Attachment-II

Outstanding Contributions to the Field of Research in

lanning and Use of Water Resources

f Dr. N K Tyagi, Member ASRB and formerly Principal Scientist and Soil Salinity Research Institute Karnal (India) is being made for the ment planning and promotion of environment friendly land and water nology that averted desertification and ensured food security in a Basin in India. The merit of the research and development planning ed at national level through conferment of high ranking awards and nominee, who also worked as Adjunct Professor with a number of abled a team of students, technicians and scientists to work on different ter resources management planning and development. Close linkages vith development agencies (Land Reclamation Corporations, Irrigation Development Authorities Water Resources Ministry and Soil ganization). The technical personnel belonging to these organizations ainings to equip them with new knowledge of salinity prevention and hnologies. Center of Excellence in Irrigation Management and a on Land Drainage were established to organize periodic trainings and hops. These centers not only helped in training manpower, but also ess in the community about the dangers of unchecked salinity menace. ions, exhibitions and farmers fairs were held in rural areas. This partnership with line departments and the farming community.

Strategies

a water logging and salinity became national concerns during 1960-70 s of the problem in the river basin in consultation with the established he interaction with the farming community, made it apparent that the lted from failure to plan, operate and maintain big irrigation systems. lishment of institutions to undertake research and the development come the threat of desertification. The Nominee planned research lop strategies for improving water use efficiencies through irrigation ents and the technology innovation for rehabilitation of salt affected

rocesses

There were three related but distinct components of the research and evelopment efforts: understanding the hydrology of alkalinity affected during the rocess of reclamation and developing appropriate crop and water management trategies for different stages of reclamation; visualizing the complexities of river-canal-roundwater interaction in a saline environment, conceptualizing the framework of echnological options and evaluating them with the aid of decision support system; and roposing design procedures for some water use enhancing structural and nonstructural nprovements stating from the level of unit command area to primary and secondary anal water delivery system.

ehabilitation of Alkali Land and its Impact on Hydrology

Alkalinity reduces infiltration, pollutes surface runoff, and in monsoon climate it lso increases flood hazards. But reclamation can help in overcoming these problems. In haggar –Yamuna Basin alkali land reclamation has been a big success and the roductivity of nearly 300000 ha of such lands has been restored to the level of 10 ons/ha food grains annually. Reclamation has significantly altered the surface and roundwater hydrology and has impacted the water quality. A study was setup to onitor the changes and analyze the implications on water balance and the environment ith the aid of integrated hydrologic-agronomic –economic models. There were several onclusions of scientific and applied nature showing that in hydrological sense, the eclamation of alkali soils is a continuous process spread over a long period (about 20 ears) of time. During the transient stages of reclamation, the irrigation requirements, roundwater recharge and crop-water-production relationships change with time and so o the optimal mix of crop and irrigation activities.

rainage and Conjunctive Use of Marginal Quality Waters

Saline ground waters underlie about 60 percent of area in Ghaggar-Yamuna asin. Drainage and reuse of these waters is essential not only for supplementing limited anal waters, but also for reducing secondary salinization hazards due to rise in water ble. A set of decision support models that first perform simulation and the hydraulic ptimization to determine optimal groundwater development in different parts of the asin and subsequently its use in conjunction with canal waters were developed. Based n the results of model applications, a number of pilot projects were implemented to eclaim water logged salty lands. The salty effluents were disposed into regional drains uring monsoon season (period high flows), and it did not cause any salinity problem ue to high degree of dilution in the receiving drains and rivers. During winter season, hese were used for irrigation of salt tolerant crops. The quality of saline effluents mproved with time leading to augmentation of useable water supply. This is gradually volving into a concept of bio-saline agriculture.

Decision Support for Irrigation System Improvements to Increase Water Use Efficiency

Low water use efficiencies are considered one of the major causes of water logging and salinity. Diagnostic analysis established that intra-seasonal modifications in water delivery schedules; revision in water allocations, precision leveling and rationalization of unit command size would considerably improve the prevailing efficiency. To achieve this end, procedures for designing the required interventions were developed and tested. Convincing the development department of the importance of suggested innovations and getting them implemented, has been a major hurdle. It was easier to convince the people at policymaking level, but people at implementation level, at times considered it as an unnecessary intrusion into their domain. Repeated efforts only could bring some success.

Results Achieved

The research efforts, aimed at developing integrated water resources management programme for prevention and amelioration of water logged saline lands in major irrigated areas, were quite successful. The outputs of this effort are: i) increased understanding of hydrology of alkali lands at different stages of reclamation and its implication on water allocation and ground water development ii) a set of decision support models that first perform simulation and the hydraulic optimization to determine optimal groundwater development in different parts of the basin and subsequently its use in conjunction with water from different sources with consideration for salinity in the saturated and unsaturated zones and the crop-soil-water salinity interactions; iii) a decision support model to decide the optimal mix of technology interventions in irrigation systems and their impact on groundwater behaviour with outputs enabling specification of priorities for implementing the best management practices and iv) a set of design procedures to modify water delivery schedules for warabandi (rotational) irrigation supply system in north India, optimize size of unit command area and auxiliary storage to take care of the uncertainty of supply system and for facilitating introduction of high frequency irrigation techniques.

