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ABSTRACTS

Vth WORLD CONGRESS ON WATER RESOURCES BRUSSELS 1985

WATER RESOURCES FOR RURAL AREAS AND THEIR COMMUNITIES

ABSTRACTS

Vth WORLD CONGRESS ON WATER RESOURCES

9-15 JUNE 1985 Brussels Belgium

organized by the

IWRA
INTERNATIONAL WATER RESOURCES ASSOCIATION

AIRE
ASSOCIATION INTERNATIONALE DES RESSOURCES EN EAU

AIREH
ASOCIACION INTERNACIONAL DE RECURSOS HIDRICOS

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With this book of abstracts, the members of the Conference Committee invite you to prepare your participation in the IWRA Vth World Congress on Water Resources in a most efficient way.
For your convenience, each abstract is identified by its paper number, a session symbol and an aspect number.
The session symbols are: □ for Formal, ★ for Poster, ○ for Workshops, ▽ for Policy, △ for Free Courses and ◇ for Special Sessions.

You are fully registered now and have already received the Programme of the Congress, in which you will find a Personal Programme Form.
Please, prepare your personal programme carefully and send it to us. In this way, you will help in the organisation of the Conference and in the identification of the interdisciplinary and inter-professional links between aspects and stages.

The aim of the Congress is, primarily, to revive a stronger awareness among world populations and governments of the actual water mismanagement and its adverse effects on the development and well-being of future generations. Secondly, the Congress aims to provide the decision makers, individuals or international institutions, with guidelines for identifying water problems and solution schemes that incorporate all aspects of water resources management. Finally, examples should be made available to emphasize objective coordination on a long term basis, not only to prevent further degradation, but especially to promote a harmonious balance between our various water supplies.

Take this book of abstracts with you to the Congress; it will be very useful to complete your information on the spot.

The members of the Conference Committee are looking foreward to meet you in Brussels and to share our preoccupation with « Water Resources for Rural Areas and their Communities ».

The Conference Committee

Brussels, January 1985

LEGEND

ABBREVIATIONS

NAME : The name of the author or the name of one of the authors of the paper.

\- : Indicates the author who will present the paper at the congress according to the information received on the paper.

NA : The number of authors who contributed to the paper.

PAPN : The paper number.

TYP : The type of the session. The session symbol is mostly completed with the aspect number.

SESSION SYMBOLS

□	: FORMAL SESSION.	▽	: IWRA POLICY SESSION.
★	: POSTER SESSION.	△	: FREE COURSE.
○	: WORKSHOP.	◇	: SPECIAL SESSION.

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SINGH J.	2	225	□ 4
SINGH K.	2	41c	□ 2
→ SINGH K.P.	1	253	★12
→ SINGH Kr.P.	1	149	□ 5
SINGH R.	3	288	□12
→ SINGH S.V.	2	294	□ 5
→ SINGH V.P.	4	41a	□ 2
→ SINGH V.P.	2	41b	□ 2
→ SINGH V.P.	2	41c	□ 2
→ SINGH V.P.	3	41d	□ 2
→ SIVANAPPAN R.K.	1	182	□ 1
SOMASEKHAR H.I.	3	178	□ 4
→ SONI B.	3	68	□12
SPAANS W.	2	47a	△
→ SPENCER A.L.	1	27	□ 3
→ SRINIVASAN V.S.	2	92	□ 5
→ STEPHENSON D.	2	177	□ 5
→ STOUT G.E.	1	26a	▽
→ STOUT G.E.	1	26b	▽
→ SVANIDZE G.G.	2	302	○ 6
→ TAKAHASI Y.	1	200	□ 7
TAM D.M.	3	185	□ 6
→ TAMIR O.	2	262	★10
TARAPORE Z.S.	4	244	□12
TEIXEIRA J.L.	3	236	★12
→ TESARIK I.	2	40	□ 6
THAPAR O.D.	4	309	★12
→ THOMAS A.	2	78	□ 5
THOMAS J.M.	3	39a	□ 6
THOMPSON T.	3	158	□ 8
TOUHAMI H.	2	62	□11
TRIETSCH R.	2	138	□ 4
TRIETSCH R.	2	140	□10
→ TUCKER R.C.	3	123	□12
→ TYTECA D.	3	33	□ 6
UBERTINI L.	4	41a	□ 2
van BEEK E.	3	47b	△
VANBELLINGEN R.	3	242	□10
VANCON J.P.	11	76	□10
→ Van der BEKEN A.	2	126a	□ 2
→ Van der BEKEN A.	2	126b	★ 2
VANDER BORGHT P.	3	112	□ 6
VANDER BORGHT P.	3	208	□ 4
VAN HOOF F.	5	111a	□ 6
van WALSUM P.E.V.	2	297	□10
→ VASEL J.-L.	3	112	□ 6
VASILIEV Yu.S.	2	232	★ 5
VIEGAND S.	2	71	★ 6
→ VIGNESWARAN S.	3	185	□ 6
VILAND M.C.	2	184	□ 2
VISVANATHAN C.	3	185	□ 6
→ WALTER M.	1	310	□ 4
→ WARD C.H.	3	39a	□ 6
→ WARD C.H.	2	39b	□ 6
WENG WEN-BIN	3	296	□10
WESTMORE R.R.	3	80	□12
WOEHL B.	3	136	□ 1
→ WONG S.T.	2	219	□ 1
YANG LIYE	4	97	□12
YAO RU-XIANG	3	296	□10
→ YEVJEVICH V.	1	141a	▽
→ YEVJEVICH V.	1	141b	▽
YOGANARASIMHAN G.N.	4	309	★12
ZHANG YADING	4	97	□12
→ ZILLIOX L.	11	76	□10
ZIMMERMAN R.	3	123	□12
ZIROUT A.	3	308	★ 9

INRA POLICY SESSIONS ▽

NAME.....	NA	PAPN
→ YEVJEVICH V.	1	141a
→ YEVJEVICH V.	1	141b
→ STOUT G.E.	1	26a
→ STOUT G.E.	1	26b

FREE COURSES △

NAME.....	NA	PAPN
→ MOSTERTMAN L.	2	47a
SPAANS W.	2	47a
→ MOSTERTMAN L.	3	47b
van BEEK E.	3	47b
KLOMP R.	3	47b

SPECIAL SESSION ◇

→ BEYER M.G.	1	307

ASPECT INDEX

ASPECT 1 : SOCIAL AND CULTURAL (13 PAPERS : 10□ + 3★).

NAME.....	NA	PAPN	TYP
→ ALAERTS G.	1	51	□
AZIMI M.R.	2	219	□
→ CHATURVEDI M.C.	1	267	□
COSTA V.B.	5	249	□
→ DA SILVA V.M.	5	249	□
→ DEWAN R.L.	2	233	★
→ FERGUSON B.K.	1	293	★
→ FROEHLICHER R.	3	136	□
GHOSE N.C.	2	233	★
→ KINNERSLEY D.J.	1	235	□
→ MATHIEU P.	1	142	□
MIRANDA J.C.	5	249	□
→ OLSENIUS C.	1	248a	□
→ OZIS U.	1	31b	★
→ RADY M.A.	1	196b	□
RITZ J.	3	136	□
ROCHA J.S.	5	249	□
RODRIGUES A.M.	5	249	□
→ SIVANAPPAN R.K.	1	182	□
WOEHL B.	3	136	□
→ WONG S.T.	2	219	□

ASPECT 2 : EDUCATION AND TRANSFER OF TECHNOLOGY (17 PAPERS : 14□ + 3★).

NAME.....	NA	PAPN	TYP
ABU-ZEID M.A.	2	196c	□
→ BHADORIA P.B.S.	1	128	□
→ CHATURVEDI A.C.	1	2	□
CORRADINI C.	4	41a	□
DE KETELAERE D.	2	126a	□
DE KETELAERE D.	2	126b	★
DENSHAM J.K.	2	260	□
→ ESKENAZI Ed.	1	289	□
→ GREIG F.W.	2	260	□
HAKKINEN R.	3	287	★
IYENGAR S.S.	3	41d	□
JAIN D.	2	41b	□
→ KATKO T.	3	287	★
MELONE F.	4	41a	□
MILLER S.W.	3	41d	□
→ MOUNIER J.P.	2	184	□
→ NAWANG W.M.	1	259	★
→ NEMEC J.	1	285	□
→ PEREZ FARRAS L.E.	1	95	□
→ RADY M.A.	2	196c	□
RANTALA P.	3	287	★
→ RASMUSSEN J.	2	96	□
REFSGAARD J.Chr.	2	96	□
SINGH K.	2	41c	□
→ SINGH V.P.	4	41a	□
→ SINGH V.P.	2	41b	□
→ SINGH V.P.	2	41c	□
→ SINGH V.P.	3	41d	□
UBERTINI L.	4	41a	□
→ Van der BEKEN A.	2	126a	□
→ Van der BEKEN A.	2	126b	★
VILAND M.C.	2	184	□

ASPECT INDEX

ASPECT 3 : ADMINISTRATION, ECONOMY, FINANCE AND MANAGEMENT (19 PAPERS : 17□ + 1★ + 1○).

NAME.....	NA	PAPN	TYP
- ABELIUK R.R.	1	85	□
- CHICOINE D.L.	3	246	□
- DAVID L.	1	210	□
- de BRUYN W.A.	1	131	○
- de KOSINSKY V.	1	116	□
- DOEKSEN G.A.	3	205	□
- FAHMY S.H.	1	195	□
- GESSAMAN P.H.	1	168	□
GOODWIN H.L.	3	205	□
GROSSMAN M.R.	3	246	□
- HEIDARI M.	1	261	□
- HUFSCHMIDT M.M.	1	239	□
- HUNG P.L.	1	44	★
- JOHNSON III S.H.	1	231	□
KRAJEWSKI K.	3	104	□
- LAURIA D.T.	1	124	□
- MATHEW T.	3	230	□
MIKOLAJCZYK R.	3	104	□
- MILASZEWICZ-KICINSKA W.	2	19	□
MOHANTY R.P.	3	230	□
- MURTY K.S.	1	29	□
OEHRTMAN R.L.	3	205	□
PANIKAR J.T.	3	230	□
RAMAMURTHY G.	3	246	□
ROMAN M.	2	19	□
- SAHU H.L.	1	198	□
- SIKORSKI W.	3	104	□
- SPENCER A.L.	1	27	□

ASPECT 4 : METHODOLOGY, EQUIPMENT AND MATERIAL (18 PAPERS : 16□ + 2★).

NAME.....	NA	PAPN	TYP
- ADAMOWSKI K.	3	222	□
- AFONSO A.S.	1	189	★
- ARLOSOROFF S.	1	25	□
- BASAK P.	3	216	□
- BAUMANN D.D.	2	245	□
- BAZIER G.	3	208	□
- CAILLOT A.	1	171	□
CALMELS P.	3	277	□
CEFIS G.M.	3	63	□
CREWS J.E.	2	245	□
DAY T.	3	222	□
- ENGELSMAN C.M.	2	138	□
- GAILLARD B.	3	277	□
GINGRAS D.	3	222	□
GOPAKUMAR	3	216	□
JI H.K.	3	213	□
KIM S.W.	3	213	□
- KRAUSNEKER P.	1	59	□
- LEE S.	3	213	□
- MANNING T.E.	3	63	□
MARGRITA R.	3	277	□
- MARIEN J.L.	1	311	□
MENCARELLI E.	3	63	□
MICHEL D.	3	208	□
- PERSOONS E.	1	183	□
PRABHASANKER P.N.	3	216	□
- PRASAD R.	3	178	□
- RAJPUT G.S.	2	225	□
RAVINDRANATH N.H.	3	178	□
- SELLARS C.D.	1	303	★
SINGH J.	2	225	□
SOMASEKHAR H.I.	3	178	□
TRIETSCH R.	2	138	□
VANDER BORGHT P.	3	208	□
- WALTER M.	1	310	□

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ASPECT 5 : WATER RESOURCES ASSESSMENT AND MONITORING (25 PAPERS : 19□ + 6★).

NAME.....	NA	PAPN	TYP
→ AWADALLA S.	1	258	★
→ BABIY L.G.	3	38	★
BENZEDEN E.	4	31a	□
→ BRETOTEAN M.	2	84	□
BRONDERS J.	2	127	□
→ DE SMEDT F.H.	2	127	□
→ FOROUGHI H.	1	165	★
GHEORGHE A.	2	84	□
→ GONDWE E.S.	1	75	□
HARMANCIOGLU N.	4	31a	□
→ HASNAIN S.I.	1	105	★
HEINRICH-MILETIC M.	2	15	□
→ ISSAR A.	1	23	□
KELOGLU N.	4	31a	□
→ KHRISANOV N.I.	2	232	★
→ KNISEL W.G.	3	53	□
→ KOS Z.	1	151	□
KOZLOV M.Ph.	3	38	★
KRIPALANI R.H.	2	294	□
→ LIN T.-T.	2	52	□
MICHEL C.	2	78	□
MIDDLETON B.J.	2	37	□
→ MILETIC P.	2	15	□
→ NILSSON A.	1	209	□
OP ten NOORT T.H.	2	177	□
→ OZIS U.	4	31a	□
→ PHAM QUOC TUONG	1	214	★
→ PITMAN W.V.	2	37	□
→ REES N.P.	1	13	□
RISMAN M.	2	52	□
→ ROUHANI S.	1	175	□
SHERIDAN J.M.	3	53	□
SHIRMOHAMMADI A.	3	53	□
SHPAKOV O.N.	3	38	★
SILVA A.G.C.	2	92	□
→ SIMMERS I.	1	49	□
→ SINGH Kr.P.	1	149	□
→ SINGH S.V.	2	294	□
→ SRINIVASAN V.S.	2	92	□
→ STEPHENSON D.	2	177	□
→ THOMAS A.	2	78	□
VASILIEV Yu.S.	2	232	★

ASPECT 6 : WATER QUALITY AND TREATMENT (26 PAPERS : 20□ + 5★ + 1○).

NAME.....	NA	PAPN	TYP
→ ADHITYAN APPAN	1	240	□
ATTALAH N.G.	2	43	□
→ BALBA A.M.	2	43	□
BERGAMIN F.H.	3	211	★
→ BHOMMIK N.G.	1	58b	□
→ BUEKENS A.	5	111a	□
→ CHANDRASEKHARAM D.	1	163	□
→ COCCAGNA L.	2	201	□
COVELIERS G.	3	33	□
→ DAHI E.	2	71	★
→ DE TROCH F.P.	1	106	□
FINA G.T.	5	161	★
→ FINA L.R.	5	161	★
FRANKEN W.	3	211	★
→ GHOSE N.C.	2	274	★
→ HALLMANS B.	2	50	□
HARLAUT A.	2	50	□
HORLOCK K.	2	201	□
HUTCHINS S.R.	2	39b	□
IMASUEN O.I.	2	280	★
→ JAMES E.J.	1	269	□
JANSSENS J.	5	111a	□
→ JINNOUCHI T.	1	191	□
KAPLAN B.S.	5	161	★

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ASPECT 6 : WATER QUALITY AND TREATMENT (CONT'D)

NAME.....	NA	PAPN	TYP
KEIRSSE H.	5	111a	□
KHOMERIKI I.V.	2	302	○
LAMBERT J.L.	5	161	★
LEE M.D.	3	39a	□
→ LEOPOLDO P.R.	3	211	★
MARCHIN G.L.	5	161	★
MIERGE J.J.	3	112	□
→ MINAMI I.	1	237	□
→ NOVOTNY V.	1	17	□
→ OLORUNFEMI B.N.	2	280	★
→ PREUL H.C.	1	98	□
REYNTJENS P.	3	33	□
→ ROJANSCHI V.	1	173	□
ROZKYDALEK J.	2	40	□
SCHOETERS J.	5	111a	□
SHARMA C.B.	2	274	★
→ SVANIDZE G.G.	2	302	○
TAM D.M.	3	185	□
→ TESARIK I.	2	40	□
THOMAS J.M.	3	39a	□
→ TYTECA D.	3	33	□
VANDER BORGHT P.	3	112	□
VAN HOOF F.	5	111a	□
→ VASEL J.-L.	3	112	□
VIEGAND S.	2	71	★
→ VIGNESWARAN S.	3	185	□
VISVANATHAN C.	3	185	□
→ WARD C.H.	3	39a	□
→ WARD C.H.	2	39b	□

ASPECT 7 : ALTERNATIVE SOURCES OF ENERGY (8 PAPERS : 8□).

NAME.....	NA	PAPN	TYP
→ BUEKENS A.	2	111b	□
DAXHELET Ch.	3	99a	□
→ DENG BINGLI	1	108	□
DEVADUTTA D.	2	298	□
→ GAO R.	1	69	□
KAHANGIRE P.O.	2	150	□
→ KUMAR A.	2	298	□
→ LEJEUNE A.	3	99a	□
→ LIAO T.T.L.	1	73	□
MANIATIS K.	2	111b	□
OURY F.	3	99a	□
→ SCHILLER E.J.	2	150	□
→ TAKAHASI Y.	1	200	□

ASPECT 8 : NATIONAL AND INTERNATIONAL LEGAL ASPECTS (10 PAPERS : 10□).

NAME.....	NA	PAPN	TYP
BREWSTER M.	3	158	□
→ CONYBEARE WILLIAMS A.G.	2	263	□
→ DA CUNHA L.V.	1	206	□
DAVIGO J.	4	65	□
→ DELAVALLE M.	4	65	□
ECON M.A.	2	263	□
→ FANO E.	3	158	□
GENDRIN P.	4	65	□
→ HASSAN I.A.	1	197	□
HUMMAD A.A.	2	139	□
→ LOY W.C.L.	1	202	□
→ MOSES R.J.	1	11	□
→ MURPHY I.L.	2	229	□
OLLAGNON H.	4	65	□
→ OOSTERMAN J.	2	139	□
→ REYNOLDS P.J.	1	153	□
SABADELL J.E.	2	229	□
THOMPSON T.	3	158	□

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ASPECT 9 : PUBLIC HEALTH (5 PAPERS : 4□ + 1★).

NAME.....	NA	PAPN	TYP	NAME.....	NA	PAPN	TYP
- BERRABAH Y.	3	308	★	KREMER M.	5	91	□
- DERR-HARF C.	5	91	□	- LINDSKOG P.A.	2	102	□
DJELLALI L.	3	308	★	LINDSKOG R.U.M.	2	102	□
- HEBERT J.R.	1	114	□	MONTEIL H.	5	91	□
HEIDT A.	5	91	□	- OLSENIUS C.	1	248b	□
KOENIG H.	5	91	□	ZIROUT A.	3	308	★

ASPECT 10 : INTEGRATED WATER RESOURCES MANAGEMENT PROJECTS (28 PAPERS : 24□ + 4★).

NAME.....	NA	PAPN	TYP	NAME.....	NA	PAPN	TYP
ABDEL HADY M.	2	188	□	- ILLANGASEKARE T.H.	2	42	□
ABOU-SEIDA M.	3	194	□	IONESCU Fl.	2	167	□
ABU-ZEID M.A.	3	194	□	- JADHAV G.S.	2	301	★
- ADAMS J.R.	2	48	□	- KADEN S.	1	279	□
AL-ERYANI M.	2	21	□	- LEE M.T.	1	122	□
AMBROISE B	11	76	□	- LIAO-SONG	3	296	□
BARDOSSY A.	3	162	□	LOAICIGA H.A.	2	241	□
BHOWMIK N.G.	2	48	□	- LUITEN J.P.A.	1	107	□
- BHOWMIK N.G.	3	58a	□	- MALIK R.S.	3	66	★
BOGARDI I.	3	162	□	MAMPAEY G.	3	242	□
- BULKLEY J.W.	3	82	□	MANCHANDA H.R.	3	66	★
CARBIENER R.	11	76	□	- MARINO M.A.	2	241	□
CLOOTS A.R.	11	76	□	MARR J.K.	3	82	□
- deJONG R.L.	1	79	□	MASSABUAU J.CH.	11	76	□
DERR-HARF C.	11	76	□	MOREL-SEYTOUX H.J.	2	42	□
- DOP J.	1	155	□	MUNTZER P.	11	76	□
- DUCKSTEIN L.	3	162	□	- ORLOVSKI S.	2	297	□
- EL-ASSIOTI I.	3	194	□	PAWAR K.R.	2	301	★
- ESMAEIL-BEIK S.	2	167	□	RISSER P.G.	3	58a	□
- FAUCHON J.	1	154	□	SCHENCK Ch.	11	76	□
- FONTAINE J.-C.	3	242	□	- SCHENKEVELD M.M.	1	137	□
FREEDMAN P.L.	3	82	□	- SELBST N.	2	262	★
FRITZ B.	11	76	□	SHARMA S.K.	3	66	★
FROEHLICHER R.	11	76	□	- TAMIR O.	2	262	★
GROSS D.L.	3	58a	□	TRIETSCH R.	2	140	□
- HARBOE R.	1	88	□	VANBELLINGEN R.	3	242	□
- HASSANZADEH Y.	1	271	★	VANCON J.P.	11	76	□
- HEFNY K.	2	188	□	van WALSUM P.E.V.	2	297	□
- HEIDRICH Z.	1	46	□	WENG WEN-BIN	3	296	□
- HEYNEN J.D.	2	140	□	YAO RU-XIANG	3	296	□
- HUGHES T.C.	2	21	□	- ZILLIOX L.	11	76	□

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ASPECT 11 : WATER RESOURCES MANAGEMENT IN DISASTER AREAS (9 PAPERS : 8□ + 1★).

NAME.....	NA	PAPN	TYP
→ BOUSSABAH M.	2	62	□
→ BRIGHENTI G.	1	22	□
→ BUCK W.	1	169	□
→ DELLEUR J.W.	2	220	□
→ DEVOTO G.A.	1	101	□
→ DHILLON G.S.	2	304	★
→ EGBOKA B.C.E.	2	199	□
KELLER R.	2	86	□
→ MAUSER W.	2	86	□
OBLED C.	2	220	□
ORAJAKA I.P.	2	199	□
PANSHI B.S.	2	304	★
→ POPOLIZIO E.	1	100	□
TOUHAMI H.	2	62	□

ASPECT 12 : CASE STUDIES (27 PAPERS : 21□ + 6★).

NAME.....	NA	PAPN	TYP
AL-LAYLA R.I.	2	299	□
BELGAL P.R.	4	244	□
→ CHAUHAN R.C.	4	309	★
→ COGELS F.-X.	1	110	□
CORTES G.	3	215	□
→ DIACON A.	3	300	□
→ EL-JABI N.	2	257	□
ERHAN M.	3	300	□
→ FAROOQ S.	2	299	□
→ FAROOQUI S.A.	1	54	□
FERNANDO R.M.	3	236	★
FONCK R.	3	99b	□
GHEYI H.R.	4	67	□
GUIMARAES J.G.	4	67	□
→ HADDADIN M.J.	3	80	□
HISSENE A.	3	228	★
→ ISHAQ A.M.	1	212	□
→ JUNGFER E.V.	1	130	□
KAILASH CHAND	4	309	★
KHEIR O.	3	228	★
→ LAROUSSI Ch.	1	221	□
→ LEJEUNE A.	3	99b	□
→ LI RUIQING	4	97	□
→ MAILHOL J.-Cl.	1	81	□
MALIK R.S.	3	288	□
→ NATH J.	3	288	□
→ NIELSEN K.A.	1	57	□
OLIVEIRA G.R.	4	67	□
→ ONGWENYI G.S.	1	286	★
→ PEREIRA L.S.	3	236	★
RAJAGOPALAN K.S.	4	244	□
RODRIGUEZ C.	3	215	□
SAHAY S.S.	3	68	□
SAHLOUL M.	3	99b	□
→ SALAM HAGGAZ Y.A.	1	227	★
SALAZAR A.	3	123	□
→ SALDARRIAGA J.	3	215	□
→ SARMA S.V.K.	4	67	□
SARRAF S.	2	257	□
SAUNDERS M.P.	3	80	□
→ SAXENA P.C.	4	244	□
→ SCHITTEKAT J.	1	278a	□
→ SCHITTEKAT J.	1	278b	□
→ SCHNEIDER M.	3	228	★
SETEANU I.	3	300	□
SHI BINBIN	4	97	□
SINGH J.	3	68	□
→ SINGH K.P.	1	253	★
SINGH R.	3	288	□
→ SONI B.	3	68	□
TARAPORE Z.S.	4	244	□
TEIXEIRA J.L.	3	236	★
THAPAR O.D.	4	309	★
→ TUCKER R.C.	3	123	□
WESTMORE R.R.	3	80	□
YANG LIYE	4	97	□
YOGANARASIMHAN G.N.	4	309	★
ZHANG YADING	4	97	□
ZIMMERMAN R.	3	123	□

2 □2

NEW IRRIGATION THRUST IN RURAL INDIA

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ABSTRACT

Over 75 % of the Indian population of 700 million is dependent on agriculture. Fifty percent of the cultivated land is served by private irrigation works and thirty percent of the area is served by the assured State Irrigation Works. Utilisation of irrigation potential varies from 10 % to 30 % and productivity varies from 25 % to 50 % of the optimum. The thrust has to be directed towards making the people self reliant. The role of Government development agencies has to be advisory but responsibility has to be brought in by linking their career prospects with achievement on the fields, as regards effected drainage and soil conservation along with water conservation measures. A start has been made by the medium farmers, cultivating an area of 2-12 hectares in forming Irrigation Societies and Developing Irrigation by (1) spreading distribution system (2) use of sprinklers and other mechanically operated devices (3) arranging proper upkeep of channels, pumps and motors (4) keeping watch on theft of pumps, motors and cutting of channels specially during the drought season. The societies may harness and regulate irrigation supplies leaving the rest of the input to be supplied on the initiative of the individual farmers. It is proposed to cover 3 million of the target population annually, spreading the scheme to the bulk of small and marginal farmers in a decade with adoption of appropriate technological packages under irrigated conditions.

