NO STRANGER TO SALT

The Indus Basin is no stranger to salt. Most of the salinity that occurs there is ancient, produced as the result of soil-forming processes that followed the evaporation of the shallow sea that covered the Indus Plains and the Potwar Plateau 600 million years ago, leaving behind the twin salt ridges known as the Salt Range that transect the northern part of modern-day Punjab.

With the advent of modern canal irrigation, saline patches were recognized as occurring within good land in an intricate spatial pattern at the time systems were first being developed. Although larger saline tracts could be and were excluded from design canal command areas, the inclusion of smaller patches of salinity within areas of good soils was inevitable. Some were subsequently reclaimed; in other areas, reclamation attempts failed. The severity and extent of salinity problems became obvious by the middle of the present century, prompting the first Salinity Control and Reclamation Project (SCARP I), initiated in the central Rechna Doab in 1960, and later deep drainage tubewell projects.

Increased capillary action occasioned by the greater surface area and rate of evaporation in waterlogged land, was observed to be drawing growing increments of salt into the root zone of croplands. It seemed natural, therefore, to assume that with the reduction of waterlogging in large parts of the country, especially in Punjab, through extensive development and operation of tubewells, the problem of salinity should largely have been solved at the same time. But as early as 1978, surveyors warned that this was not the case.

Secondary salinity, which is of much greater concern than that akin to waterlogging, is the buildup of high sodicity in first-rate, nonsaline

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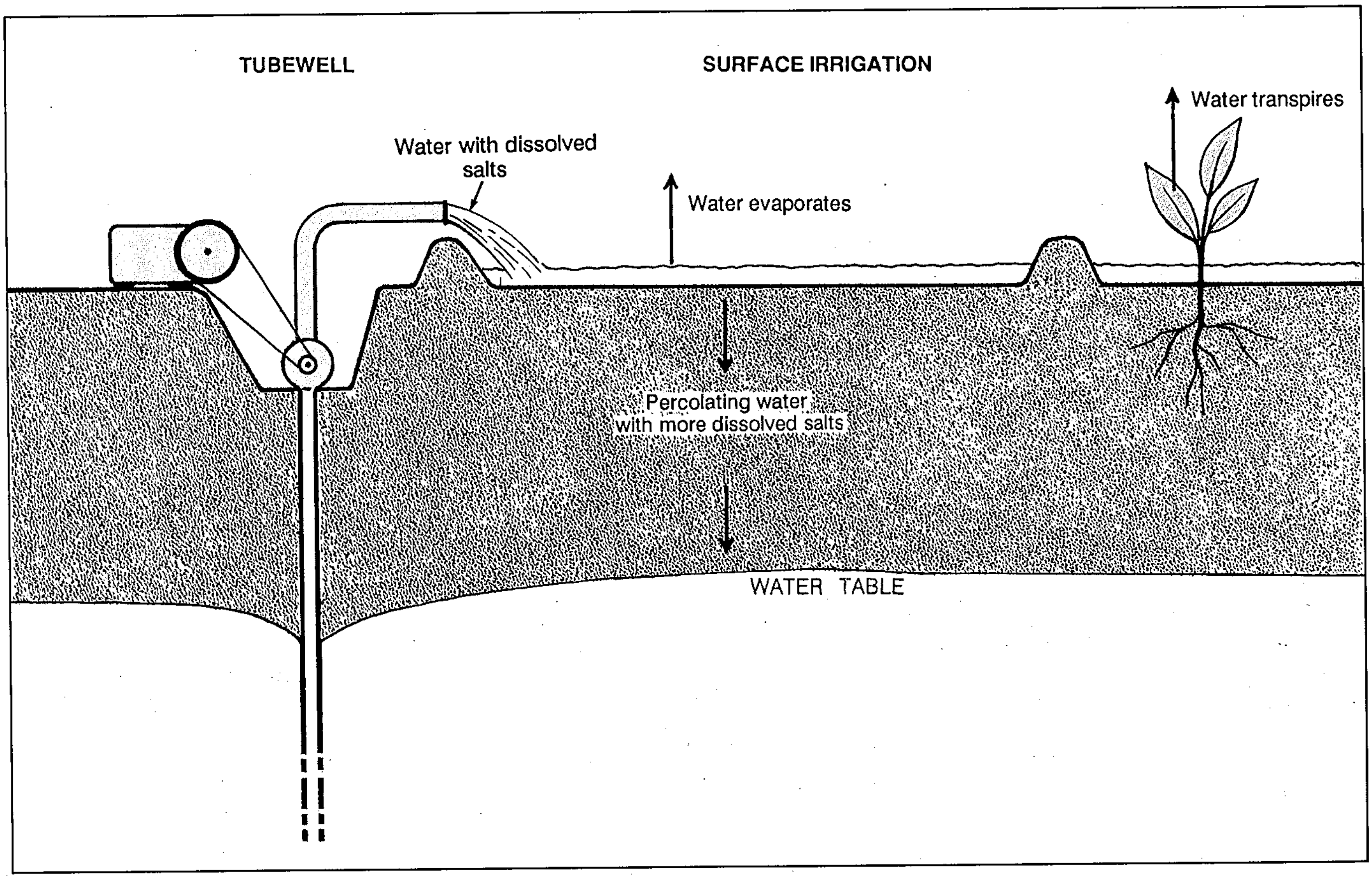


