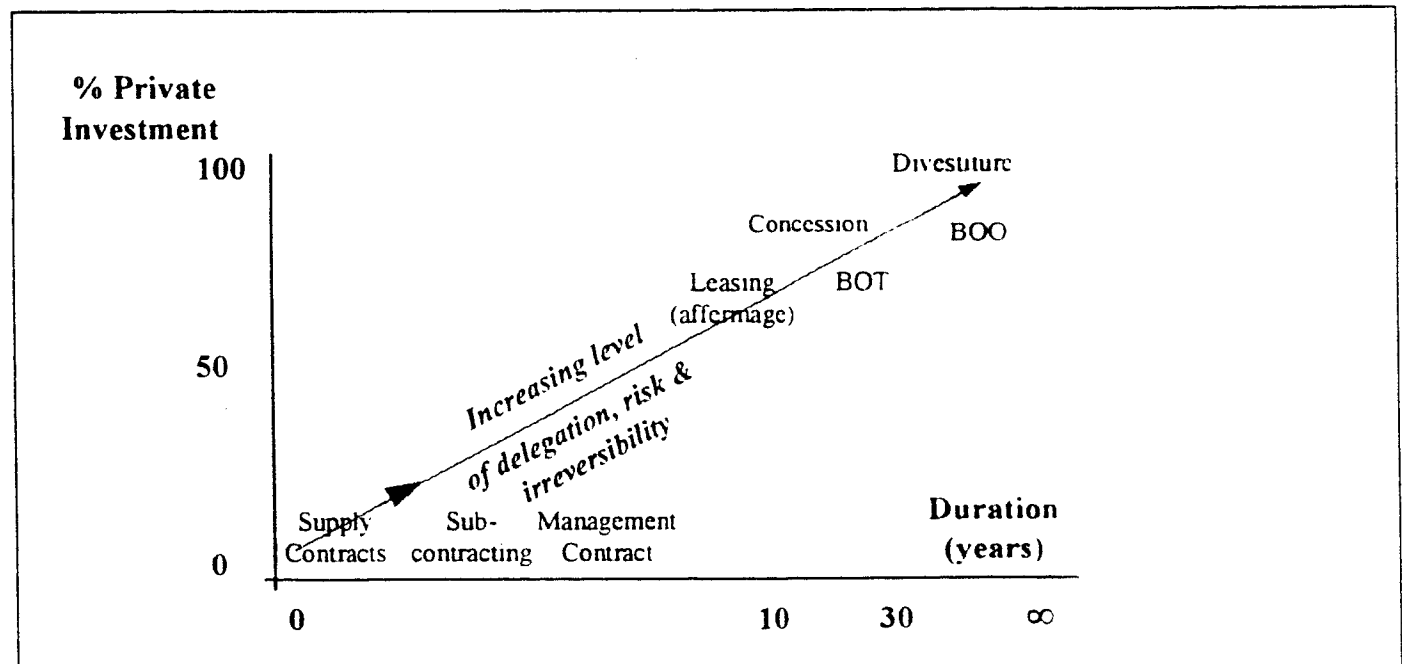
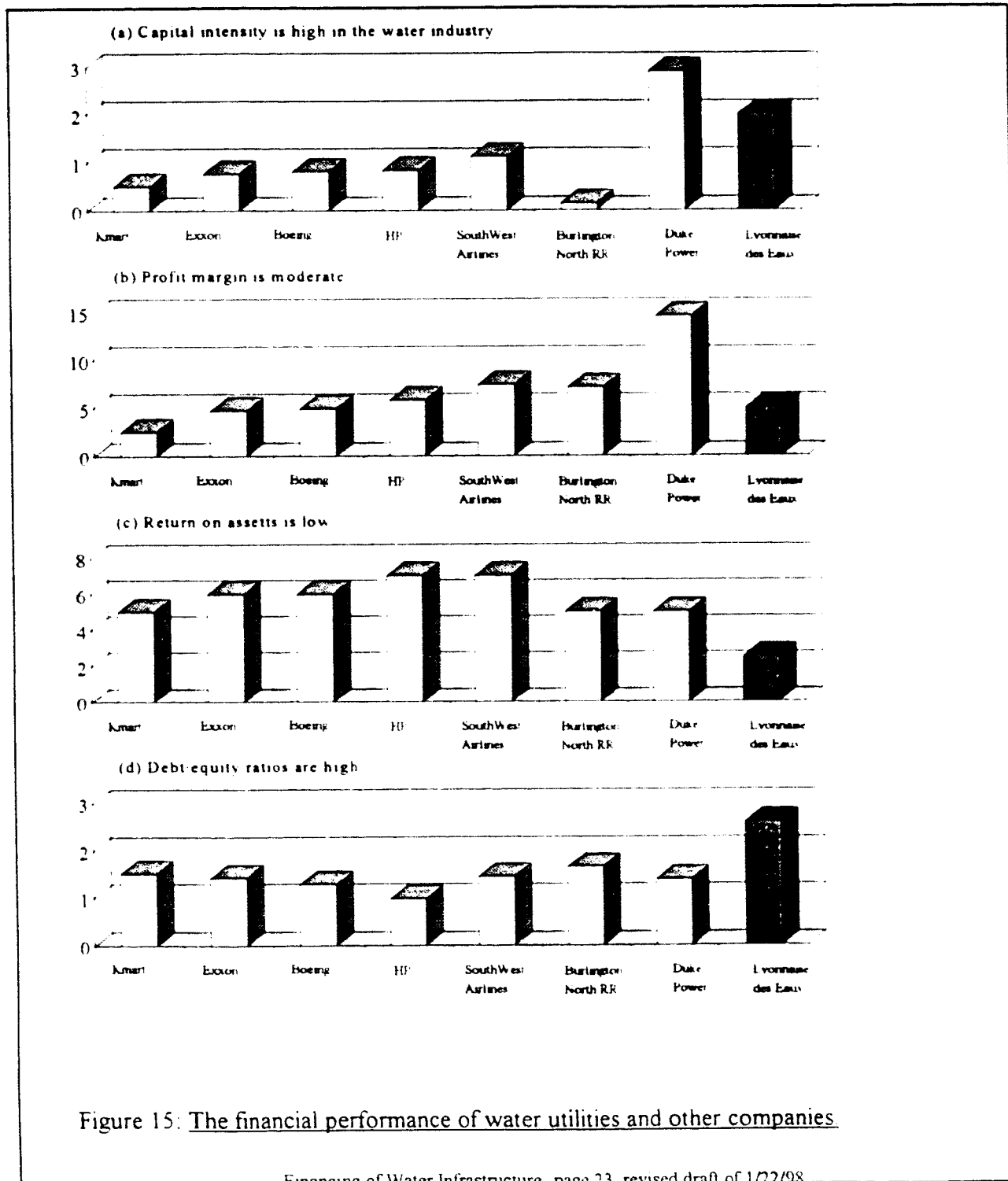