Keywords : Crop productivity, irrigation potential, Irrigation Societies, sprinklers, cropping pattern, drainage facilities, yield potential, salinity, technological package.

11 □8

MAXIMIZING USE OF SURFACE AND UNDERGROUND WATER RESOURCES IN RURAL AREAS - LEGAL CASE HISTORIES

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ABSTRACT

Inadequate water supply, because of poor quality or uncertain quantity, is but one consideration which causes migration from rural to urban areas in underdeveloped countries. The provision of an adequate water supply of good quality not only helps maintain rural communities, but affords potential for economic stability and development.

This paper will recount the experience of three western states of the United States in encouraging the development of adequate water supplies in order to discourage migration to metropolitan areas, while also creating a favorable climate for economic development in rural areas.

All three of these states, Colorado, New Mexico and Wyoming, follow the "no injury" doctrine in the development of water supplies. This paper will outline the methodology for maximizing water supplies in arid areas by joint use of tributary and non-tributary water and will explain the "multiplier" potential of such joint use by the use of specific examples.

Finally, there will be a discussion of the role of central governments in developing the guidelines for insuring adequate water supplies in rural areas.

13 05

A WATER PLAN FOR THE STATE OF NEW SOUTH WALES, AUSTRALIA

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ABSTRACT

The paper describes the water-related problems and issues that have prompted the preparation of Australia's first State Water Plan. It also outlines the planning concepts, methods and opportunities for public involvement leading to publication of the Plan. Water, so very variable in its occurrence in New South Wales, is controlled by several government authorities. The Water Resources Commission has overall responsibility for co-ordinating water management and development. Recent substantial development of the State's primary and secondary industries has resulted in a growing demand and competition for water. The water of all the State's regulated streams is now fully committed. Increasing competition for Government funds to be spent on other services and public agitation for environmental protection compound the problem. Money, attitudes and the degree of development already achieved restrict further dam building. Water planning in New South Wales has therefore reached a turning point - away from projects such as dams and towards the better management of existing resources. A comprehensive review of all water-related needs and expectations is necessary to ensure that economic, environmental and social goals are fully considered in future water resources management. This review is being done for the State Water Plan. It will identify the problems, determine priorities and assist in the resolution of conflicts. The paper concludes that more effective management and more efficient use of water could be the cheapest as well as the most environmentally benign way to augment as well as improve the quality of our water supplies.

Keywords: State Water Plan; planning concepts and issues; demand, competition and commitment of water; management of water; economic, environmental and social goals; water quality.

15 05

IMPLEMENTATION OF DATA BANKS AND NUMERICAL MODELS IN GROUND WATER INVESTIGATIONS AND MANAGEMENT

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ABSTRACT

Continuous collecting of ground water data and their sucessive analysis can in many cases replace expensive and long-term investigations. Process of gathering and interpretation gradually leades to creation of an information system that need not be especially sofisticated and though to be able to satisfy successfully all current needs for the knowledge and management of ground water reserves. For the application of such an information system it is necessary to take into account that the ground water reservoir is a subsystem of the environmental system, with all the positive and negative consequences and that the exploitational reserves, among other things, depend on the way of exploitation. Using data banks, it is possible to define hydrogeological systems and mathematical models and by their application to manage ground water reserves. As an illustration of this we are presenting authors' experience with survey of the obtained results in a part of the Sava river basin.

17 06

URBANIZATION AND NONPOINT POLLUTION

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ABSTRACT

Sources of pollution of surface waters can be divided into two groups; effluent discharges (point) and diffuse sources (nonpoint). Pollution from nonpoint sources is due to use of land by man and due to his activities taking place on the land surface. The pollution causing activities include agriculture, urbanization, construction, fertilizer application, transportation, etc. This pollution is distinguished from the background water quality contributions caused by the contact of water with rocks, undisturbed soils and geological formations, natural erosion and other natural processes responsible for chemical enrichment of surface waters.

The sources of nonpoint pollution due to urbanization include: atmospheric deposition, litter deposition, traffic emission, erosion from open lands and by construction activities, road surface deterioration. On the other side of the spectrum, soil loss is the major source of pollution from agricultural watersheds.

In Wisconsin, several large research projects have been conducted in the last 10 years, the result of which enabled to characterize the loadings and the strength of pollutants from small watersheds with a uniform land use. A synthesis of the results and computer simulation yielded then an overall picture on the effects of changed land use - - urbanization - - on the water quality. Consequently, the major factors causing the change, such as increased imperviousness, increased traffic densities, were defined and by a sensitivity analysis their effect was determined. The pattern of the change depends also on the type of drainage system used for conveyance of increased volumes of stormwater.

Keywords: Nonpoint pollution, urbanization effects, unit loadings of pollutants, water quality, urban erosion, hydrologic modeling, hazardous land uses, land use effects, traffic effects.

19 □3

ECONOMICAL ASPECTS OF GROUP RURAL WATER SUPPLY SYSTEMS

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ABSTRACT

The system which supplies water to at least two rural communities is termed a group water supply system. Its essential feature is the necessity of water transit from a water supply plant to the individual villages. Feasibility of a group water supply system in a given area should be determined with economic calculation including a comparison of economic effectiveness index calculated for a group water supply system with the mean effectiveness index calculated for all local water supply devices to be replaced by the group system. Analysis of economic effectiveness was carried out on adopted models of water supply systems /capacity within the range of 75÷6000 m^3/d/, using the formulae which permitted to evaluate feasibility of the group water supply system and its economic range. Values of the system economic range were calculated for three adopted schemes of transit pipelines: radial, ring, and in-series mains. The results have shown that the in-series system is the longest, and the radial system the shortest one. In practice, selection of pipelines should be based on economic calculation.

Keywords: Water supply, group water supply system, transit pipelines, economic distance of water transit.

21 □10

REGIONAL PLANNING METHODOLOGY FOR MUNICIPAL/RURAL WATER SUPPLY

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ABSTRACT

In a comprehensive regional planning setting, it is important but difficult to make "best" decisions as to type of water development and transmission facilities, their capacity, and investment timing. Since there is never enough money to construct all needed projects, they must be prioritized (thereby changing the structure of groups which may optimally be connected to a single source) and priority sequences must be easily modified in response to changing political, institutional, and technical constraints as available information increases. Each of these changes requires the solution of a new possibly very large optimization problem. A planning methodology is presented which has the following capabilities: 1. The planning problem is efficiently converted to a mathematical model solvable by an appropriate solution algorithm via a truly generalized input data model generator. 2. Alternative solution algorithms include mixed integer programming, nonlinear and iterative linear programming. Recommendations as to which approach is appropriate vary with size of the problem and stage of planning (preliminary screening or more detailed). 3. The software is interactive and user friendly in order to allow very rapid modification in response to "what if" type questions from decision makers. Application of the procedure to an example problem is presented.

Keywords: Optimization model, water supply planning, rural water supply, model generators, integer programming, nonlinear optimization

22 □11

WATER RESOURCE MANAGEMENT IN AREAS SUBJECT TO LAND SUBSIDENCE

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ABSTRACT

An extreme, often irrational exploitation of underground water resources in a great number of areas resulted into the emergence of alarming subsidence. Such occurrences are most frequently reported in the Po Valley and caused considerable damage, especially in the coast areas (Po Delta, Ravenna, Venice, etc).
After briefly reviewing the main factors responsible for this phenomenon, the results of some experimental studies carried out at the Mining Science Institute of the University of Bologna are reported. Special emphasis is placed upon the compressibility features of some soils in the Po Valley and how their compaction is affected by salinity variations.
A few instances of subsidence which occurred in the eastern erea of the Po Valley as a result of underground water withdrawal are reported and the most severe damages to the environment and, in particular, to agriculture, are described.
Eventually, some investigations conducted in the Emilia-Romagna Region with a view to working out a sensible scheme of action are referred to as well as suggestions advanced as to how a rational integration between underground and surface waters should be achieved.

Keywords : Subsidence in the Po Valley, subsidence due to gas production, subsidence due to ground-water production, salinity variations, economic impact of subsidence.

23 05

THE MINING OF GROUNDWATER AS A LONG-TERM RESOURCE FOR THE DEVELOPMENT OF ARID REGIONS

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ABSTRACT

Hydrogeological research in various parts of the world has shown that tremendous reserves of water exist under many deserts. In most cases these reserves are paleowater which infiltrated into the aquifers tens of thousands of years ago and since then has very slowly flowed towards outlet areas. Although many of these resources are already utilized, the author maintains that recognition of the importance of these aquifers as a basis for long-term regional development is still lacking. He believes that these resources should be regarded as other similarly mined non-replenishable resources, such as oil. A case history of such an aquifer located in the arid part of Israel is presented. In this instance, mining of the water through the use of galleries is suggested.

25 □4

MANAGEMENT AND TECHNIQUES FOR LOW-COST, LOW-DISCHARGE RURAL WATER SUPPLY

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ABSTRACT

The importance of providing safe water to the more than two billion people who lack this basic service in developing countries has been repeatedly stressed by national governments and international agencies. Among the activities of the International Drinking Water Supply and Sanitation Decade designed to address this problem are the United Nations Development Programme (UNDP) Global and Interregional Projects for laboratory testing, field trials and technological development of handpumps, executed by the World Bank.

Investment, operation and maintenance costs of mechanical rural water supply systems have made them prohibitive for most of the rural populations in the developing countries. Conventional handpumps and boreholes lead to early and frequent failures and rely on mobile maintenance teams which again create a prohibitive situation in many, if not most, regions. A new strategy had to be adopted to develop the technology, motivation, training, education, and incentives for the delegation of management responsibility to the villages. Adequate water supply for all the rural poor worldwide is a major objective; only low-cost options present a realistic solution. An enormous magnitude of costs can be saved through low-cost options.

Handpumps installed in wells where groundwater is easily available provide one of the simplest and least costly methods of supplying the rural population with water. Therefore, the program of the Decade has placed special emphasis upon handpump development and installation. Meeting the goals of the Decade would require the manufacture and installation of about five to seven million handpumps, each serving an average of 150 - 200 persons.

26a ▽

26b ▽

POLICY SESSION

Rapporteur : Glenn E. STOUT

ABSTRACT

IWRA'S EXTERNAL RELATIONSHIPS

IWRA's relationships to the other international associations and various United Nations water-related agencies, will be the major focus of discussion. Proliferation of international and national meetings in water disciplines, falling in quality of meetings and proceedings, significant overlapping of these meetings, require a full attention by IWRA's members.

GROWTH AND INTERNAL STRUCTURE OF IWRA

The session will examine the 13-year history of the IWRA, evaluate its performance and project a concept for future growth. The necessity of an interdisciplinary organization such as IWRA will be explored during the session. The role of IWRA's regional committees and their functions which have only been partially successful has to be evaluated. An examination of the management of the Association will be opened to discussion.
In summary, a redefinition of the goals and objectives of the IWRA will be presented for discussion and future action of the executive board.

27 03

HUMAN RESOURCES AND WATER SECTOR MANAGEMENT STRATEGY

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ABSTRACT

It is a sad fact that the developing world contains many examples of water supply schemes which upon completion fail to reach even a small fraction of expected levels of performance. The reasons given for these failures are numerous, and are often attributed to "inappropriate technology". But it can be argued that the true causes of many failures so attributed lie more in the realms of manpower deficiencies rather than technological problems.

The traditional approach to human resource development has often been to set up short training schemes for water supply staff, timed to coincide with completion of physical works. This approach fails to take account of the fact that training is not a once-and-for-all event, but, especially for managerial staff, is a continuous process of development. Furthermore, the activities necessary to create a fully competent water supply organisation go far beyond the relatively narrow confines of job training.

In addition to knowledge and skills employees need other things before they can perform their work satisfactorily : (a) motivation and (b) tools, materials, equipment etc. To tackle these issues effectively involves consideration of the whole institutional structure of the water supply sector, as well as the organisation of individual enterprises. All contributors to water supply development, especially donor agencies, national governments, water supply managers and consultants, have a role to play in ensuring that the potential of human resources is fully developed and utilised.

This paper is based on the author's involvement in water supply both in UK and in developing countries, primarily Indonesia. It attempts to look objectively at some of the issues and constraints to be faced during human resources development exercises, and some of the lessons learnt.

29 □3

WATER SUPPLY TO INDIA'S RURAL AREAS

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ABSTRACT

Because of its sheer size, India is probably the most important single country for the International Water and Sanitation Decade, 1981-90. One in every three people lacking clean water and sanitation is an Indian. At present only 30 per cent of the rural and 80 per cent of the urban population in India has safe water supply. There are about 576,000 villages out of which about 200,000 villages have still to be provided with protected drinking water. It is proposed to cover these 'problem' villages by the end of the Sixth Five Year Plan Period(1985) for which an amount of Rs.14071.1 million has been earmarked. A subsequent supplement of Rs.6,000 millions has been added to this under the Centrally Sponsored Accelerated Rural Water Supply Programme by the Government of India. It has been estimated that an outlay of Rs.141,670 millions at 1980 price level would be required to achieve a 100 per cent coverage of rural and urban population with water supply and to provide 100 per cent population in Class I and 50 per cent population in Class II and other cities and 25 per cent population in rural areas with sanitary toilets. A lot remains to be done if by 1990 no village should be found deficient in the supply of water or in the provision of improved sanitation. The population in India might go up to 900 millions by 2000 A.D., a fact that planners would have to bear in mind. UNICEF, SIDA and DANIDA are among the International agencies, extending their help in some form or the other in the water supply programmes in India. There is a proposal to start a Training Institute for Hydrogeologists and Drilling Personnel to increase the availability of trained manpower to successfully execute the programme.

Keywords: Problem villages, Sixth Plan, Accelerated Rural Water Supply, International Water and Sanitation Decade.

31a 05

ASSESSMENT OF KARST WATER RESOURCES

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ABSTRACT

Karstified carbonate rock formations are predominant over a large number of regions throughout the world, being of primary importance for certain countries. These formations significantly affect the potential and the use of water resources, both quantitatively and qualitatively.

Certain new or modified hydrological techniques, based primarily on regression analysis and structural mathematical modelling, have been developed to assess the areal and timely distribution of karst water resources.

The application of these techniques to basins in Turkey, where karst formations cover almost on third of the country and affect more than one third of the water potential, proved to yield satisfactory results.

ANCIENT WATER SUPPLY SYSTEMS IN ANATOLIA

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ABSTRACT

In Anatolia, called also Asia Minor and territory of the modern republic of Turkey, evidence of human living goes back to millions of years; remains of civilization date back to the VII. millenium B.C.; those of water works to the Hittite period of the II. millenium B.C.

As a crossroads of civilizations, there are numerous remains of hydraulic works from later periods. Dams and canals of the first half of the I. millenium B.C. Urartu period are still in partly use. Ruins of Hellenistic and especially Roman water systems are among the most attractive examples of their time. New discoveries add to the rich variety of them.

At certain locations, primarily in Istanbul, there are extremely interesting water works and documents from the Byzantine and especially Ottoman Turkish periods; most of them being still in modest use.

Thus, Anatolia bears a great variety of ancient water systems of the last four milleniums of years; and the paper presents the highlights of those systems.

33 06

ON THE OPTIMAL LOCATION OF WASTEWATER TREATMENT PLANTS IN LOWLAND AREAS

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ABSTRACT

This paper reports on a particular application of a previously developed and well-tested model for the optimal location of wastewater treatment plants. The model allows one to select and design a set of treatment plants and the appropriate conveyance system for collecting and treating wastewaters coming from various discharge points in a given region, in such a way that the global discounted cost be minimized. In the primary version of the model, an average depth is assumed for each wastewater collector and no depth compensation allowing e.g. for gravity flowing on flat sections is possible. In previous uses the model was applied to moderately undulating areas, resulting in most cases in gravity flowing solutions for which the model is well suited. The paper is mainly devoted to a description of more recent experiments of the model, performed on an area with important parts where relief is practically absent. Accordingly, the model was modified in order to incorporate the possibility of optimizing, in addition to each collector's diameter, both its slope and excavation depth, thus enabling more frequent gravity flowing even on flat or slightly climbing grounds. The optimal costs are significantly affected by adding this new component to the model, while the required number of pumping stations is strongly decreased, resulting in more centralized optimal solutions where the number of treatment plants is much reduced. The model is proposed as an useful aid in regional planning of wastewater treatment.

37 □5

DEVELOPMENT OF METHODS OF APPRAISING WATER RESOURCES

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ABSTRACT

These are two basic steps to the process of appraising the water resources of a river: first, to identify the characteristics of river flow - i.e. the hydrology - and second, to establish the relationship between reservoir capacity and yield. When an appraisal of the resources of a region - or even an entire country - is attempted, the first step is usually the more difficult. Long records are generally scarce and most records are affected by land-use changes and consequently do not represent stationary time series. One must therefore resort to some form of synthesis in order to generate long hydrographs for inadequately gauged or ungauged catchments.

This paper describes how spatial and temporal extrapolation of streamflow observations can be accomplished with the aid of a deterministic rainfall-runoff model, provided the network of long-term (>50) year rainfall records is adequate. Spatial extrapolation can be facilitated by sub-division of the study region into relatively homogeneous catchments and, after mapping the model parameters, by generation of synthetic records for each of these sub-catchments.

Also described are the techniques for statistical analysis of synthetic and observed flow records to provide information for determination of storage/yield relationships at any point in the study area, i.e. the second basic step in water resources appraisal. The procedure entails the generation and regionalisation of dimensionless drought flow/duration/frequency relationships which are employed in turn to derive storage/draft/frequency/time-of-year diagrams for each hydrological zone in the study area. Reference is made to a recent survey of South Africa undertaken along these lines.

38 *5

HOW TO MANAGE BY WATER RESOURCES

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SUMMARY

The management by water resources is a global and complex problem. The theoretical and methodical aspects of this problem are not yet elaborated. In the structure of the management by water resources scientific-theoretical and administrative aspects should be distinguished. A complex structure of the hydrosphere, the lack of reliable information about its distribution and formation conditions, as well as of an effective estimation of potential reserves and the control of the exploitation regime of water resources in individual regions, states and continents, of qualitative and quantitative indices,of the methods of economic effective use of water resources, the methods of calculation of water consumption, the criteria of estimation of the man influence make it difficult to create the scientific-theoretical and methodical principles of the mana - gement by water resources. The improvement and elaboration of the methods of hydrogeological, hydrological and hydrogeoche - mical mapping are necessary for the qualitative and quantita - tive estimation of the water resources formation. Some difficulties of creating a theory of the management by water reso - urces which are the most characteristic of the developing countries have been discussed. The solution of a problem of the management requires the following: the natural and social phenomena are to be classified and standardized; the structure of the observation net and the reserved hydrogeological fields,as well as a common system of the classification and presentation of operative and reliable initial hydrogeological,hydrological, hydrogeochemical and other information are to be created ; the methods of mathematical modelling are to be improved and the methods of estimating the effectiveness of searches, use and protection of water resources are to be elaborated. The creation of general and departmental inventories of water resources, the training of skilled specialists having necessary knowledge allowing to decide a number of questions connected with the use of and management by water resources, as well as the development of international cooperation in the sphere of wa - ter resources management and their protection will be a considerable contribution to the management by water resources.

39a 06

MICROBIALLY MEDIATED FATE OF GROUND WATER CONTAMINANTS FROM ABANDONED HAZARDOUS WASTE SITES

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ABSTRACT

Organic contaminants from abandoned hazardous waste sites threaten ground water supplies in many places. Microbial degradation of the contaminants may be an important mechanism for their removal. The fate of ground water contaminants at hazardous waste sites was investigated in this study to determine rates of biodegradation of toxic chemicals, the factors that limit biodegradation, the general types and numbers of microbes in the subsurface environment responsible for this biodegradation, and the extent of microbial adaptation to compounds present. Much of the work was done at an abandoned wood creosoting operation in Conroe, Texas, U.S.A. The ground water and soil were contaminated with several aromatic organic compounds. Results from these experiments showed that microbes were involved in the removal of the contaminants. Degradation rates ranged from 30 to 100 percent per week for some of the contaminants in ground water samples taken from the site. These results can be used to predict the extent of microbial activity at hazardous waste sites and to help devise microbial techniques for the restoration of contaminated aquifer systems.

Keywords: ground water, aquifer, hazardous waste site, biodegradation, microbial ecology

MICROBIAL INVOLVEMENT IN THE REMOVAL OF TRACE ORGANICS DURING RAPID INFILTRATION RECHARGE OF GROUND WATER

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ABSTRACT

A series of soil column tests and field experiments were designed to evaluate microbial removal of trace organics during rapid infiltration recharge of ground water. Column tests using acclimated soil from an operational system demonstrated good removal of trace organics. Increased concentrations of target compounds in the feed did not always result in corresponding increases in the column effluent. Microbial adaptation was evident for some compounds. Other compounds appeared to exhibit a minimum concentration below which biodegradation did not proceed. Microbial activity was confirmed as a fate mechanism for several target compounds using radiolabels. In direct correlation with field results, the induction of anaerobiosis in the soil columns resulted in increased fractional breakthrough of trace organics.

Keywords: Land application, rapid infiltration, trace organics, soil columns, biodegradation

40 06

PACKED WATER TREATMENT PLANT FOR RURAL COMMUNITIES

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ABSTRACT

The packed water treatment plant has been developed for small rural communities taking raw water from superficial sources. The unit is based on chemical precipitation and separation on flocs in the lamellar settling module and in the buoyant layer of discrete particles having the density less than water. The granular filtration layer is formed by foamed styrene balls, having the diameter of approximately 1 mm with a density of 80 $kg.m^{-3}$. The depth of the layer is 0,8 m. The inflowing suspension enters underneath the filtration layer and flows upwards at the rate of 6 $m.h^{-1}$. The washing of the filter is by means of a siphon with automatic operation. The treated water is in the storage space above the filtration layer. During the washing it flows in a downward direction. The expansion of the filtration layer is by 30 to 100 %. The washing lasts approximately 60 seconds. During the washing the pumping of raw water with a dose of the coagulating agent is not stopped.

Keywords : Packed water treatment plant, chemical precipitation, lamellar settling module, sludge blanket.

41a 02

SYNTHESIS OF FLOOD HYDROGRAPH IN TIBER RIVER BASIN OF ITALY

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ABSTRACT

A dimensionless instantaneous unit hydrograph (IUH) is derived for the Upper Tiber River basin in Central Italy by assuming basin linearity and time-invariance. The derivation contains parameters which can be determined from basin geomorphology and may therefore be potentially applicable to data-scarce watersheds. The IUH and the effective rainfall are convoluted to produce the flood hydrograph for a given rainfall event. A determination of the effective rainfall assumes an a priori knowledge of the volume of direct runoff. The two-term Philip infiltration equation is employed to determine it by satisfying the equality between the volume of effective rainfall and that of direct runoff obtained by hydrograph separation of streamflow. The applicability of the dimensionless IUH is verified by comparing its results with streamflow data observed for a number of rainfall events on four watersheds in the Upper Tiber River basin.

COMPARING METHODS OF PARAMETER ESTIMATION FOR EVI DISTRIBUTION FOR FLOOD FREQUENCY ANALYSIS

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ABSTRACT

The parameters of extreme value type 1 (or EV1 in short) distribution were estimated for five flood data sets by seven methods. These are the methods of (1) moments, (2) probability weighted moments, (3) mixed moments, (4) maximum likelihood, (5) incomplete means, (6) principle of maximum entropy, and (7) least squares. The method of maximum likelihood was found to be the best and the method of incomplete means the worst. The difference between the methods of principle of maximum entropy, probability weighted moments, moments, and least squares is only minor. The difference between these methods and the method of maximum likelihood is not pronounced.

41c 02

PEARSON TYPE III DISTRIBUTION AND THE PRINCIPLE OF MAXIMUM ENTROPY

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ABSTRACT

The properties and problems in parameter estimation of the Pearson Type III (PT III) distribution are discussed and then further examined using the principle of maximum entropy (POME). The POME yields the minimally prejudiced PT III distribution by maximizing the entropy subject to two appropriate constraints which are the mean and the mean of the logarithm of real values about a constant > 0. This provides a unique way for parameter estimation. Historical flood data are used to evaluate this method and compare it with the methods of moments and maximum likelihood.

