Socio-Economic Considerations in Irrigation Development

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The Decision to Realize Hydraulic Potential

The contradiction inherent in a potentially hydraulic landscape is manifest. Such a landscape has an insufficient rainfall or none at all, but it possesses other accessible sources of water supply. If man decides to utilize such sources, he may transform dry lands into fertile fields and gardens. He may, but will he? What makes him engage in an adventure which involves great effort and which is fraught with highly problematic institutional consequences?

Historical evidence reveals that numerous groups of persons have made this decision; it also reveals that many others have failed to do so. Over millennia, tribal gatherers, hunters, fishermen, and pastoralists inhabited potentially hydraulic regions, often in close proximity to irrigation farmers, but few abandoned their traditional occupations for a hydroagricultural way of life.

The agrarian alternative had a limited—and very diverse—appeal to nonfarming groups when cultivation was primitive and leadership not overly demanding. After the emergence of stratified agricultural societies, choice became even more serious. The authority wielded by governments and wealthy landowners of nearby agrarian states acted as a deterrent, because under these conditions the shift might involve submission to distasteful methods of political and proprietary control. Although women, children, and war captives might till a few fields close to a campsite, the dominant members of the tribe, the adult males, stubbornly refused to abandon their hunting, fishing, or herding activities. The many primitive peoples who endured lean years and even long periods of famine without making the

1Organization and paraphrasing of this section are from: K. A. Wittfogel, Oriental Despotism (Chapter 1, pt D). New Haven: Yale University Press, 1957.
crucial changeover to agriculture demonstrates the immense attraction of nonmaterial values when increased material security can be obtained only at the price of political, economic, and cultural submission.

The transition to irrigation farming poses the problem of choice in a still more complex form. The primary choice—whether or not to start hydroagriculture where it had not been known previously—was generally, though perhaps not exclusively, made by groups familiar with the techniques of primitive rainfall farming. Notwithstanding such background, the choice, once made, brought with it a new realization: irrigation farming always requires more physical effort than rainfall farming performed under comparable conditions.

But it requires radical, social and political adjustments only in a special geohistorical setting. Strictly local tasks of digging, damming, and water distribution can be performed by a single husbandman, a single family, or a small group of neighbors and, in this case, no far reaching organizational steps are necessary. Hydroagriculture—farming based on small scale irrigation—requires more effort and increases the food supply, but does not involve the patterns of organization and social control that characterize hydraulic agriculture and "oriental despotism."

These patterns come into being when an experimenting community of farmers or protofarmers find large sources of moisture in a dry but potentially fertile area. If irrigation farming depends on the effective handling of a major supply of water, the distinctive quality of water—its tendency to gather in bulk—becomes institutionally decisive. A large quantity of water can be channeled and kept within bounds only by the use of mass labor, and this mass labor must be coordinated, disciplined, and led. Thus, a number of farmers eager to conquer arid lowlands and plains are forced to invoke the organizational devices which—on the basis of
premachine technology—offer their one chance of success: they must work in
coopera
The representitives of rainfall farming made history and controlled
certain areas of the Western World which were uniquely suited to this kind
of economy. But the hydraulic agriculturists outgrew and outfought the
majority of all neighboring peoples wherever local conditions and interna-
tional circumstances one-sidedly favored an agromanagerial economy and
attendant statecraft. The pioneers of hydraulic agriculture, like the
pioneers of rainfall farming, were unaware of the ultimate consequences of
their choice. Pursuing recognized advantage, they initiated an insti-
tutional development which led far beyond the starting point. Their heirs
and successors built colossal political and social structures but they did
so at the cost of many of those freedoms which the conservative dissentors
endeavored and, in part, were able to preserve.

The Physical and Cultural Situation in Our Day

At this moment in history, there is still little necessity for rainfed
regions to to be concerned with irrigation, even though some turning toward
small and individualized hydro developments in special zones can be
detected. The chief pressure for irrigation is in the old historic areas
and in certain regions where bulk water could not be harnessed in earlier
times due to lack of technique or inability to control its application.

