

INDEX

Abernethy, Charles, 38, 39, 40, 113, 242 Bekri, El, 134 Action research, 67, 205, 211, 220, 221, Beni-Amir Project (Morocco), 134, 137 222, 247, 248, 250 water scheduling at, 149 Accountability, 181, 198, 201, 202 Benor, Daniel, 93 Africa, 3, 15 Bergmann, Hellmuth, 202 Agrarian Research and Training Institute Bethna system, 215 (Colombo), 175, 240 Bevan, Digby, 63 Agricultural economics, 69, 249 Bhakra Nangal Project, 130, 205 Agricultural economists, 30, 35, 40, 66, 69, water availability in, 112, 114 82-83, 249 Bhargava, G.S., 188 Bhavani Project, Lower, see Lower Bhavani Agricultural engineering, 30, 35, 40, 66, 69, .82,249Project Agricultural engineers, 30, 35, 40, 82, 100, Bhima Project, 10, 13 125 Biases, spatial, 228 Agriculture, irrigation and, 5 Bottrall, Anthony, 39, 46n, 64, 111, 122, 130, 137, 182, 202, 209, 225-26, 229 employment in, 5, 8, 10, 11-12 Agronomists, 27, 30, 35, 40, 82, 84, 224 Bribes, paid to irrigation staff by farmers, Agronomy, 27, 69, 82, 224, 249 190, 191, 198 Ali, Syed Hashim, xxii, 37, 90-91, 92, 110 Burton, Martin, 249 America, North, irrigation schedules in, 126-27 Campbell, Don, 150 Analysis, modes and tools of, 216 Canal irrigation, challenges to 71 diagnostic, see Diagnostic analysis at night, 96, 133, 149-50 in India, 18, 19, 26 Antaki, El, 134 Appraisals, 221 potential, 17, 19, 25, 26, 112; diagnostic, 71 purpose of, 29, 31 of Indian Central Water Commission, rural poverty and, 3 222, 223-25 subsidy to, 179 of Water Management Synthesis Project, types of, 16 222-23 Canal irrigation systems, 16 options and techniques for, 226 as whole systems, 27, 40, 209, 222, purposes of 222 223-26 Rapid Rural, 209, 222, 225-26 dimensions of, 40 Area irrigated, through irrigation projects, domains of, 40 17, 20, 110, 212-13, 234 linkages in, 40 Asia, South, canal irrigation in, 16 Carruthers, Ian, 230n rural poverty in, 3, 4 Central Water Commission (India), 107, Asopa, V., 50, 53, 65, 66, 91 117, 129, 222, 223, 234 'Ayacut' development, 88, 188, 198 recommendations on waterlogging by, Bailly, Charles, 243 Chak, reduction in size of, 54, 55 Bandyopadhyay, Jayantha, 233 scheduling of, 125 Bangladesh, 4, 6, 12, 13 sub-division of, and rotation of water to, area irrigated in, 17 54-59 Bari Doab system, 75 Chambal Project, 137



274 Managing Canal Irrigation

Channel and zonal committees, 175 Dimensions, of canal irrigation system, 40, Chhatis Mauja Project (Nepal), 163, 164, 42, 45 171, 176 space and time, 42, 45 desilting in, 166 Children, 39, 70, 217 China, 3 195-96 Civil engineering, 69, 100, 203, 246, 249 Distribution, of water, 28, 99, 203 Command Area Development, 50, 62, 65, 86, 87, 89, 91, 99, 110, Command Area Development Authority, 86, 41-45 88, 100, 101, 199, 235, 251 bio-economic, 41, 42 functions of, 88, 100 human, 41, 42, 181 Communal irrigation systems, 16, 17, 80, physical, 41, 42 163, 229 water as a, 41, 42 Communications, 85, 127, 232, 236, 237, Drainage system 77, 78 239, 240, 245 Duncan, S., 90 to farmers, 130-31, 159, 198, 237, 239, Dusi-Mamandur tank, 163, 164 242, 247 to managers, 128-30, 242 Early, Alan, C., 109, 119 Computers, in irrigation, 206, 220, 249 analysis, 232, 242-43, 245 Education, female, 14 Conjuctive use, 215-16, 224 Efficiency, water, 29, 30, 31, 109 Construction, 47, 88, 165, 203, 204, 205 Egypt, 3, 129 delay in, 19 new, as false trial, 233-234, 236 Elumalai, G., 214 Coordination, as false trial, 234-35 Corruption, by officials, 185, 187-88, 202, and income, 11, 15 232, 247 seasonal, 14 effects of, 181, 188-94 effect on farmers, 181, 189, 191 76, 82, 84, 181-206, 234 Cost-benefit analysis, 30 accountability of, 198, 201 Cost-effective appraisals, 209, 221, 222, 230 201, 236 demoralisation among, 193 Coward, Walter, 80 Criteria, Single, 28, 29, 40 discipline among, 195 see, Productivity, Equity, Stability training of, 248-50 see also, Performance transfers of 185-86, 193 Crop Zoning, 213 Cultivation rights, 214 37-38 benefits of, 37 Damodar Valley Canals, 11 night irrigation and, 146 Dams, cases against construction of new, proportionate, 37, 38 233 Esman, Milton J., 240 maintenance of, 106 preoccupation of engineers on, 73 145-46, 156 Dantiwada Canal Irrigation Project, 11,238 Farmers, above the outlet, 158-80

