Technology Assessment, Soviet Style

Thane Gustafson

Summary. The Soviet Union is actively considering two plans to divert large northern lakes and rivers to the south of the country. If adopted, these would rank among the most expensive and complicated engineering projects ever undertaken, with unforeseeable but possibly far-reaching environmental effects. The plans, now at an advanced stage, have aroused a spirited public controversy, providing an unusual glimpse of Soviet policy-making and technology assessment. Major decisions are due by 1985. The question is, what will happen to the quality and openness of this debate as the political stakes rise and the time of decision draws near?

In the mid-1960's, an American engineering firm achieved notoriety with a plan to divert more than 130 cubic kilometers of water annually from Alaska and northwestern Canada to the United States and Mexico, via a network of canals and reservoirs that included an 800-kilometer trench reservoir in the Rocky Mountains (*1*). Now, after 15 years of environmental legislation and litigation, such a project could sooner be built on the moon than in the United States or Canada. But something like it may soon be built in the Soviet Union. Soviet planners and engineers are discussing plans to reroute the flow of several northern lakes and rivers to support irrigated agriculture in the southern half of the country, arrest the decline of the Caspian and Aral seas, and alleviate local pollution problems with clean northern water—in short to remove at one bound the most important obstacles to the further development of the southern half of the country. The idea has recently gained official backing and is moving rapidly toward advanced engineering and economic studies. Construction could conceivably begin within the next 5 years.

Conceivably, but not inevitably. The idea of such an engineering venture has stirred up an emotional public debate in the Soviet Union among competing regions, institutions, and technical specialists. The result is an unusual and relatively open "technology assessment" of a project that an earlier Soviet generation would have undertaken without public debate. But what has been the effect of that debate on the actual course of policy? That is the subject of this article.

That the diversion idea (which, I shall show, is not new) is now being discussed seriously is due, first of all, to the high priority of agriculture and conservation under Brezhnev. In the 15 years since Khrushchev's overthrow, agricultural investment has grown faster than any other sector and now takes over a quarter of the Soviet capital investment budget (*2*). The Soviet government has launched several heavily funded reforms, including one of the world's largest irrigation programs. After 35 years of neglect of the countryside, the Soviet Union under Brezhnev has made the creation of a modern, self-sufficient agriculture one of its chief goals.

A crucial key to success of this goal is water. More than 88 percent of the Soviet Union's freshwater runoff is located in the north and east, whereas only 12 percent is located in the south and west (*3*). The south has plenty of sunlight and a long growing season, and the Brezhnev agricultural program depends heavily on the southern regions. But according to one Soviet authority, by the year 2000 the water needed for irrigation in the southern half of the European USSR (that is, the portion lying west of the Urals), together with the amounts necessary to maintain the levels and ecological conditions of the Caspian and Azov seas, will exceed what the area's rivers supply in an average year (*4*). In Central Asia, irrigation already takes 75 percent of all the water consumed in the Aral Sea basin, and experts warn that if more water is not available by the 1990's, further development will cease and this southern strategy will fail (*5*).

There are three possibile remedies to this situation. The first is to make additional water available by using present supplies more efficiently, notably by means of a much more effective reclamation program (*6*), a better regulation of streamflow, a larger investment in pollution control (*7*), and rapid reallocation of water from established users to agriculture. This is the so-called "intensification" strategy, which amounts to wagering that the water liberated through efficiency and reallocation among users will be sufficient to support the growth of the south and west at least through the end of the century. I do not discuss this strategy here. Suffice it to say that the efficiency of the new agriculture and related programs has become one of the chief issues within the leadership in the past year (*8*). Some leaders are apparently shaken in their faith that "intensification" alone will solve the problem.

The second possibility is to cut back the southern half of the agricultural program in favor of a northern strategy. Some Soviet agricultural specialists have long believed that top priority should go to drainage and liming in the wet and acid regions around Moscow and the northwest. Indeed, in 1974 the government began an ambitious program to develop the region known as the non-black-earth zone (*nechernozem'e*). This program calls for 10 million hectares of new drainage projects by 1980, and great publicity is being given to the fact that important parts of it are being directed by Central Asian reclamation teams working in the north as contractors (*9*). Yet the southern programs continue at the same rapid pace as before, and there is no sign that the southern strategy has lost first place.

The third possibility is to bring more water into the south from outside. The basic idea is to block the path of some of the country's largest northward-flowing rivers, back up their flow over the low divide that separates the country's northern and southern faces, and run the water to the south (*10*). Such north-south transfers could ultimately cost well over 100 billion rubles and would represent one of the largest engineering projects ever undertaken by any civilization. Until now the Soviet leadership has sought to avoid making any commitment to a project of such size and scope, and there are still some top leaders, notably Kosygin, who clearly prefer the intensification alternative, at any rate for the foreseeable future (*11*). Recent events, however, have caused the diversion idea to

The author is associate professor of government, Harvard University, and a social scientist at the Rand Corporation, Santa Monica, California.