Research led to formulation and implementation of rehabilitation and modernization programmes dealing with land reclamation, irrigation and drainage improvements and ground water development. At present the basin supports 600,000 shallow tube wells, of which 30 percent depend on additional groundwater recharge, generated from rainwater harvested in rice paddies. Also, floods and inundation of populated areas that were common phenomenon in alkali-affected areas have been almost completely eliminated. Subsurface drainage of saline areas has improved shallow groundwater quality, making it useable for irrigation after 3-4 years of drainage operation. Controlled drainage, that allows not only maintenance of salt balance, but also the reuse of marginal quality groundwater, has become in vogue. The technology option on pilot scale, established the feasibility of skimming relatively fresh shallow groundwater on large scale and it irrigates 20-30 percent of crop area. It is estimated that out of 4.5 million tons of food grains production in Ghaggar-Yamuna Basin, about

5 percent is largely due to conjunctive use of saline and fresh waters. An indirect enefit of conjunctive use is the control of water table, averting desertification through econdary salinization. Human resource development through training at center of xcellence in irrigation and drainage management established for this purpose, helped rain about 450 researchers and subject matter specialists. Sensitization of development lanners/ executing agencies resulted in faster approval of development schemes and nplementation of large-scale pilot projects. Efforts led to development of basin level aster plan and identification of institutions for undertaking such works in overnmental and nongovernmental organizations.

ustainability

The sustainability has several dimensions including: (1) sustained physical npacts on land and water system (2) sustained knowledge base and awareness and (3) stained socio-economic changes at the individual, community and the basin level. All f them are interrelated and compliment each other.

The physical sustainability depends upon the soundness of the technology and ontinued observance of the guidelines. In the basin states, there is provision of ontinued scientific back up and the users avail of this facility either free or by paying ominal cost. Thus a linkage between lab and the land has been established. Further, the conomic advantages gained by adoption of technology are very high. This has created a ested interest in the rural community in the maintenance of productivity of land and ater in order to sustain their high living standard and life style.

The most important impact of the technology implementation has been the nprovement in livelihood security. Land and water resources management rogrammes generated opportunities for direct employment of the order of million man-ays in the basin and 100 million man-days on national level. In a short time, the land eclamation programme developed into a rural development programme by creating venues for earning livelihood through dairying, rice-wheat processing and poultry etc. s earning capacity increased, more schools, hospitals and banks started functioning in ne rural areas. Some growth indicators like increase in number of tractors, combine arvesters, rice processing mills, oil mills etc., show 3-10 fold increase, indicating remendous rise in production and productivity of land, which is supporting 20 million opulation within the basin. This has greatly benefited the women and weaker section of ne society by helping them gain confidence and self-respect. In the past weaker section f the society and women folk seldom got adequate, food and schooling for girls was onsidered a luxury. But the situation is gradually changing and a new resurgent rural ndia is emerging.

ransferability

Desertification through secondary salinization is a problem not only in Ghaggar-amuna Basin, but also in the entire Indian subcontinent and the neighboring countries

of arid. The integrated land and water resources management model for averting desertification, developed and tested in Ghaggar-Yamuna Basin with good result, found application in several other Indian River Basins, like Satluj Basin in Indian Punjab, Tung-Bhadra Basin in the state of Karnataka, Krishna Basin in Andhra in south India. Pilot projects for rehabilitation of water logged salt affected lands and rehabilitation of irrigation system have been launched in these basins with positive effects on soil health and environment. Though the philosophy remained the same, the design of technical intervention varied according to local conditions. The experience was also shared with National Salinity Research Center Yadz (Iran), where the nominee worked as consultant and with Uzbekistan, China and Egypt in course expert consultations organized by Food and Agricultural Organization (FAO) from 1992-2004.

In nutshell, the research and development planning efforts of the Nominee helped in overcoming the existing and potential threats to the security of land and water system encompassed by Ghaggar-Yamuna Basin(North India). The development of technology interventions, those were implemented on a large scale, improved water use efficiency halted secondary salinization and rehabilitated the affected areas. In bringing about the positive changes in the ecosystem the awareness programmes that were organized, played a major role. This is an example, how the livelihood security and environment in which irrigation communities live, can be improved through better water management planned and implemented on scientific principles.

Note: The detailed list of research publications and other documents emanating from the research and development planning efforts is appended as Attachment V