Dave, K.M., 60 Decision-making, farmers participation in, 50, 174, 198 Delivery, of water, 101, 114, 123-24, 244 scheduling and, 71, 85, 105, 124-27, 236

Design, 156, 203, 204, 205 Dhanori Changa Piyat Sahakari Mandli, 61 Dhawan, B.D., 24

Diagnostic analysis, 209, 222-23, 232, 236, 237, 246, 247, 248

Diagrams, 219

Discipline, effect of corruption, of staff, 191; need for, in irrigation departments, re-, from head to tail-end reaches, 116-17 Domain(s), of canal irrigation systems, 40,

Economy, agricultural production and, 5 Electricity charges, for lifting water, 83, 216 Employment, in agriculture, 5, 8, 10, 11-12 Engineers, irrigation, (managers), 35, 72, conditions and incentives to, 183-85, Equity, criterion of performance, 28, 33, Evaporation, night irrigation and, 144,

below the outlet, xxxi communications to, 130-31, 159, 198, impact of night irrigation on, 138-40 organisations of, 79, 81, 86, 87, 89, 90, 167, 169, 171, 176, 240 participation of, in irrigation, 71, 176, 237, 239-42, 245 rights to water of, 37, 198, 199, 239 small, 9, 10, 15, 37, 170, 251