41d 02

DESIGN OF A CONSULTATION SYSTEM FOR HYDROLOGIC MODELING

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ABSTRACT

The following paper describes a design for an expert computer system which will aid practitioners in the implementation and use of hydrologic simulation models. WADS, for Watershed Analysis and Display System, will support applications in which the objective is to simulate single hydrologic events. The intended users, resource analysts with limited hydrologic modeling experience, will drive this system through interactive responses given to queries. The objective of the system is to produce a simulation model that meets: 1) the needs and accuracy requirements of the user; 2) the constraints imposed by a lack of data and costs of data processing.

Keywords: Hydrologic simulation modeling, expert computer system, artificially intelligent systems.

42 □10

A PHYSICALLY BASED MODEL FOR ARID ZONE SURFACE-GROUNDWATER MANAGEMENT

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ABSTRACT

A conjunctive use study was conducted in the coastal aquifers of the Red Sea coast in Saudi Arabia. The objective of the study was to investigate the conceptual feasibility of implementing a good development strategy of surface and groundwater in the region. A model was needed to simulate the physical behavior of the surface and groundwater system and the operational behavior of water allocation. The arid hydrology of the region and the agronomic practices and traditions of water allocation unique to the region required the design and development of a special model. A physically based distributed parameter model was developed. The model components were designed to simulate the physical behavior of the surface water conveyance system and the unsaturated and saturated zones of the aquifer. The "Discrete Kernel Approach" of groundwater modeling was used in the design of the model. The model was applied to compare a set of alternate conjunctive use strategies in the Wadi Jiza aquifer in Saudi Arabia. These strategies were designed with the objective of conserving the limited surface water supplies which escapes to the sea during the floods and to maximize the availability of surface and groundwater for irrigation.

43 □6

WATER QUALITY IN WEST OF THE NILE DELTA

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ABSTRACT

Samples from water sources and bodies in the West of the Nile Delta Region, including irrigation and drainage water, Maryut Lake, Mediterranean Sea, tap water, industrial wastes and sewage water were regularly analysed during 6 monthes.

Irrigation water is generally of good quality, except in its western part due to discharging the drainage water into the irrigation canals.

The drainage water in the southern part of the area is suitable for irrigation especially after being mixed with irrigation water. In the north and west of the area, the drained water is not suitable for irrigation.

The sewage water and industrial wastes in Alexandria are discharged into the sea, Maryut Lake and in some agricultural drains. The chemical analysis of the sea water at several discharging pumps showed considerable variations; suspended solids from 500 to 15000 ppm, pH 8 to 10, P 0.1 to 3.9 ppm and NO_3^- up to 2.8 meq/L. The total plate count of bacteria in yeast extract-agar incubated at 30°C for water samples was up to 12 $X10^6$ bacteria/ml.

The tap water is of good quality. It has EC 0.68 mmhos/cm, NO_3^- 0.18 meq/L and bacterial count of about 4412/ml.

44 *3

IRRIGATION ASSOCIATIONS IN TAIWAN

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SUMMARY

With the favorable condition for agriculture and the important role played in the development of Taiwan, Irrigation Associations, scattered around the island, becomes the vast water user of the rural area in Taiwan. Seventeen irrigation associations are organized to undertake irrigation affairs for the fulfilment of the rural need and the agricultural policy of the government. They are responsible for the initiation, operation and maintainance of the facilities in their dominant areas. The Irrigation Associations are public-benefit legal persons according to the water conservancy law. The functions of the Associations are conducted through correlated actions of the assembly of member's representatives, elected by the farmers in the irrigation area, and the Irrigation Association. The Associations are financed mainly by collecting membership fees. Some governement aid or other revenue of supplying water also contribute to the financing. The Irrigation Associations have encountered great difficulty, in operation and maintenance, owing to the decreasing importance of agriculture in the social economy. Nevertheless, they have to maintain, rehabilitate and upgrad their facilities to cope with the conflict caused by the surroundings.

DUAL WATER SUPPLY AND WASTE-WATER DISPOSAL SYSTEMS FOR RURAL COMMUNITIES

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ABSTRACT

Local water supply and waste-water systems designed for individual farms or conventional systems designed for whole rural communities are commonly used in the country. Application of these solutions depends on the accessibility of water sources of sufficient output as well as receiving waters able to accept certain pollution loads contained in the waste-water. When the water resources are limited or in the case of lack receiving water application of separated water supply and waste-water systems can be useful.

The separated water supply and waste-water systems are characterized by supplying water of different quality. The high-standard water (60 % approximately of the total consumption) is used for drinking, cooking, washing and maintaining of personal hygiene. The low-standard water (40 % approximately) is applied for flushing WC. This solution forces to use dual water supply systems and separated waste-water systems. The sewage originated from the used high-standard water is purificated and applied for flushing WC, while the WC sewage should be utilized in agriculture, due to its fertilizing properties.

This paper will comprise all technical and economical aspects of using separated water supply and waste-water systems in dependence on the size of the rural community and the density of population, as well as in dependence on other technical factors.

47a Δ

FREE COURSE

INTEGRATED GROUNDWATER-SURFACEWATER MANAGEMENT

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ABSTRACT

The growing complexity of water resources management applies for a systematic planning of water resources development. In this respect the field of Systems Analysis offers tools for generating, analysing and evaluating those policies or courses of action which satisfy the (pre)specified demands. Expressing the impacts of each policy on society, natural system and environment enables a well balanced comparison.

The systems analysis approach as presented during the free course will concentrate on integrated groundwater-surfacewater management and contain the following steps :
- Problem definition and activity analysis;
- Natural system(s) and computational framework;
- Strategy analysis;
- Multi criteria analysis.

Each of the steps will be illustrated by examples and (simplified) problems. Ample time will be devoted to the use of computer models in the field of economic analysis, groundwater-surfacewater flow and multi criteria analysis. Demonstrations will be given using micro computers. Participants will have the opportunity to exercise the above mentioned models themselves.

One or more case studies will illustrate the overall planning process in the field of groundwater-surfacewater management.

47b Δ

FREE COURSE

FRAMEWORK FOR ANALYSIS FOR WATER RESOURCES MANAGEMENT

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ABSTRACT

The growing complexity of Water Resources Management (WRM) is forcing planners and engineers to seek methods to help them in their tasks to analyse water resources problems and to choose between the infinite variations of possible strategies to develop the water resources system. Systems analysis is such method. It provides a systematic approach for generating, analyzing and evaluating alternative WRM-strategies (courses of actions).

In the free course a systems analysis approach will be presented consisting of :
- an analysis framework (coordinated sequence of steps); and
- a computational framework (coherent set of computation techniques).

The different steps in the analysis framework will be explained and illustrated by presenting some examples and case studies, both in developed and developing countries. This will be followed by an explanation of the use of computational frameworks in the analysis process; including the use of computer models and analytical techniques. Also this will be illustrated by examples and case studies.

Computer modelling for WRM will be demonstrated on a number of available microcomputers. The participants will be able to exercise with these microcomputers and WRM-models.

48 □10

LONG TERM ECOLOGICAL RESEARCH AND MANAGEMENT OF THE UPPER MISSISSIPPI RIVER SYSTEM

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ABSTRACT

The commercially navigable Upper Mississippi River extends 1370 km from its confluence with the Ohio River at Cairo, Illinois to Minneapolis, Minnesota. Above St. Louis, Missouri (river km 293), 27 lock and dam structures provide a channel depth adequate for 2.75 m draft barge tows. The 1000 km of Mississippi River between St. Louis and Minneapolis is managed by two federal agencies and five states for multiple use. System management objectives include commercial navigation, commercial fisheries, minimum flood damage, energy development, water based recreation, water quality, aquatic and adjacent terrestrial or wetland habitat preservation. All management decisions require information on economics, public attitudes, physical environment, and biological structure and function. If any of the types of information are not properly used, the plans and decisions will not achieve their objective or achieve one objective to the detriment of other elements of the system.

The basic data are the hydrologic variables of water flux and depth and sediment concentration and transport rate. The water, sediment, and associated nutrient fluxes are being studied at three sites in the Upper Mississippi River System as part of a program of Long Term Ecological Research. This program began in 1982 and is expected to continue into the next century. Water and sediment transport data for Pool 19 are used to describe the riverine environment. Particular emphasis is given to the impacts of tributary sediment loads and to changes in channel border areas.

Keywords: Rivers, sedimentation, hydraulics, waterways, ecology, aquatic habitat, navigation, dams, multiple use.

49 05

AN OUTLINE OF A SYSTEMATIC PROBLEM, ORIENTED METHODOLOGY FOR HYDROLOGICAL DATA REGIONALISATION

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ABSTRACT

Regionalisation has long been used as a standard tool to facilitate extrapolation from sites at which hydrological records have been collected to others at which data are required but unavailable. The need for such information has escalated dramatically in recent years to the point where the procedure has become a standard prerequisite for adequate solution of innumerable water resource management problems in a spectrum of climatic regions and geographical areas.

Because of the obvious complexity now inherently associated with hydrological data regionalisation, it is thus timely to rationalise the practical steps involved, hence placing them in some logical schematic perspective. A systematic, problem oriented flow diagram is presented within which the user can readily identify techniques at present most appropriate to a given problem. Regionalisation can hence be viewed as an hierarchical, problem oriented, decision making process which does not allow development of a single, robust, universally applicable procedure. In most cases this process is optimally suited to an integrated multidisciplinary approach, involving a combination of mapping, statistical and remote sensing techniques.

50 06

REVERSE OSMOSIS DESALINATION IN SEMI-DEVELOPED CONDITIONS

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ABSTRACT

In semi-developed conditions simple operation is deemed to be important, specially for small plants. In the presentation comparison will be made between different types of Reverse Osmosis membranes, their need of pretreatment etc. and the feasibility of different kind of improvements of the membranes.

51 □1

SOCIAL AND CULTURAL RANDOM CONDITIONS FOR WATER TREATMENT AND CONSUMPTION IN DEVELOPING COUNTRIES

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ABSTRACT

The term 'developing' here indicates the process in which a traditional, village-scale technology and its cultural environment evolve into large-scale, sophisticated structures. Three basic differences distinguish the perception of water quality in developing countries from that in developed countries : the notion of waste which has nothing objectionable in any traditional culture because it is fully re-used, the symbolic connotation of pure water, and under certain aspects, a more static conception of life.
Developed countries have a homogeneous distribution of available technology and corresponding education on their territory. Developing countries however feature 3 typical areas. The first is marked by full availability of technology, specialized work force and educated customers (major city(ies), industrial complexes). Here only technological and economic considerations determine which type of water or wastewater treatment will be required. The second kind of area includes large parts of the cited major cities as well as other small cities: intermediate technology can be provided, installed and used. The available budget is limited. Efficiency is of less concern than providing work and training for people using locally made components combined with conservative design. Local habits gain importance; construction, operation and use require simple procedures. The third area covers isolated parts of the territory. Power supply is absent or unreliable and so are other parts of the technological infrastructure; the potential users of the facility usually have to be instructed as well. Design has to be simple, of low cost and sturdy, requiring little maintenance; efficiency of the facility is of subordinate importance.

Keywords : Environment, sanitation, water treatment, developing countries.

52 05

ZERO OPERATION COST AND LEAST INVESTMENT WATER SUPPLY MODEL FOR TRANSMIGRATION PROJECTS

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ABSTRACT

This paper explains the procedures and philosophy for a water supply model to meet the requirements for a strategy of zero operation cost and the least initial investment in Transmigration projects for the mass rural population.

The Republic of Indonesia is currently carrying out a Transmigration program to provide new settlement areas for 500,000 farming families or a population of 2,500,000 in a 5-year implementation period. The program offers limited funds for the initial cost of the water supply system, but no funds for operation. Therefore, a water supply model needing the least initial investment and a zero operation cost is essential for the success of the system.

The project sites are presently scattered, covered by primary forests or secondary growth, and located far from existing settlement areas. The hydrometeorological data are extremely limited. The studies were conducted through the analysis of the limited rainfall data, the interpretation of aerial photographs, the field reconnaissance, and the assessment of physical models.

A Model using rainwater as the main water source and groundwater as a supplement was developed. This Model is considered satisfactory as far as economical, technical, and time factors are concerned. Therefore, it possesses potential benefit for rural settlement projects in humid regions.

53 05

CHARACTERIZATION OF DAILY STREAMFLOW DATA USING AN APPROXIMATE PARTITIONING METHOD

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ABSTRACT

Adequate water resources planning in any region is based upon proper characterization of the respective hydrologic processes. Knowledge of storm runoff and baseflow may be necessary for developing flood control practices and estimating flows for water supply or pollution abatement. Often, in rural areas, only limited data are available on individual components of the hydrologic cycle. While the traditional separation of streamflow hydrographs into flow components require data for each event, daily data such as daily rainfall and streamflow amounts, may be the best information available to planners.

This study describes a procedure for partitioning daily total streamflow volumes into storm runoff and subsurface flow components. A method is also presented for estimating time base for storm runoff using topographic data. Constant and seasonally-variable rainfall threshold amounts were tested to represent an initial abstraction for soil water storage. The seasonally varied initial abstraction was determined from 12 years of soil moisture data and was represented by a third-degree polynomial function.

The method of partitioning was tested on daily streamflow data from rural agricultural watersheds with drainage areas up to 1,494 km^2 in the Coastal Plain of the Southeastern United States. Estimated volumes obtained for these watersheds were representative of observed stormflow and subsurface flow volumes from a small upland drainage area, 0.34 hectares in size. Average ratios of subsurface flow to total streamflow for the watersheds ranged from 0.58 to 0.83. Results indicate that the procedure gives reasonable estimates and may be useful for application in areas where available streamflow and rainfall data are limited to daily values.

Keywords : Streamflow partitioning, surface flow, subsurface flow, stormtime base, rainfall threshold value (initial abstraction).

54 □12

RELATIONSHIP OF THE DECCAN TRAP LANDFORMS WITH GROUNDWATER IN LOWER NARMADA VALLEY, INDIA

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ABSTRACT

The paper discusses the relationship of groundwater with various landforms of the Deccan Trap which were developed as a result of three distinct types of igneous activities viz., fissure, central and intrusive.

The study reveals that the nature, occurence and distribution of groundwater differs in the lava plains, lava plateaus and undulating plains from that of conical hillocks, lava domes and linear ridges. The differences in the groundwater conditions attributed to the large aerial extent of the lava flows, greater depth of weathering, low runoff, low hydraulic conductivity and high concentration of total dissolved salts in the former case and limited aerial extent of the lava flows, smaller depth of weathering, high runoff, high hydraulic conductivity and low concentration of dissolved salts in the latter cases.

The relationship suggests that the landforms developed by the fissure type of igneous activity are poor in quality of groundwater, while in the latter cases the quality is relatively superior.

Keywords : Fissure type, central type, intrusive type, lava plains, lava plateaus, undulating plains, conical hillocks, lava domes, linear ridges, lava flows, trellis rectangular, dendritic, morphogenetic regions, hydraulic conductivity, total dissolved salts, quaquaversal dip, runoff, columnar joints, homoclinical dip, pediplanation, bole beds, radial pattern, solum.

GROUNDWATER OCCURRENCES IN WEATHERED BASEMENT COMPLEX AREAS

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ABSTRACT

In deeply weathered Basement Complex areas, the occurrence of groundwater is closely related to the in-situ weathered overburden, the saprolite. It has been found that groundwater is almost exclusively present in the lower part of the saprolite which exhibits a high degree of hydrogeological uniformity. Well yields from the saprolite aquifers are predictable using simple probability methods. The landforms play a significant role and a geomorphological approach proves itself a useful method in describing the hydrogeology. In less weathered areas, groundwater is located in fractures which renders the groundwater occurrences less predictable, but still, geomorphological rules apply. The geomorphological approach is particularly useful in rural areas where the use of hand pumps requires a successful borehole rather than a high yielding one. Data from Tanzania, Sri Lanka and Niger are used to demonstrate the approach and explain the Basement Complex hydrogeology.

Keywords : Crystalline rocks, hydrogeology, geomorphology, groundwater occurrence, recharge, groundwater level, landforms, erosion surface, saprolite, weathering, boreholes, specific capacity, rural water supply, hand pumps.

58a □10

CONCEPTUAL MODEL OF EROSION AND SEDIMENTATION PROCESSES

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ABSTRACT

Erosion and sedimentation have been occurring since prehistoric times. Indeed, these natural processes have resulted in topographic features such as peneplains, rearrangements of glacial materials, and the sinuous nature and maturity of rivers and streams. Erosion and sedimentation are not processes that can be completely stopped--water moving on the land surface and in streams and rivers will always move sediments. In recent times man's activities have drastically increased the rate of these processes. In order to better define the interrelationships between various components and processes that impact erosion and sedimentation, a set of "conceptual models" has been developed to provide a sound and comprehensive framework for future plans of action.

Two levels of models were developed. The Level I model serves the important function of identifying the major subdivisions of the environment including natural and human factors that influence the erosion and sedimentation processes. Within the Level II models, the total environment has been divided into ten systems or subsystems and a model for each system or subsystem has been developed. The ten Level II models are for Agriculture, Grassland, Forest, Mining, Urban, Construction, Streams and Rivers, Lakes and Reservoirs, Permanent Wetland, and Seasonal Wetland. Generalized descriptions of the Level I model and two of the Level II models is presented in this paper.

Keywords: Erosion, sedimentation, conceptual model(s), agriculture, grassland, forest, mining, construction, urban, streams and rivers, lakes, wetland.

SEDIMENT MOVEMENT IN NATURAL RIVERS IN ILLINOIS, USA

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ABSTRACT

The hydraulics of flow in a natural stream and its sediment transport characteristics are the two basic phenomena that determine its geometric and planform shape. There are many variables that affect the hydraulics of flow and the nature of sediment transport in a river. The materials through which a river flows, the characteristics of the watershed, the rainfall-runoff pattern from the basin, the constraints imposed by humans, and the geology of the watershed are some of the factors that determine the hydraulic and sediment transport characteristics of the river.

This paper presents a comprehensive analysis of the suspended sediment data collected within the State of Illinois. Analyses of the data have shown that most of the yearly sediment load moved in a short period of time with storm events, and simple regression relationships between water discharge and sediment load can be developed for prediction purposes. It has also been shown that generalized analyses of the yearly sediment load in streams can be utilized to delineate the region or areas of the state or of a nation where instream sediment load may be excessive. It has been observed that some correlations do exist between geomorphological characteristics of the basin and the average annual sediment load.

Keywords: Sediment transport, suspended load, streams, Illinois, climate, regression equations, discharge.

59 □4

EXPERIMENTOS CON EL AGUAPULSOR - UNA BOMBA HIDROSTATICA

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RESUMEN

Por parte de un ejido Mexicano de difícil acceso y recursos económicos limitados se presentó un problema hidráulico ante un centro universitario de coordinación de los servicios sociales obligatorios : regar unos terrenos cuesta arriba de un canal marginal de irrigación. Como la caída disponible en ese canal solo es de unos 50 cm, el ariete hidráulico no hubiera funcionado. Se trató entonces de construir un prototipo de otra bomba en el plan de la tecnología intermedia. En tiempos pasados hubo bombas llamadas aguapulsores que aprovecharon los principios hidrostáticos para bombear una parte pequeña de un caudal hacia alturas mayores de la caída aprovechada.

Se diseñó tal máquina como un sistema de dos émbolos y un doble pistón más un contrapeso. Hubo dos problemas : los empaques de los pistones y el manejo adecuado de dos válvulas.

Como etapa final de los ensayos en el laboratorio estaba prevista la instalación del aguapulsor en el ejido mencionado. Se buscó entonces la participación de dos campesinos del ejido ya en la fase de la construcción, logrando un éxito por ejemplo en la solución eficiente de los empaques. Al resolver los problemas graves del manejo de dos válvulas se investigó el funcionamiento del aparato. La eficiencia hidráulica óptima resultó con : η = 0.52. Se terminó el trabajo del equipo conjunto de estudiantes, campesinos y otros ayudantes con la instalación del aguapulsor en el pueblo mencionado.

Palabras claves : tecnología intermedia, bomba de agua.

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AMENAGEMENTS HYDRAULIQUES

DANS LES CAS DE CATASTROPHES NATURELLES

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au Ministère de l'Equipement

S U J E T

- Les inondations et leurs causes : Des phénomènes hydrologiques exceptionnels dans un urbanisme en pleine expansion. L'auteur fera notamment des remarques et observations sur le degré de précisions des données hydrologiques.

- Les inondations et leurs conséquences : Perturbation du milieu physique, du milieu humain et aussi de la Cité.

- Les inondations et les remèdes : Vu leur soudaineté et leurs conséquences, les solutions sont à plusieurs niveaux : amont (aménagement urbain) et même au niveau social et civique...

- Le calcul du dimensionnement des ouvrages : Les méthodes utilisées couramment, posent certains problèmes : elles sont expérimentales et en général, adpatées à la région et au pays où elles ont été mises au point. Elles demandent aussi une certaine connaissance de l'hydrologie de la région et aussi beaucoup de bon sens.

- Commentaire : En dernier lieu, on trouvera un état sommaire récapitulatif des interventions de l'Etat à travers la Tunisie.

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THE "PULSA" WATER OSCILLATION SYSTEM FOR HAND PUMPING

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ABSTRACT

The development of the "Pulsa" system for water oscillation hand pumps for deep wells represents a major technological breakthrough which is expected to have a profound influence on the International Drinking Water and Sanitation Decade.

The water oscillation system of pumping presented allows for extreme simplicity of pump construction, the total elimination of all organs of transmission and parts in relative movement below ground level, extreme facility of installation and maintenance, particularly wide possibilities of application, maximum security of water supply including the use of multiple independent unit installations and excellent resistance to sand, adaptability to local social and cultural structures, universal use especially by children, low global long term costs of operation, village level operation and maintenance, and real prospectives for local manufacture of pumps and/or spare parts.

Keywords : water oscillation pumps, hand pumps, multiple independent unit pumps, oscillating water columns, multiple pump installations, village water supply, plastic feed pipe, maximum pump security, parallel technologies principle, progressive investment principle, multiple re-utilisation of parts principle, self-compensating parts, village level operation and maintenance, use by children, local manufacture, standardisation of stocks and parts, resistance to sand, universal application.

65 □8

LA GESTION PATRIMONIALE DES EAUX

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RESUME

L'eau apparaît de plus en plus comme une ressource rare dont la qualité doit être préservée ou améliorée. L'Etat a été conduit par des préoccupations d'intérêt public ou général à intervenir de plus en plus activement dans sa gestion, essentiellement par la voie réglementaire. La complexité des systèmes de relations ainsi mis en jeu a conduit, pour ce faire, à un éclatement de la vision des problèmes de gestion des eaux sous la forme de filières sectorielles dont la coordination est au moins malaisée. Le rôle prééminent de l'Etat a induit parallèlement un transfert de responsabilités qui ne sont plus assumées convenablement par les multiples acteurs directs et réels impliqués dans la gestion sur le terrain. Il s'en suit au mieux une indifférence vis-à-vis des interactions entre parties prenantes, et fréquemment des situations conflictuelles inévitables en pareil cas.

Sans mettre en cause le rôle décisif de la puissance publique, responsable de la politique de l'eau, il apparaît possible de développer une nouvelle approche fondée sur la gestion d'un patrimoine commun par la voie d'un dispositif de concertation fondé sur la diffusion de l'information mutuelle, le développement de processus de négociation impliquant les acteurs réels, individuellement ou par représentation de communautés d'intérêts, la mise en oeuvre subséquente d'engagements contractuels venant se combiner aux dispositions réglementaires qui représentent à la fois dans cette perspective un cadre de référence et une voie de recours. Il peut normalement en résulter une restauration d'une attitude de responsabilité véritablement assumée par les acteurs réels, et à terme un infléchissement positif de leur comportement.

Les dispositions relatives aux grands bassins adoptées en France dès 1964 ont constitué une première démarche sur cette voie, à l'échelle de vastes ensembles hydrographiques. Plus récemment des études approfondies sur l'instauration d'une gestion patrimoniale ont été réalisées à propos de la nappe phréatique d'Alsace, et du bassin de la Sèvre Nantaise pour les eaux superficielles.

66 *10

CHANGE IN SOIL PHYSICAL BEHAVIOUR WITH THE USE OF SODIC GROUND WATER WITH FARM-YARD MANURE AND GYPSUM IN THE PRESENCE OF CROPS

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ABSTRACT

The role of adding farm yard manure (FYM) alone or in conjunction with gypsum in reducing the adverse effect of continuous use of sodic water for six years on soil physical properties was studied under field cropped conditions. Sodic water with and without FYM adversely affected the soil dynamic properties viz. bulk density, dispersion ratio, coefficient of linear extensibility and saturation percentage; and soil water transmission properties viz. hydraulic conductivity and infilteration characteristics. The volume of repacked soil decreased on wetting under continuous use of sodic water while swelling of the soil was observed under the canal water use. FYM plus sodic water treated soil also showed considerable shrinkage on wetting while it was not so in gypsum treated soil. These observations indicate that FYM may have lost most of it's aggregating properties in the presence of excess residual sodium carbonate content of irrigation water (15 me/l). Also infiltration rate and hydraulic conductivity were reduced by about 4 and 100 folds over canal water, respectively, with continuous sodic water use. Continuous use of sodic water with FYM reduced the infilteration rate without much affecting the hydraulic conductivity. It may be attributed to an increase in contact angle by FYM application. Gypsum, at 100 per cent neutralization of residual sodium carbonate, RSC was found to mitigate the adverse effect of the continuous use of sodic water on soil physical conditions to a large extent. Surface soil exchangeable sodium percentage ESP did not far exceed the sodium adsorption ratio SAR of irrigation water inspite of it's high RSC content. Grain yields of wheat over the years were not affected by the use of sodic water.