Figure 14: Forms of private sector participation

The prospects for private sector investment in the water sector in developing countries

The prospects for private sector investment in the water sector in developing countries are conditioned by several factors. First, there is the nature of the water industry itself. As shown in Figure 15, in industrialized countries the water industry has the following characteristics: (a) high capital intensity; (b) the low profitability associated with a relatively competitive industry; and (c) the low return on assets associated with a mature, low-risk industry. Financial leverage is a direct consequence of the interplay of (a) through (c) – as shown in (d). debt-equity ratios are inevitably high for the water sector. The implication is that private sector financing in developing countries is going to depend (as it does in industrialized countries) heavily on the availability of debt financing.



As described earlier, while official sources of development assistance have stagnated in the 1990s, there have been huge increases in private sources of financing. Over this period about \$150 billion of private sector investment has gone into infrastructure in developing countries. As shown in Figure 16, however, very little of this investment has gone into the poorer parts of the world (Africa and South Asia), and very little has gone into the water sector.

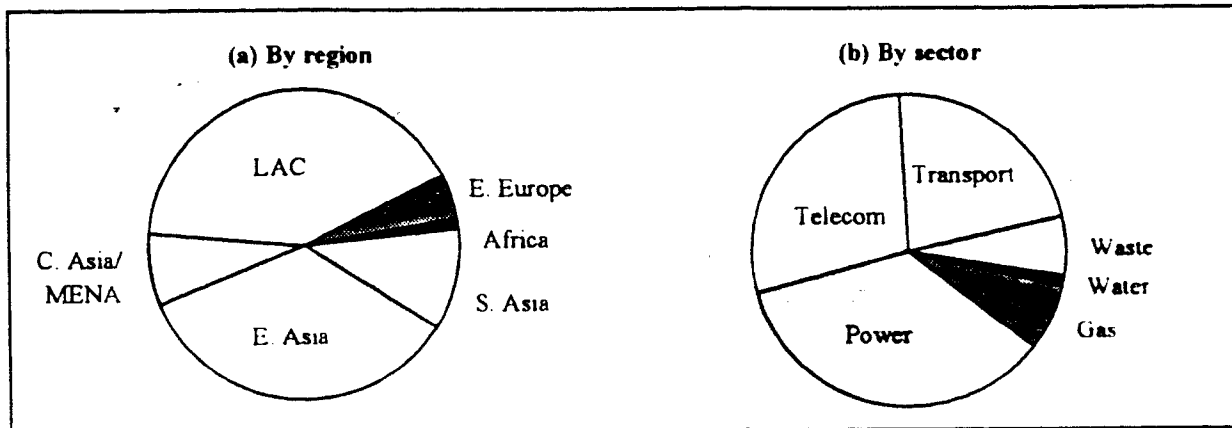


Figure 16: \$150 billion of private investment in infrastructure in developing countries between 1990 and 1995: Where it went and what it went for

There are two fundamental reasons why so little of this private investment has gone into water supply and sanitation. First, because the level of cost recovery in the water sector is so much lower (see Figure 17) than it is for other infrastructure. And, second, because the capital intensity of the water industry means that pay-back periods (and hence vulnerability to political risk) is particularly high.