Index 275

Farmer Joint Management (FJM), 158, decline in, at tailends, 23 172-79, 200, 232, 236, 240, 247 India, area irrigated in, 17 channel and zonal committees, 173 canal irrigation in, 16, 18, 19, 26, 106 kanna meetings, 173 Command Area Development in, 87-82 open meetings, 173 FJM in. 179 project level committees, 173 food production in, 6, 233 Freeman, David M., 81 hierarchy of engineering staff, 183 irrigation potential in, 17-19, 25-27, 87, Gal Oya Project (Sri Lanka), 22, 23, 131, 112, 234 137, 171 poverty in rural, 4 farmers participation in, 164, 165, 166, Seventh Plan of, 4, 19, 62, 78, 89, 98, 199, 234, 235 Farmer Joint Management in, 158, 175, Sixth Plan of, 89, 99 200 Indonesia, 3, 225 MSM of, 111, 119 Information, to farmers, 159, 181 night irrigation in, 114, 146 Integrated Area Development Programme, project level committees in, 177 50 Gambhiri Project, 23, 24, 128, 137, 173 Integrated Rural Development Programme, Gandak, waterlogging in, 77 4,5 Gàndhi, P.R., 137 Integrated Water Management, 37 Ganga-Cauvery link, National Water Plan Internal rate of return, 25, 29, 30 for, 234 International Food Policy Research Gezira Scheme (Sudan), night storage of Institute, 5-6 water in, 149 International Fund for Agricultural Ghataprabha Project, 141, 151 Development, 10, 14 Ghosh, M.G., 11 International Irrigation Management Girna Project, effects of excess water in, Institute, 205, 248 120 Irrigation, agriculture and, 5 new warabandi in, 93 and employment, 5, 8, 11 warabandi in Borkheda Minor on, 97 and impact on poor, 10, 11, 15 Groundwater, 19, 22, 34, 39, 52, 152 non-agricultural uses of, water, 15 lift from, 215-16 objectives of, 73 problem of waterlogging and, 77 see also night irrigation recharge of, 24, 25, 215-16 Irrigation Commissions (India), 87, 88, Group participation, 169-72, 173 154 Hardware, side of irrigation management, recommendations on waterlogging, 76, 75, 76 78 Hart, Henry, 151 Irrigation department, 86, 88, 89, 100, 102, Hasdeo Bango Project (HBP), 49, 54-59 168, 194, 199 Hassan, Syed Turabul, 92, 127 Irrigation engineering, normal, 27, 68, 72-Hattawar, H.B., 125 76, 82, 246 Headreach farmers, advantages of, 117, 118, see also Engineers 168 Irrigation fees, see water rates rights to water of, 45 Irrigation schemes, communal, 13 Irrigation staff, 41, 183 Health, effects of irrigation on, 9, 40 High-yielding practices, adoption of, 26, corruption among, 185, 202 discipline among, 195 34, 172 incentives and accountability of, 201-202 and employment, 11 night irrigation and, 142 Hirakud Project, 22 'Islands of Salvation', 59, 62, 64, 86, 94, Howes, Michael, 13 Hydrologists, 35 Iyer, Shankara, 135 Hydrology, problems of, 73 Hukkeri, S.B., 127, 128, 144, 154 Incentives, 181, 183, 201, 236, 242 Jayaraman, T.K., 53, 93 Income, to labourers, irrigation and, 11, 12, and Pushpa, 193, 196, 203 15 Joshi, N.M., 111, 127, 148, 157, 239



276 Managing Canal Irrigation

Kakatiya Canal, of Sriramasagar Project, warabandi in, 93, 96, 97 water loss in, 115, 116 Mahaweli Project (Sri Lanka), 75, 80, 107, Kakrapar Canal system, 60, 61 Kamalpuri, Upendra Nath, 182 175, 243 Kaudulla Project (Sri Lanka), 117, 242 Karmeli, David, 242 203 Katariya, S.R., 137 Kathpalia, G.N., 122 Keller, Jack, 26, 122 membrane concept of, 212-13, 246 238 Kennedy, R.G., 75 Key probes, 217-19 Kolavalli, Shashi, 189 Koliary outlet, higher yields in, 56, 57, 58, 63 Kosi Canal, 131, 191 area irrigated by, 20 Lal, Pande B.B., 78, 79 Land, area to be irrigated, 212 levelling of, 236 see also Area irrigated Landless labourers, 8, 11, 13, 14, 15, 24, 37, 215, 227, 228, 232, 247, 250, 251 Land use, efficient, 51 Leach, Edmund, 79 Learning, and mislearning, 63-64 Lele, S.N., 93 Lenton, Roberto, 38, 40, 71, 205, 220 Leonard, David, 199 Lift irrigation, 16, 151, 215-16 water allocation from, 38 Linkages, of canal irrigation system, 40, 45-46 Livelihood, food production and, 5, 7, 8 gains in, 11, 13 potential for, 26 Lowdermilk, Max L., 81, 139 Lower Bhavani Project, 114, 139, 141 Lower Talavera River Irrigation System (LTRIS), 119

Mahakanadarawa (Sri Lanka), rotational irrigation in, 111 Mahanadi River Project (MRP), 23, 49, 54-59, 106, 234 research on, for sub chaks, 55, 58 Mahanadi Delta Irrigation System, 224 Maharashtra, Phad system in, 215 State Irrigation Commission, 60 Mahi-Kadana Project, 49-54, 120, 130, 134, 189 area irrigated, 20 Command Area Development in, 50, 91 night irrigation in, 141, 142 salinity problem in, 21 studies on, 50, 51, 52, 53, 66, 203-204