Key words : Infiltration, hydraulic conductivity, coefficient of linear extensibility, dispersion ratio, residual sodium carbonate, exchangeable sodium percentage.

67 □12

STATUS OF GROUNDWATER IN SUMÉ OF SEMI-ARID PARAIBA, BRAZIL

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ABSTRACT

The present study deals with the Sukuru river basin in the Sumé, an irrigation district of DNOCS in Paraiba, Brazil. Of the total 360 ha of the valley, 210 ha were programmed for development, for which a network of observation wells was installed in April, 1981 to moniter the groundwater level fluctuations. The interpretation of the results has been made in the light of such parameters as rainfall, land slope and lithology of well material in the area of study. Recharge sources and discharge areas were identified and suggestions for surface and sub-surface drainage were given in the plots,where the problem of water-logging may arise in rainy season and induced recharge by way of furrows has been recommended where the freatic levels were too low. The steps proposed are expected to meet the demands of the rural population by creating better living conditions with increased food production and public water supply.

Keywords: Groundwater, Water level fluctuations, Drainage, Recharge.

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A GOAL PROGRAMMING APPROACH FOR WATER RESOURCES MANAGEMENT - A CASE STUDY

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ABSTRACT

This case study has been conducted in the Debra block of district Midnapore of West Bengal in India. The project area consists of 4631 ha of land having a population of 25268 persons. The area is inhabited by a predominantly agro-based rural community. Three main elements of water resources management considered in this study are 1) social element (demand of water for agricultural crops), 2) resource element (rainfall, surface and groundwater) and 3) technical element (power availability for tubewell operation, irrigation efficiency). The objectives are to maximize 1) the net return, 2) agricultural production and 3) nutritional value of the product expressed in terms of calorie and protein. The planning has been done to meet the food and nutritional requirement of the projected population for the year 1985 and 1990. A Goal programming model was developed and applied for optimal allocation of land and water resources under prevailing socio-economic conditions. Required data on rainfall, evaporation, topography, soil, water resources potential, water production function of crops and existing system of water management were collected. Sensitivity analysis has been performed to study the effect of changes in water availability on the optimal allocation of land for different crops. Alternative solutions by changing the goal priorities have also been worked out for the planners to implement the best suited strategy.

Keywords : Goal programming, objective function, goal priority, deviational variable, net return, sensitivity analysis, protein and calorific value, agricultural production, optimal allocation.

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WATER POWERED WATER LIFTING DEVICES IN CHINA - THE WATER-TURBINE PUMP

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Abstract

The history of utilization of water power in China had been recorded more than 2 000 years ago. Formerly the Chinese noria was commonly used in the hilly areas of many provinces for irrigation along river side. The efficiency of this devices is low. The water-turbine pump was introduced in China since the early forties. A water-turbine pump is usually composed of two parts: the water turbine and the pump, the former is the prime mover and the latter, the working part for lifting water. The water-turbine pump is characterized by its high energy utilization ratio since the water energy is directly utilized for lifting water, whilst for the hydro-power motor pumping the energy transmission and conversion have inherent losses. In order to fully exploit the potential energy of water resources, the water-turbine pump should be constructed for comprehensive uses: water lifting, agricultural processing and power generation. The installation of water-turbine pump requires site engineering, careful design and construction. Suitable models and the number of units of the water-turbine pump are selected in accordance with the working head, discharge capacity and lift. The paper describes and reviews the principal requirements on the installation, operation, management and maintenance of the water-turbine pump and concludes that this device is simple in construction, reliable in operation, easy to handle, economical and effective in water lifting. It is worthy to be considered as a way to tackled partially the energy problem on water lifting which many countries may encounter nowadays. The paper also illustrates the applications of the water-turbine pump in China with case studies.

Keywords: prime mover, trip-hammer, tube waterlift, noria, renewable energy, water-turbine pump(wtp), working head, inherent losses, overall efficiency, agricultural processing, elevation, head ratio, machine pit, inflow, cavitation, permissible suction, submergible depth, overhaul.

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APPROPRIATE IRON REMOVAL FROM GROUNDWATER AT RURAL ORISSA, INDIA

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ABSTRACT

In the DANIDA Drinking Water Project at the coastal areas of Orissa, India, some 7,000 tube well hand pumps will be installed in 3,000 identified problem villages.
At about 1,000 sites, the iron content of the groundwater is so high, i.e. 3-30 mg/l, that iron removal is required if local people have to accept the microbiologically safe groundwater for drinking, instead of the contaminated surface- and shallow well waters used so far.
For this purpose, four Richardson & Cruddas LTD iron removal kits have been installed and studied on sites. With this background, a new construction, the DANIDA plant, has been designed, built up of locally available materials and installed for observation under low maintenance village conditions.
In the DANIDA plant water trickles through a chips- or charcoal aeration basin, placed over a concrete or brick filter tank. The aerated water falls through a downpipe to a sedimentation compartment at the bottom of the tank. After sedimentation, the water flows upwards through a grill, coarse gravel and sand to the clean water compartment of the tank.
Preliminary field and controlled investigations shows that the upflow DANIDA construction is superior to the other plants tested. Long term experiences may show whether this construction will fulfill the technical and socio-economical requirements of appropriate technology for iron removal at village conditions in Orissa.
Therefore other 16 demonstration plants have been installed for a one year control programme. Moreover controlled laboratory experiments are initiated for optimization of the final design of the DANIDA plant, before the implementation in 1985 to 1990.

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ALTERNATIVE SOURCES OF ENERGY

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ABSTRACT

Taiwan is a small island, limited in arable land and meagre in natural resources but densely populated and has to depend on two-way trade for economic development. During the past three decades, the Republic of China on Taiwan has successfully developed a booming export-oriented economy which is characterized by massive manufacturing industries and concomitantly heavy and intensive energy consumption.

However, the indigenous energy resources and energy production in Taiwan area are both highly restricted. Coal is one of the most important indigenous energies in Taiwan, but its total reserve is only 207 million tons and annual production is about 2.5 million tons. Local oil is insignificant. Natural gas is produced at a daily rate of 3.5 to 4 million cubi meters equivalent to 22,000 to 25,000 barrels of oil. Existing hydro power installation of 1,431 Mw represents the most favorable hydro electric potential on the island, leaving about 3,900 Mw of less favorable potential yet to be developed. Because of this background, most of the energy needs must be covered by the imported energy, especially oil. In 1982, 86.17 % of our energy consumption was imported as compared with 13.83 % locally produced. Naturally, the overdependance on imported energy brought far-reading and negative impact on the economy, particularly in the year after the energy crisis in 1974. Although the oil price reduction by OPEC early this year did herald good signs of recovery for the island economy as well as world economy both hard hit by the world-wide recession, yet it is quite likely that oil price will rebound when the energy demand picks up with the increasing recovery. It is doubtless that any excessive oil price escalation in the future will severely affect and retard the pace of economic development unless a correct energy strategy is mapped out and adequate alternative sources of energy are selected.

In this paper, energy background data is firstly brought up forward for introduction and roots of the energy problems are probed into. Secondly, the economic environment and the energy demand are presented and generally reviewed. Following this, the considerations and principles for mapping the national energy plan are set forth while the strategy for the plan is also recommended. Finally, some alternative sources of energy under consideration are discussed in certain length.

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PLANNING AND OPERATION OF RURAL WATER SUPPLY IN DEVELOPING COUNTRIES

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ABSTRACT

This paper discusses some of the problems associated with the planning and operation of water supply schemes in rural areas. In so doing emphasis has been placed on developing countries since rural population constitutes a disproportionate large fraction of total population in such countries. To illustrate points given in the paper some experiences of the authors' own country Tanzania have been cited. It is shown that the major problem in the planning phase of a rural water supply scheme is insufficient and unreliable data. Examples of the data of population, water consumption, and water quality have been used to illustrate some of the problems with reference to planning of a rural water supply. Operation of rural water supply in developing countries suffers from a problem of limited technical know - how. Involvement of the rural population in the operation process has not been very successful. Specific recommendations to improve planning and operation of rural water supply in developing countries have been presented in the paper.

76 □10

L'ACTION DE RECHERCHE PLURIDISCIPLINAIRE DU GROUPE PIREN-EAU EN ALSACE : CONTRIBUTION D'UN PARTENAIRE SCIENTIFIQUE A LA DEFINITION D'OBJECTIFS REGIONAUX DE GESTION DE L'EAU.

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RESUME

Dans le cadre de son programme interdisciplinaire de recherche sur l'environnement (PIREN) le Centre National de la Recherche Scientifique (CNRS) développe depuis 1979 des actions de recherche appliquées à la gestion écologique des ressources en eau.

Le Groupe PIREN-Eau en Alsace inscrit son action de recherche dans les objectifs suivants :

- aide à la décision en matière de gestion des ressources en eau ;
- connaissance des mécanismes d'hydrosystèmes spécifiques en Alsace à partir d'une analyse approfondie des divers éléments et de leurs relations évolutives mettant en jeu des transferts de matière, des organisations de vie, des comportements humains.

Sur un modèle représentatif (couple rivière Fecht - nappe phréatique autour du Ried Central de l'Ill) les acquis se situent au niveau de

- la constitution de la ressource Eau au plan quantitatif et l'alimentation de la nappe phréatique ;
- la qualité physico-chimique des eaux, les flux de matière au niveau du sol, les mouvements et échanges dans l'aquifère et les transferts de polluants ;
- la qualité biologique des eaux, les fonctions bioindicatrices d'espèces aquatiques témoins, les impacts sur l'environnement et sur la santé ;
- les usages et enjeux, l'approche analytique pour une gestion globale des ressources en eau.

78 05

REVISION DE LA GESTION D'UN RESERVOIR DESTINE A IRRIGUER DES TERRES ET A LES PROTEGER CONTRE LES DEGATS DES CRUES

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R E S U M E

Le cas concret présenté concerne une région du Sud-Est de la France, qui est très souvent touchée par la sécheresse pendant les mois d'été. Tout un système de canaux très anciens assure l'irrigation de 7000 ha de vergers et de cultures maraîchères. Pour remédier au manque d'eau, il a été créé un réservoir à objectif multiple : écrêtement des crues et fourniture d'eau pour les besoins d'irrigation. L'aspect contradictoire de ces deux objectifs impose pratiquement une gestion annuelle, de façon à ce que la retenue soit vide en hiver et pleine au début de la saison sèche. Pour résoudre ce problème, on a tenu compte de différentes valeurs des débits réservés et de ceux nécessaires aux canaux, d'un apport supplémentaire éventuel provenant d'une retenue plus en amont et de coefficients mensuels pondérateurs du risque de crue ; ceci conduit à une courbe d'objectifs de remplissage que le gestionnaire du barrage doit s'efforcer de suivre en fonction des apports journaliers de la rivière, afin de satisfaire les besoins d'irrigation avec un taux acceptable de défaillance - inférieur à 20 % - tout en laissant le creux le plus intéressant possible pour l'écrêtement des crues. Ultérieurement, une prévision des crues sera mise en place pour améliorer la gestion du creux.

La méthode proposée pour déterminer les courbes d'objectifs de remplissage se veut résolument plus simple que les méthodes habituelles issues des applications de l'algèbre linéaire à la recherche opérationnelle.

Mots cles : ressources en eau, gestion de réservoir, réservoir.

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MULTIOBJECTIVE WATER PLANNING IN SAUDI ARABIA

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ABSTRACT

The development of water resources is never an end in itself, but rather it is undertaken in support of the economic development of a country, and of the well-being of its people.

The Government of Kingdom of Saudi Arabia is faced with the daunting task of guiding a nation through a period of unusally rapid socio-economic growth and it has decided to do this by means of adopting a series of 5-year Development Plans, the most recent of which spans the years 1980-1985. Some of the promulgated objectives of this plan, which have a bearing on water planning, are :

- Industrialization based on hydrocarbon/energy-intensive activities.
- Modernized agriculture
- Housing programs

Obviously, these socio-economic objectives are predicated on the ability of the country to mobilize adequate water resources in their support. Saudi Arabia is unusually short of such resources, and, moreover, the conservation of depletable resources by itself is one of the development goals stated in the current Development Plan. This would appear to rule out an accelerated exploitation of the (non-renewable) fossil waters stored in the country's extensive aquifer systems.

The paper illustrates some of the alternatives available to Saudi decision makers in choosing among various potential water sources in order to satisfy the many competing demands, within a framework of certain economic, geographic and traditional guidelines.

KEYWORDS : Water planning, multiobjective decision-making, Saudi Arabia, water importation, desalination.

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SURFACE WATER MANAGEMENT IN THE JORDAN VALLEY

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ABSTRACT

The population of Jordan is expanding at a rate of about three percent per year. Industrial growth is forecast at more than twenty percent per year. The available water supply is limited. Major shortages now occur in the capital city, Amman; agricultural and industrial development are restricted due to the lack of a firm water supply. Competition among the various water use sectors is keen.

The Jordan Valley Authority, its predecessors, and other agencies in the Government of Jordan have been responsible for formulating and implementing water management plans to develop and distribute the available supply of water to maximize its contribution to the economy of Jordan.

Agriculture is identified as an important element in the plans. Increased agricultural production will reduce the import of agricultural commodities and help to move a portion of the labor force out of the service sector.

The key to agricultural development in the country is the Jordan Valley. Its climate make the Valley a favorable location for the year-round production of fruits and vegetables. However, rainfall in the Valley amounts to only about 100 mm to 400 mm per year and supplemental water is required.

The two major surface water sources in Jordan drain through the Valley. These rivers are the primary sources for all water users in North Jordan. The pattern of runoff requires that regulation be provided to develop a firm, year-round supply of water.

In recent times, many plans have been conceived for the development of the Valley. Changes in the political climate have required continuous revision to these plans; in some instances complete reversals. This has required that plans for the implementation of water resources development projects be flexible as the demand for water continues to grow.

81 □ 12

UN EXEMPLE D'ETUDES PRELIMINAIRES DES RESSOURCES EN EAU D'UN PETIT BASSIN RURAL et AGRICOLE EN VUE DE SON AMENAGEMENT HYDRAULIQUE : LE HAUT CHAPEAUROUX (Lozère) - France

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RESUME

Il s'agit de fournir aux collectivités locales une méthodologie permettant de prévoir les travaux hydrauliques nécessaires à l'aménagement des terres agricoles du département de la Lozère. Cette méthodologie est testée sur le bassin du CHAPEAUROUX qui a déjà fait l'objet d'aménagements dans sa partie aval (hydroélectricité et réaménagements de cours d'eau). Le contexte climatique implique une prise en compte du facteur nival.

Il s'agit d'abord de tirer le meilleur parti possible de l'information hydro-climatologique disponible car le bassin lui-même (18 Km2) est dépourvu d'observations

Puisque les premiers besoins semblent concerner l'assainissement et le drainage, on décrit les caractéristiques hydro-climatologiques afin de délimiter les secteurs dont le comportement hydraulique pourrait être homogène. A ce niveau, on peut déjà concevoir la structure du réseau d'évacuation des eaux excédentaires.

On tente ensuite de préciser les termes du bilan hydrologique et d'étendre l'information pluviométrique régionale aux apports et aux débits grâce à une modélisation ; cette dernière est orientée prioritairement en vue d'une utilisation pour les projets d'assainissement et de drainage.

On estime bien entendu les paramètres habituels descriptifs des fortes crues.

L'ensemble du travail a été mené de façon à ce que la méthodologie puisse être reproduite sur d'autres bassins versants de la région.

WATER RESOURCE PLANNING: MULTI-OBJECTIVE CONCEPTS APPLIED TO RURAL WATER MANAGEMENT

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ABSTRACT

Multi-objective techniques for the planning and management of large scale river basin development plans are well established. These techniques have also been applied to assist in the solution of complex water supply problems in urban situations. This paper will present information on the potential for the application of these concepts of multi-objective planning and analysis to rural water management problems. This paper will identify a range of rural water objectives which could be considered in a multi-objective planning framework. Preliminary problem formulation will be presented. Examples will be developed for non-point source pollution and nutrient enrichment. It is anticipated that the techniques of multi-objective planning applied to rural water management issues will sharpen the policy trade-off decisions which must be made by responsible decision-makers. It is anticipated that the application of those techniques will assist in the further clarification of data needs required to support multi-objective techniques for rural water resource management.

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EVALUATION DES RESSOURCES EN EAU SOUTERRAINE ET DETERMINATION DES SCHEMAS D'EXPLOITATION OPTIMUMS, EN VUE DE SATISFAIRE LES BESOINS CONJUGUES EN EAU DES LOCALITES URBAINES ET RURALES

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RESUME

La méthode présentée synthétise l'expérience acquise dans la réalisation des travaux d'évaluation des ressources en eau souterraine et d'élaboration des schémas d'exploitation optimums, dans des zones de captage des localités urbaines et rurales, pour satisfaire leurs besoins conjugués en eau. On présente les travaux nécessaires pour obtenir et interpréter les données et leur programme de réalisation. L'évaluation des ressources en eau souterraine et l'élaboration des schémas d'exploitation optimums se réalisent par modélisation mathématique de l'écoulement de l'eau en régime permanent et non permanente. On expose la méthode pratique de modélisation, en présentant les équations de l'écoulement de l'eau dans des formes possibles à programmer, les conditions aux limites, la résolution des systèmes d'équations, les programmes de modélisation PERMAN et NOPERMAN et leurs fonctions, ainsi que la technique de calage des modèles. A la fin, on présente la manière d'utilisation des modèles obtenus, pour déterminer les réserves et les ressources en eau souterraine et pour élaborer les schémas d'exploitation optimums.

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EVALUACION DE PROGRAMAS DE ABASTECIMIENTO DE AGUA POTABLE RURAL

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RESUMEN

El presente artículo entrega una metodología para la evaluación de proyectos de abastecimiento de agua potable rural en Chile. Las comunidades rurales chilenas se definen como aquellas que poseen menos de 3.000 habitantes. Sus abastecimientos de agua potable son diseñados por el Gobierno Central y generalmente operados por la comunidad.

En este trabajo se ha desarrollado un esquema de evaluación para cualquier comunidad rural chilena. Se ha supuesto que existe una fuente de agua de calidad satisfactoria y que cumple con los requisitos de calidad de agua estipulados en las normas chilenas referentes a aguas para fines potables. Como estas comunidades generalmente son bastantes remotas, un problema frecuente que enfrentan es que carecen de personal técnico idóneo para la mantención y operación de equipos mecánicos por lo tanto el sistema de tratamiento propuesto incluye sólo un equipo básico de cloración.

El proyecto sujeto a evaluación consta entonces de obras de captación de agua, tendido de la red, estanques de almacenamiento, sistema de cloración y programas de control de calidad. La ventaja principal del método propuesto es que con pequeñas modificaciones éste puede ser aplicado a cualquier comunidad real.

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CALCULATION OF FLOOD HYDROGRAPHS USING SATELLITE-DERIVED LAND-USE INFORMATION IN THE DREISAM WATERSHED/S-W GERMANY

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ABSTRACT

Flood hydrograph calculations have been carried out using the SCS TR 20 unit-hydrograph model and a data-bank, describing the properties of the 257 km² Dreisam-watershed according to the input requirements of the model. The data-bank contains the input-parameters land-use, soil properties and slope for each point in the watershed with a resolution of 65x 104 m.

The land-use information has been gained through a supervised maximum-likelihood classification of a 4-channel digital LANDSAT imagery using well-known training sites as definition for the land-use classes.

The calculations of the flood hydrographs have been carried out with an uncalibrated model to be able to estimate the accuracy of the calculations for ungauged areas. Results of the calculations for several storms have been compared to measured hydrographs. The peak discharge and the runoff volumes of the calculations lie within a 20 % range around the measured values. Calculations of desing floods using rainfall events of selected return periods correspond well with the design floods estimated from measured data.

The management of the data-bank using spatially distributed parameters makes it possible to simulate influences of future land-cover changes on the flood peaks and volumes. The possible change in the runoff characteristics of the watershed caused by forest damages has been simulated assuming five different scenarios for the damage. The assumptions about the damage distribution include elevation- as well as aspect-influences on the degree of damage and a change in vegetation as well as in soil properties. Assuming these scenarios an increase in peak discharge by a factor of 2.2 to 5 has been calculated.

Keywords: Flood hydrograph calculations, remote sensing, geographical data-banks, deforestation, design flood calculations

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USE OF PHYSICAL OBJECTIVE FUNCTIONS IN RESERVOIR SYSTEM OPERATION

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ABSTRACT

In most reservoir operation problems several purposes must be included in the objective function. When the purposes are non-commensurate, it is difficult to define a single economic or other objective function. In case of multiple objectives several criteria have been developed to find the optimal or near optimal solution, but the set of non-dominated solutions has to be obtained first through mathematical modelling. In both cases, a model which selects one purpose as the main one to be optimized and the others to be kept in the constraints, can be of significant help. The original reservoir operation problem can be analized in a deterministic or a stochastic framework. The purpose of this paper is to present three examples in which such an approach was successfully applied.

Keywords: Optimization, reservoir systems, reservoir operation, objective function, hydroelectric power, low-flow augmentation, dynamic programming, multiple objectives

RECHERCHE DE MICROORGANISMES DANS L'ENVIRONNEMENT AQUATIQUE ET INFLUENCE SUR LA SANTE DE L'HOMME

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RESUME

Les contaminations thermiques et organiques des eaux superficielles et de la nappe phréatique d'Alsace permettent le développement de microorganismes peu exigeants : amibes, bactéries et levures. Ces microorganismes sont susceptibles d'être pathogènes pour l'homme à travers les diverses utilisations de l'eau (eaux d'alimentation, eaux à usage récréatif, eaux de baignades, eaux d'hôpital, eaux réchauffées...).

Amibes, bactéries et levures sont recherchées parallèlement en divers sites et leurs populations sont analysées en fonction de l'influence des variations physicochimiques. Les résultats montrent que la quantité de microorganismes dénombrée croît régulièrement à partir du point d'émergence de la nappe phréatique en fonction des apports dus à l'activité humaine ou animale. Le Rhin et les sites rhénans présentent les eaux les plus polluées avec une forte augmentation des entérobactéries, une prédominance d'amibes pathogènes thermophiles et la présence de levures potentiellement pathogènes.

Mots clés : Amibes libres, bactéries, levures, nappe phréatique, eaux de surface, risques infectieux.

Keywords : free living amoebae, bacteria, yeasts, ground water, infectious hazards, surface water.

92 05

EVALUATION OF THE EFFECTIVE RAINY SEASON IN SEMI-ARID REGIONS FOR AGRICULTURAL APPLICATIONS

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ABSTRACT

Semi-Arid regions experience a great variation of precipitation in both time and space. Frequently, the rain is the only source of soil moisture and thus the agricultural activities like the selection of crop and planting the seeds depend very much on the identification of the effective rainy season in terms of its beginning and duration. In the semi-arid region of the North-Eastern Brazil, loss of crops due to early planting or late planting is quite common. The present paper describes a methodology developed to evaluate the effective rainy season in the semi-arid region of the State of Paraiba in Brazil using only the historical precipitation data. The method allows the determination of the effective rainy season associated with an acceptable or pre-specified degree of risk of failure. Although the specific criteria adopted were for the region of Paraiba, the same principles are applicable to other geographical regions with some modifications that may be necessary.

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EXPERIENCIA DEL SERVICIO NACIONAL DE AGUA POTABLE Y SANEAMIENTO RURAL EN CAPACITACION DE PERSONAL DEL PLAN NACIONAL DE AGUA POTABLE RURAL

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RESUMEN

La República Argentina presenta un gran territorio habitado por unos 30.000.000 de habitantes, distribuidos en forma irregular. Buenos Aires y alrededores concentran 10.000.000 htes. y el 70% de la población habita sólo una cuarta parte de su superficie. Para 1964 las pequeñas poblaciones carecían casi en su totalidad de servicios públicos de agua potable mientras que el abasto a Bs.As. constituía el segundo sistema del mundo. Esta contradicción fue enfrentada con la concreción del S.N.A.P., Organismo que a la fecha ha concretado más de 800 servicios a ciudades de menos de 15.000 hates. La modalidad en la instrumentación del denominado Plan Nacional de Agua Potable Rural lleva a una compleja relación entre el gobierno de la Nación, las provincias y las comunidades beneficiarias. La relación entre el B.I.D. completa el cuadro de relaciones que implica la necesidad de personal adiestrado en diversas disciplinas. Nació así el programa de capacitación del S.N.A.P. destinado a promotores, educadores sanitarios, Funcionarios, Operadores de sistemas, Supervisores, Inspectores de obras, Ingenieros Proyectistas, técnicos contables y perforadores, habiéndose realizado un total de 44 cursos durante 1000 días de clases con un total de 8000 horas, en la que se adiestraron un total de 1281 agentes de todos los niveles. Es de destacar que como apoyo a los cursos se han publicado 11 textos con un total de 102 capítulos y 2811 páginas. Concluimos que la experiencia es muy positiva y recomendable para los países que emprendan programas similares de infraestructura sanitaria.