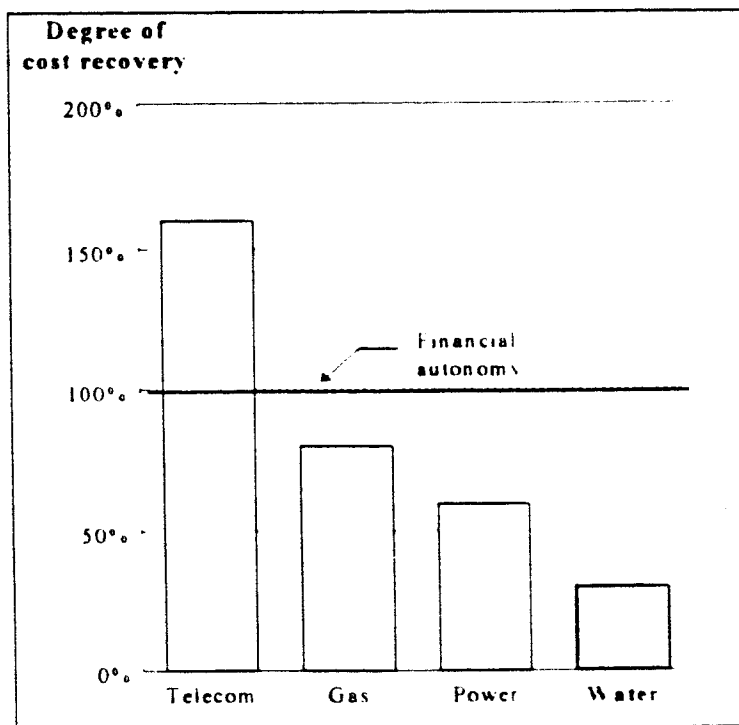


Figure 17: Cost recovery in infrastructure in developing countries

The bottom line for water and sewerage financing

Recent years have seen a sea change in the role of the private sector in operating and financing water and sanitation facilities throughout the world. It is obvious that this process has only just begun, and that it will deepen and mature in coming years. But it is equally clear that there is a vital role for other actors. As the Orangi case illustrated, there is a need for creative partnerships between formal providers (who provide the bulk infrastructure) and informal providers (who deal with the feeder infrastructure) in many poor areas. And, as illustrated by the successful Chilean experiment with "water stamps", there will remain a vital role for the public sector in ensuring that the poor have access to services. It is also apparent that, for a very long time, the public sector will have an important role in partial financing of water supply services (even when they are publicly-provided) and, even more so in financing sewerage services. (It should be noted that after many decades of heavy private involvement in the water sector in France, about 50% of financing still comes from local and regional governments). Finally, it is obvious that governments have a vital role, most of all in providing an appropriate legal and regulatory framework which will provide the incentives and checks and balances for all providers -- public and private -- to provide efficient, accountable services.

PART 4: THE FINANCING OF IRRIGATION AND DRAINAGE

What is "irrigation" and how is it financed?

The word "irrigation" refers to an extraordinarily large variety of activities. Many think of irrigation as a storage dam on a river with off-take structures and a network of canals and drains. For others, it is a well equipped with a pumped linked by water channels to nearby fields, or a shaduf or shipa to lift stream water by hand. This diversity makes it difficult to analyze "irrigation". And when the subject is financing, the difficulty is greater still. To most in the public irrigation world, "financing" falls into two categories. The most common perception is that "financing" is synonymous with "budget allocations" and therefore of little systemic interest (aside for lobbying for larger allocations). With some exceptions, private irrigation in the developing world is a family affair, again with no systematic public policy attention to financing issues. To illustrate just how complete this neglect of financing is, a recent major review of the World Bank experience in irrigation has this, and not a word more, to say about irrigation financing: "*There are no reliable statistics on global irrigation investment*". The subject is of so little interest (including, presumably to reviewers and the audience in the irrigation community) that the subject is not mentioned again in this 140-page report. Similarly, a policy review for the UK Department for International Development does not mention the issue of financing, save for a report on official development assistance flows to the irrigation sector.

In this "data desert", estimates of aggregate levels of investment on irrigation are little more than partially-informed guesses. The most common figure in circulation is "\$10-\$15 billion per year". Since the perspective of the international irrigation community is so firmly on public irrigation, the existing estimates appear to capture only public expenditures. This ignores, among other things, the fact that a large amount of irrigation is privately provided -- 70% in Pakistan, 40% in the Philippines and India. A variety of perspectives (ranging from ratios of World Bank spending to national expenditures, and from country-level data from India, Morocco, Colombia, Egypt, Mexico, Ethiopia, Nigeria, Laos, Vietnam and Bangladesh) give a surprisingly consistent picture, suggesting that about \$25 billion a year is invested in irrigation in developing countries.

Does cost recovery matter?