In traditional areas, expanding irrigation is a matter of improving
existing systems along with possible enlargement of facilities. In China,
for example, considerable expansion apparently has been possible by joining
some modern construction knowledge with human-core energy.
Nontraditional areas obviously have a narrower historic irrigation foundation upon which to build and must develop physical infrastructure and create administrative institutions from the very beginning. Once the process is begun, it soon becomes clear that water storage and conveyance is a matter of corralling capital to apply technique. Also, resulting system operation may not be successful until farmers have made necessary mental shifts that enable them to accept the control or regimentation that is necessary to make a collective organization workable. (Much of the previous discussion also applies to pumping situations; although, it is probable that a little more flexibility is retained for individuals in such hydroagronomy situations. Cf. Keller & Plocher, 1984.)

In summary, there is a cultural dimension that must be taken into consideration in irrigation development.

This requirement has shaped many of the elements that form the history of the Western U.S.A in the modern era. In the arid West, an underlying issue always has been: how can society obtain the benefits that private initiative confers in development, yet temper individuals' self-interest inside a collective? Unfettered individualism must be given up, yet initiative retained. But this amalgam has been difficult to affect or sustain beyond the level of "mutual irrigation companies" except on a foundation of public subsidy. (Wilde, 1976a & b; 1978)

In other cultures, it may be natural for farmers to understand and work within a framework of collective interests, but the larger society will not be able to obtain dynamic economic impacts of individual innovation and enterprise. An example of this might be found in the strong group traditions of an indigenous society such as is found among the indians in
the Andean Highlands. Here, even an overlay of compensating (ameliorating) subsidy may not call forth incentive.2 (Aitken, 1983)

Water Source Tenure

One way or another, those who develop a water source and conveyance structures have to be guaranteed ownership rights. If these rights are retained by the State, the possible implication is that only the State is in a position to guide and manage what is created. On the other hand, if individuals or groups have recognized tenure rights to water sources, automatic development will tend to occur.3 This may be seen in cases where a group relies on a natural source such as a spring. Each family utilizes the water in turn to the degree it can be "stretched out."

A person may "sell" water to others if he can control either the water or access to it. This type of ownership, of a necessary and vital source, causes conflict even to a greater degree than in situations where land is monopolized.4 If the State owns all the water, then, as ancient history has shown, the population will be subject to many controls of centralized power. However, if the State does not choose to direct all things in a despotic way, the farmers may not do all things with the created system that is technically feasible. That is, if the State retains management control and still expects voluntary response, it may be

2 An Andean counter example in a non-highland, contrasting cultural situation is illustrated by the explosion of atomistic irrigation development initiative in Ecuador's Guayas Basin, in a situation of hydroagronomy, fueled by good produce markets. (WMS, #121982).

3 Tenure does not have to extend to the source itself, although in the case of a spring it might. It is sufficient if "tenure" is simply a usufruct right to the "production" of the source.

4 There is a tendency to try to control land areas great enough to utilize all the source, then there will be no surplus to guard or protect.
disappointed at the response from farmers. This suggests a possible rule of development; the state should only develop and control a source down to a level where it can create the counterpart of a "spring" for potential users lying below. The users might be expected to "reach up" the system as far as possible to find their "spring" and be responsible to develop and manage all the area commanded by this sub-source.5

**Water Development**

In the first instance the collective can be left to its own devices. That is to say, if the "members" have tenure to a "spring" they can proceed along certain development paths themselves--this merely requires some degree of initiative and imagination (which is rewarded by the results).

If a larger collective identifies a "spring," size and technical requirements for development may be too great for private initiative. Whether or not private initiative is up to the task depends upon agreed tenure rights and potential economic payoffs.

In the Western U.S. the economic payoffs were uneven; early irrigation companies, established as profit making entities, failed. On the other hand, the easy development of smaller scale sources (mainly river diversions) based on investment of human and animal capital (not bank loans), in a spirit of mutual self-help were more successful.

