
IRRIGATION--WHAT IS ITS FUTURE?

The subject assigned to me for discussion by your Chairman is an interesting one. In the limited time available, and with your permission and indulgence, I would like to discuss some of the over-all aspects of the future of irrigation, so that we may consider the question in broad perspective. Secondly, I would like to indicate what you as managers of water user organizations and as individuals might do.

We are all aware that the population of both the United States and of the Western States has increased, and is expected to continue to increase. However, the West has been increasing at a greater rate than the Nation as a whole. The Nation's population by year 2000 is expected to be more than double the present population of the country. Also, by year 2000, the 17 Western States' population is expected to be about 1-1/2 times the present 44 million persons, and the four states of Colorado, Kansas, Nebraska, and Wyoming, which you represent will be about 88 percent greater than it is today.

These population increases, National, Regional, and local, will create future heavy demands for the products of agriculture and will require the creation of job opportunities for these new citizens.

The cropland base of our country has remained relatively constant since about 1920. We have about 400 million acres of useable cropland but the Department of Agriculture advises that we are losing more than one million acres of agricultural land to nonagricultural uses each year. The number of farms is declining, farms are getting larger, and efficiency of farm workers continues to increase.

Within this context of agricultural resources available for future generations, I would like to point out that the Department of Agriculture reports that 49 million acres, or about one-eighth of the cropland base, is represented by lands that are severely limited for cultivation and should be used only in long time rotations. Additionally, another 40 million acres are not ideally suitable for cropland. Thus, in terms of 40 years hence, we must realize that, if current trends continue and if needed land use adjustments are made, we will lose 40 million acres of present cropland to nonagricultural uses, and we should remove or limit production on 89 million acres. This would reduce the total agricultural base resources by about one-third. This is a staggering prospect when we know that much of the world's population today suffers from malnutrition and hunger.

The Department of Agriculture has reported to the Senate Select Committee on National Water Resources that by 1980 our domestic and export needs for agricultural commodities likely will be 60 to 90 percent above the 1954 levels.
By year 2000, the total domestic and export needs have been estimated at 90 to 190 percent above the 1954 level. This need ranges from double to triple the 1954 production level. We are told that to meet these needs will require a 75 percent increase in crop yields, plus 63 million additional acres of equivalent cropland. The land-use shifts to accomplish this would involve a loss of 31 million acres of pasture land and the clearing of 73 million acres of forest land, or about one-fourth of the land growing timber products. This adjustment in forest land was, of course, not recommended.

About two years ago, the Senate Select Committee on National Water Resources asked the Bureau of Reclamation for a report on potential irrigation developments during the next 40 years for the 17 Reclamation states. We examined over 1,000 potential projects offering the long-term potential development equivalent to 17 million acres of new land. This represents a formidable development, being more than double the area served by Bureau facilities constructed in the past 59 years. However, it represents only a minor part of the total gain in production needed for year 2000 to meet projected needs.

After its study of some 32 reports by various agencies and Departments, the Senate Select Committee on National Water Resources reported that if the projected population and economic activity levels are to be attained, full development of all available resources will be required by 1980 in 5 of the 11 principal water resource regions of the Western States. By year 2000, full development will be needed of two additional western regions.

The foregoing is a framework for consideration of what the water needs of the country, in particular the West, will be in the future and what has to be done to ensure that future generations do not find their economic progress stymied by the failure of this generation to take appropriate action. How can the need be met?

Historically, irrigation has been the largest user of the Nation's water resources. Even today irrigation use accounts for approximately 42 percent of total withdrawals of water from streams and wells. Most of the water that you use for irrigation today has already fulfilled numerous uses upstream, such as power, recreation, fish and wildlife, navigation, and possibly dilution of upstream pollution. As water resources become more completely developed and utilized, you will be competing more and more with municipal, industrial, and other demands for the limited supply.

In many areas of the West the greatest potential "new supply" of water must come from the conservation and more efficient use of existing supplies. Conservation efforts can be most effective when individuals and groups such as you represent become convinced that conservation practices are a sound financial investment.