Salinity buildup in cropland due to accelerated irrigation from low-quality water in shallow tubewells.

Book Reviews

**14th Congress on Irrigation and Drainage
Rio de Janeiro, Brazil 1990
Volumes 1 A-F (French and English)**

A wealth of new materials stemming from the 14th Congress on Irrigation and Drainage has now become available from the 1990 meeting of the International Commission on Irrigation and Drainage in Rio de Janeiro.

In addition to the six books dealing with general reports and papers presented at the congress, there are three additional volumes (not a part of the congress papers) dealing with methodologies for information acquisition (French), a bibiliography on the influence of wind on sprinkler irrigation (French and English) and a publication dealing with guidelines on the construction of horizontal subsurface drainage systems (English).

One of the more interesting papers presented in the material is one written by Prof. Milos Holy, Czechoslovakia, dealing with man's influence on the environment. In it, Holy quite accurately emphasizes that " ... the environmental situation indicates that further development of the environment is becoming an essential question for the existence of the future generations of mankind."

Holy calls for "scientfic management and planning of life on Earth on a global scale," and also says that man's economic activities "must be developed in harmony with nature as only in this way can we guarantee the sustainable development of the present and future environment."

The cooperation demanded of men by Holy is all well and good in principle, but, unfortunately for Earth's sake, it will likely be a long time in coming on the scale necessary to satisfy Holy's call and therefore, the degradation of the Earth will likely continue to be news into the next century.

Matthew Driskill

PEEM GUIDELINES SERIES 1

Joint WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector control - Guidelines for the Incorporation of Health Safeguards into Irrigation Projects through Intersectoral Cooperation; prepared by Dr. Mary Tiffen, Overseas Development Institute (ODI) Regent's Park, London.

The Panel of Experts on Environmental Management for Vector Control (PEEM) was established in 1981 as a joint activity of the World Health Organization, the Food and Agriculture Organization and the United Nations Environment Program. The panel's objective is to create an institutional framework for effective interagency and intersectoral collaboration by bringing together various organizations and institutions involved in health, water and land development and the protection of the environment, with a view to promoting the extended use of environmental management measures for disease vector control in development projects.

Publications in this series are aimed at giving technical guidance to a multidisciplinary audience whose responsibilities have an interface with vector-borne disease implications of development projects.

These guidelines are set out for policymakers, planners and managers who are themselves neither irrigation nor health specialists but who may wish to know of the impact of the project in terms of the targets envisaged within its economic framework, for irrigation projects are usually costly, and have to be carefully assessed to ensure that expected benefits will indeed flow and outweigh the costs.

This publication aims to alert planners and managers to the linkages between irrigation and health and the collaboration between government agencies needed to secure advantages of increased agricultural production and a better health status in a cost-effective way.

The Guidelines point out that

"A good irrigation scheme will provide greater security of water supply over a longer period of the year. It will enable farmers without risk, to invest in a higher level of inputs, so that they can produce a larger volume and/or more valuable crops, to the benefit of both themselves and their country. Amongst the human health benefits should be improved diets resulting from an increased production of staple foods, new opportunities of growing fruits and vegetables and increased purchasing power for foods not produced on the farm. Improved incomes should also positively affect health status by enabling people to spend more on clothing, housing, recreation and health.

"Other beneficial side-effects of irrigation can be new fishing areas, the possible development of recreation areas alongside reservoirs and canals, and better facilities for feeding and watering the domestic livestock which can also improve diet and income considerably."