Maintenance, of projects, 74, 106, 165-66, see also Operation and Maintenance Main System Management, 53, 54, 59, 64, 68, 81, 88, 90, 91, 105-32, 156, 168, 236, communication in, 127-32 scheduling and delivery, 124-27 Malaprabha, 164 Malhotra, S.P., 127 Management, water, 51, 71, 182, 203, 204 on Mahi-Kadana, 51 Managers, communication to, 128 financial incentives to, 201, 206 and motivation, 181, 199 see also Engineers Merriam, John L., 126 Merrey, Douglas, 139, 169, 170 Methodologies, 71, 232 Mettur Dam, 19, 159 Mexico, 3 Michael, A.M., 73 Migration, of labourers, irrigation and, 11, 13-14, 39, 42, 44 seasonal, 42 Minipe Project (Sri Lanka), 171 desilting in, 166 farmers committees in, 175 project level committees in, 158, 177 water to the tailend reaches in, 117, 118 Modelling, 219-20 Modes and tools, of analysis 216 Mohini Water Cooperative Society, 59, 62, 83, 175 Monitoring and Evaluation methods, 217 Moore, M.P., 129, 137, 174, 182 Morna Project, 79, 137, 148-49, 157, 239 Morocco, 149 Motivation, managers and, 181-206 Mula Project, 90, 97, 175 Mukerji Task Force, 30, 61 Murray-Rust, Douglas Hammond, 131, 137, 164, 174 Nagarjuna Canal, area irrigated by, 20, 110-11, 238 warabandi system, in, 95, 96, 100

Narayanamurthy, S.G., 220, 244

warabandi in, 97-98

Naurangdeshar Canal System, 59, 62-63,

National Agricultural Commission, 27n

National Research Council (USA), 87



Index 277

National Water Management Project Pani Panchayats, 90, 175 (India), 111, 232, 238, 244 Pant, Niranjan, 94, 131, 153, 165, 182, 191 Nepal, 4, 163, 170, 171 Panzara Right Bank, warabandi in, 98 Night irrigation, 96, 133-57, 236, 247 Pardhiapali Subminor, 22 above the outlet, 141 Participation, xviii, 169-72, 173, 232, 239-40, 242, 245-46 below the outlet, 138 evaluation of, 144 see also farmers Patil, R.K., 90, 94 impact on farmers of, 138-40 importance of, 135, 156 Patwardhan, M.M., 242 inefficient use of, 137-38, 141, 145 Payments, by farmers, 201 methods of improving, 153-55 Penaranda River Irrigation System, 109, reducing, 147 119 shortage of night flows, 148-52 Perambikulam Aliyar Project, 137, 142, Normal professionalism see Professiona-214 area irrigated by, 20 Normal standard programme, see Performance, -based approaches, 217 Programmes criteria, 28, 29, 209 improving, 33, 34, 40, 202, 232, 242 Objectives, of irrigation, 28, 39, 73, 78, 210 monitoring of, 71, 203, 205, 217, 232, On-farm development (OFD) programme, 237, 242-44, 245, 247 objectives for 28, 29, 167, 209 50, 86, 87, 89, 91, 92, 100 On-farm water management, 86, 87, 223 Periyar Vaigai Project, 37, 63, 169 On-Farm Water Management Research warabandi in, 98 Phad, 213, 215 Project (Pakistan), 81 Operation and Maintenance, 62, 203, 205 Philippines, 3, 13, 59, 142, 161 need for separate cadres, 181, 196-98 communals in, 175 National Irrigation Administration in by farmers, 163-65 Operational plans, 232, 237, 238-39, 248 176 on large systems, 244, 245, 246 rotational irrigation in, 90, 108, 109 Organisations, farmers', 79, 81, 86, 87, 89, see also PENRIS, UPRIIS 90, 171, 176, 240 Pipe committees, 90 leadership in, 169, 170 Pochampad Project, 165 spontaneous, 167, 169 Political interests, 25 Outlet, CADAs below the, 86, 101 Political pressure, and farmers, 160, 170, physical development below, 86, 87, 100 Outlet, farmers above the, 158 on irrigation staff, 5, 193, 194, 195 appropriation of water by, 161 Postings, payments made for, in irrigation lobbying by, 160 departments, 186 operating canals by, 163-65, 166 Potential, canal irrigation, 17, 19, 25, 26, 112, 238 Paddy, cultivation of, 22, 23, 73, 107, 112, Potten, David, 209, 222, 226, 228 133, 141 146, 154, 188, 214 Poverty, rural, 4 lock-in, excess of water and, 121-22 canal irrigation and, 3 storage of water in paddy fields, 152, 154 Pressure groups, 160, 169, 170 Pai, A.A., 122, 127, 128, 144, 154 Prior appropriation, 37 Pakistan, 3, 4, 5, 6, 81, 106, 134, 135, 156, Production thinking, 29, 31, 40 172, 222, 245 Productivity, criterion of performance, 28, area irrigated in, 17 33, 34; night irrigation and, 144-46 communications to farmers in, 130 Professionalism, 82, 100 food production in, 5, 6 irrigation potential in, 17, 18, 26 enhanced, 181, 203 night irrigation in 145, 154 nature of, 68-69 problem of waterlogging in, 87, 92 new, 232, 246-47, 248, 250 warabandi in, 87, 92 Professionalism, normal, 27, 67, 68, 82, Palanisami, K., 114 84, 125, 246, 250;