I think it is appropriate to consider here today the action programs that could be undertaken in the light of (1) activities best approached by group effort; and (2) other responsibilities or jobs more properly resolved by the individual's effort.
In regard to the group effort that should be undertaken, it is most essential that we continue the type of liaison that is taking place here today to spearhead discussions and support every phase of effort leading to the improvement of water management and utilization. This group and its member groups, for instance, should lead in the support for water and land conservation research programs by the Federal, State, and local Government bodies. Conservation solely for posterity is seldom attractive to the present generation. Only when conservation becomes a sound financial investment does it become really attractive. To make the conservation dream a sound financial undertaking to the individual requires research to discover and develop economical methods and materials which he can adopt and apply.

It is not news to most of you that irrigation systems deliver to the farms only about 2/3 of the water supplies diverted from the streams. This waste of approximately one out of every 3 acre-feet of the water constitutes one of the most readily available sources of increased water supply for existing projects.

One of the ways by which a large proportion of this waste could be avoided in some of the older irrigation areas is by combining, rerouting, and tightening up the supply systems. For example, the planning engineers in the Region 7 office of the Bureau have made a reconnaissance study of a typical area not far north of Denver, Colorado, where the problem of overlapping and duplicating ditch systems exists.

The sample area studied contains eight canals on the north side of St. Vrain Creek, all heading within a distance of about four miles. The upper four canals are within a distance of 300 feet. Two of those canals use the same diversion dam. The eight canals have a combined length of about 100 miles and a combined capacity of approximately 900 second-feet. The individual canals range in capacity from 20 second-feet to 425 second-feet. All of the canals have steeper grades than necessary and are eroded badly in places. The eight canals supply laterals that have an estimated combined length of 200 miles and serve approximately 54,000 acres of land.

By reorganizing the systems it was figured that the length of main canals could be reduced by about 48 miles; a reduction of 50 percent. About 150 acres of land could be returned to cultivation. Naturally, significant operation and maintenance economies could be effected due to the consolidation and simplification. The reorganization would result in a significant saving of water. No estimate was made of the extent of reduction of seepage and other losses but they obviously would do well worth while.

A similar study of a portion of the Cache la Poudre drainage was made by the Civil Engineering Department of the Colorado State University at Fort Collins. The Area involved constituted about 18,000 acres of irrigated land and was served by four major canals and 5 smaller ditches having an aggregate capacity exceeding 1800 second-feet. Through the consolidation of ditches and rearrangement of storage reservoir space, it was concluded
that water losses could be reduced from about 40 percent down to 12 percent (a 28 percent saving) and that the length of canals could be reduced by 25 percent. As a further benefit, it was determined that 20 percent more land could be irrigated as a result of the water saved. Operation and maintenance expenses could be reduced significantly. Many irrigation systems lend themselves to rather spectacular savings in water and seepage and almost all offer some opportunity for improved efficiency and economy of operation.

The Northeastern Colorado area has also been the subject of limited study concerning the transfer of plains storage reservoirs to higher elevations in the watershed. Many of the irrigation reservoirs in the northeastern Colorado area occupy shallow off-channel basins and thus have a high evaporation loss. They contribute to the seepage of land in many cases. As an example of the complexity of this problem, the Cache la Poudre Valley alone has more than 70 existing storage reservoirs. These range in capacity from 100 acre-feet to 18,000 acre-feet. Only 25 of them are reported to have capacities of 1,000 acre-feet or more.

A group of 18 of these reservoirs was included in a reconnaissance study designed to indicate the possible advantages of transferring storage capacity upstream. The combined capacity of these reservoirs is 91,400 acre-feet and their combined surface area is 5,100 acres. Reservoir perimeters have a total of nearly 500 acres in trees, shrubs, and grass which constitute a wasteful consumptive use of water. In addition, nearly 400 acres below the reservoirs are seeped, thus nearly 6,000 acres of land could be gained, much of it useful cropland, if reservoirs were eliminated from the farming area. As to water savings, it was estimated that about 2,000 acre-feet of water could be save on the seeped and perimeter lands and over 5,000 acre-feet saved from reservoir evaporation. These savings are significant. Some storage near or within the irrigated area is highly beneficial for reregulation and thus permits better water service with a minimum of operational waste of water. Basic storage, however, is more efficient in deeper reservoirs, higher in the watershed.

While the Bureau does not have authority to launch broadly into investigations such as these, there is an urgent need for these studies. Your own water user organizations have the talent and manpower to do at least part of this job. Also, as you probably know, intensive investigations of these problems can be undertaken by the Bureau when cooperative financing of the study is arranged.