The Guidelines state that "... However, we often find that health has either been ignored, or has been considered a separate item in the development of agricultural projects ... irrigation leads to changes in the distribution of areas of standing and flowing water and in the location of human settlements, and to a modified micro-climate.

"It is worth stressing, however, that a major health hazard of some types of irrigation scheme is associated with the displacement of people from their homes and livelihoods, particularly in schemes involving the creation of reservoirs. The guidelines provide some information on integrated planning for these situations.

"Domestic water supply and improved sanitation can sometimes also be incorporated into irrigation planning, thereby bringing great health benefits through the access to improved water supplies for drinking and general cleanliness. Here, naturally, the quality of the water is of great importance."

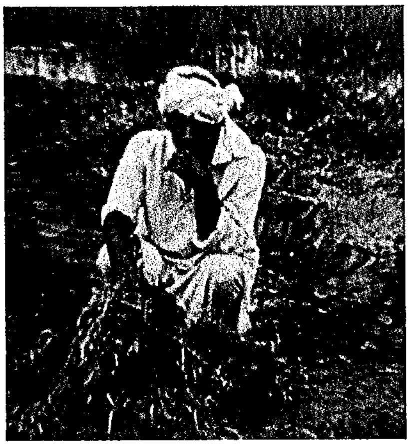
B.H. Hemapriya.

FARMER PERSPECTIVES

Farmers and their families bear the brunt of problems of water supply in areas prone to secondary salinity. Many of the large distributary canals in Punjab run for 200 km or more without meeting a single gated structure. The individual farmer has to use a mix of regular and improvised means to secure enough water to raise a worthwhile crop. Interviewed beside their watercourses, two typical Punjabi farmers give their own accounts of the day-to-day consequences.

Habib's story

"My name is Habib — I'm 37 years old. My three brothers and I inherited this farm and we run it together. It's bigger than average for this area — a lot of land has been divided up between families till there's hardly enough in one plot to support a household. Ours is about 42 acres [17 hectares], mostly under wheat in winter, rice in summer plus sugarcane and fodder crops all year-round. It's part of a *chak* [watercourse command area] served by Sharkpur Distributary. The *mogha* [offtake] is supposed to serve 20 squares [about 500 acres] but apart from a few farms near the mogha where they use a *jalar* [traditional lift device] when the water runs low, nobody gets enough canal water and many get none at all.



Portrait of a Pakistan farmer.

"Things improved a lot when the Irrigation Department put in a tubewell 30 years ago. Then we had enough water to begin growing rice and sugarcane. But after working poorly for several years, this well broke down completely five years ago. Now we can't get it working again unless we collect money from ourselves, make some payments to irrigation staff and chase after the ID's maintenance gang to get them to repair the well. All the farmers in this chak organized two years ago to get the watercourse *pucca* [lined], but since that job was completed, the "committee" [water users' association] we formed never met again.

"When the government tubewell stopped working, we had to install our own tubewell to get enough water for the crops. This well has become very necessary now because canal water has also become less. But sometime after we began to use our tubewell to irrigate our crops much of the time, we noticed our yields were dropping back — the water from our tubewell isn't good for the soil unless you add gypsum. The agriculture extension people told us about using gypsum: we put a pile of the rocks under the tubewell discharge pipe and it definitely makes a difference to the crop. A truckload of rock gypsum lasts about two years, but it has become more and more costly; we just got a new load this month for 4,000 rupees [about US$170].

"But we still pay double *abiana* (water service fees) for public tubewell and canal water, even though we're not getting enough of one or the other. The fees are about 43 rupees for wheat, and 64 rupees for rice per acre. Many farmers cook the books so they pay more at the fodder rate of about 27 rupees and I can't say I blame them. Now and then they're caught out and of course the officials say this proves you can't trust farmers."

Khadim's story

"My name is Khadim: I'm 49. I support a family of seven and I share these 15 acres with my brother Boota, who has no family. Our fields used to be near the tail of the *sarkari khal* [watercourse] of the chak upstream [on Mananwala Distributary] but a group of us persuaded the Irrigation Department to install a new mogha just here. So now our fields are almost at the head of the watercourse instead of nearly two miles from canal water as we were before. We also installed our own tubewell, which we use mainly during the [annual] canal closure and at other times when canal water is less.

"This was ruined land till we got the new mogha. As you can see, there's still some salt on the surface in patches even though we've already scraped six inches of affected topsoil from these fields, which is in that pile over there. We're still in the process of reclaiming this land, even though it's hard to drain and we need a lot of water for this purpose.