0036-8075/80/0620-1343$01.50/0

be moved up toward more active consideration. In October 1976, a resolution of the Central Committee of the Communist Party of the Soviet Union on the targets of the Tenth Five-Year Plan authorized preliminary economic and engineering studies for the two main diversion projects. In December 1978, the Party Central Committee and the Soviet Council of Ministers issued a joint decree setting specific deadlines for the completion of full engineering and economic justifications for the diversion projects (*12*). In 2 years, the leadership has come a long way toward committing the country to the diversions. Even so, they have taken 20 years to reach this point, and the delay has had an important consequence: it has given technical specialists and advisers an open window to study, criticize, and even alter the diversion proposals. However, as the leadership, however unwillingly moves closer to commitment, this window may close.

Background of the Diversion Projects: Institutional Forces

The river-diversion debate has had a long history. A design proposal was first advanced in 1954 by the Leningrad office of Gidroproekt, the Soviet hydropower design agency. It was a hydropower project typical of the Stalin era: the plans called for a single large dam across the Pechora River in north Russia, which would have flooded more than 1.5 million hectares and would have completely cut off the lower reach of the river (*13*). The original design would have diverted approximately 40 cubic kilometers a year from the Pechora and Vychegda rivers to the Kama-Volga basin, primarily to supply additional water to the hydropower projects there (*14*). In other words, the initial motivation was energy, not water.

But even as this first design was being developed the political priority of hydropower collapsed, and the Pechora project was one of the major casualties (*15*). The initial design aroused opposition because it would have submerged oil and gas deposits and cut out a major part of the food resources of the Komi region in the far north. To meet opponents' objections and push the project through, Gidroproekt engineers redesigned it several times. One of the later versions shows how much national priorities were shifting away from the big hydroprojects of Stalin's time and toward greater regard for the scarcity of agricultural land: it would have flooded 6000 square kilometers less, but would have required 500 megawatts of electrical capacity annually to pump the water over a divide so as to make it flow south—a trade-off that would have been unthinkable in Stalin's time.

Despite these changes the Pechora project, which had come close to adoption in the 1960's, gradually lost ground (*16–18*). As hydropower agencies weakened politically they began to have trouble from upstart competitors, especially after 1965, once Brezhnev's expanded agricultural program got under way. The Ministry of Reclamation began taking over tasks that had previously been the province of Gidroproekt and luring away Gidroproekt personnel to work in its own research-and-design network. In 1971 the Ministry of Reclamation was named the lead agency for the major river diversion projects, and the hydropower planners found themselves faced with a strong rival agency (*19*).

Reclamation designers, as they gained influence, had their own ideas about major river basin diversions. Around 1969, the ministry's principal institute for long-term planning, Soiuzvodproekt, developed an alternative scheme that called for drawing water from the western lakes and rivers of north Russia instead of the Pechora. By 1973 Soiuzvodproekt had refined the western lakes project, given it a lower price tag, and was advertising it as superior to the Pechora scheme (*20*). Among its claimed advantages are several that are much in tune with current Soviet policies: the western lakes proposal would not require any reservoirs and would flood 15 to 20 times less land than the Pechora project, supply water to the most polluted stretches of the Volga (thus indirectly helping Moscow), and require less time to build and less capital (*20–22*).

Gidroproekt's Pechora project is far from dead, however. Even Soiuzvodproekt recommends proceeding with both the western lakes and the Pechora projects, and the fact that they complement one another makes an alliance between the two agencies possible. Still at issue, however, is which of the two projects should come first (*23*); no official decision has yet been made (*24*). In the most recent Party-State decree on the subject, Soiuzvodproekt and Gidroproekt have equal responsibility for the projects (*12*).

Thus the shifting political fortunes of rival agencies have been an important element in the shaping of the diversion proposals in the European USSR over the years, reflecting the changing priorities of the political leadership. The brute-force approach that Gidroproekt proposed to employ in the 1950's has become unfashionable today, so much so that the design, location, and even the principal justification of the Pechora project are completely different now from what they were 20 years ago (*25*). This is due in part to the fact that 20 years have passed, and the context of Soviet energy and agricultural problems has changed. But in addition, a significant part was played by scientists and technical specialists, who acted as defenders of the affected regions and interests, and to this aspect of the matter I now turn.

The Pechora Diversion Project: Protest from the North

The early version of the Pechora project would have flooded large areas of lowland in the part of northern Russia known as the Komi Autonomous Soviet Socialist Republic (ASSR). In 1967, geographers and economists in the Komi ASSR began attacking the project (*17*). They found allies in the oil and gas industry because the diversion project also threatened to inundate valuable oil fields, greatly raising the costs of extraction. According to local calculations, these costs, if reckoned into Gidroproekt's economic analysis, would have added 2.5 billion rubles to the total costs of the project over the period 1970–2000 (*16*). The Komi geographers also objected to the anticipated loss of agricultural land, because the Pechora project would have flooded the area's major sources of food and made it necessary for food from other parts of the country to be shipped in for the region's growing labor force. In addition, the proposed compensatory dam originally included in the project would have clashed with plans to build thermal power plants that were to be dependent on cheap Pechora basin coal (*16*, pp. 52–55). As the Pechora project was redesigned during the 1960's, these same specialists kept a watchful eye on it (*18*, pp. 3–5). Their findings appeared for the most part in local journals with very small circulations, but they were subsequently picked up by geographers in Moscow and widely discussed in national journals. The result was a sizable campaign against the Pechora project.