Most of you are probably aware of the Rehabilitation and Betterment program authorized by the R&B Act of 1949. We have been pleased to observe that very favorable progress has been made in irrigation system improvements via the R&B program. The North Platte Project in Wyoming and Nebraska is one of several fine examples of this. System improvements include new structures, ditch linings, buried pipe laterals, and so forth. The Goshen Irrigation District will have converted approximately 65 miles of open ditch to pipelines by the end of F. Y. 1962. The Gering-Fort Laramie
District has approximately 8 miles of pipeline and intends to start 2 million dollars worth of further work as soon as practicable. I understand that the Pathfinder Irrigation District has shown interest in buried pipe laterals and the Farmers Irrigation District, a Warren Act Contractor, has a sizeable system improvement program under consideration at the present time.

In a recap of the benefits on these two districts, Charles Rader, our Construction Engineer at Torrington, noted that the savings of water amounts to 36,400 acre-feet annually, conservatively valued at 69 thousand dollars. Between the two districts, over 2,000 acres of land have been completely reclaimed for use, and over 2,700 acres of land have been partially benefited. This resultant increase in land value amounts to 110 thousand dollars. In addition to these benefits, the cost of operation and maintenance has been reduced by more than 19 thousand dollars per year. I believe the management and the water users of those two districts are among the strongest advocates of the Bureau's R&B program. For them, the improvements have been paying off in many ways.

There is another source of irrigation water that has not been exploited to a very great extent in our irrigation areas. This is the balancing of water supplies from gravity and subsurface sources. A large portion of our irrigable land lies over valley aquifers of considerable capacity. By the strategic location of wells, water supply management can be effected which will not only supplement gravity water sources but reclaim seeped lands as well. Even where this ground water is highly charged with soluble salts it can usually be mixed with gravity supplies and be rendered suitable for use on crops. In this same vein, the pooling of water rights and water exchanges can, in some circumstances, lead toward improved water supply and more efficient administration. I realize this is not a popular proposal to any group that has an adequate surface water supply, but with proper safeguards to holders of such rights, the future may see a number of such exchanges in effect.

Of course, it is hardly necessary for me to mention that large amounts of water are being lost to phreatophytes (water loving shrubs). Likewise, it is well known that there are many simple and inexpensive shortcuts to supply system arrangement and management which will pay large dividends. In these cases management is shortsighted if it fails to take the steps to correct glaring deficiencies.

I think it is also imperative that water users take advantage of every opportunity to adopt rules that encourage economical water use on the farm. The Bureau has found it highly practical to establish a progressively higher water charge for additional increments of water over and above a base allotment which is approximately the minimum water requirement. To be fair, of course, the base water allotment must be geared to the water requirement of the particular soil condition.
It will be sufficient, I believe, to make a passing reference to the fact that the Bureau is working in quite a number of research fields which are primarily for the benefit of operating projects. These include weed control, evaporation reduction, lower cost canal lining, weather modification, and saline water conversion. Each of these holds promise of genuine benefits, but often results are obtained slowly and with difficulty.

Now, finally, I want to mention briefly the responsibility that you as individuals have in the matter of efficient water administration. If you are a farmer as well as one of the officers or managers of the water users organizations, you have a dual responsibility. Not only are you responsible for the group effort, but it is up to you to get busy on the home place. Call in the necessary help and look closely at your farm ditches, your land development needs and drainage problems. Take full advantage of the technical assistance available through the U. S. Department of Agriculture and your State Extension Service. The organization you are helping to administer can hardly be more progressive than you are as a farmer. There is much room for improving the efficiency of water use on the farm. On-farm efficiency of 50 percent or less is too common. In other words, half the water delivered over the farm weir is lost through over-irrigation, deep percolation, and run-off at the lower end of the field. Such losses cannot be completely eliminated but they can be significantly reduced. Frequently, also, water users employ excessive quantities of water as a substitute for land leveling or labor for tending the irrigation set. This overuse of water may be at some other irrigator's expense. Equally bad, sustained overuse results too often in excessive leaching or water-logging of the soil.

As an individual each of us needs to have a realization of the water problem complex—the expanding demand, the diminishing supply, the opportunities to save water, to reduce seepage, to reduce drainage costs, to put the water savings to work on new lands or as needed supplemental supply on presently irrigated lands. The benefits accrue to the individual, the local area economy, and the Nation. This is the future of irrigation.
Mr. Chairman, ladies and gentlemen, 

Delight to be introduced by a testimonial. 