of economists, 69

Panam Irrigation Project, 151, 203, 204



278

Managing Canal Irrigation of irrigation engineers, 68, 69, 72, 73, 76, of sociologists, 68, 69, 70, 79, 82, 84, 125 factors of, 69-70 Programmes, normal standard, 232, 235-36 Project level committees, 176-77 Promotions, of irrigation staff 184, 185 Proportionate equality, 37 Punmia, B.C., 78, 79 Purna Irrigation Project, 120 Rajakkal channel, 166 Rajangana Scheme (Sri Lanka), 109 Rajasthan Canal, area irrigated by, 20 Rajolibanda Diversion Scheme, area irrigated by, 20 Ramachandram, V.K., 169 Ramganga Project, 22 Rao, P.S., 63, 128, 249 Rapid Rural Appraisals, 208, 222, 225-26 Rathi, B.D., 130 Reidinger, Richard B., 130 Replogle, John A., 126 Research, 248, 250 areas chosen for, specially favoured, 63, 64 and development, 65-66, 232, 247 determinants of, 65-66 open learning process approach to, 66-67 reflections on, 64 Reservoirs, 148-49, 152, 173, 221, 239 lift irrgation from, 215, 216 Rights, 232, 237 to water, 37, 181, 198, 199, 239, 245 cultivation, 214 Rotational irrigation, 78, 86, 90, 92, 94, 96, 97, 106, 108-109, 111, 146, 199, 238, 249 advantages of, 108-109 Rules of Thumb, and management, 75, 110, 116, 203, 230 Run-of-the-river diversions, 18, 113, 150, Salinity, problem of, 9, 21, 76, 120, 236 Sapolsky, Harvey M., 220 Sarda Sahayak Project, area irrigated by, 20 waterlogging in, 21, 77 Scheduling, 79, 200, 244 chak, 125 through computers, 220 on-farm irrigation, 125 Scheduling and delivery, 71, 85, 105,

124-27, 131, 175, 199, 205, 232, 236,

Seepage, 34, 36, 75, 144, 165, 215 Sen, Amartya, 7 Sequences, causal, 31, 244 Sharda Sahayak System, 120 Singh, Bharat, 72, 76, 78, 79 Singh, K.K., 91, 93, 94 Sinha, V.S., 60, 61, 176 Sivanappan, R.K., 137, 146 Social anthropologists, 81, 82 Social anthropology, 68, 79, 80, 83 Social aspects, of irrigation, 66, 79 Sociologists, 30, 40, 65, 80, 81, 182 Sociology, 68, 69, 70 Software aspects, of irrigation management, 74, 76, 105 Sone Command, 162 warabandi in, 94, 95, 96, 97 Sri Lanka, 4, 6, 15, 16, 72, 129, 143, 151, 170, 171, 172, 195 area irrigated in, 17 channel and zonal committees in, 175 dry zone area, irrigation in, 24, 175 engineers in, 184 field staff in, 183 FJM in, 158, 173, 177, 179 kanna meetings in, 173-74 main system management in, 107 organisations in, 79 Sriramasagar Project, area irrigated by, 20, 90, 91, 101 farmers' organisation in, 90 Ramajipet area in, 94-95 warabandi in, 92, 93, 94, 98, 101, 108, 198 waterlogging in, 121 Stability, criterion of performance, 28, 33, 38-39 effect of night irrigation on, 147 Staggering, of cultivation, 214 Standard programmes, normal, as false trial, 235-36 Storage, of water, at night, 148-52 in canals, 149-50 on farms, 151 in main reservoirs, 148 intermediate, 150-51 as ground water, 152 Sudan, 3, 149 Sukhomajři Project, water allocation from, Sundar, A., 128, 249 Suryavanshi, A.R., 242 Svendsen, Mark, 134, 142, 161, 164 Systematic Canal Operation (SCO), 110 Tailend farmers, 110, 227, 232 lower yields of, 22