The Komi geographers still view the present Gidroproekt version as undesirable, for it would still cut off virtually the entire flow of the Pechora River, wipe out the migration of anadromous fish, diminish the fertility of floodplains, and cut down the agriculture of the region (*26*).

But in the last year or two a new note has crept into their writing: the Komi scientists are beginning to sound as though some sort of major diversion project is now inevitable (*26*):

> No one doubts nowadays the necessity of diverting a portion of the flow of northern rivers to the south of the country. . . . Yes, the north must help the south; that was talked about at the 25th Party Congress. . . . [But] it is no secret that many design decisions [are taken on what] in our water-resource projects amount to purely engineering grounds: how to obtain the necessary quantity of water. The ecology is often simply forgotten.

Clearly, the Komi scientists' suspicion of Gidroproekt has not relaxed, but their changed tone suggests that since the 25th Party Congress the diversions have become the declared policy of the leadership. Thus the critics can no longer oppose the project in principle and under such conditions may not be able to retain their influence.

The Central Asian Diversion Project

In the last 4 years the entire diversion issue has been unexpectedly transformed by the emergence of a large and ambitious proposal to divert Siberian waters to Central Asia. This proposal is not exactly new—the basic concept goes back to the 19th century—but what has changed is that it is suddenly being considered as a feasible project for the 1980's rather than the next century.

The water supply of Central Asia depends largely on two rivers, the Amu-Dar'ia and the Syr-Dar'ia, that flow into the Aral Sea. These rivers, fed by snowmelt from the Pamir mountains to the southeast, support a thriving cotton economy and a booming population in one of the world's most arid regions. Both rivers are now used to their maximum, and the level of the Aral Sea is falling. A crisis looms, no more than 10 or 15 years away. The idea behind the Central Asian transfer scheme is to divert a portion of the Ob' River in Western Siberia southward over the Turgai divide, which separates Western Siberia from Central Asia, to the Aral Sea basin (*27*). Whereas the various proposals for the European USSR make use for the most part of existing river basins, the Central Asian proposal would require constructing a canal some 1500 kilometers long. The problems involved in laying an artificial river across established roads, power lines, and railroads while controlling seepage and evaporation put the Central Asian project on an entirely different scale compared to the Pechora and western lakes diversions, in terms of expense, time, and possible side effects (*28*).

Only 2 or 3 years ago the Central Asian scheme was spoken of, even by its promoters, as a project for the next century (*29*). Weighing against it, first of all, were its complexity and expense. Preliminary estimates put the cost of just the first stage of the Central Asian project at over 30 billion rubles (including associated agricultural development) (*24*), a figure that, if experience anywhere else in the world is a guide, is only a first installment. Second, until recently, the thrust of the Brezhnev agricultural program pointed away from Central Asia toward the European USSR, and it seemed highly improbable that a project of such magnitude could be adopted for that region, especially since in the mid-1970's the growth of agricultural investment began to taper off. Still another count against the Central Asian project was the potential damage it would do in Western Siberia. In the 1960's, an alliance of geographers and the oil and gas industry defeated a Gidroproekt plan to build a major reservoir on the middle part of the Ob' River (*30*), not far downstream from the proposed diversion point. That episode is unlikely to have been forgotten. Finally, early versions of the Central Asian project alarmed geographers and climatologists, who warned that withdrawing such large quantities of relatively warm water from the inflow to the Arctic Ocean might change climates the world over (*28, 31*). For all these reasons, Soviet sources until recently spoke of the Central Asian diversion scheme as a long-range prospect, and there was no doubt in anyone's mind that the projects in the European USSR came first.

What has apparently changed all that is the vigorous lobbying of southern party leaders and a growing awareness in Moscow of the grave problem of explosive population growth in Central Asia (*9*). The role of party officials as lobbyists for their region was evident in the way the diversions issue was handled at the 25th Party Congress. Two members of the Politburo—Kunaev of Kazakhstan and Rashidov of Uzbekistan—spoke out strongly in favor of transferring water to the Aral Sea basin. Kunaev's argument stressed economic benefits for the entire country:

> [Diversions] will provide explosive industrial and agricultural development of new and exceptionally promising areas, in the interests of the entire Soviet nation (*32*).

His speech was seconded in the same terms by Rashidov, who spoke of the "immense importance to the state" of the Central Asian diversion scheme (*33*), as did First Party Secretary Gapurov of Turkmenistan (*34*).

Two officials from the southern part of the European USSR defended the diversion projects: Bondarenko of Rostov province and Medunov of Krasnodar province, both of whom stressed the importance of diversions for irrigated grain production in the North Caucasus. But curiously, although more water in the Volga would benefit other regions as well, such as Saratov province and the Tatar ASSR, the representatives of those regions had nothing to say on the subject.