Reply to introduction - There was a Bachelor Girl in Wash. 

or I like a simple, straightforward introduction like the one given me here today.

Mark Twain was introduced once by a friend who said, "I know two things about Mark.

It's a real pleasure for me to be here today.

I had the privilege of speaking to this group two years ago. I had been in Washington only a few months and I felt highly honored to be asked a second time causes me to be really flattered. But if you ever do it a third time I'll lose confidence in the good judgment of you men for whom I have gained great respect.

Any way I'm glad to be here today.

Two years ago, as I recall, I put in a strong plea for the irrigation managers. They are expected to be highly versatile and to work wonders, but even so.

I was 100% sincere and have not wavered since. I understand all you managers have done for your work.

This time, I was asked to talk about the future of irrigation.

Chairman tells me that like the Egyptians we are pressed for time.

IRRIGATION--WHAT IS ITS FUTURE?

I would like first to discuss the over-all aspects of the future of irrigation in broad perspective. Secondly, I would like to indicate what you as irrigation managers, board members, and water users might do.

We are all aware that the population of both the United States and of the Western States has expanded rapidly in the past and is expected to continue to increase. However, the West has been increasing at a greater rate than the Nation as a whole. The Nation's population by year 2000 is expected to be more than double the present population of the country. Also, by year 2000, the 17 Western States' population is expected to be about 1-1/2 times the present 44 million persons, and the four states of North Dakota, South Dakota, Montana, and Wyoming, which you represent will be about 85 percent greater than it is today.

These population increases, National, Regional, and local, will create future heavy demands for the products of agriculture and will require the creation of job opportunities for these new citizens.
The cropland base of our country has remained relatively constant since about 1920. We have about 400 million acres of usable cropland, but the Department of Agriculture advises that we are losing every year more than one million acres of agricultural land to nonagricultural uses. The number of farms is declining, farms are getting larger, yields are increasing, and efficiency of farm workers continues to increase.

Within this context of agricultural resources available for future generations, I would like to point out that the Department of Agriculture reports that 49 million acres, or about one-eighth of the country's cropland base, is represented by lands that are severely limited or marginal for cultivation and should be used only in long-time rotations. Additionally, another 40 million acres are not ideally suitable as cropland. Thus, in terms of 40 years hence, if current trends continue and if needed land use adjustments are made, we will lose 40 million acres of present cropland to nonagricultural uses, and we ought to remove or limit production on 89 million acres. This would reduce the total agricultural base acreage by about one-third. This is a staggering prospect when we know that much of the world's population today suffers from malnutrition and hunger.

The Department of Agriculture has reported to the Senate
Select Committee on National Water Resources that by 1980 our 
domestic and export needs for agricultural commodities likely 
will be 60 to 90 percent above the 1954 levels, and by the year 
2000 these needs will be 90 to 190 percent above 1954 level. 
This need ranges from double to triple the 1954 production 
level. We are told that to meet these needs will require a 75 
percent increase in crop yields, plus 63 million additional 
acres of equivalent cropland.

About two years ago, the Senate Select Committee on National 
Water Resources asked the Bureau of Reclamation for a report on 
potential irrigation developments during the next 40 years for 
the 17 Reclamation states. We examined over 1,000 potential 
projects offering the long-term potential development equivalent 
to 17 million acres of new land. This represents a sizeable 
development, being more than double the area served by Bureau 
facilities constructed in the past 60 years. However, it 
represents only a minor part of the total gain in production 
needed by year 2000 to meet projected needs.

After its study of some 32 reports by various agencies and 
Departments, the Senate Select Committee on National Water 
Resources reported that if the projected population and economic 
activity levels are to be attained, full development of all
available water resources will be required by 1980 in 5 of the 11 principal water resource regions of the Western States. By year 2000, full development will be needed of two additional western regions. Thus, 7 of the 11 western water resource basins will need to be fully developed by year 2000.

The foregoing is a framework for consideration of what the water needs of the country, in particular the West, will be in the future and what has to be done to ensure that future generations do not find their economic progress stymied by the failure of this generation to take appropriate action. How can the need be met?