"We didn't find it easy to get the new watercourse put in — it took three years of pushing. Now we've been asked why we don't improve the watercourse by putting in *pakanaka* [locally made turnout junctions] and so on, but I'm in no hurry — this close to the offtake, if the watercourse or the turnout breaks, I get more water!

"We reclaim the abandoned land by spreading powder gypsum on the field and soaking it through with fresh water. Then we grow salt-resistant fodder grass such as *kallar* for a season or two before we can grow such crops as rice. The official price of the gypsum is 8 rupees a bag but the dealers who hold permits to sell it say they haven't got any, so we buy it 'on the black' for 15 rupees.

"It takes roughly ten 50-kg bags of powdered gypsum a year over three years to reclaim a field of one or two acres, so it's not cheap. We don't have much faith in the official agencies. They don't seem to have much control over the water in the canals; why should we do their job for them? They look after themselves — but only God looks after the farmer!"

JACOB KIJNE IS APPOINTED DIRECTOR IIMI PAKISTAN

The Board of Governors of the International Irrigation Management Institute has appointed Dr. Jacob W. Kijne to the position of Director for Pakistan. Dr. Kijne, was previously Senior Irrigation Specialist in the Pakistan Division of IIMI.

Prior to his arrival in Pakistan, Dr. Kijne served in various leadership positions, including that of Principal of the National Agricultural College in Deventer, the Netherlands. He has also served as senior lecturer in Agriculture at the Department of Irrigation and Civil Engineering, Wageningen Agricultural University, the Netherlands, and was Acting Chairman and visiting senior lecturer in the Department of Agricultural Engineering at the University of Nairobi in Kenya from 1977 to 1981.

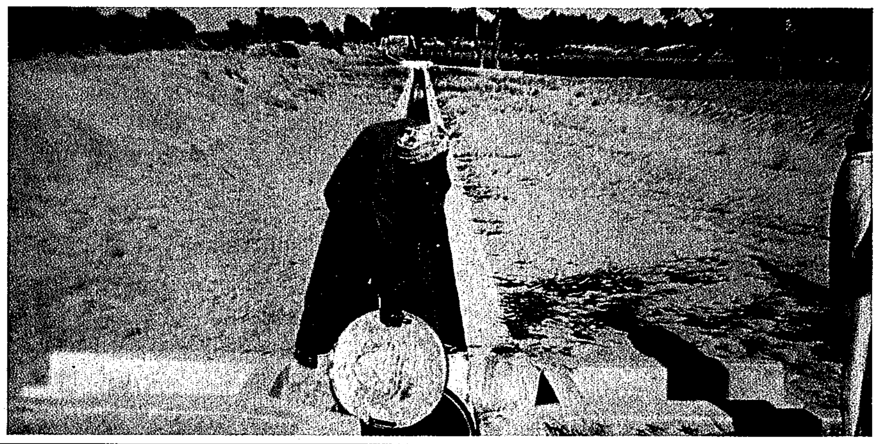
When asked about his new appointment, Jacob Kijne said that he expected the IIMI team in Pakistan to make timely and valuable contributions to irrigation management in the country. The recently resolved issue of apportionment of Indus water between the provinces and last year's Water Sector Investment Planning Study have caused renewed interest in the management of the irrigation system.

Commenting on Dr. Kijne's appointment at IIMI Headquarters in Colombo, the Institute's Director General, Dr. Roberto L. Lenton, said he was confident that Dr. Kijne's extensive research background, intimate knowledge of water and salinity management, and extensive managerial experience will serve IIMI exceptionally well.

FEEDBACK ON THE FARM

by M. Akhtar Bhatti

Irrigation conditions and practices at farm level truthfully reflect the operation of main systems. The farm is the "business end" of irrigation systems, where an intermediate output — water — is converted into a final output — agricultural production. Improving the performance of irrigation systems through management interventions at different levels, depends vitally on a two-way feedback of knowledge about the impact irrigation water has on agricultural production, and the efficiency of water use.



Locally manufactured turnout device ("pakanaka") – a boon to on-farm water management in many parts of Pakistan.