It is possible that the intervention of the southern Party leaders actually swayed the Politburo. In his opening report to the Congress, Brezhnev had not mentioned the diversion proposals. In fact the spirit of his words was entirely in the opposite direction: he stressed efficiency and intensification, discouragement of new projects, and rapid completion of old ones (*35*).

But in Kosygin's speech the next day (*36*), detailed studies of all three diversion projects were recommended by the Congress as the basis for the Tenth Five-Year Plan (*37*). Although the importance of saving water and using it more efficiently was also stressed by Kosygin before he mentioned the diversions, what is notable is the diversions finally reached the official agenda.

In the last 4 years the link between Central Asian population growth and water shortages has received an increasing amount of attention in the Soviet press. The preliminary results of the 1979 census show that during the period 1970 to 1979 the populations of the Turkmen, Uzbek, and Tadzhik republics grew by 28, 30, and 31 percent, respectively, compared to 6 percent for the Russian republic (*38*). In the last few years the more alarming implications of the differential growth rates have been addressed directly and publicly by Soviet experts themselves (*39*). The first article explicitly connecting Central Asian population growth to the need for large-scale diversions from Siberia appeared, to my knowledge, in 1975 (*40*), but the demographic problem has since become one of the strongest justifications used by the project's promoters (*41*). Though it is not possible to trace in detail the link between the demographic problem and the need for additional water, one can only note that as the public treatment of the former has grown franker, official support for the latter has grown stronger.

During the spring of 1978, the Central Asian project cleared a major hurdle

when it was approved by a review commission (*ekspertnaia komissiia*) of Gosplan, the powerful State Planning Committee. What this means is that a preliminary plan has now gained official sanction and will serve as the basis for subsequent engineering and economic studies (*42*). The most recent official action on the diversion proposals is a decree of the Party Central Committee and the Soviet Council of Ministers, which takes the first step into actual engineering and economic studies of the diversion proposals both in the European USSR and Central Asia. In this decree, dated 21 December 1978, these projects are given virtually equal billing: the economic and engineering justifications (*tekhniko-ekonomicheskie obosnovaniia*) for the projects in the European USSR are due in 1979, and for the Central Asian project in 1980 (*12*). What is especially striking about the decree is that it contains detailed instructions to various supporting ministries to prepare working models of the new construction equipment and materials that will be needed for the job, and to draw up plans for mass production. Evidently, all of the preparatory steps are being taken to make it possible to begin construction sometime during the decade of the 1980's.

Yet the government has not yet committed itself. The expense would mean a major shift in investment priorities and a degree of commitment to the development of Central Asia that the Soviet regime has never made before. The projects together would be the ultimate expression of the "southern strategy" of development, which leaves many people in the northern regions less than enthusiastic, especially those who favor competing programs in the Ukraine, the nonblack-earth zone, and Western Siberia. The military and their seven supporting industrial ministries presumably have their own opinions about the diversion of so much money, and investment capital in the 1980's will be extremely tight. In a recent article on the upcoming 11th Five-Year Plan (1981 to 1985), Kosygin repeated his views of 2 years before, saying that the diversions are expensive, insufficiently studied, and premature (*11*). The approval of Gosplan's review commission means little more than a preliminary technical approval; many a project has been approved at that level but has never been heard from again. The real fight will begin when the engineering and economic studies now under preparation provide the authorities with something concrete to argue about.

The Role of Technical Specialists and Scientific Advisers

The Party-State decree of December 1978 calls for a full assessment of the environmental as well as social and economic effects of the proposed diversion projects, and recent Soviet articles report an extraordinary mobilization of specialists to study them. More than 120 research institutes and design organizations are involved (*43*), and one often reads in the Soviet press the claim that such technological assessment has never been seen anywhere else in the world. The question is, what is this elaborate technological assessment likely to achieve?

The specialists involved until now can be divided into three broad groups. First, there are engineers and related specialists working for the design institutes attached to the major ministries: Gidroproekt for hydropower and Soiuzvodproekt and Soiuzgiprovodkhoz for reclamation. They have not been blind advocates: in the official journal of Gidroproekt in the early 1970's, for example, there were articles discussing the environmental impact of large diversion projects (*44*), or even questioning the need for any such projects at all (*45*). But the role of these specialists, on balance, is that of boosters for the large projects that are part of their mission.

The second group of specialists consists of locally based scientists working in regional institutes of the various academies of sciences. To this group belong the spokesmen for the interests of the Komi ASSR and Western Siberia, who oppose the projects, and also the Central Asians and the South Russians, who favor them.

The third and most interesting group of specialists consists of geographers and biological scientists located at institutes of the USSR Academy of Sciences in Moscow, especially the Institute of Geography and the Institute of Water Problems. Neither of these institutes expresses only one view on the diversions issue. In the Institute of Geography, for example, M. I. L'vovich, a well-known authority on the world's water resources, mentions the generally beneficial effects of the Siberian diversion project on the environment of Western Siberia (*21*). His equally distinguished colleague at the Institute of Water Problems, S. L. Vendrov, an authority on the environmental impact of large reservoirs, takes the opposite view. The Institute of Water Problems (IVP) is staffed to a large extent by hydrologists, many of them with career experience in hydropower and, to a lesser extent, in reclamation (S. L. Vendrov, for example, worked in inland-waterway transportation institutes for 25 years) (*46*). The Institute of Geography, in contrast, is staffed primarily by professional geographers. If there is a difference in outlook between the two institutes, it is that the IVP is basically well disposed toward large engineering projects. The decree of December 1978 gives IVP the job of lead agency and prime contractor for all research bearing on the size and order of execution of the diversion projects. The Institute of Geography is better known as an environmental defender. Its specialists have fought battles against large projects in the past and have won several of them (*47*).