HYDROLOGICAL MODELLING AS A TOOL FOR WATER RESOURCES MANAGEMENT IN RURAL AREAS

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ABSTRACT

In recent years mathematical hydrological models have been developed and extensively applied for a number of purposes. In projects concerning for instance irrigation, water supply, flood forecasting, flood control and reservoir operation mathematical models have become indispensable tools. The future will show increasing requirements for application of hydrological models in water resources management in rural areas. If these requirements are to be fulfilled optimally, it is necessary to engage local engineers in the modelling work. Therefore, training and transfer of know-how is an important aspect of project implementation.

In the present paper the types of hydrological models required for reaching the various goals within water resources management in rural areas are described and illustrated in case studies, and general experience gained within modelling transfer and training is outlined.

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THE PRACTICE AND EXPERIENCE OF UTILIZATION OF WATER RESOURCES IN THE JINGHUI IRRIGATION PROJECT

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ABSTRACT

The Jinghui Irrigation Project is situated in the central plain of Shaanxi Province. It covers an irrigated area of 90,000 hectares. In 1982 the per hectare yield reached 8,800 kg.

In the past ten-odd years, the relationship of the mutual transformation of the precipitation, the surface water and the groundwater has been studied. In winter and spring, water is supplied mainly from the canal and water from wells is secondary. In summer, water for irrigation mainly comes from wells.

According to the preliminary calculation, storage of groundwater in the irrigation area is 150 to 200 million cubic meters. On the one hand, it can make up for the storage of surface water, and on the other hand, through its exploitation the groundwater level can be lowered so as to store the excess water from irrigation. Therefore, the groundwater level can be kept in a state of relative dynamic equilibrium for a long period of time.

In saline areas where groundwater is suitable for irrigation, irrigation by canal system in combination with wells which work at the same time as vertical drainage system is one of the effective means to control the groundwater level and hence the salinity of the soil.

The optimum proportion of surface water to groundwater used for irrigation depends upon many factors, for example: the pattern of rainfall in the irrigation season, the replenishment condition of ground water, the drainage condition of river runoff, the water duty of crops, the water balance relationship and so on.

Keywords : Water resources utilization, irrigation project, surface water, groundwater, irrigation, drainage, canal system, well, groundwater recharge.

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WASTEWATER SYSTEM ALTERNATIVES FOR VILLAGES IN LOWER EGYPT

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ABSTRACT

With the advent of increased irrigation and water usage which followed the completion of the high Aswan dam in 1965, groundwater levels have risen in Lower Egypt, particularly in the irrigated areas of the River Nile delta from Cairo to the Meditteranean Sea, and most significantly in the village areas. With respect to villages, the regional rise of groundwaters has been compounded by the increased underground disposal of wastewaters which has followed improved domestic water distribution systems.

In many villages, the disposal of wastewaters to the ground surface or subsurface has been practiced for hundreds or perhaps even thousands of years. But, now villages may be seen as sitting on a groundwater mound elevated above regional levels, and they are experiencing considerable difficulties with wastewater disposal due to subsurface saturation, high groundwater, emerging surface pools of septic waters, gross groundwater pollution, deterioration of buildings and structures due to moisture absorption, and other related problems. A further complication in certain areas is the existence of a large irrigation canal which usually carries a level of flow above the general elevation of the village and therefore creates a hydraulic gradient of seepage through the dikes toward the village.

This paper describes the above problems and addresses the following:

Typical Village Drainage Engineering Problems

Current Village Wastewater Treatment and Disposal Practice

Wastewater System Alternatives, Rationale and Recommendations

Illustrative drawings are included in the paper.

Keywords: Wastewater disposal, villages, Lower Egypt, high groundwater, drainage problems, wastewater collection, subdrains, combined system, alternatives.

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ETUDE D'UNE PARTIE DU BASSIN HYDROGRAPHIQUE DE LA VESDRE EN VUE DE L'AMENAGEMENT DU COURS INFERIEUR CONTRE LES INONDATIONS ET DE L'INSTALLATION D'UNE MICRO-CENTRALE HYDRO-ELECTRIQUE A CHAUDFONTAINE

par

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RESUME

La Vesdre, rivière située à l'est de la Belgique, draine un bassin versant de 699 km².

On présente dans une première partie, une brève description du bassin, ainsi qu'une étude hydraulique reprenant les précipitations, les crues et le plan de protection contre les inondations.

La deuxième partie de cet exposé est consacrée à l'installation d'une microcentrale hydro-électrique sur le site du barrage Bacquelaine à Chaudfontaine. On y examine notamment la rentabilité et le choix du nombre de turbines.

MODELE D'EXPLOITATION DYNAMIQUE DE L'ADDUCTION D'EAU D'EUPEN - LIEGE EN BELGIQUE

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RESUME

L'augmentation de la population desservie en eau par l'adduction Eupen-Liège a engendré une croissance constante du débit véhiculé. Cette adduction initialement surdimensionnée, est actuellement sujette à des aménagements supplémentaires tels que sa configuration future ne permet plus de garantir sa sécurité sans réglementer son mode d'exploitation.

Celui-ci est déduit de la connaissance à chaque instant de la pression et du débit en tout point de cette adduction.

A cette fin, un programme ordinateur a été mis au point. Celui-ci est la traduction en langage machine du modèle mathématique, brièvement rappelé, tenant compte de deux régimes d'écoulement dans les conduites.

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CRITERIOS PARA EL ANALISIS Y MANEJO DE LAS INUNDACIONES EN EL NORDESTE ARGENTINO

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RESUMEN

El área afectada por las crecientes e inundaciones en las llanuras argentinas es superior a la extensión de varios países europeos, comprometiendo el desarrollo de decenas de millones de Has. y la seguridad de grandes áreas urbanas.

Su recurrencia en el tiempo y las características singulares de su manifestación, requieren un sistema de manejo multivariable que incluya aspectos técnicos, jurídico-institucionales y socio-económicos y la definición de estrategias globales y sectoriales a corto, mediano y largo plazo.

Se insiste especialmente en los condicionantes del sistema natural y el contexto socioeconómico sobre los criterios para la concepción, estudio y proyecto de las obras de control y se plantean las pautas básicas para las políticas y estrategias vinculadas con la formación de recursos humanos, ciencia y técnica, participación de la comunidad y relaciones interjurisdiccionales.

Palabras claves : Inundaciones, manejo de recursos hídricos, política hídrica, geomorfología aplicada, sistemas de escurrimiento.

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FUNCION DE DISTRIBUCION DE PROBABILIDADES DE CRECIDA A TRAVES DEL METODO GEOMORFOCLIMATICO

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RESUMEN

Un problema de permanente vigencia en hidrología y probablemente el de mayor interés a los fines de diseño de estructuras hidráulicas es el de estimación de crecidas y el de asignación de probabilidades de ocurrencia a las mismas. Es muy frecuente que este tipo de decisiones deban tomarse en regiones con datos escasos, comunes en la mayoría de los sistemas fluviales del mundo, en especial en aquellas áreas rurales de difícil acceso y de baja densidad de población. A Rodriguez-Iturbe et al. le corresponde la gloria de haber desarrollado la teoría del Hidrograma Unitario Instantáneo Geomorfoclimático, el cual constituye la vinculación entre la función respuesta de la cuenca, su geomorfología y el clima. A esta parte medular de la metodología se le ha acoplado un modelo de generación de precipitaciones intensas el cual, sumado al método de infiltración desarrollado por el U.S. Soil Conservation Service permite la generación estocástica de caudales picos. De este modo se logra evitar la errónea y difundida costumbre de asignar la probabilidad de la tormenta de diseño al caudal de diseño.

Palabras clave : Caudales extremos, lluvias intensas, distribución de caudales, geomorfología, hidrología estocástica.

EVALUATION OF THE HEALTH AND SOCIAL IMPACT OF A WATER AND SANITATION PROJECT IN MALAWI

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ABSTRACT

The paper reviews an evaluation study of a rural gravity fed water project in Malawi. The evaluation is carried out in three separate areas both before and after the intervention with water, sanitation and hygiene education, which will take place in 1984. Two of the three areas will get water in 1984 while the third area acts as a control. Of the first two areas, one gets a health education and sanitation programme by the Ministry of Health. When evaluating the impact upon health, the indicators chosen are diarrhoeal disease, skin- and eye-infection and nutritional status in 800 children under five years. Morbidity data are collected through fortnightly home-visits with 24 hours recall of symptoms. All children in the study are weighed and measured twice a year and those born after 83-01-01 are measured every second month. On a sample of children a food intake survey is done. Also, a study of the etiology of diarrhoeal disease is carried out. Bacteriological water quality analysis is done of the water sources and of water stored in the households both before and after intervention. It is necessary to complement quantitative data with qualitative, like observation and in depth interviews, esp. regarding personal and environmental hygiene to attain an insight into the relationships between human behaviour, water, hygiene and routes of transmission of diseases. This study will give detailed information about the health and social impact of water and sanitation projects. Although the results are only for the study area, it will hopefully be possible to draw conclusions from the experience of this study for other projects.

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MANAGEMENT CENTER IN AN AGRICULTURAL WATER SYSTEM

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ABSTRACT

The paper presents a model for the management of a water system supervized by a system manager in a computerized management center. The model was first developed for an agricultural water system, but it can also be applied in an industrial region or where both agricultural and industrial demands have to be met. In an agricultural water system the most important function is to keep the soil moisture within the desired range, controlling irrigation and drainage throughout the area. Central management of a larger area helps to prevent flooding and droughts. If industrial or urban water use is also made part of the system, the manager can prevent drought losses in agriculture by restricting supplies to other users and at the same time monitor and control water quality. The system should be monitored and controlled automatically 24 hours a day, with the system manager having the power to intervene at any time. Using all means of control and information on the system, the manager can control reservoir performance, water use, water discharge, etc. in the system, thereby obtaining close to optimal water utilization in the longer term. The basic concept involves computerizing all activities of the management center, so that it can run (forecast, control, etc.) with or without intervention. The authors are currently working on the details of the organization of such a water management center.

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WATER RESOURCES OF DESERT LIBYAN AQUIFERS

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SUMMARY

For thousand of years, there have been tales that the Sahara's Arid Surface concealed large "lakes" of fresh water. The water was originally discovered in 1964 by U.S. occidental Petroleum Company. In 1969 two desert well fields namely Al-Kufrah and As-sarir were develped to irrigate agricultural farms and archards. In 1983, Libya commenced its ambitious project of extracting millions of cubic water per day from As-sarir and bring it to the coastal towns by way of 2,500 km underground pipeline. The findings on both aquifers overwhelmingly confirms that the Sahara dried out 2 million years ago and there is no present day recharge in the entire Libyan Sahara. The water stored in deep aquifers is a "fossil water" build up million of years ago. Therefore, any large scale water extraction plan as being underway, will have serious environmental impact on the region and deprive the nation of its valuable natural resource.

SURFACE WATER QUANTITY-QUALITY RELATIONSHIPS AND DISSOLVED LOADS IN A RURAL CATCHMENT AREA IN FLANDERS, BELGIUM

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ABSTRACT

In the planning stage of management works for surface water resources it is often required to consider water quality in relation to water quantity to decide on the feasability of a project.

The paper describes a study of the Zwalm river in Belgium, in which the variation of the concentrations of inorganic chemical constituents in the river water with river flow is considered. A mathematical dilution model is presented, relating concentrations of the major ions to river discharge, antecedent flow conditions and time of the year.

It is shown that the response to discharge fluctuations differs considerably for the different solute parameters at the particular measuring station and mean yearly dissolved loads are calculated from the model. The model is able to simulate the observed cyclical pattern of changes of concentrations versus discharge.

Keywords : surface water quality, water quantity-quality relationships, inorganic dissolved load, water quality simulation models.

POLICY ANALYSIS OF WATERMANAGEMENT FOR THE NETHERLANDS (PAWN)

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ABSTRACT

Watermanagement is defined as the care for the control of water, taking into consideration the interests connected. It applies to both surface- and groundwater and to waterquantity and -quality. The interests associated with it vary widely: agriculture,shipping, the processing industry, drinking water companies, power plants etc. are all very much affected by watermanagement measures. Further, the safety against flooding is very important. Last but not least there are the interests of the environment, although no direct financial implication are at stake. It is not possible in practice to satisfy all wishes coming from the many interests. That's why it is necessary to study the most efficient way to manage the water resources. In the PAWN-study much use is made of computermodels, which simulate the watermanagement of the Netherlands. The results of the study have contributed strongly to the design of the watermanagement policy of the Netherlands for the coming 10-15 years.
The used techniques is made applicable in planning studies of water resources management abroad.

Keywords: policy analysis, system analysis, waterresources management, surfacewater, groundwater, waterquality, waterquantity.

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A BRIEF REVIEW OF SMALL HYDRO POWER (SHP) DEVELOPMENT IN CHINA

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ABSTRACT

In old China, there was almost no electric power supply in the rural areas. When new China was born in 1949, only 26 SHP stations with 2800 kW installed capacity existed in the whole country. Since 1949 the SHP of our country has been developed at high speed. By the end of 1982, there were 80,000 SHP stations with total installed capacity of 8 million kW.

The Benifits of SHP in China.

It provides cheaper motive power for county or commune run industries; developes the electric irrigation and drainage projects in farmlands; facilitates the processing of farm and sideline products; promotes the financial accumulation of the local government; and livens up the cultural life of peasants.

Basic Characteristics of SHP Development in China.

The principle of "self-reliance" by local people with the support of the State; utilization of dispersed water resources for supplying electric power to scattered rural areas; independent local grids parallel with the national grids; over-all planning and comprehensive utilization of water resources; national grids giving full support to the development of SHP; training of technicians for SHP.

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MODELE DE GESTION DES EAUX D'UN LAC SAHELIEN : LE LAC DE GUIERS (SENEGAL)

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RESUME

Le lac de Guiers constitue la principale réserve d'eau douce de surface du Sénégal. Les futurs aménagements du fleuve Sénégal et les deux barrages qui y seront construits auront des effets bénéfiques mais aussi néfastes sur le milieu. Nous proposons un modèle de gestion quantitative de ses eaux, basé sur les différents termes du bilan hydrologique, modèle qui devrait permettre de minimiser les impacts négatifs des aménagements tout en sauvegardant les intérêts des divers utilisateurs des eaux du lac. Le modèle est testé sur six années hydrologiques.

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WATER TREATMENT BY MEANS OF ACTIVATED CARBON PREPARED FROM LOCALLY AVAILABLE WASTE MATERIALS

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ABSTRACT

Man's natural water supplies are threatened by a large number of nonbiodegradable and toxic organic compounds. Proper environmental standards can often only be attained using tertiary treatment processes, such as adsorption on activated carbon. The latter is an expensive process, owing to the cost of activated carbon and the losses occuring during regeneration. Methods are being investigated at the Free University of Brussels for producing and activating carbon, using various types of waste as a raw material.
Both carbonization and activation have been conducted under the carefully controlled conditions of a fluidized bed reactor. The influence of the following process parameters has been investigated : pyrolysis temperature and time, activation temperature and time and composition of the furnace atmosphere.
The resulting activated carbons should exhibit the following qualities : high adsorption capacity and rate, good resistance to attrition, and the possibility of regenerating the carbon. The properties of the carbon obtained have been evaluated by means of a number of standard tests and adsorption isotherms. In general these properties were comparable to those of commercial qualities.
Some of the activated carbons tested, were evaluated using synthetic and real phenolic industrial wastewaters.

PRODUCER GAS FOR SMALL AND LARGE SCALE IRRIGATION IN RURAL AREAS

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ABSTRACT

In the rural areas of the developing countries, the availability of relatively small amounts of cheap energy is of vital importance. Thermal energy is needed for all kinds of heating purposes related to human activities such as cooking and crop drying while mechanical energy is required for small scale industry and agriculture such as irrigation pumps. Gasification of biomass in relatively simple plant can in some cases be the only realistic solution to these problems.
This paper presents a factual picture of the potential role of producer gas technology in developing countries. After a brief summary of the basic principles and the state of the art in producer gas technology some results obtained from a downdraft gasifier are presented and discussed. The problems associated with operating various engines with producer gas are also adressed with special emphasis to irrigation pumps and systems.

Keywords : Producer gas, gasifiers, engines, energy needs, rural areas, irrigation pumps.

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L'EPURATION EN ZONE RURALE,

ETUDE EXPERIMENTALE D'UN SYSTEME MIXTE

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ABSTRACT

Semi-natural purification by intermediate technology ("Bertrix Project"). This experimental station has been chosen as a pilot project by the Belgian Government (Region Wallonne). The latest trend in natural wastewater treatment is to remplace traditional "stabilization ponds" by basins with emergent vegetation. The present experiment will use the complementary properties of aerated lagoons and such basins in order to reduce the total area of the installation. The aim of the emergent vegetation basin is not only to remove nutrients (N, P) and bacteria, but also to contribute largely to the removal of the organic matter.

The following botanical aspects will be studied thorougly :

- the vegetation as support for microorganisms;
- mineralization at root level;
- nutrient storage and removal.

The economic aspect of the project will be also examined.

L'étude du présent projet a reçu l'appui financier du Ministère pour l'Eau, l'Environnement et la Vie Rurale de la Région Wallonne.

EFFECTS OF WATER QUALITY AND WATER QUANTITY ON NUTRITIONAL STATUS

FINDINGS FROM SOUTH INDIAN SETTLEMENTS

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ABSTRACT

Quantitative assessments of the relative effects on health of various aspects of water supply are virtually absent from the literature. Despite the lack of information, resources are being allocated throughout the developing world, for projects related to water and sanitation. The present study was designed specifically to overcome many of the methodological problems that other researchers have faced. Data were collected concerning the nutritional status of 627 children in three urban communities in South India. Information was also collected on water quality, water quantity, household sanitation, socio-economic conditions and housing. A statistical technique is presented that allows for controlling potential confounders in analyses. Results, in general, indicated that at young ages (i.e. under three years of age) water quality is relatively more important as a determinant of nutritional status while at the older ages water quantity is relatively more important.

Keywords : Water supply, water quality, water quantity, child health, nutritional status, confounding, India.

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LA GESTION DES RIVIERES EN PERIODE D'ETIAGE ET LES PREVISIONS HYDROLOGIQUES

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RESUME

Le bassin hydrologique de la Meuse est le plus important de la Belgique. Le débit de la rivière est extrêmement variable à proximité de la région liégeoise : 3000 m³/s en période de crue exceptionnelle et souvent inférieur à 30 m³/s pendant des mois d'étiage. Pour répondre à tous les besoins en eau de la population, de l'industrie et de la navigation, le débit de la Meuse doit être maintenu à 50 m³/s en lâchant à un ou à plusieurs barrages-réservoirs le complément nécessaire. La présente communication expose le problème et traite les facteurs intervenant dans la détermination de la capacité des réservoirs à construire et de l'importance des lâchers d'eau à effectuer pour soutenir le débit naturel en période de sécheresse. Les limites opérationnelles et les possibilités de gestion sont examinées et leur lien avec la qualité des prévisions hydrologiques est établi. Nous démontrons aussi, qu'en première approximation, la capacité des réserves à établir doit être au moins de 150% du volume net du déficit de l'étiage le plus faible.

ABSTRACT

The most important hydrological basin in Belgium is that of the river Meuse. The discharge in the Liège industrial region is extremely variable reaching 3000 m³/s during floods, but falling often below 30 m³/s during droughts. To provide a satisfactory supply of water for the industry, population and navigation, a minimum discharge of 50 m³/s must be maintained by releasing the necessary quantity from reservoirs. The paper describes the problem and discusses the criteria governing the volumes of reservoirs to be constructed and the discharges that should be released to maintain an acceptable flow in the river during drought periods. The operational limits and the management factors are examined and their close dependence on the quality of hydrological forecasts is shown. It is established, that the capacity of the reservoirs should be at least 150% of the net deficit in volume of the worst known draught.

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ASSESSMENT OF EROSION, SEDIMENTATION AND WATER QUALITY IN SMALL AGRICULTURAL WATERSHEDS

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ABSTRACT

The Illinois Water Quality Management Plan revealed that the most severe agriculture related problem in Illinois is soil erosion. In this plan, eleven high priority watersheds were identified. The top two priority watersheds which were selected for project funding are the Blue Creek and Highland Silver Lake watersheds. The Illinois State Water Survey has established monitoring systems and are conducting a hydrologic evaluation in these two watersheds.

These two studies were designed to assist the state and federal agencies to implement an erosion and sediment control program. The detailed information of sediment sources such as sheet and rill erosion and gully erosion would need to be assessed. At the same time, sediment transport, delivery, and deposition in the downstream channels would also need to be addressed. In order to acquire the field data, tasks were established in both watersheds: 1) gross erosion assessment using the field survey and Universal Soil Loss Equation (USLE); 2) a detailed channel cross section survey to determine stream bank and bed erosion and deposition; 3) stream bed material analysis to determine particle-size distribution; 4) suspended sediment and runoff monitoring at main stream and major tributaries to measure total suspended solid and runoff; 5) a series of small field sites (20 to 150 acres) to determine sediment delivery from sources; and 6) reservoir sediment survey to determine the amounts of sediment deposition at the outlet of the watersheds. All the information was used to determine the sediment delivery from the field to the stream and to construct sediment budgets.

In the water quality area, eight water quality parameters were determined on daily storm event basis at stream gaging stations and small field sites. The associated pollution loads at these monitoring sites were also computed. The water quantity and quality data were also used to calibrate watershed models for evaluating the impacts of applying best management practices in the agricultural watersheds.

Keywords: Watershed hydrology, soil erosion, sediment yield, water quality, nonpoint source pollution, sediment transport, nutrient load.

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WATER RESOURCES MANAGEMENT IN MEDELLIN, COLOMBIA

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ABSTRACT

The City of Medellin, located in the Aburra Valley in the Colombian Andes, is a metropolitan area of 2.3 million people. With the population of the drainage basin projected to grow to 3.1 million by the year 2000, water supply and wastewater management problems are paramount. Severe flood damage, extensive erosion, and considerable sediment transport contribute to the area's water problems. Planning for the valley is presently focused on wastewater management, since only 40 percent of the population is currently sewered and there are at present no wastewater treatment facilities.

This paper presents the results of special studies conducted for the Empresas Publicas de Medellin as part of the Rio Medellin Sanitation Project. The studies involved an integrated assessment of the effects of water supply diversions, hydroelectric power diversions, point source discharges, solid waste practices, and nonpoint runoff on achievement of beneficial uses in the Rio Medellin. Potential beneficial uses of the river (including recreation, water supply, aesthetics, and irrigation) were developed to evaluate pollution control alternatives. Relative impacts of each factor were evaluated using a steady state river quality model, supported by comprehensive water quality sampling programs and hydrologic data analyses. River water quality was predicted under both high and low flow regimes, assuming various combinations of dilution water, point source controls, and solid waste controls. An evaluation of in-stream mining of sand and gravel was performed to determine the sediment contribution and resultant water quality degradation due to such practices. This effort was supported by a sediment sampling program, aerial photo interpretation, and an analysis of sediment transport capacity. Sensitivity analyses using the stream model were performed for each pollutant source under varying river flow conditions.

Keywords: Water pollution, river quality, flood control, nonpoint sources, water supply, wastewater management, erosion, solid waste.

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REVISED DESIGN STANDARDS FOR COMMUNITY WATER SYSTEMS IN INDONESIA

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ABSTRACT

At the start of the UN Water Supply Decade, the Government of Indonesia decided to implement 1700 community water systems in a period of 3 years. The projects serve places with populations between 3000 and 20,000, and the total estimated cost is about US$ 300 million. In order to facilitate implementation, standard modules were adopted, but because of little experience with such projects, several assumptions had to be made about the design standards. For example, it was assumed that houses contain 10 persons each, half the population served in each town would want house connections and the rest would use public standposts, systems would operate 24 hours daily, and peak demands could be avoided by using flow restrictors. Based on a recent study of completed projects, some of the original assumptions were found to be erroneous, and many systems, particularly those that require pumping, are not operating as designed. This paper presents a set of revised standards that has been proposed for improving the design of new systems. The standards had to be developed so that program cost increases would be minimized while meeting constraints on the target population to be served, minimum per capita flows, and robustness of systems to perform satisfactorily outside the design range.