The one area where the irrigation community has paid some attention to financing-related issues is that of cost recovery. As is well known (and sometimes derided) the World Bank has made something of a religion of the virtues of cost recovery in general, and has preached the virtues of cost recovery for irrigation, too. What are the performance of the large irrigation agencies in terms of cost recovery? Estimates of the ratio between receipts and fiscal costs of irrigation systems include: Pakistan - 13%; China - 25%; and Philippines - 10%. In some particularly

egregious cases (such as the state of Bihar in India) revenues do not even cover the cost of collection. Even in World Bank-financed projects, where so much attention is paid to this, cost recovery (modestly defined as covering operation and maintenance costs) is successful in only about 30% of projects. Why is this so?

The answer is usually that receipts from irrigation in many instances go into general revenues. For the irrigators the moral hazard is clear – whether or not I pay, I still get the same service, so why pay? The corollary is also true – experience has shown that cost recovery in and of itself achieves little, unless the money collected is used efficiently to improve the quality of services provided. The experience of Mexico in this regard is salutary. In recent years, as a component of overall economic restructuring, the operation of irrigation districts throughout Mexico have been turned over to farmers. One (of many) consequences is that there has been a dramatic increase in cost recovery – from about 30% to 80%. For now the farmers know what the charges are for, and they apply the revenues to improving the maintenance and operation of their systems.

The case of Victoria, Australia, provides a fascinating example of what can happen when the challenges of structural reform and fiscal austerity are faced creatively. Over a relatively short period irrigated agriculture moved from being a heavily-subsidized sector into one in which market principles play a dominant role – water markets are used to ensure that the resource is used efficiently, and farmers now are accountable for the full costs of their infrastructure. When this happened (see Box 2), Victorian farmers made sure that nothing was spent frivolously (and succeeded in cutting the costs of an already quite efficient delivery organization by about 40%), and ensured that all receiving services paid their fair share. The key, then, as indicated in several illuminating studies by the International Irrigation Management Institute, is not “cost recovery” per se, but rather financial autonomy and accountability to users.

Box 3: Cost recovery and financing in Victorian irrigation systems

Until recently, irrigation financing in Australia has followed the familiar world-wide pattern – government pays for investments and a substantial part of the operating costs. In recent years this pattern has undergone a fundamental reform, which provides important insights into likely future evolutions in many irrigation systems.

The key turning point came through a confluence of external influences in the early 1990s. The general context was that the Australian economy was in serious difficulties, losing its ability to compete successfully on international markets. The upshot was that a series of national and state governments decided that a change of tack was necessary – Australia decided to liberalize its economy, putting an emphasis on removing distortions in both input and output markets, and opening the economy up to domestic and international competition. In the specific case of the state of Victoria, this general liberalization coincided with a crisis in the state fiscus.

As part of the overall liberalization process, the Coalition of Australian Governments initiated a Water Reform process, designed to bring market forces to bear (both through reductions of subsidies and through the broadening and deepening of the use of tradeable permits for both water and salinity). In the State of Victoria, this coincided with a crisis in state fiscal affairs, and a decision by the State government to withdraw all subsidies from, inter alia, the irrigation sector.

The result was predictable and colorful, in an era when Australian farmers watch CNN and see how their French colleagues take their tractors to Paris when the EU considers reducing agricultural subsidies. And so the Victorian irrigators took their cows (and other things) to Melbourne to protest. Unusually, this tactic did not work. The consensus on economic reform was deep, the state financial crisis was very serious, and the government would not back down.

Once the farmers realized that there was no “return to the good old days”, then they focused their attention on dealing with the new reality. The first thing that became clear was that if it was they who paid, then the irrigation agencies in the state would be accountable to them (the farmers) not the government. And if they were to pay, they were going to make absolutely certain that they would pay only for things that were absolutely necessary, and that the irrigation services business would be run efficiently. This launched a new era for the (already sophisticated and quite efficient

and effective) water agencies in the State. Now these agencies were, *de facto*, accountable to the farmers, not to the government. The result is remarkable. There was a strong imperative to drive down costs – and costs of water management have fallen by about 40% (with, if anything, an improvement in the quality of services). And there has been a revolution in management of assets and financing of rehabilitation and new investments. The water agencies have devised a sophisticated asset management scheme, in which the condition of all assets is assessed and judged, in which requirements for rehabilitation and new infrastructure are determined, and in which a financing plan is developed (jointly with the farmers) for financing of these investment costs. The result, of course, is that every single item is scrutinized, with farmers constantly asking the critical “what if” questions, and often deciding that particular elements of the infrastructure are not worth preserving. This has resulted in a sharp fall in rehabilitation and investment needs, with little negative impact on the quality of service.

The story in Victoria is not yet over, with the government and the irrigators still wrangling over what “payment of full costs” means. (For the government it means that the farmers would pay for past investments; the farmers argue that they will not pay for past investments, many of which were overtly political in intent.) To an outside observer a likely and reasonable outcome would be the farmers’ position – that they will pay the full costs of operation and maintenance, the full costs of rehabilitation and replacement of existing infrastructure, and the full costs of any new infrastructure.