Historically, irrigation has been the largest user of the Nation's water resources. Even today irrigation use accounts for approximately 42 percent of total withdrawals of water from streams and wells. Most of the water that you use for irrigation today has already fulfilled numerous uses upstream, such as power, recreation, fish and wildlife, and possibly navigation and dilution of upstream pollution. As water resources become more completely developed and utilized, and as population pressures increase, you will be competing more and more with municipal, industrial, recreation, and other demands for the limited supply.

In many areas of the West the greatest potential "new supply" of water can come from the conservation and more efficient use of existing supplies. Conservation efforts can be most effective when individuals and groups such as you represent become convinced
that conservation measures are a sound financial investment.

I think it is appropriate to consider here today the actions that could be undertaken by group effort and by individual effort in meeting the challenges of the future.

In regard to the group effort, it is most essential that we continue the type of liaison that is taking place here, yesterday and today, to spearhead discussions and support every phase of effort leading to the improvement of water management and utilization. This group and its member groups, for instance, should lead in the support for water and land conservation research programs by the Federal, State, and local Government bodies. Conservation solely for posterity is seldom attractive to the present generation. [What has posterity done for me?]

Only when conservation becomes a sound financial investment today for those who make the investment, does it become really attractive. To make the conservation dream a sound financial undertaking to the individual requires research to discover and develop methods and materials which he can adopt and apply economically.

It is not news to most of you that irrigation canals and laterals deliver to the farms only about two-thirds of the water supplies diverted from the streams. This loss of approximately one out of every three acre-feet of water before it ever reaches
the farm turn-out constitutes one of the most readily available sources of increased water supply for existing projects.

One of the ways by which a large portion of this waste could be avoided in some of the older irrigation areas is by combining, rerouting, and tightening up the canal and lateral systems. For example, planning engineers in the Region 7 office of the Bureau have made a reconnaissance study of an area not far north of Denver, Colorado, where the problem of overlapping and duplicating ditch systems exists.

The sample area studied contains eight canals on the north side of St. Vrain Creek, all heading within a distance of about four miles. The upper four canals head within a distance of about 300 feet. Two of those canals use the same diversion dam. The eight canals have a combined length of about 100 miles and a combined capacity of approximately 900 second-feet. The individual canals range in capacity from 20 second-feet to 425 second-feet. All of the canals have steeper grades than necessary and are eroded badly in places. The eight canals supply laterals have an estimated combined length of 200 miles and serve approximately 54,000 acres of land.

By reorganizing these irrigation systems it was figured that the length of main canals could be shortened by about 48 miles;
a reduction of 50 percent. About 150 acres of land could be returned to cultivation. Naturally, significant operation and maintenance economies could be effected due to the consolidation and simplification, and a significant saving of water would result. [No estimate was made of the extent of reduction of seepage and other losses but they obviously would be significant.]

Where water is more scarce than it is here, you'd be surprised at some of the deals that are made. In one case in Arizona a mining company built a storage dam costing several million dollars and turned it over to an irrigation organization all in return for 250,000 acre-feet of water. Once that quantity of water is delivered to the mining company it no longer has any interest or right in the structure or water supply.

Another study in Northern Colorado was made of a portion of the Cache la Poudre drainage by the Civil Engineering Department of the Colorado State University at Fort Collins. The area involved constituted about 18,000 acres of irrigated land and was served by four major canals and five smaller ditches having an aggregate capacity exceeding 1800 second-feet. Through the consolidation of ditches and rearrangement of storage reservoir space, it was concluded that water losses could be reduced from about 40 percent down to 12 percent and that the length of canals
could be reduced by 25 percent. As a further benefit, it was determined that 20 percent more land could be irrigated as a result of the water saved. Operation and maintenance expenses could be reduced. Many irrigation systems lend themselves to rather spectacular savings in water and seepage and almost all offer some opportunity for improved efficiency and economy of operation.

The Rehabilitation and Betterment program, authorized by the Congress in 1949, is helping some areas to meet their future requirements. We have been pleased to observe that very favorable progress has been made in irrigation system improvements by means of the R&B program. The North Platte Project in Wyoming and Nebraska is one of several fine examples of this. System improvements include new structures, ditch linings, buried pipe laterals, and so forth. The Goshen Irrigation District will have converted approximately 65 miles of open ditch to pipelines by the end of F. Y. 1962. The Gering-Fort Laramie District has approximately 8 miles of pipeline and intends to start two million dollars worth of further work as soon as practicable. I understand that the Pathfinder Irrigation District has shown interest in buried pipe laterals and the Farmers Irrigation District, a Warren Act Contractor, has a sizeable system improvement program.
under consideration at the present time. Four districts along
the Lower Rio Grande River in Texas are putting their distri-
bution systems in pipe up to 36 feet, diverting only about half
as much water for irrigation as before.