In sum, the specialists evaluating the diversion projects are a highly varied group, and as time goes on they are becoming more so. There are now demographers and economists working on Central Asian population problems, geologists specializing in oil and gas deposits in Western Siberia and North Russia, climatologists and soil scientists, and even the occasional Americanist who may contribute an article about American diversion schemes. The concern of these specialists over the costs and dangers of the diversions has led to an explosion of environmental research (*48, 49*). But the danger is that a growing share of the research funding is being channeled through the two main agencies designing the projects, Gidroproekt and Soiuzvodproekt, the prime contractors for most of the research effort. If pressure grows to produce results supporting the diversions, the critics may have difficulty in being heard.

The position of the geographers is especially delicate because, although they fear ill effects from the diversion, they are as yet unable to document them; they are also divided among themselves. The matter of possible climatic effects from the diversions is a case in point: Soiuzvodproekt now proposes to divert such a relatively small quantity of water during the first phase of the Central Asian project that it seems unlikely that it could have any effect on the temperature balance or the climate of the Arctic Circle. In the spring of 1978, this view was supported by a sufficient number of specialists to enable the review commission of Gosplan to dismiss the climatic issue as groundless (*42*). However, even those who go along with the Gosplan decision write that the data on which it was based were "quite modest" (*50*). Similarly, ex-

pert opinion is divided over whether the Central Asian project will be favorable or unfavorable to Western Siberia (*51, 52*).

Geographers and their academic colleagues now fear that in the rush to get on with the next stage of the project the environmental aspects will get lost. They point out that most of the scientific and technical organizations mobilized to study the diversion projects are located in Moscow and Leningrad, not on location (*53*). They maintain that information currently available is not enough to enable them to make intelligent decisions (*43*). There is some awareness, for example, that the threat of damage to Western Siberia must be weighed against the possibility of the disappearance of the Aral Sea (with the consequent possibility of dust and salt storms in surrounding regions), but which situation would be worse cannot be determined without more information (*50*). Research institutes in Siberia, according to critics, have been especially slow in getting organized. The powerful Siberian Division of the USSR academy of Sciences has organized a Scientific Council on Water Transfer Problems, a device commonly used by the academy to deal with practical policy problems, but so far the creation of the council has not led to the next step, which would be the organization of laboratories or divisions within existing institutes to do research on the effects of the transfers (*54*). One problem may simply be that it takes a year or two to make significant alterations in a Soviet institute's research plan, and the scientists may have been caught by surprise when the formerly long-range project suddenly began to move (*55*). Another problem may be found in the language of the December 1978 decree, which does not provide for specific funding but leaves general responsibility for financing the necessary research to the major organizations involved. Such vague instructions, on past form, may well lead to underfunding of the research required on the environmental impact of the diversion projects.

Thus it appears that the latitude enjoyed by technical specialists to criticize or oppose the diversion projects has become hostage to the projects' political priority. So long as the major backers were competing against one another and the political leadership favored the intensive strategy anyway, specialists in all fields could criticize the projects freely and hope to have an impact. But now the West Siberians and the North Russians are moderating their criticism in print, institute directors, such as IVP's Voropaev, are going along with the stepwise approach now proposed by the projects' backers, and the leadership of research is passing into the hands of the prime contractors—that is, the very agencies in charge of developing the project designs. Meanwhile, scientists who are concerned about the long-term effects of the diversions find themselves at a disadvantage because their own research will take a long time to reach the stage at which they can back up their disquiet with hard facts. Consequently, while at earlier stages the advice of specialists manifestly played a part in altering the initial project designs, the window for effective influence may now be closing. Perhaps the greatest single force keeping it open is the tightness of investment capital, which makes a full-scale commitment by the leadership unlikely in the near term.

Conclusion

The river diversion issue is perhaps the most remarkable example of a phenomenon to which Western observers of Soviet politics have been calling attention for some time: that policy debate in the Soviet Union is remarkably open under some circumstances and can actually affect official policy. Yet what this case also demonstrates is that when the political stakes begin to rise, scientists are not in a strong position to maintain their influence.

An even more remarkable feature of the river diversion issue is that events have gradually rushed the political leadership, over the course of a decade, closer and closer to adopting a course of action it initially thought of as far over the horizon. How did that happen? Two separate forces appear to account for the recent stepping-up of the diversion projects. First, the implementation of intensive water-saving measures in the southern half of the country is proceeding much more slowly than the leader's goals for the region require. Though these programs have been vigorously pursued, they have so far cost more and achieved less than the leadership evidently hoped for. But as the intensive strategy loses ground, the "extensive" strategy—bringing in more water from outside—grows more and more attractive.

