Some Problems of Expanding Agriculture With Irrigation In the Desert Zone of Soviet Central Asia

RALPH D. CROSS, Oklahoma State University, Stillwater

The need for increased agricultural production in the Soviet Union is becoming more and more apparent. Despite the fact that nearly half of the nation's population is engaged in tilling the soil, the country still suffers a deficit in many of the basic agricultural commodities. The need for the Soviet Government to import wheat from the West is a case in point.

Part of the difficulty arises from the limitations imposed by the natural conditions. However, agricultural production is further restricted by the present administrative policy of poor planning and inadequate financial investment. Most of the area that is best suited for agriculture is already under cultivation and, since 1913, the primary method of increasing agricultural production has been to increase acreage. This practice has not been entirely satisfactory, since most of the newly cultivated land is marginal or submarginal, thus increasing the potential of excessive erosion and boosting the need for large quantities of fertilizers of which there is a current shortage in the Soviet Union.

The alternative to increasing acreage as a means of raising agricultural production is the intensification of land use, and the Soviets are gradually giving more and more attention to this technology. One type of intensive agriculture, irrigation, is becoming increasingly important, especially in the Desert Zone of Soviet Central Asia.

It is the purpose of this paper to point out a few of the problems that the Soviets have encountered in their attempt to expand agricultural production with irrigation on the lands of Soviet Central Asia, and to analyse a few of the proposed and activated solutions. The area under study here is a region that has been classified as the Desert Zone by Berg (1950) (Fig. 1).

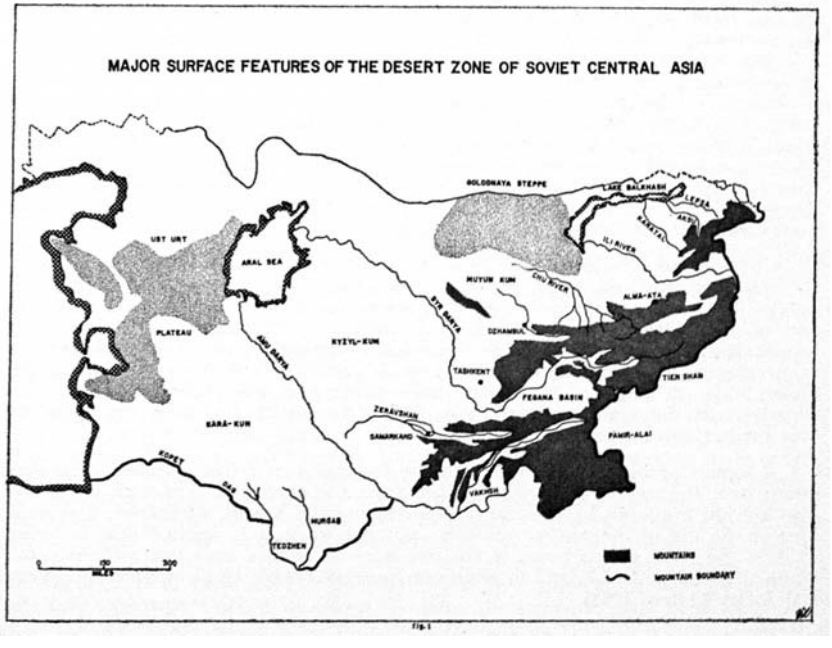

Figure 1

Problems of Water Supply

The area under consideration is a desert basin with high mountains on three sides, which account to some extent for the aridity. The Tien Shan, Pamir-alai, Kopet Dag, and Caucasus mountains, beyond the Caspian sea, act as a barrier to the warm moist winds emanating from the Arabian and Mediterranean Seas. The moisture is precipitated from these winds as they ascend the windward slopes of the highlands, and on the leeward slopes, compression causes a rise in temperature, thus increasing the potential evaporation in the Basin. As a result this region is the most arid area in the Soviet Union. Precipitation averages from four to eight inches annually, but because of the high summer temperatures and the dryness of the air, the potential evaporation is probably 10 times that much. In addition to the paucity of precipitation, the rain comes during the winter season, with very little rain falling during the summer months when it is needed most. Thus the basic problem for irrigation is an available source of water.