The operation of Pakistan's irrigation systems has long been administrative in character, concentrating on straightforward water delivery with scant concern for end use. The 40 years since modern Pakistan was founded have seen little change in management style despite significant changes in field realities. For instance, groundwater obtained from public and private tubewells has provided a fast-growing — albeit unevenly distributed — supplement to canal water. Cropping practices have altered and crop intensities have risen dramatically as a result of growing use of improved crop production technologies. High yielding crop varieties, mechanization and use of agrochemicals have all become part of the farming scene.

They have failed, however, to raise yields of most crops to anything like the potential realized elsewhere in Asia. Agencies in the water sector recognize that irrigation is a critical factor in the production equation and may well hold the key to this paradox.

Soon after its establishment in September 1986, IIMI Pakistan began seeking opportunities to put potential management (hence performance) improvements to the test at farm level in collaboration with home agencies, particularly provincial irrigation and agriculture departments. Several joint research activities were undertaken with these aims in view during 1987-90 in the Central Punjab. Most were carried out in collaboration with Punjab Irrigation and Agriculture departments in the head and tail portions of the Gugera Branch of the Lower Chenab Canal system. This work gave rise to several important preliminary findings.

Since the design and introduction of the *warabandi* (the practice of irrigation turns taken according to an established roster) system of water allocation, it appears no effort has been made to reassess historic water rights. Despite the major physical, political and socioeconomic upheavals of the past hundred years, allocation is still based on landholding. Comparison of agricultural census data from 1960 and 1980 shows that the number of small farms less than 3 hectares in extent increased from 34 percent of the total in 1960 to 51 percent 20 years later. Expressed as a fraction of total cultivated land, the area cropped on small farms also increased. Conversely, the fraction of medium and large farms within the total decreased significantly over the same period. Decrease in farm size directly affects water rights by governing the duration of the irrigation turn, which is set in proportion to land area.

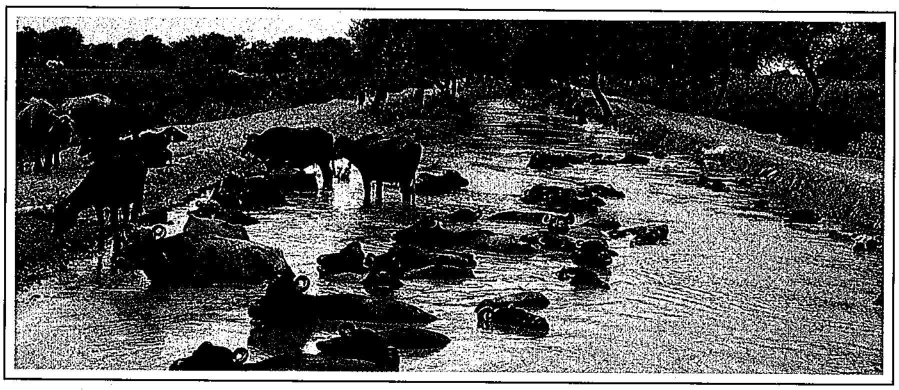
Much has been said about shortage of water resources in relation to crop water requirements, but little has been done to reevaluate allocation practices or to find ways and means to improve distribution procedures to match crop needs or cropping patterns. Sample data suggest that current management procedures preclude effective use of available irrigation supplies.

Flexible water allocation is rarely possible under the present warabandi system. In drawing up new rules for distribution and allocation of irrigation water, thought should be given to the growing quantities of water available to the farmer from tubewells, public and private. This trend is not confined to areas with good quality groundwater. Many private tubewells have also been installed in areas known to overlie saline groundwater. Here farmers tap or skim fresh (or marginal) groundwater from the aquifer using shallow wells.

Irrigation deliveries at the farm gate not only vary in quality and level from day to day but are also highly unreliable overall. In the case of wheat, prolonged canal closures for maintenance have proved specially detrimental to crop yields. Variability and unreliability appear to be key obstacles to improving water use efficiency on the farm.

In general, studies showed that the seasonal irrigation application falls short of the conventional requirement for maximum crop yield per unit area. A fortuitous result is higher-than-average yield *per unit of water*. The efficiency of Pakistan's farmers in this respect has been used to justify a rationale of "limited irrigation" (whereby irrigation system performance is judged mainly on the basis of yield per unit water) as the appropriate and realistic benchmark in water-scarce environments as in Pakistan. Wide dissemination of this concept will be required before further increase of productivity per unit of irrigation water can be achieved countrywide. Neither measurement sufficiently explains anomalies in the pattern of performance of different water sources. For instance, private tubewells, alone or in combination, offer greater water efficiency than public sources: farmers are perhaps more careful with their own resources than with public utilities. Notwithstanding lower frequencies of seasonal irrigation applications, the efficiency of individual applications was found to be quite low. Hence, it can be argued that improved irrigation practices could boost agricultural production without stretching the bounds of the present irrigation water supply. As irrigation applications are related to available stream size, improvements can only be made when a smaller range of sizes is made available.