Seckler, David, 26, 242

247



Index 279

deprivation of, 21-24, 247, 250 gains from, 198 disadvantages to, 38, 45, 118, 168, 189, in Pakistan, 87, 92 191 effects of redistribution of water to, 116-17 water supply to, 110, 111 Taiwan, 225 Task Force on Increasing Agricultural Productivity in Command Areas of Irrigation System, 98 Tawa Project, waterlogging in, 20 205, 248 Tram discussions, 229 Textbooks, lack of and need for, 67, 76, 205, 232 Thailand, 3, 90 Tiffen, Mary, 209, 222, 226 Timing, of cultivation and staggering, 214 Trade-offs, 210 Training, of managers, 232, 248 97, 220 field visits during, 249, 251 role-playing during, 232, 249 Transfers, of irrigation officials, 185-86, 193, 197, 200 Trilateral Commission, 87 Tripathi, B.L., 50, 53, 65, 66, 91 Tungabhadra Canal, 109 area irrigated by, 20 65, 130 waterlogging and salinity in, 21 Uda Walawe Project (Sri Lanka), area irrigated by 20 Ukai-Kakrapar system, 175, 176 Uphoff, Norman, 199, 202, 240 Upper Ganga Canal, 22, 74, 75, 115 Upper Krishna, operational plan of, 238 Upper Pampanga River Integrated Irrigation System (UPRIIS), appropriation of water by farmers on, 161-62, 163 farmers' participation in, 163, 164, 165

Vedulla, 164 Velera, A., 90, 119 Velde, Vander, 114 Venkatesan, M.N., 231n Verma, R.K., 94, 231

Utility, criterion of performance, 33

Wade, Robert, 115, 154, 163, 169, 170, 182, 186, 189, 190, 193, 196, 198
Wagon Project, 165, 173
Walker, Wynn, 243
Warabandi for Irrigated Agriculture, workshop on 93, 97
Warabandi system, 81, 86, 87, 92-99, 101, 137, 141, 146, 153, 167, 199, 235, 236, 239

new, 92-99 Northwest Indian, 22, 37, 87, 96, 99, 108, 127, 143, 146, 153, 167, 211, 214, precondition for, 95-96, 97 schedules, 93, 95 tailend deprivation in, 22 Water and Land Management Institutes, Water and Power Consultancy Services, 54, report of, 55, 58 Water cooperatives, 50, 59-62, 83, 175 Water delivery, characterstics of, 62 see also Delivery Water flows, measurement of, 53, 71, 73, Water loss, due to sedimentation, 113, 115 due to transmission, 113, 114, 115 Water management, efficient, 51, 203, 204, Water Management Synthesis Project, study on Mahi-Kadana Project, 52, 53, study in Pakistan, 222 diagnostic analysis by, 222-23 Water problem, and distribution, 44 due to excess, 120, 121 Water ratesm, 18, 83, 216 Water Technology Centre, 26 study on Mahi-Kadana Project, 51, 53, 60, 65, 115, 116 Waterlogging, 9, 21, 24, 68, 76-79, 120-21, 130, 147, 149, 214, 236 Wickham, T.H., 90, 109, 119 Wickramasekara, Piyasiri, 117, 118, 129 Witt fogel, Karl A., 80 Women, 15, 37, 39, 227, 228, 249, 250, and night irrigation, 139 effect of electricity on, 27n gains from irrigation to, 9 not preferred professionally, 70 World Bank, 86, 101, 111, 116, 209, 225,

Yields, average, as measure of performance, 24 variance in, due to subdivisions, 58, 59

Zoning, crop choice and, 213 for crops against waterlogging, 78 for night flows, 154

234