The Victoria example is instructive in many ways. It shows that reform of deeply-entrenched patronage-based financing systems will come only when there is a broad overall context of economic reform, and only when there is a fiscal crisis so serious that it cannot be avoided. But it also shows that there is great potential in critical elements of the institutional structure – the farmers and the service agencies – to change from the past patterns to ones in which efficiency, customer service and quality matter. And the Victoria experience shows that irrigated agriculture can – the dire early prognostications notwithstanding – flourish in this new environment.

It is instructive, too, to note that the same broad set of social forces – the adoption of the tenets of a market economy, greater discipline in public spending, greater participation by users, and greater attention to the environment – have induced quite similar changes in irrigation practices elsewhere. Water markets are now instruments being used in the Western United States, Chile and Mexico; users’ associations play a huge role in operating systems (and increasing cost recovery) in Argentina, Mexico, Brazil, Chile, and Turkey; etc.

What is so special about irrigation?

A fundamental question (and one which raises the hackles of the irrigation community), is “what is special about irrigation vis a vis other utility-type services”? The answer is a combination of the legitimate and the disingenuous. In many countries there has been a reasonable claim that government-controlled food prices (designed to keep prices down for the urban poor) have been a massive tax on agriculture, which has to be redressed through distortions in the factor markets, and thus subsidies for fertilizers, pesticides, energy and water. What is striking is that when such distortions operate in the opposite direction (in the Western US, for example), the “irrigation is special” plea finds other arguments (“culture”, “multipliers”, “a way of life”, “sovereignty” etc.) Several things ARE clear – this privileged “special” place of agriculture (and irrigation) respects few boundaries – it is as difficult to remove the subsidies from French farmers as it is to charge irrigators in Tamil Nadu a paise for the electricity used for their tubewells. The easy path – and the path much taken by politicians everywhere in the world – has been to avoid this political hot potato. The beneficiaries of this – the “pork barrel” politicians, the irrigation bureaucracies, and the farmers themselves – have played their roles, claiming a “special place for agriculture”. Critics of the activities of governments and agencies such as the World Bank have put it as follows: “*World Bank policy objectives in irrigation differ substantially from those applied to other sectors, such as energy, telecommunications and even urban water supply. There, World Bank policies put considerable emphasis on creating autonomous, financially viable entities capable of making rational investment decisions and mobilizing the funds needed to service debt and contribute to future investments. The borrowers are expected to levy tariffs and charges related to the costs of*

providing services so as to discourage excess consumption and waste. Why these objectives and policies are not equally applicable to public sector irrigation lending is not clear."

What will happen to irrigation in a market-driven world?

What is clear today is that the aggregate impact of these distortions have been highly uneconomic, inequitable and environmentally destructive. And it is equally clear that the future will be quite different from the past. The world is rapidly becoming one where output and factor markets are liberalized, and where there is heightened concern with the extensive environmental destruction caused by profligate use of irrigation water becomes a public issue. Where this has happened (to varying degrees in many developed countries and in parts of the developing world – much of Latin America, and South Africa, for example) there are radical changes in store or irrigated agriculture. Water then becomes a resource which will find its highest value. This means that formal water markets emerge, and farmers have to decide whether they will use their allocation or sell it to another farmer who values the water more highly, or to a city, or even for environmental purposes. The era of fiscal restraint which is similarly a part of the emerging economic landscape also means that subsidized irrigation (which accounts for over half of all investments in agriculture in developing countries) will come under fiscal pressure. Although the initial response of irrigators and irrigation agencies is to claim that this is "the end of the world", the experience of countries as diverse as Mexico and Australia shows that it will mean that users finally exert control, and that the impossible happens -- costs come down, cost recovery goes up and water services are greatly improved.

It is also clear that, just as in the peri-urban sanitation examples described earlier, "co-production" between the private and public sectors will become more common. In Colombia, for example, although the public sector is still involved in major investments, the private sector is increasingly taking over investments in secondary and tertiary irrigation-water conveyance systems, and in farm-level investment.

Finally, it should not be concluded that the dismal state of information on, and perspective about, irrigation financing necessarily means that the huge public investments in irrigation have been a waste or that the era of irrigation is over. On the contrary, they have made a great contribution to welfare, food security, poverty alleviation and the economy. As documented in a recent World Bank review, the benefits of most irrigation investment have also directly reached the poor. Large numbers of poor farmers have benefited directly. But equally important, since irrigation increases farming intensity, it greatly increases labor demand. A typical example of the aggregate impact on poverty comes from India -- districts with little irrigation had an incidence of poverty 2.5 times greater than in districts which had substantial irrigation. And irrigation projects -- at least those financed by the World Bank -- have substantial economic returns -- the average rate of return of World Bank-financed irrigation projects is 15%.

It is also apparent that the developing world faces immense challenges in coming decades in producing sufficient food. The International Food Policy Research Institute estimates that "the food gap" (the difference between consumption and production) in developing countries will grow from about 90 million tons in 1993 to about 230 million tons in 2020. The FAO estimates that 60% of future gains in food production will have to come from irrigation. It is evident that the era of meeting these growing needs through expanding the irrigated area is over, and equally evident that a modernized, efficient, intensive irrigated agriculture will have to play a central role.