POSTGRADUATE EDUCATION OF HYDROLOGISTS

AN INTERUNIVERSITY PROGRAMME

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ABSTRACT

The Interuniversity Postgraduate Programme in Hydrology (IUPHY), located at the Free University Brussels (VUB), is oriented towards students from developing countries. IUPHY has a formal instruction programme over one or two years. At the beginning of the first year an evaluation of prerequisites is made and examinations are scheduled throughout the academic year. This allows for a step by step screening, guidance and interaction with the students of different background. The first year leads to a Diploma in Hydrology, the second year to a M.Sc. Degree in Hydrology. The programme offers basic courses, three orientations (surface water hydrology, groundwater hydrology and water pollution control), seminars, field training and the M.Sc. Thesis. Continuation is possible with a four year programme leading to a Doctorate (Ph.D.) in Sciences, Agricultural Sciences or Applied Sciences. Specific assets of the programme are believed to be 1° a thorough and practical training in computer programming and 2° an in-depth training of operational research techniques applied to water resources management.

INTERUNIVERSITY POSTGRADUATE PROGRAMME IN HYDROLOGY (IUPHY)

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SUMMARY

IUPHY, the Interuniversity Postgraduate Programme in Hydrology, offers a formal instruction programme over one or two years, leading to a Diploma in Hydrology after the first year or to a Master's Degree after the second year and a four year programme leading to a Doctorate in Sciences, Agricultural Sciences or Applied Sciences. The M.Sc. Thesis, a research project selected at the end of the first year, is the backbone of the second year programme. The poster gives an overview of research projects, divided into three categories : real-time control of reservoirs, groundwaterflow models and water quality models.

Keywords : IUPHY, Diploma, Master's Degree, Doctorate.

A REGIONAL GROUNDWATER FLOW MODEL BASED UPON THE VARIABLE SOURCE AREA CONCEPT

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ABSTRACT

A model is presented for groundwater flow, on a regional scale, based upon the variable source area concept. This implies that the catchment is divided into recharge areas, characterised by diverging groundwater flows and deep groundwater levels, where all netto precipitation is recharged in the groundwater reservoir, and discharge areas, characterised by shallow groundwater levels almost coinciding with the groundsurface, where all excess water, netto precipitation and possible converging groundwater flow, is drained away by the river system. The division between discharge and recharge areas is variable and depends upon climatological, topographical and hydrogeological conditions. Such a formulation makes it possible to take into consideration the very complex and heterogeneous hydrological conditions that usually exists in a large river catchment. The model was applied to the Demer catchment with an area of 2240 km^2 . The results are very satisfactory and give a complete picture of the hydrological situation in the area. This type of model can be of great importance for the study of many hydrological problems in the screening and planning phase, such as groundwater abstraction, pollution control, storm flow and soil drainage.

Keywords : Regional groundwater flow, numerical model, variable source areas, recharge and discharge areas, water balance, river catchment.

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PROBLEMS OF TRANSFER OF TECHNOLOGY IN RURAL INDIA

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ABSTRACT

The apparently impresive rate of increase in production in India- both in industry as well as in agriculture - hides the more important fact that it has been much less than - not only what is needed by the people, but also what was possible by adopting already existing knowledge of Science and Technology. In agriculture, for example, the known technology of the package of inputs and other allied practices could so far been adopted in less than 25 per cent of the area in India. Reason being that for the poorer majority money for input have to come from the money lender, say 100 per cent rate of interest, doubling the actual cost of input and selling of crop as soon as it harvested for paying back the debt to money lender at lower price by 30 to 50 per cent than what it would be after 4 months. Under such circumstances poor can not adopt the modern technology. The rich also need not adopt the known technology for production because of better avenues for earning income by usury, trading rack renting and leasing of land.

WATER RESOURCES MANAGEMENT FOR VILLAGE WATER SUPPLIES IN AL MAHWIT PROVINCE, YEMEN ARAB REPUBLIC

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ABSTRACT

The growing population and the decrease of spring discharge have led to bottlenecks in the water supply of villages and dispersed settlements in the Al Mahwit Province. The economic development of the country, extensive road construction last years and the introduction of adapted technologies have contributed to the reduction of this bottleneck. Considering the natural ecological conditions the possible solutions for five villages in typical locations are presented: pressure or gravity pipe schemes, water truck systems and for the zones with more severe aridity, a prototype of a bacteriologically clean cistern that works without outside energy supply, has been developed.

Keywords: Yemen Arab Republic, hydrogeology, groundwater exploration, natural conditions, adapted technologies, village water supply, pressure pipe schemes, clean cisterns.

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TECHNICAL WORKSHOP
on
WATER RESOURCES DEMAND PROJECTION PARAMETERS

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ABSTRACT

OBJECTIVE OF THE WORKSHOP

To establish the structure of a water resources demand projection information system with a data bank of measurable parameters.

THE INFORMATION SYSTEM

In an information system a flow of information is exchanged in the exchange of reports.

The reports are produced as the result of the operation of the information system, with the help of data processing and -analysis and they are based on data stored in the data bank.

The reports are used by private and legal persons to realise the objective of the information system. These persons determine by their questions which information is exchanged.

GOAL OF THE WORKSHOP

To establish a data bank with these parameters linked with the professional information of each participating expert to the workshop.

Such a data bank can then be connected to regional data banks which contain the actual measurement data for the water resources demand projection parameters.

USE OF THE INFORMATION SYSTEM

It can be used to draw expertise together for local water resources demand projection solutions.

Keywords: Water Resources, Demand Projection, Parameters, Measurements, Information System, Data Bank, Data Element.

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LA GESTION DE L'EAU ET SES PROBLEMES

Analyse sociologique à partir de l'exemple de quelques communes rurales de la plaine d'Alsace

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RESUME

Le présent papier, s'inscrivant dans le cadre plus vaste d'une réflexion pluridisciplinaire sur la gestion de la ressource eau en Alsace, n'a pour ambition que de mettre en situation réelle, sur la base d'enquêtes sociologiques de terrain, la manière dont le problème de l'eau est perçu par les groupes sociaux. Une simple "administration" de l'eau, indépendante trop souvent du rapport réel des partenaires sociaux à l'eau, à l'environnement en général, ne permet la plupart du temps pas de raisonner en terme de "gestion" globale.

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EAST MPANDA RURAL DEVELOPMENT PROJECT

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ABSTRACT

The East Mpanda region is the easterly part of the Imbo plain, north of Bujumbura, Burundi. It covers some 12,600 ha.
The farmers there cultivate mainly cotton, sorghum and maize on rainfed plots, and rice on irrigated fields. The present irrigation system, covering a total of 1500 ha, dates back to the 1950's and is in urgent need of rehabilitation. This fact was confirmed by a survey carried out by the Consultant in 1981, which showed that only about 750 of these hectares are now actually irrigated. The reason is either inadequate maintenance of the irrigation system or frequent flooding of the fields by rivers that top their banks in the rainy season. The Government intends to rehabilitate and to extend the areas under irrigated cultivation to 2100 ha in order to increase the agricultural output.
A feasibility study for a development project was carried out in 1976-1977. This was followed by further studies and preparation of detailed design and tender documents in 1981-1982. The execution of the works started in 1984. The project will be operational in 1987. Financing of the project is guaranteed by loans from AfDB, IFAD, OPEC, EDF, WFP and the Government of Burundi.
The studies revealed that two crops a year could be grown if night storage reservoirs were used. The proposed crops are rice (three varieties), vegetables and coffee. The proposed irrigation system consists of a gravity system fed by rivers via dams and intake works. Canals need to be lined, as a smaller cross-section will reduce losses and construction costs.
The overflowing of river banks is to be checked by constructing dikes along the rivers.
It has been recommended to upgrade the road system that was constructed in the plain in the 1950's and to construct new roads to serve more farmer families.
Social economic studies have been carried out on the unregulated immigration from other regions of Burundi. The influx of people has led to a need for new social-infrastructural works, such as a drinking water supply throughout the Imbo plain and village centers comprising schools, dispensaries, a hospital, sheds for storing produce.

LARGE-SCALE IMPLEMENTATION OF WATER SUPPLY SCHEMES FOR SUB-DISTRICT CAPITALS (IKK) IN INDONESIA; A STANDARDIZED APPROACH

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ABSTRACT

In 1981 the Indonesian Government initiated a nation-wide campaign, aimed at supplying a major part of the Indonesian population with drinking water before 1985.

To achieve this objective, the so-called IKK programme was initiated, covering the water supply to approx. 3000 sub-district capitals in the coming years. So far, about 400 IKK's have been selected for implementation; a considerable number of these will be realized with Netherlands aid funds.

A task force, consisting of staff of the Indonesian Public Works Ministry (Directorate General of Cipta Karya), and of Netherlands consultants, developed a special, standardized approach, in order to provide people with safe water in the shortest time possible and at minimum costs.

The main characteristics of this approach are:

- low cost water supply systems, resulting from a relatively short design period, restricted availability of water (both litres per head per day and overall availability in litres per minute per connection) and decentralized storage (in the homes and at public taps)
- standardized survey, design and construction procedures that allow the bulk of the work to be done at district or regional level, and - as far as possible - without having to refer to the Ministry for expert advice
- manuals for survey, design, supervision, operation and maintenance, and for community involvement related to water supply
- centralized procurement and stockpiling of pipes, accessories, pumps, generators and other mechanical/electrical water supply system components
- application of standard package plants for surface water treatment
- testing and monitoring programmes
- setting up an institutional management system for water enterprises, and related training programmes.

WATER RESOURCES TIHAMA COASTAL PLAIN

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ABSTRACT

The Yemen Arab Republic is situated in the south-western corner of the Arabian peninsula between longitude 43° and 46° east and latitude 13° and 17° north (see Figure 1). It covers an area of about 195 000 km^2 with a population of about six million people. The largest cities are Sana'a, Taizz and Hodeidah.

The country can be divided into four geographical units typified by north-south trending topography. From east to west successively: desert area, highlands, midlands, lowlands or Tihama

The upland region constitutes a series of uplifted fault blocks, mainly of volcanic rock of tertiary age. The Tihama plain is a sediment filled part of the Red Sea graben. The alluvium which constitutes the ground water aquifer consists largely of cobbles, silt, gravel and sand.

Part of the drainage from the mountains flows eastward and is lost in the Arabian Desert. However, most of the water from the mountains is drained through wadis which flow westward to the Tihama.

The wadis provide an important source of water for irrigated agriculture. Traditionally, water for irrigation has been provided by diverting both flood water and base flow from these wadis. However, in recent years water for irrigation is being pumped increasingly from the aquifer.

After an introduction on climatological conditions, an overall picture of all available data concerning the Tihama water resources and an approximate assessment of water resources in the Tihama Coastal Plain will be presented.

APPRAISAL OF RURAL WATER SUPPLY PROJECTS IN INDIA

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ABSTRACT

Financial assistance for a number of rural water supply schemes in India is provided by the Netherlands Government, in the framework of its bilateral assistance programme. Proposals for the schemes submitted for Netherlands financing are prepared by the relevant technical departments of the Indian Government and appraised by teams of experts set up for that specific purpose by the Netherlands Government.

This paper deals with some typical aspects of rural water supply schemes, in the Indian States of Kerala and Uttar Pradesh, that have been appraised by combined missions of DHV staff and Indian experts. Supplementary experience from other Netherlands-financed rural water supply schemes in India is included. Details are provided of the technical and financial aspects of these schemes, their operation and maintenance, and notably the problem of free access for all, in relation to the revenue producing capacity of the projects.

Attention is also paid to health education, drainage and sanitation.

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POLICY SESSION

Rapporteur : Vujica YEVJEVICH

ABSTRACT

FURTHER IDENTIFICATION AND FOCUS OF THE IWRA'S BASIC FUNCTION

The center core of basic missions of IWRA will be reviewed, better identified, and so focussed as to clearly differeciate it from the other water resources oriented international associations. Strategies and policies will be discussed with special emphasis on planning and operation of water resources systems. Externalities of open water resources systems, as interactions with the connected outside systems, should be a further emphasis in discussions.

BRANCHING INTO THE NEW INTERDISCIPLINARY IWRA'S ACTIVITIES

This session will cover special activities, such as financing, legal constraints, social conditions, public participation, environmental interactions, political factors, intersection of water systems with energy, agriculture, transportation, urban, health delivery, tourism, rural and other systems, as the further branching of IWRA's missions into new areas.

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"MAÎTRISE DE L'EAU" ET ENJEUX FONCIERS DES AMÉNAGEMENTS HYDRO-AGRICOLES : LE CAS DU LAC DE GUIERS ET DE LA VALLÉE DU FLEUVE SÉNÉGAL

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La vallée du fleuve Sénégal connaît en 1983 une nouvelle période de sécheresse. Au même moment, se poursuivent les travaux de deux grands barrages de régularisation du cours du fleuve. Ces deux barrages permettront la double culture irriguée annuelle sur près de 300 000 hectares d'ici l'an 2000. Ces cultures irriguées apparaissent comme la seule solution à l'actuelle sécheresse : elles doivent assurer l'autosuffisance alimentaire, d'abord à l'échelle régionale des populations riveraines du fleuve, et ensuite au niveau national.
Ces barrages et ces aménagements modifieront donc radicalement le régime hydrologique du fleuve, le paysage agricole de la région et les activités des populations.

Les modifications techniques et écologiques liées à la "maîtrise (technique) de l'eau" entraînent donc des transformations économiques et sociales fondamentales dans le milieu rural traditionnel. Ces transformations bouleversent parfois aveuglément les équilibres anciens dans les règles sociales d'utilisation de l'espace agricole, sans nécessairement introduire une nouvelle "règle du jeu" foncier socialement équilibrée et acceptée.

La communication discute ces transformations et la liaison entre "maîtrise de l'eau - maîtrise de la terre", à partir d'études de cas dans la vallée du fleuve Sénégal et particulièrement la zone du lac de Guiers.

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GENERAL WATER RESOURCES ASSESSMENT FOR RURAL AREAS

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ABSTRACT

General water resources assessment for rural areas requires information on hydrologic attributes of interest and their statistical characteristics for feasibility studies and for the design and operation of water projects for specific purposes. The statistical characteristics, usually determinable at gaging stations, can be analyzed to delineate hydrologically homogeneous regions and to develop significant relationships between these characteristics and measurable watershed factors for each region. Water resources assessment may be needed for the design of ground-water wells, in-channel and off-channel reservoirs, and farm ponds; for the determination of protected streamflow, and for management of effluent discharges.

Hydrologic attributes and their statistics were developed for the state of Illinois, USA, by dividing it into 10 hydrologically homogeneous regions. The attributes and their statistics were highly correlated with drainage area and sometimes also with main channel length and/or slope. General water resources assessment for rural areas can be made with the help of regional equations. A new interactive basinwide water resources assessment model has been developed to modify the hydrologic attributes downstream of any new water resources development.

Keywords: water resources assessment, regional analyses, storage reservoirs, farm ponds, protected streamflow, regression analyses, irrigation, water supply.

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RECENT EXPERIMENTAL AND COMPUTER MODELING STUDIES ON THE HYDRAULIC RAM PUMP

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ABSTRACT

The hydraulic ram pump (hydram) is introduced and explained. Experiments done on locally-made and commercial hydrams are described and the main results discussed. A computerized model for the hydram is outlined and the main results are plotted. A recent hydram workshop in Arusha, Tanzania is described.

Keywords: Pumping, renewable energy technology, hydram, hydraulic ram pumps, rural water supply.

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LONG-TERM WATER RESOURCES PLANNING FOR AGRICULTURAL DEVELOPMENT IN THE ISTRA PENINSULA, YUGOSLAVIA

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ABSTRACT

The Istra peninsula is situated on the extreme north-west part of Yugoslavia and it cover an area of 3100 sq. km. with about 200000 inhabitants. The western coastal belt and the Mirna and Raša valleys are extensive plains with terra rossa and alluvial soils of a thick top soil cover. This is suitable for high-yield crop development, particularly orchards and vegetables and have been the target of investigations and planning. Although the area benefits of relatively high rainfalls, because of unfavorable orographic and geologic conditions the major part of it is lost for the water resources, for which reason a lack of water for all needs have been felt for a long time. This is the reason that comprehensive investigation works comprising both underground water development and collecting of surface water by storage basin construction have been undertaken some years ago. The most serious limitations for intensive agricultural development is the deficit of the water in the vegetation season which ranges between 300 and 400 mm. yearly. Together with the proposed plan for long-term water supply for irrigation, a significant changement of the traditional cropping pattern have been considered. The hydrotechnical solution consists in construction of a douzine of storage basins which will satisfy the region with water up to the year 2015. It is estimated that by this time, owing to a very intensive touristic and agricultural development, particularly by introducing irrigation, a ninefold water consumption will occur. The most important estimates and computations are performed by using a set of mathematical models, foremostly the flow analyses, water requirements for irrigation; single reservoir operations, system reservoir operations, etc.

Keywords: Irrigation, storage basin, cropping pattern, water requirement, long-term planning, irrigation system, geologic conditions, pedological surveyings, mathematical models, simulation techniques.

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AN OPERATIONAL MODEL FOR ASSESSING WATER SUPPLY: CONSTRAINTS AND AGRICULTURAL-ENERGY CONFLICTS

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ABSTRACT

A developing concern in parts of Canada is the impact of new water using developments on both existing areas as well as on the potential for other developments, including agriculture, energy and industrial, in the future. A model has been developed for Environment Canada to examine the constraints on developments arising from limited water availability. The model compares monthly water availability and demands at a number of locations throughout a basin or basins and produces statistics of failure.

Water demands are related to level of economic activity in each major sector of the economy and the intersectoral effects can be handled using an input-output matrix. Changes in activity in each region arising from demands in the other regions of Canada are dealt with in a similar way. As well as the demands arising from the growth in each major economic sector the model will also handle specified individual large-scale users, such as major energy-related projects. At present the demands are deterministic based on the level of economic activity, actual water demands where available, population levels for municipal supply, and area and crop type for irrigated land. The model runs on an IBM-PC and has a modular structure so that each major component can be upgraded as required.

Keywords: Modelling, water demands, input-output, energy, agriculture, municipal, industrial, irrigation, personal computer.

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ENVIRONNEMENT, DEVELOPPEMENT ET ETUDES D'IMPACT APPLIQUÉS AUX AMENAGEMENTS HYDRAULIQUES EN PARTICULIER DANS LES PAYS EN DEVELOPPEMENT

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RESUME

Entreprendre de grands travaux hydrauliques, en particulier dans les pays tropicaux en développement, entraîne fréquemment des perturbations étendues dans la région dans laquelle ils sont établis, par leur présence même, leur construction puis leur fonctionnement.

Des études d'impact sont alors nécessaires pour déterminer dans quelle mesure il est possible de minimiser les conséquences négatives du projet sur le milieur naturel et humain, ou, au contraire, d'en développer les potentialités favorables. Une surveillance attentive des répercussions du projet aux différentes étapes de son établissement doit permettre de connaître l'état de l'environnement à un moment donné et d'essayer d'en prévoir l'évolution, en prenant alors les mesures pratiques adéquates, secteur par secteur tout en assurant les coordinations nécessaires.

Cela peut se faire par l'adoption d'une législation nationale sur l'environnement, sous réserve qu'elle soit accompagnée des moyens pratiques qui en permettent l'application. Mais le caractère multiple des interventions à envisager et leur variété exigent souvent des décisions immédiates que, seul, un organisme ayant l'autorité, la compétence technique et les ressources financières peut prendre, tout en répondant aux aspirations des populations locales directement concernées. Les organismes de coopération et de financement doivent en favoriser la création, dans le cadre des structures politiques et administratives nationales, et ceci dès l'origine du projet.

Mots clés : Environnement-développement-aménagements hydrauliques-pays tropicaux-Etudes d'impact-matrices-milieux naturels-milieux humains-hydrologie-géophysique-pédologie-agriculture-reboisements-pisciculture-collectivités rurales-transferts de village-reclassement-compensations-autorité locale-législation-coordination.

DOMESTIC RURAL WATER-SUPPLY IN AL BAYDA PROVINCE, YEMEN ARAB REPUBLIC

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ABSTRACT

The Rada Integrated Rural Development Project (RIRDP) is involved in the improvement of domestic rural water-supply and the improvement of rural sanitation systems in Al Bayda Province of the Yemen Arab Republic. The RIRDP has been operating in the area around Rada town since 1977. At first, success was limited mainly due to lack of confidence of the rural population and an approach which they did not accept. A change in approach in 1979, which included the implementation of entire water-supply schemes, increased the interest of the villagers greatly.

Experience with these schemes shows that water consumption increases after piped water-supplies are provided. A survey carried out in 1983 indicated that the average domestic water consumption will probably increase from the present 45 litres/head per day to 100 litres/head per day in the year 2000. Water fetching, traditionally done by the women, will be strongly reduced, as the vast majority of the population seem to prefer a piped water-supply system with house connections. Most water-supply systems in Al Bayda Province will consist of a groundwater source, pumping plant, rising main, reservoir and gravity-fed distribution system.

Implementation of these water-supply schemes will lead to increased flows from the houses, and thus require improvement in the sanitation systems in the area. The RIRDP has taken the initiative for planning and implementing pilot sanitation schemes. In doing so the RIRDP expects to raise the interest of the rural population in these utilities, and to demonstrate how safe health conditions can be created. Once the rural population has accepted the sanitation systems, one of the final aims of the RIRDP will be to implement both water-supply and sanitation systems in the project area.

Keywords: Yemen Arab Republic, water-supply, domestic water consumption, livestock water consumption, school water use, mosque water use, groundwater sources, rural sanitation, health conditions, sanitation development, pilot sanitation projects.

WATER QUALITY MANAGEMENT IN DEVELOPING COUNTRIES

By

Enzo Fano, Marcia Brewster
and Terrence Thompson*

Abstract

It may be expected that over the next decade the management of water quality problems will be one of the outstanding issues relating to the protection and conservation of the national stock of water in each country. In the past, particularly in countries well endowed with water resources, this has been considered to be a relatively negligible problem; however, the rapid aggregation of population in major urban centres, the polarization of industries, and the heavy dependence on chemical products in the agricultural sector are leading to a serious deterioration of water quality in developing countries.

The paper will review the nature of the pollution issue, the institutional requirements to deal with the problem in an effective and comprehensive manner and the near term actions which governments should take to protect their existing water resources for the generations to come.

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THE GIARDIACIDAL CAPABILITY OF THE PENTACIDE- A QUATERNARY AMMONIUM DEMAND-TYPE RESIN-I_5

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SUMMARY

Resin-I_3 (Triocide) as reported at the Second and Third World Congresses on Water Resources has proven to be both viricidal and bactericidal. This resin is a demand-type disinfectant. Iodine, as triiodide, is complexed to a strong base, quaternary ammonium anion exchange resin. Bacteria and virus suspended in water are killed when they contact resin-I_3 beads.

We now wish to report on the capability of the resin-I_5 (Pentacide), the next higher homologue. In addition to having viricidal and bactericidal capabilities, data are presented to show that Pentacide is giardiacidal. Mouse intubation of Pentacide treated Giardia muris cysts as well as in vitro excystation experiments using G. muris and G. lamblia indicate the Pentacide effectively kills cysts. As in testing for viricidal and bactericidal capabilities, one merely pours suspensions of the germ to be tested through a column made of resin-I_5 beads. Unlike viral and bacterial disinfection which is nearly instantaneous, a holding period of five minutes is required to insure complete inactivation of G. lamblia and G. muris cysts.

Key Words: Giardiacidal, demand-type disinfectant, pentaiodide, resin-I_5, "Pentacide," cysticidal.

HARMONIZING AGRICULTURE, ENVIRONMENT AND RUNOFF IN WATERSHED MANAGEMENT

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ABSTRACT

The management of watersheds under the three conflicting objectives of economic benefit-cost, environmental architecture and hydrology is analyzed using a multicriterion decision-making scheme. The criteria corresponding to the three objectives include in particular agricultural revenue and investment for the first objective, yields of sediments and of nutrients for the second one, and water yield for the third objective. A discrete number of alternative plans consisting of land use and crop management schemes, fertilizer application, erosion control and engineering interventions is defined. The approach accounts for stochastic rainfall input, which introduces uncertainty into most of the model elements.

A harmonization of the criterion values is developed by means of composite programming, which provides a two-level trade-off between conflicting criteria. At the first level, the criteria within a given objective are traded off: at the second level a compromise between the objectives themselves is sought. The approach is illustrated by the real-life example of a 27 km^2 Hungarian watershed where agricultural activities influence the yield of sediments, nutrients and water. A small reservoir is located at the outlet of the watershed, trapping most of the sediment. The composite programming technique is applied step-by-step and leads to a "good" compromise solution.

QUALITY OF GROUNDWATER ALONG THE COASTAL BELT OF THE SOUTH WEST INDIAN SUBCONTINENT

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ABSTRACT

The coastal belt of Kerala covers 10% of the State's total area of 38,363 sq.km. 25% of the State's population is accommodated in the coastal belt. Groundwater is extensively tapped through open dug wells and used for domestic purpose. The density of the wells varies from 300 to 350 in 1 sq.km area. The area receives 3000 mm of rain fall and as a consequence of which the groundwater table level shows considerable fluctuation. The water table levels in certain areas fall below the mean sea level thus giving rise to a negative gradient. If the Ghyben-Herzberg seawater intrusion mechanism is envisaged then the water samples from the wells showing negative gradient of groundwater flow should apprcach seawater composition. The water level,water chemistry data and the sea-aquifer water mixing model do not support this view. The present seawater intrusion mechanism is due to the onset of reverse gradient caused due to excess withdrawal of groundwater and hence Ghyben-Herzberg seawater intrusion mechanism may not be applicable in such areas.