The principal source of water for irrigation in Soviet Central Asia is from the streams flowing from the mountain areas. There are five major rivers and several smaller streams which supply the necessary water. The Amu-Darya and the Syr-Darya are the largest, and the only two streams which flow through the desert for their entire course and enter a permanent body of water, the Aral Sea. The other streams terminate in the sands of the deserts, some of them ending in lakes which dry up during part of the year, or traverse the desert region for only part of their course. The other important rivers are the Chu, Naryn, Zeravahan, Ili, and Talass.

The volume of water carried by these streams is affected by climatic variations from year to year and lack of water at the necessary time could greatly hinder agricultural irrigation. Fortunately, however, the stream flow is not wholly dependent on the scanty and erratic distribution of precipitation.

Most of the water carried by the streams comes from the accumulations of ice and snow on the mountain slopes. Actually, two sources are available here, since the water supply is dependent on the time of melting. The snows of the lower slopes melt in the spring or early summer, thus supplying water to the streams at the onset of the agricultural season. The ice and eternal snows of the higher slopes melt in the late summer, as late as August, and furnish a second supply of water. The larger streams flowing from the Tien Shan and the Pamir-alai Mountains, therefore, carry water throughout the summer with an increased flow twice during the year. The streams flowing from the Kopet Dag (mountains of lower elevation with no accumulations of firn snows) have, at times, a water deficiency. They reach their maximum level during the spring and there is no additional supply of water for late summer irrigation.

Under these conditions one method to insure a yearlong supply of water is to dam a stream and form an artificial lake or reservoir to collect and store water until it is needed. For example, a power station on the Syr-Darya near the city of Leninabad was completed in December 1957. This dam, the Kayrak-Kumskaya, forms the Tadzhikskoe Sea which supplies water for 400,000 hectares of previously nonirrigated waste land, three-fourths of which is located in the Uzbek S.S.R. In addition, the Soviets have constructed still another reservoir, the Chardara, in the southern Kazakhstan Oblast, to collect and store water for an area further down stream.

A second problem, associated with the formation of artificial lakes, is an economic one; the cost of constructing such dams and reservoirs. Although exact figures are not available for the cost of constructing the Kayrak Kumskaya, a general idea of the size of the project becomes apparent when it is realized that in order to dam the river at this point it was necessary to remove over two million cubic yards of gravel and rock, and to pour nearly 400,000 cubic yards of concrete. (Central Asian Review, 1963).

Despite the costs involved in increasing agricultural irrigation, the Soviets apparently intend to go ahead with their expansion. They have proposed rather

elaborate plans for the construction of dams, reservoirs, canals, drainage ditches, etc., some of which have already been completed. There are also recent indications that the necessary funds will be made available for further expansion.

As can be seen, the extension of irrigation is limited by the amount of water available. Recently, a Russian geographer, Avsyuk (1963) advocated a scheme for increasing stream volume by the artificial melting of glacial ice. His scheme is relatively simple and has been used before but not on the large scale which he proposes. Avsyuk suggests the dusting of glaciers with some dark material, such as coal dust, to increase the absorption rate of solar radiation and thus increase melting. However, this project is still in the testing stage, and it will require a great deal of research and experimentation before it can be put into practice. Avsyuk is cognizant of the fact that his scheme of intensifying melting could lead to an eventual depletion of "frozen" water and result in a decrease in stream flow.

If the Soviets are able to employ this method successfully and are able to regulate the melting of glaciers, it is conceivable that they can greatly increase the number of acres irrigated. Water could thus be provided during the otherwise dry parts of the year and stream flow could be increased in extremely dry years. Therefore the scheme could be a very valuable asset as long as it is regulated and the store of water is not diminished too rapidly.

A third possible supply of water can be obtained by snow retention. This process of preserving a water supply is accomplished by using machines to pack snow into ridges to retard spring melting and run off. The amount of water retained in this manner is not large, but it is a means of preserving and stretching a limited water supply in a very arid agricultural area.