PART 5: THE FINANCING OF WATER RESOURCE MANAGEMENT

Developing countries face a daunting situation. While the challenges of developing sustainable financing of traditional sub-sectors (such as urban water supply and irrigation) have yet to be met, they simultaneously face enormous financial, technical and institutional challenges in managing the quantity and quality of their water resources in a sustainable way. Since water resource management investments are mostly financed as part of the dominant sub-sectors (sometimes hydro, sometimes irrigation, sometimes urban water and sanitation) there is no separate and additional estimate of the magnitude of the investments. For the sake of completeness, however, it is relevant to review briefly the financial and other challenges which face developing countries in addressing water resource management issues.

Aquatic water quality is deteriorating in many developing countries...

The quality of the aquatic environment is a concern in all countries; in many developing countries the situation is acute. This is most obvious in cities. Even in middle-income countries sewage is rarely treated. Middle-income countries of Latin America, for instance, typically treat only about 2% of sewage. As shown in Figure 18, water quality is far worse in developing countries (and especially poor countries) than in industrialized countries. Furthermore, while environmental quality in industrialized countries improved over the 1980s, it did not improve in middle-income countries, and declined sharply in low-income countries.

There are also very major problems associated with inappropriate land and water use in agriculture. The rapid expansion of arid-zone irrigation and the profligate use of water in these areas has meant, in many cases, the mobilization of large amounts of salt and the eventual leaching of this salt into rivers. The salinity of the River Murray, for example, rises from 50 mg/l in the headwaters to about 500 mg/l at the South Australian border; the Nile has 200 mg/l of salt at Lake Nasser, 350 mg/l by Cairo, and up to 1,000 mg/l in the Delta.

Costs are a major issue, even in rich countries....

It is always expensive to treat wastewater -- in the United States about \$400 per capita for conventional primary, and about double that for biological secondary treatment. Wastewater treatment costs are thus a major issue, even in rich countries. In the United States, for instance, local governments face huge investments -- about \$3 billion in the case of San Diego -- in meeting mandatory EPA discharge requirements. These costs have been an important element in the political controversy over "unfunded mandates" over the past several years.

What does it cost, and how can investments be financed?

At the risk of some simplification, one can discern two major approaches to dealing with environmental standards and the costs required to achieve those standards. The first approach can be characterized as the "set-the-standards-and-then-raise-the-money" approach. The prime example of this approach is the European Union, where the magnitude of investments required to meet standards is staggering. Germany, for example, needs to invest an estimated \$300 billion if existing water quality standards are to be met. At current (high) investment levels this would take 40 years to achieve. (A European parliamentarian and bureaucrat was once asked how issues of cost were factored into the discussions of standards -- "Simple", he replied, "we never discussed costs"!) And if this is impossible for Germany, what about Portugal? The ingenious (and disingenuous) European solution is now to talk about "common standards but different time-tables"!

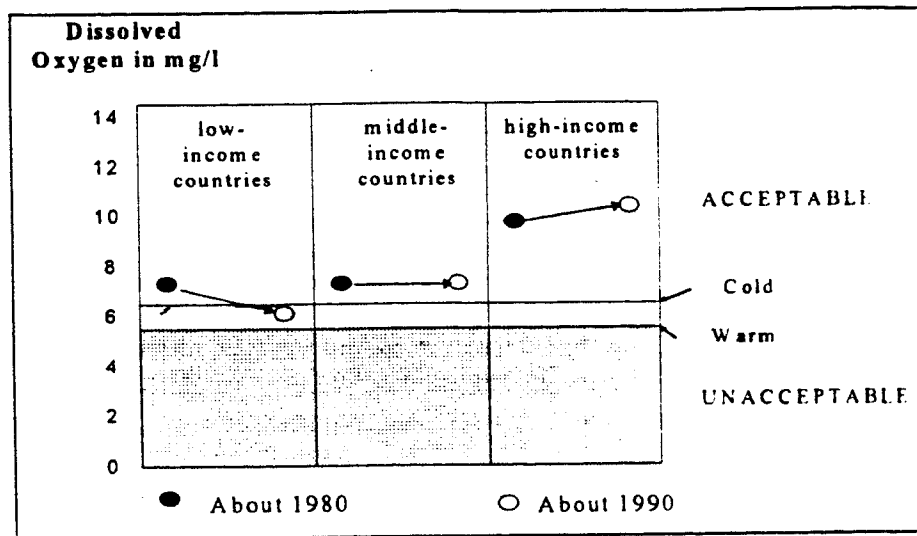


Figure 18: Surface water quality in developed and developed countries

The second approach is one in which environmental quality and the required financing are considered simultaneously. The origin of this approach was in the Ruhr basin in Germany at the time of the First World War, the approach was subsequently (in 1960) adapted by France on a national scale, and it is now being used in several developing countries. The new Brazilian Water Law, for example, incorporates many of the lessons of the Ruhr/French experience.