The second force, which accounts particularly for the remarkable advance of the Central Asian diversion project, is the growing alarm reflected in Soviet press and official speeches over the population boom in Central Asia and the limits to growth imposed by scarce water. While additional water alone will not resolve the dilemmas of employment in Central Asia (*56*), the lack of water sets the ceiling beyond which no growth can take place, and hence it is emerging as one of the most serious problems confronting Moscow.

Agencies and individuals have aggravated these problems by failing to respond satisfactorily to the leaders' bidding. Agencies fail to save water; Central Asians do not leave the farm; Russians do not have more children. The leaders are failing to get their way at the pace and price they want, and in that sense one may say that their power, as absolute as it may appear, yields to the "tyranny of small obstructions." Some will find in that fact evidence that "interest groups make a difference" in Soviet politics. That misses the point. It is certainly true that the case for the diversion projects has been vigorously argued, in some cases for decades, by powerful agencies and republic officials, including some of the top members of the Party apparatus. But what seems to have swayed the political leadership is not so much the power of groups or regions as the force of circumstances, which impels the leaders to take steps to defend their own top priorities, especially the southern agricultural programs.

The contribution of technical advisers has been to document and publicize problems of existing resource and population policies and to call attention to the possible consequences of alternative courses. In this particular case their participation has been, at least until now, as vigorous and public as it might have been in the United States. But it was a very special political conjunction that enabled specialists to voice their views and find allies. As circumstances change we can observe the increasingly constrained position of the experts, for they have no independent bases of power or means of publicity once the political leadership commits itself and is no longer receptive to debate on every side of the question.

The importance of foreseeing the long-term consequences of major technological undertakings is as well understood in the Soviet Union today as it is in the United States, and the concept of technology assessment has become part of the official language of both countries (*57*). But the crucial test of such assessment is whether it can withstand political pressure. The outcome of the river diversions debate in the Soviet Union will tell

us a great deal about the authority of scientific advice in Soviet policy-making and the capacity of technical experts to adopt and maintain independent political positions.