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ESSAI DE BILAN HYDRO-GEOLOGIQUE DE LA PLAINE DE KERMAN, IRAN

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RESUME

La plaine de Kerman est une des grandes plaines de comblement typique de l'Iran. Elle est située dans le secteur sud-ouest de la chaine intérieure occidentale de l'Iran Central et à l'ouest du Kavir-e-Lut.
La région qui fut l'objet de cette étude est le versant de la grande plaine de Kerman, dont la superficie couverte est de l'ordre de 6000 km^2.

L'ensemble des données climatiques permet d'attribuer à la région de Kerman un climat aride avec une pluviométrie moyenne qui ne dépasse que rarement 200 mm par an.

Les études géologiques et géophysiques ont permis de mettre en évidence :

- La fermeture de la plaine au sud de Mahan par les chaines de Sekondje et du massif de Djoupar.
- La nature variable du substratum qui est formé par le Pliocène ou le Crétace suivant les secteurs.
- La nature du remplissage qui est très fine au centre de la plaine et plus au nord, et qui est grossière dans les zones plus au sud.
- La barrière créée par le massif de Badamou pour l'écoulement des eaux et l'existence entre ce massif et le Rud-e-Tchari d'une ligne de partage des eaux aussi bien de surface que souterraines.

L'alimentation en eau des nappes souterraines, assurée par un bassin versant peu pluvieux, s'effectue par l'infiltration des eaux météoriques dans les massifs rocheux perméables et l'infiltration des eaux de crues et de ruissellement.

Le calcul de bilan et l'ensemble de l'étude permettent de préciser qu'il y a des apports d'eau à partir des massifs de calcaires crétaces dans la nappe d'une façon inapparente sous la plaine.

A CASE STUDY OF WATER RESOURCES ENGINEERING METHODS AND ENGINEERING ECONOMY USE IN EVALUATION ANALYSIS.

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ABSTRACT

A detailed analysis procedure for sizing the optimum conservation storage of a reservoir for irrigation purposes in a semiarid zone (Abbas-Abad Reservoir on Ghom River in Iran) is presented. The analysis covers the following aspects of the problem:

- conjunctive use of river flow and ground water for irrigation needs;
- effect of shortages in satisfying the demands on the optimality of the solution.
- optimum economical insurance level (probability of satisfying irrigation water requirements).

The analysis commences with the global evaluation of the capabilities of the system (river flow-reservoir-ground water source-irrigation demands) taking into account the system's physical limitations. Then the estimation of expected system performance on the basis of effectiveness and efficiency criteria is made using simulation techniques for reservoir operation and extensive economic evaluations of various design alternatives. A tentative approach to define an optimum, economically justified, insurance level for reservoir sizing is briefly described. Results obtained for the case study of Abbas Abad reservoir are concisely presented and commented.

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OPERATIONAL PERFORMANCE OF THE FmHA RURAL WATER SYSTEM PROGRAM

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ABSTRACT

Rural residents secure water from many private sources including wells, surface water diversions, and hauled water. Where present, public supply entities provide water from a central system referred to here as a "Rural Water System."

The Farmers Home Administration (FMHA) is authorized to provide grants and long-term low-interest loans ". . . for the installation, repair, improvement, or expansion of a rural water facility . . ." Grants and loans support 90 percent or more of rural water system capital costs. Interest-only payments in the first two or three years of a loan are followed by 38 or 37 years of level payment amortization. Funding of this program totaled to an estimated $10.22 Billion during Fiscal Years 1966 through 1983.

This study examined the physical, organizational, and operational characteristics of 108 FmHA-funded rural water systems with major construction in the 1970-77 period. Heterogeneity of physical and financial attributes characterized the subject systems. Many systems were well managed and operated, but more than half had moderate to severe financial problems. Most problems were attributable to inadequate revenues due to inappropriate water rate schedules or customers' use of alternative water sources. No system reported having a depreciation reserve and all were consuming their capital investments. Implicit subsidies were estimated as nearly equal to the principal amounts of the FmHA loans.

It was concluded that the FmHA program most nearly achieves these intended goals: "improving rural residents' access to adequate supplies of potable water", and "maintaining sanitary and healthful living conditions in rural areas". Goals of "urban-rural parity", and "making rural water-sewer services affordable" were less well attained, and may be unattainable.

DETERMINATION OF FLOOD EVENTS FOR DESIGN PURPOSES

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ABSTRACT

During the last years several flood events with rather high return periods occurred in south-west Germany, causing considerable damage also in rural areas. On behalf of the water resources administration investigations have been carried out at the Institute, to derive design values for channel improvement and detention basins. According to the data situation, newly developed regionalized methods had to be applied to determine the system function and the effective rainfall.

In connexion with the determination of the height of the platform for nuclear power plants near the River Rhine hydrological and hydraulic computations have been carried out. The aim was to protect the site against a a_{-4} design flood with a frequency in the order of magnitude of 10^{-4} per year. In particular, statistical calculations of flood peaks and flood volumes have been performed, together with the determination of flood stages inside and outside the main channel, of flood waves caused by breaking of levees, etc.

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LES TECHNIQUES NUCLEAIRES UTILISEES EN SEDIMENTOLOGIE DYNAMIQUE

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RESUME

Les techniques nucléaires sont de plus en plus souvent utilisées pour mettre en évidence et mesurer les mouvements sédimentaires. Elles complètent les méthodes conventionnelles en permettant des mesures directement in-situ. Ce sont maintenant, trente ans après leur premier emploi, des procédés éprouvés.

Les traceurs radioactifs, dont un large éventail est disponible, permettent, avec des activités limitées, d'estimer les transports sédimentaires (galets, sables, argiles) sous l'action des courants et/ou des houles. Les fines particules, souvent support physique et vecteur des polluants, sont marquées et suivies dans l'espace et le temps. L'interprétation de ces mesures lagrangiennes conduit à des modèles simples mais réalistes de la dispersion (trajectoire, dilution, décantation) des fines particules dans des conditions connues.

D'autres radionucléides à durée de vie courte, obtenus à partir de générateurs d'isotopes (couramment utilisés en médecine nucléaire) facilitent les mesures dans les canaux hydrauliques ou certains modèles physiques à fonds mobiles.

Les jauges nucléaires de turbidité, association d'une source radioactive émettrice et d'un détecteur de radioactivité, donnent la concentration des sédiments en suspension ou bien le profil vertical de concentration des sédiments fins déposés dans les ouvrages (retenues de barrage - bassins portuaires - chenaux). Ce sont des aides appréciés à la navigation (complément des sondeurs à ultra-sons), à la gestion des chantiers de dragage et à la programmation des chasses de barrage.

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OUTLOOK ON WATER SUPPLY IN THE RURAL AREA IN THE SOCIALIST REPUBLIC OF ROMANIA

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ABSTRACT

The problem of water supply in rural areas is of utmost importance for development in the Socialist Republic of Romania.

While urban population has been almost entirely connected to centralized water-supply systems (c. 85 % of the population is already connected), furnishing the rural population with reliable and permanent sources is one of the goals of the present phases, implying considerable humain and material investments.

The paper aims at presenting the criteria taken into consideration for the achievement of this goal. It points to the benefits of achieving centralized micro-zonal water supply systems, as well as to their particularities according to the type of source : surface or underground.

The paper also makes recommendations regarding the use of different treatment techniques, under the conditions requiering the correction of water quality indicators in order to render it drinkable.

A SCHEME FOR WATER RESOURCES MONITORING IN RURAL AREAS

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ABSTRACT

One of the major problems in water resources management in rural areas is the lack of sufficient information, which demands a strategy for monitoring activities. In such cases, the location and sampling rates all depend upon the objectives of the planners.

The author proposes a new methodology called variance reduction analysis for optimal selection of sampling sites in random fields (e.g. groundwater table). This method is an extension of Kriging (i.e. a generalized Gauss-Markov estimator). The basis of variance reduction analysis is an information response function.

The analysis leads the planners to a loss function. This function incorporates specific objectives of the planners (e.g. minimizing losses due to information uncertainties) into an optimal sampling scheme. Two ranking functions are proposed. These functions represent information and economic gains due to more sampling. These two gain functions are utilized to identify the optimal location and number of new observation well sites.

RAPID SIZING OF RESERVOIRS IN DROUGHT AREAS WITH LIMITED RECORDS

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ABSTRACT

Development in some drought areas of Africa is dependent on available water. It is often difficult to justify large scale water schemes in such areas and smaller local dams are often the answer. As such dams are constructed on minor rivers, there is often insufficient record to permit accurate sizing of the dam. A method for simple estimation of the yield of such dams is described below. Regional records are extrapolated using limited parameters such as means and coefficient of variation and these also permit estimation of risk of failure. Alternative methods of estimation of dam yield are compared and a fit based on a curve fit using an extreme value type equation is described. The technique yields dimensionless storage-draft plots which also indicates the critical drought period and carry-over required. The same data can be used for simulation of the operation of the dam to permit account to be taken of evaporation and loss of capacity due to siltation.

Keywords: Critical period, drought, extreme value distribution, regional water resource development, storage-draft analysis.

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FARM PONDS FOR RAINFED AGRICULTURE

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ABSTRACT

The State of Karnataka in South India is characterised by seasonal rainfall, with rainfall events interspersed with rainless intervals of a few days or even a month. This paper reports an experiment on the feasibility of farm ponds as a device to supply protective irrigation to dry land crops at critical stages of growth during such intervals. A pond was built in the middle of an experimental farm whose upper part served as the catchment and lower part as cropped land, where a crop of finger millet was raised. Five critical stages were identified, and water from the pond was applied during three of them coinciding with rainless intervals to target plots. An indigenous human-powered lifting device was used to pump the water. After harvest, it was found that grain yield in the target plots was higher by 90% than in the control plots and straw yield by 80%. A benefit-cost analysis has been made and the net benefit worked out.

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WATER RESOURCES MANAGEMENT ON WATERSHED BASIS

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ABSTRACT

Water one among the crucial inputs in farming is tending to become increasingly scarce and costlier. Water supply status is getting fastly depleted and therefore conservation and efficient use of what is available has assumed importance perforcing strategies to meticulously harness the available quantities and put them to efficient use to realise higher productivity per unit of water per unit of land.

India lies in tropical and sub-tropical region. Rainfall is highly erratic and confined to monsoon months. Further, precipitation is unevenly distributed. Because of this, larger areas of India are faced with extensive droughts. Possibilities of providing irrigation to these tracts are remote due to various reasons. This is very essential in view of the fact that these lands belong to the rural weaker sections of the society and their living conditions have to be increased to remove the disparity between rich and poor in the country.

Apart from the need for increasing the pace of conservation programme, a qualified change is required in the basic conservation strategy. The recent concept of water resource management/ dryland technology is to tackle the problem on watershed basis rather than area basis. Each watershed having an area of say 1000-2000 ha. has to be selected and the practice of land and water resource development applied to fit into not only the physical situation, but also the rural people's wants.

This paper mainly deals with the soil moisture conservation techniques in dryland in detail with a view to benefit the rural masses to get more income from agricultural production.

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ETUDE DES RESSOURCES EN EAU ET MICROPROCESSEUR

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RESUME

L'évolution foudroyante des circuits intégrés et tout spécialement des microprocesseurs a totalement révolutionné les techniques d'acquisition de mesures dans le domaine de l'étude des ressources en eau. En effet, la collecte de mesures en nombre suffisant a jusqu'ici bloqué pas mal de recherches à cause des budgets nécessaires.

Les microprocesseurs disponibles à ce jour sont d'une fiabilité extraordinaire. L'éventail de leur application est sans limite. Le but de la communication est de montrer quelques applications en la matière. Citons :

- Le développement de réseaux de mesure à transmission par réseau téléphonique commuté avec répondeur à microprocesseur. Ceux-ci permettent d'effectuer un prétraitement de l'information (par exemple : moyennes auto-étalonnage, etc..), d'analyser le phénomène localement et de déclencher automatiquement des interventions. Tout ceci se fait à des coûts fort bas en comparaison avec ceux nécessaires pour réaliser ces missions avec les techniques classiques.
- Le matériel d'acquisition à microprocesseur avec RAM et PROM CMOS. Ces appareils, à très faible consommation de l'ordre de 50 µA, ont une autonomie de plusieurs mois, une capacité de mémoire largement suffisante et une stabilité d'horloge meilleure que 2'/an.
- Les interfaces à microprocesseur disponibles avec des entrées et des sorties digitales et analogiques aisément programmables. Ce matériel permet, suivant une programmation déterminée, d'agir sur des systèmes parfois fort sophistiqués sans intervention humaine.

Tous ces développements existent et sont disponibles à ce jour pour ceux qui oeuvrent dans le domaine difficile de l'acquisition de mesures in situ pour les études des ressources en eau.

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UNE PREMIERE EXPERIENCE DE FORMATION DE FORMATEURS AU CEFIGRE

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RESUME

Dans le souci de progresser dans la mise en oeuvre de pédagogies adaptées aux besoins et aux réalités des pays en développement; le CEFIGRE a entrepris en 1984, à la demande de la Société Béninoise d'Electricité et d'Eau (S.B.E.E.), et avec le support de la G.T.Z., une première expérience de formation de formateurs.

Le programme pédagogique a été établi compte-tenu des diverses fonctions du Centre de Formation du Personnel pour l'Adduction d'Eau (C.F.P.A.E.). Il s'agit, en effet, aussi bien d'un bureau d'experts que d'un atelier de réparation.

Le contenu pédagogique, conçu pour atteindre ces objectifs a comporté plusieurs volets :

- une formation technique théorique sur les ressources en eau, la production, la distribution d'eau potable, l'assainissement ;
- une formation technique pratique dans des centres de formation spécialisés;
- des visites techniques;
- une formation pédagogique théorique assurée par des spécialistes de la formation des adultes;
- une mise en situation pédagogique.

L'élément nouveau par rapport aux formations dispensées habituellement par le CEFIGRE a très certainement été la formation pédagogique qui s'attache non seulement à enrichir des connaissances, mais qui apprend surtout à transmettre un savoir.

WATER FILTRATION TECHNOLOGIES FOR DEVELOPING COUNTRIES

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ABSTRACT

Filtration technologies are classified into two major catagories, slow sand filtration and rapid filtration. Slow sand filtration has been extensively used in developing countries, especially in small community water supplies. The other types of filtration and prefiltration systems those can be used in small community water supplies include horizontal-flow prefiltration, and seawater supplies filtration. Rapid filtration, on the other hand, have been used in medium or large water supply schemes. The past experiences on conventional rapid filtration techniques in developing countries has often been unsuccessful. However, the modifications made to conventional rapid filtration like declining rate filtration, high rate filtration, dual-media filtration, direct filtration may change the situation and make it suitable in developing countries for the construction of new water treatment plants and for upgrading existing plants.

Keywords : Slow sand filtration, horizontal flow prefiltration, sea water supplies filtration, rapid filtration,declining rate filtration, high rate filtration, dual-media filtration, direct filtration, developing countries.

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THE ROLE OF GROUNDWATER IN RURAL DEVELOPMENT IN EGYPT

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ABSTRACT

The overall strategy for groundwater development is based on the government policy for the movement of population from the narrow strip bordering the Nile and improve the living condition in the rural communities. Groundwater is a major component of the environment and determine whether or not life is possible under arid climatic conditions in the Egyptian deserts.

The expected increase for both irrigation, domestic and industrial waters, call for more attention to the exploitation, management, proper use and control of groundwater. The planning for groundwater include also its conjunctive use with the available surface water since it will lead to:

- Improve the drainage efficiency.
- Reduce the groundwater levels.
- Increase the land fertility & in turn increase the national production.
- Finally it will lead to the rural society development as long as the groundwater is used in an effective economic way in different aspects of life as; municipal and drinking water, irrigation, industry and other uses according to the priorities layed out by the planners in these societies.

This paper discusses generally the overall strategies for groundwater development in both the Nile Valley, the deserts and its role for conservation of the environment.

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PIPE NETWORKS FOR RURAL AREAS
A NEW METHOD FOR HYDRAULIC ANALYSIS

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SUMMARY

The water distribution in rural areas generally presupposes a wide water system with low course flows, excepting the situations in which local solutions are possible and advantageons. Pipe networks for rural areas, when economicaly possible are very interesting, particularly in two aspects: a) Possibilities for low piezometrical slopes (important because of the size of the water systems); b) Allows a better response of the water system for unexpected increases of some population centres. On the other hand, the low flows to take into account for hydraulic analysis permit a great simplification of the water system; this can be reduced to a few main networks which, however, could have quite long pipes.
It's interesting to notice that in urban areas the situation is generally the opposite: the pipe networks have high flow concentration in a short pipe system.
In this paper, a new method for hydraulic analysis of pipe networks is described. This method generally presents a quicker convergence than the classical methods, such as Hardy Cross' and Newton-Raphson's, and is easily applicable to any pipe network system.
A pratical application of this method to a typical pipe network for a rural area is presented.

Keywords: Water distribution, pipe networks, hydraulic analysis.

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MAINTENANCE OF WATER QUALITY FOR DAM RESERVOIRS

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ABSTRACT

Dams have many purposes, such as flood prevention, water resources, power generation, but those constructions cause great influence on the natural environment and social activities because of artificial storaging up river water. Though dams, immediately after the world war II, were largely constructed in rural and mountanious areas, many dams constructed at that time created no environmental problems. Recently, in Japan, the potential of artificial water quality pollution infusing dam reservoirs have been heightened by vicinity of dam sites to urban areas and industrial progress. At present, some water quality problems have been created at certain dams, though such dams are not so many compared with total number of dams in Japan. These problems are mainly discharge of cold water, long-term turbid water, and eutrophication. These problems must be coped with individually, because the difference of dam situation, such as location, reservoir storage volume, operation rule, etc. presents complex phenomena. The Ministry of Construction has executed many studies and experiments concerned with these problems.

This paper gives the general explanation of eutrophication and a few examples of countermeasures for eutrophication such as shallow layer aeration, deep layer aeration and direct removal.

Key words: dam, water quality, maintenance of water quality, eutrophication shallow layer aeration, deep layer aeration, direct removal

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OPTIMIZATION MODELS FOR REGIONAL WATER PLANNING IN NEW RECLAIMED LANDS IN EGYPT

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ABSTRACT

Two mathematical models were developed by means of which the coordination of regional water resources supply and planning demands for the new reclaimed lands in Egypt is reached. For the old lands, the model is a water supply which allocates water at various subareas to satisfy the demands at a minimum cost. For new lands, the model is a water demand one that allocates the cropped area at a maximum net benefit. The coordination between the two models gives the optimization of the net benefit for the development of the old and new land as one unit. The models were applied to El-Sharkia governorate in Egypt.

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EGYPT WATER MASTER PLAN
INSTITUTIONAL BUILDING FOR DECISION MAKING

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ABSTRACT

The Ministry of Irrigation together with the World Bank under the United Nations Development Program began a Master Plan for Water Resources Development and Use in October 1977.

Phase I of the project terminated in March 1981 and the results were recorded in a main report and twenty appendices.

Water Planning is a continuous process. Changes in demands, supply, technology, costs, prices, national goals take place. Alternations in short and long range water plans must be made to accomodate these changes.

Therefore, a second phase of the project started in January 1982 scheduled for three years. While Phase I primary emphasis was on the development of planning tools and resources, skills and capabilities of project staff, the primary emphasis in Phase II is to develop the Water Planning Group (WPG) as nucleus for a water planning and coordination organization. WPG is to act as the technical secretariat of an Interministerial Water Planning Committee (IWPC) under the chairmanship of H.E. the Minister of Irrigation, the custodian and manager of the country's water resources, and the membership of representatives from all ministries and authorities using the water resources. The primary function is to provide a broad, macro-economic prospective of the planning and programming of projects envisioned by each ministry concerned with water uses, in a cross-sectoral and multidisciplinary approach.

This paper discusses the role of water planning in Egypt and concentrates on the objective of institution building for decision making.

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WATER AND RURAL DEVELOPMENT WITH SPECIAL REFERENCE TO EGYPT

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ABSTRACT

The water resources represent the cornerstone for development in different fields of life. No doubt, water lies at the heart of rural development, which is the main motivating power for rural societies progress and in turn decrease the gap between rural and urban areas, thus it leads finally to the whole country development.

The presented subject discuss the main elements of rural development, its objectives and its role in the country development. Then the water resources development in the rural areas are discussed, its policies and the planning methodology for the maximum use of the drop of water in the fields of; irrigation, drinking water and municipal, industry, hydropower, navigation, tourism and recreation.

The Author discusses the planning process for different water projects and its role in rural communities development and in increasing the capabilities of the rural society and in decreasing the social stratification, and finally discusses the role of irrigation mechanization and water use rationalization in rural development.

The Author also discusses the legal and institutional aspects with regard to water use and water scheduling in the agricultural societies and how the law can be considered as the governing factor of the whole process of development, specially in the field of extension. Also the paper discuss the cooperation between the members of the rural society & between them and the executing agencies in the field of operation and maintenance for the different water structures.

Finally the Author discusses the Egyptian concept and the interaction between the river Nile -as the lonely source of water- and the Egyptians.

The paper introduces some recommendations for the future of water resources development in rural areas in the third world.

IRRIGATION DEVELOPMENT IN RURAL SOCIETIES OF EGYPT

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ABSTRACT

Irrigation development is one of the main foundations of rural development, since it leads to the best utilization of all available water resources, protects the land fertility and results in the overall development. It also has a positive impact on drainage efficiency, aquatic weeds control, public health, individual and collective capacities to learn new technologies, social cooperation and the national income.

The planning for irrigation development in rural societies is greatly associated with the capacity to get optimal benefit from existing structures and developing them in the best economical way. It may depend mainly on modernization of the existing facilities and tools using simple technological means and also to change the related traditions and wrong religious beliefs.

This paper presents the Egyptian experience gained through applied research and field work. The general objective was to improve the social and economic conditions of small farmers through development and use of improved irrigation water management and associated practices which increase agricultural production, promote efficient water use and reduce drainage problems. The main development programmes are as follows :

1. Improve management and distribution of irrigation water.
2. Minimize transmission, distribution, operational and application losses.
3. Improve farm irrigation systems and land levelling.
4. Help the farmers to form water users associations.
5. Train the farmers on the proper water use and improve water lifting devices.

The approach taken to implement such programs is to follow a systematic procedure comprising, problem identification, search for solutions, pilot projects and developing procedures for disseminating practices which were proved through the pilot projects. This work demonstrated the value of an interdisciplinary approach and national improvement programs outlined on this basis.

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LES TENDANCES NOUVELLES DE LA DERNIERE LOI CONCERNANT L'IRRIGATION ET LE DRAINAGE EN EGYPTE

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RESUME

La loi n° 12 de 1984 concernant l'irrigation et le drainage en Egypte, tout en conservant la structure des lois qu'elle remplace, introduit de nouvelles tendances:

1- Unité de compétence du Ministère de l'Irrigation sur les ressources en eau.
2- Large incitation à l'utilisation des eaux de drainage.
3- Introduction de mesures anti-gaspillage, la lutte contre la pollution faisant l'objet d'une autre loi.
4- Introduction d'une réglementation sur l'irrigation des nouvelles terres (déserts), législation qui par ailleurs s'oriente timidement vers la vérité des prix.
5- Aggravation des peines pour les infractions commises contre les dispositions de la loi.

D'une manière générale, même si l'on observe quelque timidité en ce qui concerne la vérité du prix de l'eau, les nouvelles orientations de cette loi constituent une étape importante vers la solution du problème de l'eau en Egypte, en particulier par la politique d'économie de l'eau et d'utilisation des eaux de drainage.

Mots-clefs: Irrigation, eau, législation, agriculture, drainage, déserts, prix, droit pénal, droit économique.

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GROUND WATER RESOURCES FOR WATER SUPPLY IN RURAL AREAS OF MADHYA PRADESH

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ABSTRACT

Madhya Pradesh, the largest state, located in the heart of India, comprises an area of 44.3 million hectares i.e. 14.5 percent the size of India. Madhya Pradesh is less urbanised than most of other states and nearly 84% of its population live in rural areas. There are 70,883 villages in the state, which covers a rural population of 46.78 millions.

Geologically all rock types of the major rock formations from Archaeon of recent alluvium are present in the state. The annual ground water recharge for the state based on the infilteration method is 43,000 Mcm. In Madhya Pradesh, average rainfall is 1210 mm which is replenishing source for ground water resources. Ground water can be harnessed for domestic water supply in the rural area in the villages of Madhya Pradesh.