In modern times State mandated development of public works has been rationalized on various grounds. One of the most commonly cited is the inability of a diverse group of water users to obtain large amounts of

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5This suggestion has been made by Jack Keller. (G. Levine)
investment capital. Obviously, once built such works are not likely to be any more profitable for the State than they would be for private enterprise, especially since all easily developed areas have already been exploited. In addition, earlier irrigation works may have been situated to command the best lands. Of course, the State may be able to improve existing simple systems by introducing storage of late season water by irrigating additional land on the boundaries of what already exists or it may be able to direct some water away from current users to be employed elsewhere.

As projects become more complex, legal considerations proliferate. Tenure rights and their enforcement exact more and more attention and resources. Additional legal and legislative adjustments are needed to resolve questions of project financing. If water beneficiaries are required to bear some financial burdens, additional restrictions are placed upon individuals because the money must be collected. An engineering and administrative technostructure emerges and eventually gathers to itself the trappings of power and control that authority to move and shift vital resources confers (i.e., a modern version of oriental despotism).

**Measuring Social Benefits of Irrigation Development**

One reason why the concept of "the spring" is important is because no one expects even a voluntary, non-profit collective to expend effort or resources in development unless potential payoffs are expected to cover the costs. Assuming the collective evaluates its alternatives carefully and

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6There is no doubt that enormous amounts of private capital can be amassed for projects which contain adequate guarantees. But financing is a problem where the land security consists of a lot of separated farms, since the structures to be built are of little use to anyone except families who work the lands below them.
that markets for the necessary labor, capital, and other inputs are relatively free, any decision to go forward is a rough indication that society, as a whole, will benefit to a greater degree than if an alternate use of the resources would have been chosen. In other words, a "correct" evaluation of society's opportunity costs is made somewhat automatically by numerous market forces playing themselves out in the private arena.

The same opportunity cost principle may be invoked when evaluating economic choices made by the State. Indeed, such application is important because large projects tend to be expensive, and often return less than the value of their construction and support resources, as measured by their value in alternative uses. The mere fact that the expected benefit/cost ratio exceeds unity during the planning phase does not guarantee economic success in operation. Irrigation projects that flop waste publicly owned scarce resources. This hurts all citizens. 7

It should not be imagined that society actually will be reimbursed for the resources it devotes to irrigation works whether successful or failed. Such a feasible arrangement would only exist if the direct beneficiaries were charged the full costs of the water conveyance features constructed by the State.8 In practice, such levies are not made although the farming population obtains most though not all of the direct benefits. Thus, whether or not society gains on balance from committing resources to irrigation works depends upon whether the net value of increased farmer production is great enough to raise GNP by an amount commensurate with the

7 Private projects may fail as well, but society does not bear all the costs since part of the failure is accounted for by destruction or loss of private capital or of the private labor embodied during construction.

8 If they are charged with the "full cost," win or lose then the public will be reimbursed for the opportunity costs of the resources committed to construction even if the project fails.
annualized costs of the project. The increase in GNP must be as great or
greater than the increase in the net value of production as compared to the
"without project" state.

In some cases, of course, the State does not expect b/c > 1. The
decision to subsidize is often but not always an indication that noneco-
nomic considerations are quite important; some goals besides enhanced
production are involved.9

Existence of subsidy can mean only one of two things. Supposing
stated project goals are all economic. Subsidy may be interpreted to repre-
sent a hope that some secondary economic benefits will be created by the
project. Such benefits are hard to measure. Studies of regional economic
impacts of big U.S. water projects are inconclusive. Not much impact on
local economy can be attributed to them. If there are some explicit or
implicit welfare goals, the subsidy to irrigation may be justified on that
basis. The whole Western U.S. irrigation program was never expected to pay
its costs--the program had social not production goals as its foundation.