In a recap of the benefits on the Goshen and Gering-
Fort Laramie Districts, Charles Rader, our Construction Engineer
at Torrington, noted that the savings of water amounts to 36,400
acre-feet annually, conservatively valued at 69 thousand dollars.
Between the two districts, over 2,000 acres of land have been
completely reclaimed for use, and over 2,700 acres of land have
been partially benefitted. This resultant increase in land
value amounts to 110 thousand dollars. In addition to these
benefits, the cost of operation and maintenance has been reduced
by more than 19 thousand dollars per year. I believe the
management and the water users of those two districts are among
the strongest advocates of the Bureau's R&B program. For them,
the improvements have been paying off in many ways—savings in
water, land, and dollars.

There is another source of irrigation water that has not
been exploited to a very great extent in our irrigation areas.
This is the balancing of water supplies from gravity and sub-
surface sources. In many cases our irrigable land lies over
valley aquifers of considerable capacity. By the strategic location of wells, water supply can be developed which will not only supplement gravity water sources but conserve surface supplies and reclaim seeped lands as well. Even where this ground water is highly charged with soluble salts it can usually be mixed with gravity supplies and be rendered suitable for use on crops. In this same vein, the pooling of water rights and water exchanges can, in some circumstances, lead toward improved water supply and more efficient administration.

I realize this is not a popular proposal to any group that already has an adequate surface water supply, but with proper safeguards to holders of such rights, the future may see a number of such exchanges in effect.

Of course, it is hardly necessary for me to mention that large amounts of water are being lost to phreatophytes (water loving plants and shrubs). More so in the Southwest than in this area, but I have seen encroachment of salt cedar, for example, clear to the Pacific Northwest, and that's getting pretty close to this area.

I think it is also important that water users take advantage of every reasonable opportunity to adopt rules for themselves that encourage economical water use on the farm. The Bureau has found it highly practical to establish a progressively higher water
charge for additional increments of water over and above a base allotment which is approximately the minimum water requirement. To be fair, of course, the water allotment must be geared to the water requirement of the particular soil conditions.

It will be sufficient, I believe, to make a passing reference to the fact that the Bureau is working in quite a number of research fields which are primarily for the benefit of operating projects. These include weed control, evaporation reduction, lower cost canal lining, weather modification, and saline water conversion. Each of these holds promise of genuine benefits, but often, results are obtained slowly and with difficulty.

Now, finally I want to mention briefly the opportunity that you as individuals have in the matter of efficient water use. Let's look at the home place. Specifically let's look closely at your farm ditches, your irrigation practices, your land development needs and drainage problems. How efficient is your water use on the farm? Actually, there is much room for improving the efficiency of water use on the farm. On-farm efficiency of 50 percent or less is too common. In other words half the water delivered over the farm weir is lost through over-irrigation, deep percolation, and run-off at the lower end of the field. Such losses can never be completely eliminated, but they can be
significantly reduced. Frequently, also, water users employ excessive quantities of water as a substitute for land leveling or labor for tending the irrigation set. Frequently it is simply a matter of economics. So we must make efficiency profitable.

The foreward of Four States Irrigation Council banquet brochure said "Irrigation is not impersonal nor inanimate, irrigation is men, many of them."

So it is, that as demands for water increase and greater conservation becomes imperative, the situation will be met through the individual efforts of many people. And the benefits will accrue to many individuals, which grouped together become the local community, the State, and the Nation.

The pressures inevitably will come, the individuals will respond, and the future of irrigation will be fulfilled to its rightful maximum.
3 diverted
2 d 1 d to farm - 1 lost
1 used by crop - 1 lost

2 of 3 or 2/3 lost

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2 a.f. diverted
4 d 1 d to farm
2 used in crop production

4 of 6 lost } 2 above weir

2 below weir

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30,000 acres in district
90,000 a.f. diverted
60,000 a.f. lost

1/2 of loss saved -

30,000 a.f. annually

Use with caution - In some areas - loss returning to stream for reuse - some not.