Artesian wells which flow from underground sources offer tremendous possibilities for irrigation. These underground reservoirs result from water that sinks into the sand of the desert from springs, streams, and aquifers carrying moisture from the mountains. The Soviets estimate that three-fourths of the area of Kazakhstan is underlain by an underground "sea" and that similar reservoirs underlie the Republics of Uzbekistan, Tadzhikistan, and Turkmenistan. According to the Soviets, the Muyunkum Sea covers nearly 20,000 square miles and lies 3,000 to 3,800 feet under an erg desert of the same name. The Kzylkum conceals a still larger sea which contains 327 billion cubic yards of water, lying 700 to 3,000 feet under the surface (Central Asian Review, 1963). There are also other similar reports which indicate that more of these underground seas are present. It is a well known fact that the Soviets tend to exaggerate the quantity of natural resources, but if there is any truth to the reports, even partial truth, and if they can manage to bring the water to the surface economically, the irrigation potential is tremendous. It would enable the Soviets to create flourishing farm land from heretofore nonirrigable land because of its distance from the streams.

The possibility that these ground water resources actually exist is very good. First, the presence of the reservoirs is possible because of the basin nature of the desert area. Thus it could be a collecting area for waters which seep into the dipping aquifers originating in the mountains. The enormous size of the underground seas reported by the Soviets is questionable. Even though the seas may cover vast horizontal areas, the actual quantity of water would depend on the thickness and porosity of the aquifer. Moreover, bringing this water to the surface may very well be uneconomical. The cost of equipment, of sinking wells, and of pumping the water to the surface could be more than the Soviets wish to invest, especially since it has not been their policy to invest large sums of money in agricultural schemes for other than political reasons. Finally, the usability of the water is dependent on the mineral salt content. It is possible that some of the reservoirs have a high saline content, although the Soviets have reported many of them as fresh water resources. Water containing a small salt content would be detrimental to crops over a period of time but it could be used in a stock breeding enterprise without ill effects. To date, the reservoirs have been used very little if at all, except where they reach the surface under their own force. However, if they can be utilized to the fullest extent the Soviet dream of irrigating 60 million hectares could become a reality.

Still another source of water, even though a minor one, is the water resource peculiar to Central Asia called "returning rivers." The moisture comes mainly from water that has been used for irrigation and has seeped into the sand, appearing at a lower level or in an old stream bed. This reclaimed water may be a minor resource, but it still plays an important part in the present irrigation system. For example, in such places as the Fergana Valley, the returning rivers furnish 30 per cent or more of the total resource for irrigation (Central Asian Review, 1963).

Miscellaneous Problems

Additional problems other than those associated with the initial source of supply are also prevalent. One serious problem is the loss of water from streams. The sudden decrease in gradient at the junction with the plains often causes the rivers to overflow their banks. When this happens, the water is frequently spilled over nonirrigated land and is lost to agricultural use. Even if flooding does not occur, some surface moisture is lost through evaporation resulting from the high temperatures of the desert areas. Seepage accounts for additional losses from both the sides and bottoms of the rivers. Another water loss is associated with the reduction of stream gradient at the junction of the mountains and the plains. When the velocity of the stream is checked at this junction the sediment carried by the stream is deposited. This depositional debris often causes the rivers to alter their courses and makes it difficult to maintain diversion canals. Constant dredging is necessary to keep the canals clear of sediment so the water can be distributed over the cultivated land.

The soil-water problem is mainly one of salinity. Thus, in some instances, the problem of agriculture in this region is one of reclamation as well as irrigation. If the water used has a relatively high mineral salt content, the percentage of salt in the soil will continue to build until the land is useless for agriculture. The saline content of soil is further increased by the plants which do not take water and other constituents from the soil in the same proportions that are present. The plants will absorb water but they tend to leave most of the salt in the soil. One of the most effective methods of reclaiming saline soil is to flood the area and allow the water to leach the salt from the top soil and then drain the subsoil water into collection ditches.

To alleviate salination, the Soviet planners have proposed the lining of canals and more exact water budgeting to reduce seepage. The effect produced by the lining of canals is obvious and the latter process is relatively simple. In addition to rationing the water applied, water budgeting involves the measurement of the water and its salt content at the point where it enters the irrigation canal, measurement at another point prior to dispersal into the diversion channels, and again on the drainage canal just before the water re-enters the stream. In this way the input and the output of salt can be measured, and the salt balance or the approximate amount of salts remaining in the soil can be calculated. Then the amount of water needed to leach the salt to a level where it will not add to the concentration of salt in the top soil can be computed.