The benefits of irrigation expenditures become even harder to measure
when multiple-purpose projects are involved. In the U.S.A., such purposes
as flood control and recreation are not expected to repay costs. They are
subsidized because they are assumed to confer important social benefits of
a consumptive nature. They are termed consumptive because such benefits do
not involve production or direct enhancement of economic activity.

Public subsidy of very widely distributed consumptive activities such
as benefits from education and defense systems or even new roadways is
taken for granted. The taxing expenditure patterns have an appearance of
citizens paying themselves, since those who bear the subsidy by and large

9Let us call such goals welfare enhancement.
obtain the benefits. No matter how welcome, however, enhanced consumption must be paid for. When the incidence of the subsidy burden falls upon the general exchequer, the question is: how far is society willing to subsidize consumption (for welfare purposes) of a select group? An example of a consumptive activity directly related to irrigation project investment is to create water for lawns and gardens. In such cases there is little doubt that local social welfare has gone up even if measured local or national economic impacts are negligible (and it is also possible that national social welfare has gone up but that seems unlikely—and that the rest of the nation is willing to pay the subsidy involved). Realized, farm level, direct economic benefits can be measured. Calculations have been made for small U.S. irrigation projects isolated from urban centers. Some of these results show incremental production benefits in excess of planning expectations. Nevertheless, such projects still involve considerable subsidy since direct beneficiaries do not pay interest on construction outlays.

The World Bank re-evaluates irrigation projects from time to time and has published some results showing positive rates of return. Evaluations by other donors also cite some economic successes. Re-evaluations based on primary beneficiary data which show success are unexceptionable. Less confidence should be placed on positive results built upon valuation of indirect benefits.

Markets--The Iron Law

The American domestic market is so large that reclamation project designers chose to ignore whether new and additional productive output

10IDB also reports some positive results for a group of small projects in Peru. In this case, the entire irrigation "program" costs were not re-evaluated; evaluation covered the 60-70% of the program money actually invested in "hardware."
could be absorbed without price effects. Price fluctuations due to vagaries of climate would outweigh any weakening effects of adding to supply. Subsidies were paid in order that reclamation farmers could hold costs down, while the expected higher yields would increase farm revenues at the going prices.

Agricultural leaders in other regions of the nation always complained about reclamation activities supported by the public purse because they objected to subsidy of increased production which appeared to be unneeded or unnecessarily competitive with what could be produced under rainfed conditions. They were smart enough to realize that any output increases were bound to depress market prices to some degree, no matter how slight, and to that extent the farmers in their own areas would be hurt.\textsuperscript{11}

\textbf{Technical and General Lessons in American Public Irrigation Experience}

The technical lesson is that just because irrigation increases yields and, therefore, national production, this is not a guarantee that irrigation programs are an economic success. What really counts is whether the profitability of the production increases is great enough first to pay for the extra costs of production and induce farmers to work harder (as required by intensive agriculture) and, in addition, give a further increment of returns great enough to offset the cost of the project.\textsuperscript{12}

\textsuperscript{11}Since the Second World War, the complaints have been muted because surpluses of some commodities were due less or not at all to subsidized reclamation production, than to price supports by the government, and, in more recent times, the market for U.S. products has expanded greatly due to high volumes of export.

\textsuperscript{12}By this test, much American "reclamation" experience has been a failure.
American reclamation project farmers did raise output and did make somewhat more money (thus satisfying the first part of the profitability requirement) but they were never asked to pay full cost. And, it is unlikely that profitability of many projects would have been great enough to have permitted it. Inability to pass the second part of the profitability test was always accepted by reclamation program administrators. They got around this problem by utilizing revenues from the sale of generated electric power or municipal and industrial water to subsidize the costs of constructing expensive irrigation features.

The general lesson is that profitability depends upon markets. Other nations cannot get away with what the Americans have attempted in the name of "reclamation" and social equity.