References and Notes

1. United States Congress (Senate), Committee on Public Works, Special Subcommittee on Western Water Development, *Western Water Development: A Summary of Water Resources Projects, Plans, and Studies Relating to the Western and Midwestern United States* (Government Printing Office, Washington, D.C., 1966). Soviet specialists have followed with interest the fate of the NAWAPA project and the increase in environmental regulation in the United States. The fact that environmental opposition has brought a halt to such projects has not been lost on Soviet geographers. For an example of a Soviet description of the American situation, see the account of a symposium held at the International Institute for Applied Systems Analysis, in *Vodn. Resur.* (No. 3) (1979), pp. 199–203.
2. T. Gustafson, *Probl. Communism* **28**, 45 (January-February 1979).
3. These are the drainage basins of the Azov, Black, Aral, and Caspian seas.
4. S. L. Vendrov and I. S. Glukh, in *Voprosy preobrazovaniia prirody russkoi ravniny* (Institute of Geography of the USSR Academy of Sciences, Moscow, 1973), pp. 171–173. For a forecast of consumptive demand for water in the Caspian basin, see A. S. Berezner, *Vodn. Resur.* (No. 1) (1979), pp. 7–14.
5. *Pravda Vostoka*, 17 August 1978.
6. See T. Gustafson, *Publ. Policy* (summer 1977), pp. 293–312; P. P. Micklin, *Soviet Geogr. Rev. Transl.* **19** (No. 1), 1 (1978).
7. T. Gustafson, in *Soviet Politics under Brezhnev*, D. Kelley, Ed. (Praeger, New York, 1980).
8. For example, see Brezhnev's review of the agricultural situation at the July 1978 plenum of the Central Committee of the CPSU in *Pravda*, 4 July 1978.
9. S. E. Wimbush and D. Ponomareff, *Alternatives for Mobilizing Soviet Central Asian Labor: Outmigration and Regional Development* (R-2476-AF, Rand Corporation, Santa Monica, Calif., November 1979).
10. P. P. Micklin, *Can. Geogr.* **18** (No. 3), 199 (1969); *Soviet Geogr. Rev. Transl.* **18** (No. 2), 81 (1977); *Environ. Manage.* **2** (No. 6), 567 (1979); *Geogr. Mag.* (July 1979), pp. 701–706.
11. A. N. Kosygin, *Planovoe Khoziaistvo* **7**, 13 (1979).
12. Central Committee of the CPSU and USSR Council of Ministers, Decree issued 21 December 1978, No. 1048, *Sobranie postanovlenii pravitelstva SSSR, No. 4* (1979), pp. 90–95.
13. G. L. Sarukhanov, *Tr. Gidropr.* **16**, 446 (1969); V. P. Repkin, *ibid.*, p. 547; *Ekon. Gaz.* (21 February 1961), p. 3.
14. P. P. Micklin, *Water Resour. Bull.* **10** (No. 3) (June 1974), pp. 565–572.
15. T. Gustafson, in preparation.
16. For reviews of the anticipated environmental impact of the early version of the Pechora project, see G. I. Varlamov and A. F. Anufriev, *Problemy ekonomiki Komi ASSR* (Trudy Komi filiala AN SSSR, No. 20) (Syktyvkar, 1970), pp. 52–55.
17. L. A. Brattsev, V. A. Vitiazeva, V. P. Podoplepov, *O vlianii perebroski stoka severnykh rek v bassein Kaspiia na narodnoe khoziaistvo Komi ASSR* (Akademiia Nauk SSSR, Komi filial, Leningrad, 1967).
18. L. A. Brattsev and V. A. Vitiazeva, *Izv. Komi Filiala Geogr. Obshch. SSSR*, tom II, vyp. 2 (12) (1970), pp. 3–5.
19. This account of the institutional background is based on interviews conducted at the Institutes of Geography and Water Problems, USSR Academy of Sciences, in Moscow in 1972 and 1973.
20. I. A. Gerardi, *Gidrotekh. i Melior.* **11**, 112 (1973).
21. M. I. L'vovich, *Izv. Akad. Nauk SSSR Ser. Geogr.* **2**, 22 (1977).
22. S. L. Vendrov and I. S. Glukh, in *Voprosy preobrazovaniia prirody russkoi ravniny* (Institute of Geography of the USSR Academy of Sciences, Moscow, 1973), pp. 174–177.
23. *Vodn. Transport* (2 July 1977), p. 4. Gidroproekt is still calling for both versions to be executed simultaneously.
24. G. Voropaev, *Izvestiia*, 13 August 1978.
25. In the 1970's, as the Soviets gradually became aware of impending energy shortages, especially in the European USSR, the political fortunes of hydropower were revived, and it is probably no longer acceptable to think of expending electrical power to pump water.
26. V. Podoplepov and A. Brattsev, *Literaturnaia Gazeta* (No. 46) (17 November 1976), p. 10.
27. See, for example, I. A. Gerardi, *Pravda Vostoka*, 6 October 1974.
28. S. L. Vendrov and K. N. D'iakonov, *Vodokhranilishcha i okruzahaiushchaia prirodnaia sreda* (Nauka, Moscow, 1976), pp. 122–123; S. L. Vendrov, "Problemy territorial'nogo raspredeleniia rechnogo stoka," *Izv. Akad. Nauk. SSSR, Ser. Geogr.* **1**, 38 (1975).
29. G. G. Gangart, *Gidrotekhn. Stroit.* **8**, 10 (1971); translated in *Soviet Geography* **13** (No. 9) (November 1972), and related articles in the same issue.
30. *Kompleksnoe osvoenie vodnykh resursov obskogo basseina* (Nauka, Novosibirsk, 1970). See especially pp. 7–23 and 237–249.
31. P. P. Micklin, *Sov. Geogr. Rev. Transl.* **18** (No. 2) (February 1977), p. 95 and the collection published by the Arctic and Antarctic Scientific Research Institute, *Otsenka vozmozhnykh ismenenii rezhima nizov'ev i ust'ev rek arkticheskoi zony Zapadnoi Sibiri pod vliianiem vodokhoziaistvennykh meropriiatii* (AANII, Leningrad, 1976).
32. Speech of D. A. Kunaev, *XXVyi. s"ezd* **1**, 142 (1976).
33. Speech of Sh. R. Rashidov, *ibid.*, pp. 179–180. Rashidov's strong interest in the Central Asian diversion project continues, evidenced by his presence, together with the presidents of all five of the Central Asian Academies of Sciences, and 600 other official participants, at a scientific conference on diversions held in Tashkent in April 1978. See a report in *Vodn. Resur.* (No. 2) (1979), pp. 197–199.
34. Speech of M. G. Gapurov, *XXVyi, s"ezd* **1**, 348 (1976).
35. The speeches of the southern Party officials suggest that they may have been trying to reverse an unfavorable verdict. Kunaev said, "The time has come, comrades, to examine the problem of the Aral." Rashidov added, "We ask the CPSU Central Committee and the USSR Council of Ministers to decide the question of completing during the coming five-year plan all the scientific studies, surveys, and hydro-engineering design work for the diversion . . ." Gapurov in his speech referred to "Comrade Rashidov's suggestion to accelerate a practical resolution of the question. . . . We support this suggestion." Bondarenko, talking about the European projects, used similar language: "We support the suggestions made here earlier, that the time has come to determine concrete measures . . ."