The Ruhr-French approach is based on a coherent set of institutional and instrument principles. The "institutional principles" are those of participation, subsidiarity and technical efficiency. With respect to participation, the French River Basin Financing Agencies provide a good model -- 60 - 120 parliamentarians, representing all users and interested parties, choose the vector of water quality and cost appropriate for their basin, and decide on the assignment of costs among the public and private parties involved. With respect to subsidiarity, the basin agencies are careful never to do anything which can and should be done at a "lower" level (such as a municipality or irrigation district). Thus, while the basin agency decides on abstraction and pollution charges, it has nothing to say about whether a city chooses to have a public or private agency operate its water supply. With respect to technical efficiency, this model depends heavily on strong technical basin agencies, which ensure that basin management is scientifically and technically sound, and which advise the water parliament on the tradeoffs between standards and costs, and on how best to deploy available resources.

The instrument principle is simple, namely to use instruments which give users and polluters of water an incentive to change their behavior. There is, accordingly, maximum use of market-based instruments, with users paying for the water they abstract, and polluters paying according to the pollution they impose.

In the past, many industrialized countries financed much of their water quality investments through general taxation. For example, under the US Clean Water Act, passed in 1992, the Federal Government paid 75% of the capital costs of wastewater treatment plants. While public financing will always play a role in financing such public goods, the trend is towards more local or regional financing, and recovering a greater proportion of the costs from the direct beneficiaries.

Similar practices are now starting to emerge for non-point sources of pollution. In the Murray-Darling Basin in Australia, for instance, the major water quality problem is the high levels of irrigation-induced salinity. The Murray-Darling Basin Commission has now specified maximum salinity fluxes from its different member states. Salinity control measures are required to stay within these limits, with the costs of these control measures being passed on to irrigators in their water bills. (These costs are considerable. In the state of Victoria, for instance, irrigators pay

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Annex 1: An overall picture of investments in the water sector:

1. Investment in all infrastructure :

WDR '94: About 4% of GDP = 4% x \$1040/cap x 4.6 billion = \$200 billion

Board paper 1997: About \$250 billion.

2. Investment in water supply and sanitation:

About 0.5% of GDP (Garn data, based on review of Public Expenditure Reviews, reproduced in Briscoe and Garn)

3. Ratios of Bank investment: total public investment for different forms of infrastructure

As shown below, it would appear that, in the aggregate, Bank lending comprised a similar share of public investment in different infrastructure sectors. (The table below shows that the ratios of Bank lending public investment in infrastructure are similar for different infrastructure sectors for 1980s)

	Bank lending (1981-1990 commitments)	Ratio	Public investment 1980s (Garn and Briscoe)	Ratio
Power	23,635	3.5	1.6%	3.2
Transport	19,594	3	1.6%	3.2
Water and sanitation	6,729	1	0.5%	1

4. Bank investments in water-related infrastructure:

Ratio of [water+sanitation]:[irrigation and drainage]:[hydro] for Bank projects is (see Figure 7 in text) about 5:7:3

Assuming ratios for investment in developing countries is similar (see 3 above), this implies that following are annual investments in developing countries for the water sector

	Ratio of Bank investments (see above)	% of GDP	billions of dollars (1% of GDP = \$50 billion)
Water and sanitation	5	0.5	\$25
Irrigation and drainage	7	0.7	\$35
Hydropower	3	0.3	\$15
Total water sector		1.3	\$65

5. Some independent approaches on specific figures:

(a) Irrigation and drainage figures

National data, mostly from Bank Public Expenditure Reviews

India:

Public expenditures are \$100 billion per year (pi). Irrigation has accounted for about 5% of government expenditure = \$5 billion a year. Irrigated area is 43 million hectares, implying an annual

public expenditure of about \$116 per irrigated hectare per year) Source: World Bank, 1993. *India: Public Expenditure Review*)

Morocco:

Public expenditures on irrigation in Morocco account for about 0.5% of GDP. GDP is \$27 billion, implying that \$135 million is spent annually on irrigation. The irrigated area is 0.85 million hectares, implying an annual public expenditure of \$150 per hectare. Source: World Bank, 1995. *Kingdom of Morocco: Water Sector Review*

Colombia (early 1990s):

Public investment of \$35 million a year, on an irrigated area of 250,000 hectares, and private investment of \$20 million a year on an irrigated area of 400,000 hectares, gives "investment intensities" of \$150 per ha per year for public irrigation and \$50 per hectare per year for private irrigation (Source: Dinar et al, 1996)

Egypt:

Public investment in irrigation was about \$200 million per year (1990-95), and private investment amounted to 44% of total investment (World Bank, 1993. *Arab Republic of Egypt: Public Sector Investment Review*) This gives \$156 million of private investment and a total investment of \$356 million, on an area of around 3 million hectares (FAOSTAT data, average for 1990-95) The resulting investment per ha is \$119 (\$67 public and \$52 private)

Mexico:

Planned public investment for the same period was \$250 million (note that actual spending was lower due to the Peso crisis) (personal communication with Ashok Subramanian), for 6 million hectares of irrigated land, (FAOSTAT Statistics Database) giving \$42 per ha per year of public investment

Ethiopia:

Public investment is \$20 million/year, (World Bank, 1997. *Ethiopia: Public Expenditure Review* and World Bank, 1988. *Ethiopia: Public Investment Program Review*) over 162,000 ha, (FAOSTAT Statistics Database) giving about \$123/ha

Nigeria:

In 1994, PI was \$55 million, (World Bank, 1996. *Nigeria: Federal Public Expenditure Review*) for 233,000 ha, (FAOSTAT Statistics Database) or \$266/ha.