At the same time, they cannot ignore the impact new project production will have upon existing markets. If farmers on irrigation projects increase output of agricultural products, it is possible that other farmers may lose sales. Thus, GNP will not increase as much as expected. On the other hand, unless there are markets, there is little hope of obtaining, at the national level, clear gains in GNP at overall profitabilities exceeding social opportunity costs plus rewards to farmers for extra inputs and effort.

**Conditions for Positive Economic Benefits from Irrigation in LDC's**

Although instances of success are reported in World Bank or other evaluations, it is difficult to imagine any more than a narrow spectrum of situations where irrigation plays a natural, successful economic role. As mentioned, the key variable is markets. Only if they are adequate is there any hope for farmers to cover production as well as construction costs. Markets for expanded agricultural output may be opened up due to import
substitution or via foreign sales. These are the main short-run possibilities. Longer-run domestic markets expand due to higher on-farm consumption, more raw material requirements to process intermediate food products, some up-grading of tastes for higher value crops and greater meat consumption, but mostly there is normal demand growth due to increases in population. All told, domestic long-run markets may expand at about 4%-5% per year. In a large country such as India, such percentages might represent a large absolute outlet for the increases of local production associated with irrigation construction. In a small nation, such percentages might not represent an absorptive capacity greater than what could be satisfied from a small project or from technically achievable advances in yields within the structure of the existing agricultural system.

Mainly the Farmer's View

As noted, there is no necessary convergence of private and social viewpoints about project "success". Therefore, from the standpoint of a project farmer, there is an additional outlet for his proposed production increase: he can take markets away from already established domestic producers. While it is unlikely that the average farmer would analyse his participation in a proposed project in such terms, project planners and donor agencies have no excuse for ignoring the zero sum and other market consequences yet they do it all the time. The evidence for this is found in the fact that planners put projects into place that are too high cost to be successful, that is, they actually do not cut the pie differently

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13This is accomplished in two ways: by driving down prices with a flood of excess supplies and by absolute pulling of customers away from the older sources of supply by means of some sort of service or price incentive.
because the existing, traditional areas of production can hold their own. Project farmers may not exploit an "additional outlet" at all.

With this in mind, we will now concentrate on situations that do not involve beggar-thy-neighbor, instead project development is aimed at an "expanded" or "identified" market (say import substitution).

A1. Markets available--government will control food imports.

i. If another area or zone has greater comparative advantage than the proposed project, and can expand, new irrigation cannot pay unless expected unit costs are "right."14 A rise in real GNP depends on whether the marginal social costs of the increment of increased production are at least as low as the unit costs of on-farm inputs in the existing, competing zone.

ii. If there is no other producing area with comparative advantage, project output should raise real Gross National Product (GNP) to the degree that expected unit costs are below the alternative costs of imports. This combination of factors delineates the situation most suitable for irrigation investment.

iii. Argument is the same for export crop production.

A2. Domestic markets available--government cannot be relied upon to control imports

i. A new project must be able to undercut import prices as well as rainfed alternatives in order to halt imports or take some rainfed share. If, for any reason, rainfed costs start to fall,

14There is a grey zone where farmer unit costs are low enough to outcompete the alternative source for the new market, but not low enough to create an adequate margin to also cover the social costs of the irrigation project.
competition intensifies. Consumers may gain but the projects are uneconomic.

ii. A search for absolute-advantage-type crops begins. Project planners decide that farmers will be led, asked, or told to

iii. A new project must be able to undercut import prices as well plant "high powered" fruit and vegetable crops. But market outlets such crops are always narrow and extremely sensitive to alterations in supply, so the plan may fail. Even if a particular project manages successful penetration, follow-on projects cannot copy the process. Success of the initial project cannot be replicated except as the passage of time alters absolute absorptive capacity.

A3. It is possible to think in terms of "expanded" markets even in the absence of exports, or import substitution if there is absolute hunger. In order to fill a "hunger" gap the project must be very low cost, otherwise it may be better to import (for for some indeterminate length of time) rather than tie up scarce resources in noncompetitive facilities.