36. Speech of A. N. Kosygin, *XXVyi. s"ezd* **2**, 38 (1976).
37. That item was apparently judged sufficiently important by the audience (or by the editors of the transcript) to warrant a burst of official applause.
38. *Pravda*, 22 April 1979, p. 4. For Western discussions of this issue see, for example, G. Hodnett, in *Soviet Politics and Society in the 1970's*, H. W. Morton and R. L. Tokes, Eds. (Free Press, New York, 1974), pp. 60–117; M. Feshbach and S. Rapawy, *Soviet Economy in a New Perspective* (Government Printing Office, Washington, D.C., 1976), pp. 113–154.
39. One of the first Soviet works devoted explicitly to projections of future population levels is G. A. Bondarskaia, *Fertility in the USSR: Its Ethno-Demographic Aspect* (Moscow, 1977).
40. *Pravda Vostoka*, 24 April 1975.
41. See, for example, *Pravda Vostoka*, 17 August 1978 (interview with K. I. Lapkin, corresponding member of the Uzbek Academy of Sciences). An account of a scientific conference held in Tashkent in April 1978 refers to "the rapid rate of population growth, together with its low mobility, which engenders a serious social problem of rational use of the region's labor resources." See *Vodn. Resur.* **2**, 197 (1979).
42. *Pravda Vostoka*, 30 April 1978.
43. G. Voropaev, *Sotsialisticheskaia Industriia*, 7 August 1979.
44. F. Ia. Ukrainskii, *Tr. Gidropr.* **29**, 154 (1973).
45. L. G. Goruleva, *ibid.* **17**, 214 (1969).
46. *Vodn. Resur.* **6**, 196 (1978).
47. The differences between the two institutes should not be overstated. For example, during the 1970's Vendrov moved from the Institute of Geography to IVP.
48. R. V. Donchenko *et al.*, *Vodn. Resur.* **1**, 30 (1977).
49. P. Micklin, *Environ. Manage.* **2** (No. 16), 567 (1979).
50. N. Nekrasov and N. Razin, *Pravda*, 11 June 1978. In 1977, V. V. Ivanov, a specialist at the Arctic and Antarctic Scientific Research Institute, wrote that the state of knowledge "was still insufficient for a well-substantiated evaluation of the change resulting from a partial withdrawal of streamflow." *Vodn. Resur.* **5**, 194 (1977). It is important to note that the issue is data concerning the possible meso- and macroscale changes resulting from the changes. Soviet scientists have already fairly conclusively documented the likelihood of many important local environmental effects, particularly associated with downstream flow reduction and the long-term effects of reservoir construction.
51. For articles emphasizing the virtues of the diversion project in improving the drainage of Western Siberia, see I. A. Gerardi, in *Kompleksnoe osvoenie vodnykh resursov obskogo basseina* (Nauka, Novosibirsk, 1970), pp. 24–29. The same viewpoint is expressed in M. I. L'vovich, *Izv. Akad. Nauk (Ser. Geogr.)* **2**, 22 (1977). In a subsequent article, L'vovich seems to argue the other side, pointing out that even under present conditions of water use, the area covered by swamps in Western Siberia is growing by 100 km^2 annually [M. I. L'vovich, *Priroda* **3**, 100 (1978)]. On the negative side, see A. Ianshin, V. Saks, V. Shirokov, *Sotsialisticheskaia Industriia*, 7 December 1976, p. 2; S. L. Vendrov, *Izv. Akad. Nauk (Ser. Geogr.)* **1**, 35 (1975). S. L. Vendrov is an opponent of the Central Asian plan; see S. L. Vendrov and K. N. D'iakonov (*28*, p. 123). According to one study, large canals in the Soviet Union, on past form, lose about 10 percent of their water along the way. According to present designs, seepage and evaporation from the Central Asian diversion project could amount to as much as 500K acre-feet (8 km^3) yearly. [See M. S. Ivanov, L. S. Ivashenko, F. V. Stol'berg, *Problemy okhrany vod* **4**, 68 (1973)]. A. G. Aganbegian agrees, and calls the official forecasts of water losses too low [see *Vodn. Resur.* (*41*, p. 198)]. Still another negative reaction comes from a West Siberian reclamation official [see Rusinov (*52*)].
52. I. Rusinov, *Trud*, 6 December 1977.
53. Of the 100-odd institutes involved in assessment of the project, some 20 are located in Kazakhstan and Central Asia [see *Vodn. Resur.* (*41*, p. 198)]. This is not the result of a sinister design on the part of the design agencies, but simply a reflection of the fact that most research and design institutes, and certainly the best ones, happen to be located in the two largest cities.
54. V. Kiriasov and V. Mezentsev, *Pravda*, 26 October 1978.
55. For example, Abel Aganbegian, director of the Institute of the Economics of Industrial Production in Academic City, told a group of visiting Americans in October 1976 that he had been requested to take on part of the analysis of the impact of the Central Asian project, but that he had refused on the grounds that he did not have anyone qualified to undertake the assignment—this despite the fact that Aganbegian had the reputation among his colleagues as an opponent of the diversion scheme. Nevertheless, 2½ years later Aganbegian appeared to be heavily involved in the economic and social evaluation of the project.
56. See J. Azrael, *Emergent Nationality Problems in the USSR* (R-2172-AF, Rand Corporation, Santa Monica, Calif., September 1977).
57. The most remarkable recent example of that fact is the recent appearance of an article in *Kommunist*, the official biweekly of the Central Committee of the CPSU, on the environmental hazards of nuclear power development in Soviet cities [see N. Dollezhal' and Iu. Koriakin, *Kommunist* (No. 14) (1979), pp. 19–28; N. Dollezhal', *Sotsialisticheskaia Industriia*, 27 October 1979].
58. This article is adapted from a book to be published by Cambridge University Press.