Lao PDR:

1992/93-1994/95 average PI was around \$13 million, (World Bank, 1993. *Lao PDR: Public Expenditure Review*) for average 157,000 ha, (FAOSTAT Statistics Database), giving \$82/ha

Viet Nam:

1991-95 average PI/year was \$80 million, (World Bank, 1996. *Vietnam: Water Resources Sector Review*) irrigated area average 1.92 million, (FAOSTAT Statistics Database) giving \$42/ha

Bangladesh:

1990-95 average PI/year: almost \$160 million (World Bank, 1996. *Bangladesh: Public Expenditure Review*); average irrigated area: 3 million, (FAOSTAT Statistics Database) average PI/ha \$53/ha

There is remarkable (almost suspicious even to the author!) consistency. Assuming that the global average of acreage under public and private irrigation is 50:50 (it is 70:30 in Pakistan, 40:60 in India and the Philippines), and assuming that the average levels of investment are \$120 per hectare per year for public irrigation, and \$60 per hectare per year for private irrigation, then the implied annual level of investment on the 250 million irrigated hectares of land is: \$15 billion on public schemes and \$8 billion on private schemes (for a total of \$23 billion).

Alternatively:

From India -- knowing that India accounts for 17% of the world's total irrigated area, we can simply compute $50/0.17$, which gives \$29.4 billion.

From Egypt -- Egypt accounts for 1.2% of the world's irrigated area, we therefore compute $356/0.012$, which gives \$29.7 billion.

From Mexico -- Mexico has 2.4% of the world's irrigated area; assuming the 50-50 proportion between public and private investment, we compute $500/0.024$ and get \$21 billion.

Some notes:

Note 1: The area privately irrigated in India is approximately equal to the area under public (canal) irrigation. None of the expenditures on the private irrigation show up under the public expenditure figures (although there are public expenditures by way of subsidies.)

Note 2: How much of the Indian public expenditure is on new land and how much attributable to rehabilitation?

Global costs of expanding irrigated areas:

OED (Jones, 1994): World area irrigated is about 250 million ha, with expansion about 4 mill ha/yr in early 1990s. Capital costs per hectare irrigated today (Postel p 52): \$1,500-\$4,000 per ha in large projects in China, India, Indonesia, Pakistan, Philippines and Thailand (and much higher elsewhere) If average is \$2500 per ha, then implies investment of about \$10 billion per year in new irrigated lands. (Consistent with Repetto's "the pace of investment of \$10-\$15 billion per year.")

Indian costs of expanding irrigated areas:

If new area is growing in India proportional to global -- $43/250 \times 4 = 0.7$ m ha per year, and if cost of new irrigation is \$1,500 per ha then new irrigation accounts for \$1 billion a year, or about 20% of total government expenditure figure. This implies that the other 80% is being spend on operation, maintenance and rehabilitation of existing areas

(b) Hydropower figures:

John Besant Jones "Attracting finance for hydroelectric power, FPD Energy Note #3, 1995 -- "the Bank is likely to finance about 5% of new hydroelectric capacity in developing countries in the next decade" Since hydro constitutes about 3% of Bank lending, or \$0.6 billion a year, then the implied total investment in hydro is of the order of \$12 billion a year -- compare with the \$15 billion in 4 above

FIPSI database shows that about 12% of private investment in power is for hydro IFC data (figure 13) show that total private investment in infrastructure in 1990-1995 was about \$25 billion a year, of which about 35% went to power sector. Therefore -- about \$9 billion a year in power, and about \$1 billion a year of private investment in hydro.

6. The role of foreign official development assistance and bank's role.

Annual investment in water sector in developing countries is about \$60 billion
90% of this is internally financed (WDR 96)
10% (or \$6 billion) is externally financed,

World Bank funding of water sector (total) is about \$3 billion/year (15% of Bank lending), which is about half of all external financing.

7. Some cautionary notes:

The consistency of the above numbers is surprising (even suspicious!) given the huge methodological and data problems confronted in trying to derive such “order of magnitude” estimates. These include

- assuming that investment \approx public investment, when we know there are huge amounts of private money invested in domestic water supplies and irrigation
- assuming that public expenditures are for investments, when a substantial proportion – see the India numbers above – are for operation, maintenance and rehabilitation;
- inconsistencies between sub-sectors – with (at one extreme) irrigation heavily dependent on government expenditures for operation and maintenance and (at the other extreme) hydropower run on close to commercial lines (and water supply somewhere in between),
- the fact that all costs in multi-purpose projects are typically accounted for under a single purpose