Much variation was found in the sizes of basins prepared for wheat irrigation throughout the 7.5 million hectares annually planted in wheat in Pakistan. Marked variation occurred even within farms where soil, water



Damage to banks by wallowing buffalo is one of many on-farm factors that eat away at system efficiency and productivity.

Desilting a watercourse in Punjab.

supply and crop conditions were uniform. This anomaly not only results in waste of scarce irrigation water but also suppresses crop yields.

These conclusions have important management implications. For one thing, more reliable system operation has to be achieved before farmers can feel confident about making irrigation decisions that depend on availability of canal supplies. Evaluation of the stream sizes available on the farm is essential to determine their manageability: variable stream sizes can lead to significant operational losses. Improved management would require some standardization of stream sizes and corresponding re-sizing of present canal outlets. Sizes of stream issuing from tubewells should be considered in conjunctive management of canal water and groundwater. Efforts also have to be made to optimize stream and basin sizes under prevailing soil conditions to improve application and water use efficiency.

Pakistan's farmers, agency officials and policymakers agree that scarcity of irrigation water and present water use practices are the most critical constraints on growth in agricultural production. Given physical, financial and political impediments to development of new sources of water and water delivery systems, additional agricultural productivity must come primarily from more efficient use of existing water supplies.

Physical improvement of irrigation channels and watercourses can achieve significant water savings, yet the savings that can be achieved by farmers themselves through more efficient and productive use of available supplies are reckoned to be greater still. This switch of emphasis can only be brought about by improving farmer expertise: for this purpose, an efficient irrigation management extension service will be needed to demonstrate and popularize innovative on-farm water management techniques.

Finally, the anomalies discussed above underline the need for in-depth analysis of *interactions* between main system (in conjunction with tubewell) operations and on-farm management, with a view to improving the performance of both. Studies should focus on the twin questions of allocation of irrigation water over time and space and consequent impacts on agricultural production.

Akhtar Bhatti is Principal Irrigation Engineer in IIMI Pakistan.

SCHULZE RETIRES

Ernst Schulze retired as Director, IIMI Pakistan in June 1991. Ir. F. E. Schulze joined the IIMI staff in 1986. A graduate from the Wageningen Agricultural University, in the Netherlands, he worked extensively on water resources development, irrigation and drainage in a number of sub-Saharan African countries before becoming Director of the International Institute of Land Reclamation and Improvement (ILRI) in the Netherlands in 1972. In 1982 he was appointed Agricultural Counselor to the Royal Netherlands Embassy in Jakarta, Indonesia.

Schulze also served as Chairman of the Study Team commissioned by the CGIAR in 1981 whose report led to the establishment of IIMI. He became a member of IIMI's Board of Governors in 1983 and was Chairman of IIMI's Program Committee until his appointment to the IIMI staff.

(Continued from page 25)

agricultural land caused by irrigation with low-quality tubewell waters. This type of salinity was introduced with accelerated use of groundwater after about 1950, especially groundwater from shallow private tubewells. The first known private tubewell was started up near Lahore in 1938: by 1978 there were at least 21,000 in operation and today the number approaches 300,000 countrywide.

Symptoms of sodicity are hardening of topsoil, decrease in rate of infiltration and inadequate seed germination, especially of alkali-sensitive crops. This mode of salinization is treacherous, as it builds up gradually and farmers become aware of the problem only after the worst damage has been done. Apart from applications of gypsum (which conditions soils to remain open to infiltration) and the flushing through of fields with abundant fresh surface water, there is little the farmer can do about secondary salinization but delay its worst effects. The syndrome is now thought to affect more than a third of Pakistan's irrigated agriculture and — unless checked — could lead to the abandonment of fully 25 percent of the country's entire stock of cultivable land.

Part of the response of the Government of Pakistan to the problem of growing amounts of saline effluent from irrigated farms in the Indus Plains, is the massive Left Bank Outfall Drain. This billion-dollar project, presently around two-thirds completed, involves construction of a channel nearly 300 kilometers long to carry drainage water to the sea from networks of lesser drains meeting at a point near Nawabshah.