B. Markets not available--[this is not a realistic situation in which to inject new projects].

i. As noted a new project can only be a commercial success at the expense of surrounding production areas. As projects come on line prices fall. Consumers may gain. Pressures on less efficient farmers pile up. The process of displacement is accelerated. Measured at the national level the benefits from the program are mixed.

ii. Intrinsic costs may still be too high; the project cannot suck business from surrounding areas. Continued subsidy is required
to get output (i.e., success). Farmers in competing areas who are basically more efficient will be driven out by the subsidized production from the project. After supply narrows back down, prices may rise, subsidies may be reduced, but there is still no guarantee of enough profit to cover social costs as defined earlier. Consumers appear to gain in purchasing power because the terms of trade shift in their direction. This is an illusion to some degree because the consumers are the ones who bear the subsidy and at least part of any failure to cover social costs.

These arguments indicate that the most suitable situations for an irrigation project require (in every instance) a production cost structure that permits competition in an efficient way or international comparative advantage where exports are concerned. In any situation where there is potential competition for "identified" markets from other zones or areas or there is a possibility of increased food imports, there is special pressure for the project to be cost efficient in real terms. Of course, there are places in the world where an immense amount of irrigation already exists and a new project is simply a small expansion of an existing structure. Consequently, there is no particular competition from rainfed agriculture. In such situations the requirement for cost effectiveness at the farmers' level may not be quite so pressing.

Mainly From National Level

A. As we have seen, primary benefits for project farmers may or may not be high enough to insure reasonable family income from the project. If the farmers are subsidized, they naturally seem to do better--
that amount of betterness, from a national standpoint, must be accom-
panied by a raise in GNP great enough to cover the farmers production
costs as well as to cover the social subsidy on construction. If
farmers are required to pay the full construction costs, the potential
for realized profit may or may not be enough to recompense all the
factors of production. This explains the tendency to search for
high-price crops in order to augment the benefit stream and justify
expensive construction.

B. If "high powered" crop production is required in order to get a pro-
ject's B/C ratio up, a new sub-objective emerges. This is the
requirement to train farmers to take on new tasks. Such tasks may
increase the complexity of project operation by requiring farmer
marketing support functions, or other new or different farmer organi-
zation. More resources are required.

This pattern has been observed and repeated many times. There
seems to be some tendency among project leaders, planners, and
designers, when things do not function quite as expected, to search
for ways "to make it work" Most attempts to improve poor projects
involve pouring more resources into the same rat hole. "Forcing a
project to work" is the well-spring of recent development literature
featuring all the mumbo-jumbo about farming systems.

SUMMARY

Irrigation benefits, in many cases, are unlikely to reward farm fami-
lies enough to fully offset construction subsidies. As a consequence,
irrigation projects are turned into welfare programs. As we have noted
earlier, in and of itself, this may not be necessarily evil or wrong
because society may have other goals besides achieving higher production.
Nevertheless, it should be recognized that welfare programs can absorb endless quantities of resources that must be paid for by someone, somewhere, sometime.

More and more international donors are insisting upon financially sound projects. This requirement stiffens up the repayment burden by shifting the load from the general exchequer onto the backs of direct beneficiaries. Tightening up performance requirements is one explanation of donor interest in repayment ability of farmers and upon schemes to charge for water. Donors realize that all subsidy has to be covered and if the projects cannot stand on their own feet financially then the subsidy repayment must come from other sectors in society. And most nations in need of increased production and economic development, as well as social programs, are not the kinds of societies that have a lot of surplus paying power in non-agriculture sectors.

Another reason for the interest in repayment ability is that engineers want to pour concrete. They are always anxious to be able to show farmers in just what way it is possible to pay for evermore expensive undertakings--in other words if the farmers can pay, there is less reason for central government to come up with the bucks. There is no new strain on the development budget since the farmers will pick up the tab.

Perhaps another reason for emphasis on repayment ability is to put more development emphasis on the private sector. This automatically tends to involve making the direct beneficiaries pay according to the "benefit principle," because water use is quite specific and chargeable.