Another method of preventing a rapid build-up of salt in the soil is the utilization of collector canals. The collector canal is usually a very large drainage ditch and its purpose is to collect superfluous surface and subsurface water from the fields before the excess salt is precipitated into the soil.

Administrative Problems

The problems of administration for the development and reclamation of land for irrigation are important. The Soviets have made great plans to expand irrigation, and in some respects have done so despite the fact that the area that is irrigated today is not much more extensive than it was in Tzarist times. The reason for this is because much of the expansion thus far has involved only the reclamation of old irrigated areas that existed in pre-Revolution days.

One administrative problem is the delegation of responsibility for controlling the irrigation project. There seems to be no set standard of operation. Sometimes

the responsibility is left to the individual collective or state farm, or it may rest with an oblast, a rayon, or even the republic, all with a varying amount of direction from the national level. In the case of the state or collective farm, the progress is slow and on a very small scale. The oblast and rayon irrigation works, although larger in area, are still small-scale and not much better organized than the farm projects. Thus it would seem best to leave the project administration to the republic or on the national level.

Even at the republic level of administration problems arise. When an area is to be administered by two adjoining republics, often neither can determine just what its function is. The Chu River area is an example, since the river serves both Kirghizia and Kazakhstan the question of which republic is in charge arises. Another example is the southern Golodnaya Steppe which was formerly administered jointly by Kazakhstan and Uzbekistan. Now, however, national directives have placed it completely under the jurisdiction of Uzbekistan.

The other major problem of government control of irrigation is the lack of capital investment. Since the Revolution in 1917, the Soviets have poured most of their resources into developing heavy industry. In addition space research and defense have received top priority for Soviet planning since World War II when the Soviet Union become a contender for world power.

Because of these policies agriculture has been relegated to an inferior position in the economic structure as far as investment is concerned. The current crisis in agriculture is partly the result of this position. Irrigation agriculture has suffered, but not to the extent that some other agricultural enterprises have.

The ultimate expansion of irrigation depends on the Soviet Government. It will most likely take a big policy change in their economic administration to accomplish very much. During the Khrushchev administration there were indications that the importance of agriculture to the economy was at last recognized, and that a change in policy was forthcoming.

A plan for diverting 40 billion rubles to the chemical industry for the production of fertilizers, and 20 billion rubles to a long-range irrigation project extending over a seven-year period has been proposed. Soviet planners say that the diversion of capital to agriculture will not interfere with the Soviet Union's defense. However, American observers say that the Soviets will have to cut back defense or space appropriations in order to establish the necessary capital for agriculture. In any case it is obvious that the Soviet Union is at long last beginning to make attempts, or at least proposals, to solve a problem that has confronted them since the communists came to power.

Conclusions

Basically there seems to be two major problems facing the expansion of agricultural irrigation in Soviet Central Asia. One is the need for the necessary quantity of water to be in the right place at the right time. Apparently enough water is available to make the Soviet's plans for the area a reality. Thus the main difficulty is collecting and storing the water and distributing it to the areas where it is needed most. In order to do this, a means of controlling stream flow must be constructed, an expanded irrigation network to divert water from the main streams to the fields must be built, and a way to utilize underground resources economically must be found.

The second major problem is government administration and investment. To accomplish the above, better government management must be realized, and more and more capital has to be diverted to agriculture. The Soviets, after several years of agricultural deficits, now seem willing to sacrifice investments in order to make agriculture a success.

With increased investment in agriculture a possibility, the future of irrigation in Soviet Central Asia looks very promising. Undoubtedly, the Soviets will achieve their goal of bringing an additional 28 million hectares under irrigation. Moreover the chances of their approximating the speculative 60 million hectares in the

distant future does not seem wholly impossible; in fact, it seems rather feasible if it can be assumed that their statistics are reliable and their proposals are workable.

References Cited

Avsyuk, G. A. 1963. Artificial intensification of the melting of mountain glaciers to increase the stream flow in Central Asia. Soviet Geography: Review and Translation IV: 46-51.

Berg, L. S. 1950. *Natural Regions of the U. S. S. R.,* The MacMillan Co., New York.

Irrigation in Central Asia: Part One, Cent. Asian Rev. VIII: 44-51. 1963.