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.

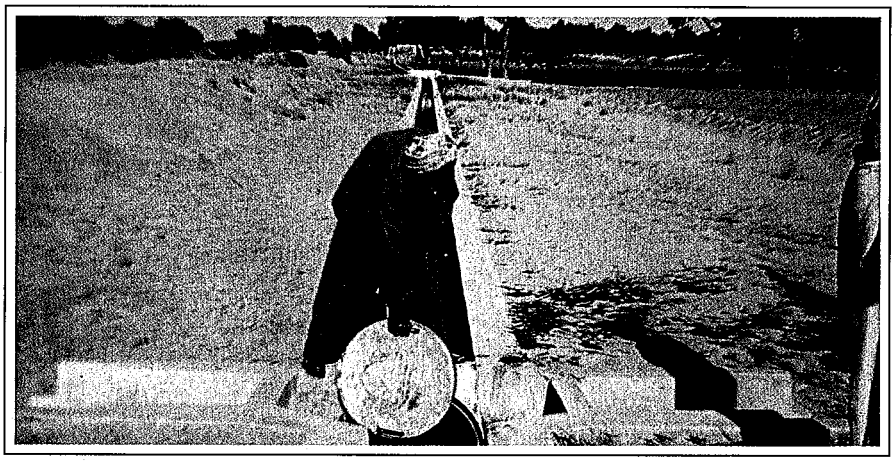
When asked about his new appointment, Jacob Kijne said that he expected the IIMI team in Pakistan to make timely and valuable contributions to irrigation management in the country. The recently resolved issue of apportionment of Indus water between the provinces and last year's Water Sector Investment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

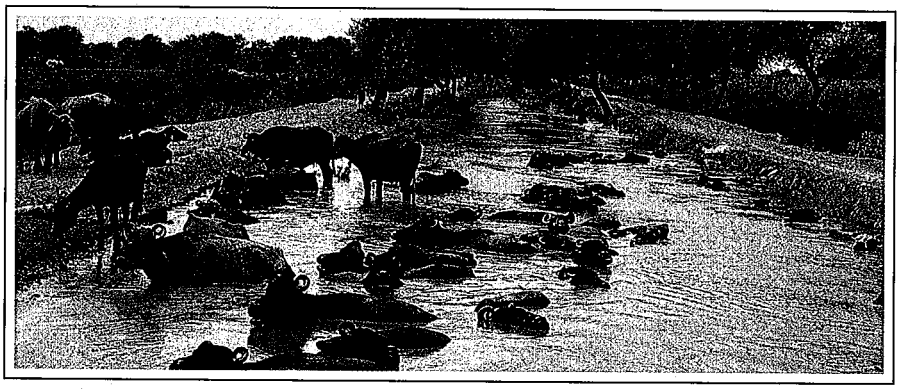
Much has been said about shortage of water resources in relation to crop water requirements, but little has been done to reevaluate allocation practices or to find ways and means to improve distribution procedures to match crop needs or cropping patterns. Sample data suggest that current management procedures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