Ground water resources should be fully exploited to meet the demands of the rural water supply. This comes under minimum needs programme and phased development should be made within 6-7 years time. The paper deals with the Planning and Development of Ground Water Resources in the rural areas of the state of Madhya Pradesh in India.

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HARNESSING A NATURAL DISASTER FOR RURAL COMMUNITIES WATER SUPPLIES

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ABSTRACT

Agulu-Nanka-Oraukwu areas in Anambra State, Nigeria have become a major environmental disaster caused by widespread gully erosion. The ravaging gullying has created an unstable landmass of badland topography, Hadesian canyons; driven many people away from ancestral homes; and caused great losses in farmlands. The gullies continue to expand at an alarming rate. Major lakes and rivers are found on both flanks of major surface water and groundwater divides. The lakes are believed to be erosional in origin. The areas are highly-stressed by a dense population of rural communities, agricultural activities and urbanisation. Attempts to check the gullying since 1935 have woefully failed. The young and aged descend precipitous gullies to fetch waters of poor quality for domestic use. Many water-tankers also fetch water-for-sale daily from the lakes. It is proposed that a major dewatering scheme for controlling the gullying through waterlevel lowering and stabilization could also be harnessed to provide lasting potable water supply for the poor rural communities. In addition to developing the lakes for tourism, they could also provide water for domestic supply, irrigation agriculture, aquaculture and animal husbandry.

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A SMALL-SCALE HYDROELECTRIC POWER DEVELOPMENT IN RURAL AREAS IN RECENT JAPAN

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ABSTRACT

After the oil shock in 1973, hydroelectric power development which was rather in decline has been evaluated again, because of the rise of petroleum price for thermal plant. This paper presents the role of hydroelectric power development after the oil shock, reviewing the historical background in modernizing Japan since the end of last century.

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EXPERIMENTS BASED ON THE POTABILIZATION OF AUSTRALIAN SURFACE WATER BY MEANS OF DIRECT FILTRATION (OMNIFILTRATION$_R$) SYSTEM

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ABSTRACT

These experiments form part of a wider research trend which aims at ascertaining the feasibility of applying a system based on in-series direct filtration at high velocity, i.e., Ofsy, to treatments for the separation of high loads of undissolved substances or of substances likely to become undissolved. Throughout Australia, almost all surface water is characterized both by a highly coloured content and by a highly colloidal turbidity (the fineness coefficient or ratio between suspended solids and NTU turbidity is very low, i.e.: less than 1). A pilot plant was installed near the banks of the Murray river which provides a typical example of surface water in Southern Australia. The tests were run almost at the end of the dry season (March 1984). The information collected gave useful indications on the ideal operating conditions for carrying out water treatment and on further organoleptic and chemical parameters for determining the potability of water. This contributed to proving that direct filtration, Ofsy in particular, can therefore be applied to water having these peculiar characteristics. It could be observed that the colour is partially apparent because of the presence of algae such as Granulate Melosira and Brown Diatoms in summertime and to silt in wintertime, whereas the true colour is due to resins given out by the vegetationmainly formed by Stringy Bark Gum trees. These resins are highly soluble in water.

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EVOLUTION RECENTE DE LA LEGISLATION SUR LES EAUX SOUTERRAINES EN BELGIQUE

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RESUME

En Belgique, la législation actuelle concernant la gestion des eaux souterraines est basée sur quatre lois qui traitent respectivement de l'aspect quantitatif (loi du 18 décembre 1946 et 9 juillet 1976), de l'aspect qualitatif (loi du 26 mars 1971) et de l'aspect "influence-dommage" (loi du 10 janvier 1977).

Ces lois sont opérationnelles sauf la loi du 26 mars 1971 qui, à défaut d'arrêtés d'exécution, n'est pas efficace. En plus leur gestion ressort de la compétence de deux Ministres.

La loi spéciale de reformes institutionnelles du 8 août 1980 institue une gestion des eaux relevant de la compétence régionale. Depuis lors les différents aspects de la gestion des eaux souterraines dans la Région nord sont regroupés dans un seul décret du 24 janvier 1984 et placés sous la compétence d'un seul Ministre.

Mots-clés : Eaux souterraines - législation - dommage - prise d'eau - zone de protection.

ECONOMIC TOOLS TO AID RURAL WATER DECISIONMAKERS

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ABSTRACT

A major determinant of the quality of life in rural areas is an abundant supply of high quality water for domestic use. Agricultural and industrial water requirements must also be met if rural areas are to flourish. Rural residents have for years relied on groundwater or have hauled water for their needs. Some rural areas do not have adequate supplies of quality water. Indications are that the water supply problem will continue or perhaps become worse in the future due to population growth. Community leaders and rural water district boards are particularly concerned with the water issue. Several problems confront these leaders as they attempt to plan and develop water supply and distribution systems to adequately meet their present and future needs. Several research projects have been undertaken to develop economic tools which will aid these leaders. They include: (1) a method to estimate future water use based on historical water use trends, socio demographic data and population projections; (2) a method to estimate annual capital and operating budgets; and (3) a tool to use to evaluate alternative water rate structures and their impact on revenue.

Keywords: Planning, rural water systems, water demand, budgets, rate schedules, demand elasticity.

MITIGATION OF DROUGHT IMPACTS

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ABSTRACT

The intention of this paper is an analysis of the different measures and strategies for the mitigation of drought impacts, with particular consideration of the different ways in which normal water strategies should be modified when drought conditions begin to develop or are already well established. Some basic drought concepts are presented, including definitions and references to the concepts of aridity and drought forecasting. A detailed analysis of the several possible drought impacts is made, presenting an enumeration of possible economic, social and environmental impacts and giving some comments on specific aspects of these impacts. The possible responses to drought situations are identified and the measures for drought impact control are classified in three groups: measures intended to increase the available water supply during the drought periods, measures intended to decrease the water demand during the drought periods and measures intended to minimize drought impacts which still occur after the application of the first two types of measures. Final comments on the implementation of these three types of measures are given.

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APPROCHE NOUVELLE POUR LA MODELISATION DE LA DISPERSION TURBULENTE DE SUBSTANCES SOLUBLES EN RIVIERE

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RESUME

Un modèle stochastique est proposé pour l'étude de la dispersion turbulente en rivière naturelle.

Il permet de restituer la dissymétrie observée sur toutes les courbes de dispersion en faisant intervenir deux paramètres dont l'identification est aisée.

Les performances du modèle sont testées sur des résultats d'essais de traçage. Elles sont nettement supérieures à celles du modèle classique de dispersion basé sur la loi de Fick.

L'introduction de ce modèle est intéressante dans les applications liées à la qualité de l'eau pour lesquelles l'importance du processus de dispersion est fondamentale.

La présente étude a reçu l'appui financier de l'ex Noyau Administratif de l'Eau du Ministère de la Santé Publique et du Ministère de la Région Wallonne.

SITING OF GROUND-WATER DAMS FOR RURAL WATER SUPPLY IN DEVELOPING COUNTRIES- HYDROGEOLOGICAL AND PLANNING ASPECTS

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ABSTRACT

In order to overcome problems related to surface storage of water, various methods have been developed in different parts of the world for storage by means of ground-water dams. A ground-water dam may either store ground water in a natural aquifer (sub-surface dam) or in a reservoir filled with sediments caused to accumulate behind a surface dam (sand-storage dam). The technical solutions that have been applied vary from highly sophisticated ones in USA and Europe to simple, low-cost alternatives in some developing countries in Africa and Asia. A survey of the schemes presently in existence and the experience gained from those has shown that ground-water dams under certain conditions are highly suitable for storage of water for rural water supply in developing countries. Examples of failures caused by unfavourable hydrogeological and other conditions are frequent, however, and thus there is a need for developing a systematic approach to the planning process in which the dams are sited and designed.

Hydrogeological aspects of ground-water dam siting and construction, and related physical planning aspects are being studied specifically in Kerala and Tamil Nadu, South India. The study is carried out at regional and local levels. Maps at 1:500.000 showing the general feasibility of constructing ground-water dams in an area of about 40.000 sq. km., and maps at 1:30.000 showing favourable sites and giving site-specific data for design and construction in selected areas are being developed. Some of the schemes thus proposed will be implemented under a ground-water project carried out by the Central Ground Water Board of India with Swedish assistance.

The paper presents the technical background, the hydrogeological and physical planning aspects of dam siting, and field examples from the study area.

Keywords: Ground-water dams, water supply, developing countries, sub-surface dams, sand-storage dams, hydrogeology, physical planning, India.

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ENVIRONMENTALLY SOUND MANAGEMENT OF FRESHWATER RESOURCES

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ABSTRACT

The main principles of environmentally sound management of water resources over the river basin are outlined, information on UNEP comprehensive water programme for this type of management is presented and the improvement of integrated river basin development and its decision making is contributed by this paper. The main functions of freshwater bodies are natural resources, ecosystem and landscape formulator. Evaluation of the present practice of water management is mainly oriented to the natural resource function. There is a need to consider all of the functions by an integrated approach, which can be implemented by environmentally sound management of water resources in the river basin as a whole. It makes it possible to harmonize continuously the different interests of socio-economic development and water-related (natural and man-made) environment over the entire river basin. It applies at the project as well as the basin-wide level and takes into account the co-existing three functions of water bodies. The output of such management will be a harmonized water-related environment which is good (not only acceptable) from socio-economic and ecological viewpoints throughout the process of long-range river basin development. Criteria and evaluation of environmentally sound management of river basins. Procedure to develop this management. UNEP's programme. Development of Action Plans and world-wide system of pilot river basins. Co-operation with the Governments, UN-agencies and non-governmental organizations.

Keywords: water resources, environment, river basin, environmentally sound development, harmonization, socio-economic interests, conflicts, integrated approach, criteria, state of environment, UNEP water programme.

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NUTRIENT FLOW THROUGH NATURAL WATERS IN "TERRA FIRME" FOREST IN CENTRAL AMAZON"

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SUMMARY

In an experiment conducted at Reserva Ducke, Cl^-, NH_4^+, PO_4^{3-}, Na^+ and K^+ ions were estimated in rain water, throughfall and run-off water of the Barro Branco Igarapē which drains a 1.3 km^2 watershed characterized by "Terra Firme" forest cover. Ca^{2+}, Mg^{2+} and SO_4^{2-} were found only in throughfall. Ion contents in rain water were ($kg.ha^{-1}.yr^{-1}$) 13.6 Cl^-, 6.6 NH_4^+, 0.1 PO_4^{3-}, 8.4 Na^+ and 2.4 K^+. This represented 45%, 89%, 37%, 76% and 11% respectively of the totals reaching forest soil by throughfall. Ca^{2+}, Mg^{2+} and SO_4^{2-} reaching the forest soil by throughfall ($kg.ha^{-1}.yr^{-1}$) were 1.0, 7.8 and 37.0 respectively. Run-off ion loss was relatively small as compared with total ion content reaching the soil forest by throughfall.

Keywords: Amazon forest, nutrient flow, water quality, natural water; nutrients recycling.

WATER HARVESTING FOR RURAL AREAS IN SAUDI ARABIA

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ABSTRACT

Water harvesting is one of the many ways of enhancing the water supply for the rural areas in the Kingdom of Saudi Arabia. It is simply a process by which the soil surface is made nearly impervious and the runoff produced from this area is collected for future use. The study reported herein deals with investigating the possibility of using crude oil as a water proofing and stabilizing agent of rural desert watersheds, and was completed in three phases using the four types of crude oil available in Saudi Arabia. In the first phase, sand box models were built out of plexiglass and infiltration rates were determined using a variable head of water on the treated and untreated surface of soils. In the second phase, the same experiments as in the first phase were repeated, with a constant head of water maintained on top of the treated and untreated sand surfaces. And in the third, a rainfall simulator was used to determine the effect of the raindrops on the treated surface of a laboratory watershed. Extremely encouraging results were obtained and the results show that crude oil (specially Medium Crude) is an excellent water proofing and binding agent, reducing infiltration upto ninety nine percent. The quality of runoff from this watershed has been determined and treatment recommended for various uses.

Keywords: Water harvesting, infiltration reduction, water supply, treated soils, water proofing, surface runoff.

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A MATHEMATICAL MODEL TO FORECAST COMMUNITY WATER DEMAND

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ABSTRACT

A mathematical model to forecast community water demand is developed from the analysis of past water consumption and factors which are related to the community water use patterns.

Total population of the community, number of water supplied population, population density, community products, water rate and other essential elements which give great influence to water consumption are considered as explanatory variables for community water demand and are determined as the factors of water demand through the factor analysis.

Those factors are then analyzed and correlated with the dependent variables by multiple regression analysis. Total gross and per capita community water demands are considered as dependent variables for which forecasting demand model is to be determined.

Finally, the projection of water demand is made from this relationship and compared with the classical or conventional estimation of community total gross and per capita water demand.

Among the developed forecasting models for total gross community water demand, linear-1 model indicates more adequacy for expected quantity and others are considered irrelevant for the forecasting purpose. For per capita community water demand, models of linear-2 and log-linear-2 are more significant for the forecasting purpose. In the general view, models for per capita water use are more adequate than those for total gross water use.

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STRATEGIE DU DEVELOPPEMENT DES RESSOURCES EN EAUX DU VIETNAM ET LEUR GESTION

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RESUME

Apercu général sur l'hydrologie et l'hydrogéologie du territoire

S'allongeant sur le rebord de l'Est et du Sud-Est de la péninsule Indochinoise, le territoire Vietnamien est constitué par les éléments structuraux de différentes zones tectoniques rattachées à l'écorce continental et océanique.

S'étaient passé les cycles successifs d'activité tectonique et volcanique intense durant toute l'ère Phanérozoique dans laquelle l'écorce continentale du Vietnam a été formé pour l'essentiel au Paléozoique supérieur et Mésozoique inférieur et était détruite et régénérée dans les époques récentes.

Le territoire avait une gamme assez complète de formations métamorphiques sédimentaires du Précambien au Cainozoique, d'abontantes variétés de formations magmatiques dont l'âge et la composition se diffèrent à compter d'ultra mafique jusqu'à acide et alcaline.

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EL RECURSO HIDRICO EN LA CUENCA DEL RIO BOGOTA

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RESUMEN

En este trabajo se presenta el sistema hídrico de la cuenca del río Bogotá. Se describen las principales características de la cuenca y el subsistema anexo de Chingaza. Se explican los principales propósitos asociados con el aprovechamiento del agua, incluyendo el agua para los usos domésticos en la cuenca, el riego y la generación eléctrica. Se identifican los principales conflictos relacionados con el uso del agua y se explican las prioridades legales para su utilización. Esto plantea algunos interrogantes fundamentales relacionados con el planeamiento del agua en la cuenca. Se hacen algunas sugerencias relativas a dicho planeamiento y se discute el potencial de las técnicas de análisis de sistemas y la importancia del concepto de tecnología apropiada .

Finalmente se plantean las conclusiones y recomendaciones de este trabajo, haciendo énfasis en revisar la filosofía de planeamiento del agua en la cuenca.

* Miembros del Comité Geográfico Colombiano de la Asociación Internacional de Recursos Hídricos.

SPRINGS - A SOURCE FOR RURAL WATER SUPPLY IN THE HIGHLANDS

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ABSTRACT

The Indian sub-continent has a geographical extent of 3,287,782 sq.km and more than 20% of this area falls in the category of mountainous region or high ranges. These areas, like other higher ranges in the world get medium to high precipitation and people living in there depend on small streams and rivulets for their domestic water needs. In humid tropical climate like that of Kerala, these streams and rivulets are non-perennial and people have to depend on wells and springs during summer months. Due to high cost of digging/ drilling wells in these hard-rock terrain, the economically weaker section of the population depend on springs for water. At present there is no record of the number, location, discharge and other relevant details on these springs. This paper reports the preliminary investigations in a small representative area along with the suggestions to exploit this perennial source of freshwater resources for optimal utilisation.

Keywords : Springs, rural water supply, highlands.

PERCEPTION AND ATTITUDE OF THAI VILLAGERS TOWARD AN IMPROVED RURAL WATER SUPPLY MANAGEMENT SYSTEM

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ABSTRACT

The conditions affecting the need for an improved rural water supply management system and the impact which an improved rural water supply system can have on the social and economic well-being of 236 rural households among thirteen villages in Tambon Sara Krue are examined in this study. The need for rural water supply improvement was found to be significantly associated with the villagers' dissatisfaction with the existing water supply, their desire for service, their willingness to contribute to the improvement and their awareness of ill health. No significant association was found between the need for water improvement vs. the number of sources and the awareness of unsanitary condition. The impact which an improved rural water supply management system can have on the social and economic well-being of the village community was found to be associated with medical cost, cleanliness, water conservation, standard of living and community health. However, no significant association was revealed by labor productivity. The feasibility of undertaking an organized rural water supply system was also explored. The analysis indicated that if the project were to succeed, certain social, economic and technical constraints must be overcome.

Keywords: Perception, attitude, improved rural water supply management system, chi-square, association, feasibility, organized rural water supply system, constraints, project and village community.

FLASH FLOOD FORECASTING IN THE CEVENNES REGION IN FRANCE - A CASE STUDY

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ABSTRACT

The Cevennes region in Southern France was selected as a pilot area for the development of flash flood forecasting systems because of the heavy rainfalls and rapid concentration of the flows which occur in this region of steep upper basins and flat lower basins. The flood forecasting system consists of a real-time data acquisition subsystem, a hydrologic forecasting subsystem and an alert information dissemination subsystem. The first two subsystems are discussed in this paper and the emphasis is on the formulation of the second subsystem. The proposed hydrologic forecasting subsystem consists of tow models in series. The first is a nonlinear model which transforms the total rainfall into an effective rainfall. This, in turn, serves as an input to the second model which is a linear transfer function model, the coefficients of which can be estimated recursively in real time. The recommended models are selected on the basis of the parsimony of parameters, the standard errors of forecasting at the identification stage and at the verification stage and on the whiteness of the residuals. A wide variety of models were tested using data from the basin of the Gardon D' Anduze.

Keywords: Flash floods, flood forecasting, real-time forecasting, rainfall-runoff relationship, recursive estimation.

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LA GESTION DES RESSOURCES EN EAU EN TUNISIE

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RESUME

Quoique méditerranéen, le climat de la Tunisie est dominé par l'aridité qui croit rapidement du Nord vers le Sud du pays. la disparité pluviométrique spatiale se retrouve également à l'échelle du temps. La forte irrégularité saisonnière de la pluviométrie se double d'une irrégularité annuelle, ce qui ôte aux paramètres moyens toute valeur prévisionnelle. Dans un tel contexte, la maîtrise de l'eau devient une nécessité non seulement économique mais vitale pour protéger les personnes et les biens contre le manque comme l'excès d'eau.

Tout plan de maîtrise des ressources en eau passe nécessairement par une évaluation aussi précise que possible des potentialités hydrauliques du pays. Cette évaluation n'a cessé de s'affiner en Tunisie tant et si bien qu'il est possible à l'heure actuelle d'avancer des prospectives chiffrées des réalisations à effectuer en matière de ressources en eaux de surface et souterraines en fonction des besoins et des ouvrages existants.

Mots- clés : Gestion des ressources en eau, Inventaire des ressources hydrauliques, confrontation besoins / ressources.

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INFORMATION CONTENT IN SEDIMENT DATA RECORDS

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ABSTRACT

The daily sediment concentration data were analyzed for trend, seasonality, probability distributions, and informtion content. It has been found that the analyzed data were trend free, and showing strong periodicity. The data is lognormally distributed. The information content varied throughout the year, observations can be discontinued at certain times of the year (i.e. winter times), and the required sample lengths are very high if it is required to reach a ten percent accuracy in the mean with ninety-five percent confidence.

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RESPONSE FUNCTIONS OF CROPS TO IRRIGATION BASED ON PAN EVAPORATION CONCEPT

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ABSTRACT

The information on crop yield water response functions is needed to make decisions on resource development and management. The approaches relating yield to evapotranspiration or transpiration appear to be, though, scientifically sound, have limitation of practical applicability under the prevailing conditions in the rural areas of the developing countries, as these require collection of data related with different components of field water budgeting. Considering the above an alternative concept of a parameter Ra, defined as the ratio of depth of water applied per irrigation and the cumulative pan evaporation, was adopted. Seasonal and growth stage functions are proposed which require input data on evaporation from Class A Pan and depth of water applied. The functions were verified for wheat with the data collected from various research stations located in different agroclimatic regions in India. The proposed functions are found to be statistically acceptable, at 1 percent probability level at most of the locations. An attempt has been made to generalize the seasonal yield response function to make it transferable. These functions will prove to be useful tool to the farmers and irrigation planners in scheduling irrigation and optimizing the water allocation among different crops.

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GROUNDWATER RESOURCES IN THE REPUBLIC OF THE SUDAN

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ABSTRACT

The major aquifers of the Sudan occur in: the Mesozoic Nubian Sandstone formation, the Subsurface continental Tertiary deposits of the Gezira, the Umm Ruwaba and the Atsham formations, as well as the quaternary alluvial sediments. They are situated separately or connected in 13 significant groundwater basins and receive current recharge directly from the Niles and through bed transmission losses of the larger seasonal streams-or indirectly by vertical leakage. Much of the groundwater stored in the Nubian basins appears to be fossil water although isotopes evidence points to some current recharge taking place on their peripheries.

The estimated total volume of groundwater stored in the Nubian and the Tertiary basins is huge (14367 milliard m^3) but their exploited water is relatively small (50.13Mm^3) and amounts to 27% of the total consumed groundwater. In contrast the quaternary alluvial basins have a small total reserve (1007Mm^3) but they produce large quantities (133.12 Mm^3) being 73% of the total abstracted groundwater.

The Salinity of groundwater in the quaternary alluvial basins is low (175-470mg/l) but is moderate in the Nubian basins (300 - 800 mg/l) and is high in the Umm Ruwaba deposits (500 - 7000 mg/l). The water is generally suitable for human consumption but that of the alluvial aquifer is best for irrigation purposes.

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ASSESSMENT OF THE GROUNDWATER RESOURCES IN THE SOUTHERN PART OF THE NUBIAN AQUIFER SYSTEM, EASTERN SAHARA

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ABSTRACT

The Nubian Aquifer System of the Eastern Sahara covers an area of about 1.8 Mill. km^2 and belongs to the world's largest aquifer systems. The aquifer consists of Paleozoic and Mesozoic sandstones which exceed thicknesses in the central part of the Libyan and Egyptian sedimentary basins of more than 4000 m. Isotope analyses have shown that the groundwater resources of this aquifer system have been formed during wet climatic periods in the late Pleistocene and Holocene. Under the present day extreme-arid conditions groundwater recharge is negligible in comparison with its discharge.

Groundwater development occurs mainly in the Kufra Oasis (Libya) and in the oases of the New Valley (Egypt) where the deeply buried, confined part of the aquifer is exploited. Due to high production rates, huge cones of depression have been formed and high values of drawdown can be observed. This situation means a serious danger for the water supply of many agricultural development projects.

A realistic assessment of the groundwater potentials requires detailed hydrogeological studies considering the outer edges of the basins and such areas where the basins are hydraulically interconnected. These are the main objectives of a multidisciplinary research project which is focusing on recent hydrogeological work in southern Egypt, northern Sudan and northern Chad. Results of these investigations will be presented.

THE IMPACT OF WATER RESOURCES PUBLIC POLICIES ON INTERNATIONAL RIVER BASIN CONFLICTS (*)

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ABSTRACT

The satisfaction of national water needs frequently requires the resolution of international water use conflicts. Success or failure of negotiations is conditioned not only on the availability of the resource, but the degree to which the public policies of each of the countries involved facilitate, constrain, or retard settlement. An analytical model of the policy process that governs the resolution and/or management of an international river basin conflict, applicable to countries at any level of development, is presented. The model identifies the components of a cycle that begins with the identification of needs requiring official government action, and ends with the production of policy outputs to allocate resources for the satisfaction of the identified needs. The model is used to analyze the conflict between Mexico and the United States over the salinity of the Colorado river, as an illustration of its usefulness for applying it to other conflicts.

* The authors are solely responsible for opinions expressed in this paper.

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TOWARDS THE EVOLUTION OF A STRATEGIC ORGANISATION MODEL FOR WATER RESOURCES DEVELOPMENTAL SYSTEMS IN A DEVELOPING COUNTRY LIKE INDIA

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ABSTRACT

This paper primarily attempts to construct a realistic organisational model for water resources management in the context of developmental perspectives of Indian subcontinent. The design of the model involves a synoptic depiction of the intricate behavioural interdependencies and the processes of information transactions between the water resources system and its environment. The model represents a multilevel hierarchical structure based on the concept of continuous interactive and iterative search and learn process to facilitate feed forward and feedback information flows so as to provide directional thinking, resources allocation and resources administration from the strategic management perspective. For diffusion of this model into the realm of operational practices, an information flow model characterising the multilevels with the system life cycle has been presented. Finally, a decision flow model has been suggested as an alternative to the current practices of rationalistic-intuitive decision making process.

Keywords : Organisational logic model, water resources management, multilevel hierarchical structure, feed forward and feedback information flows, strategic effectiveness.

ECONOMIC, SOCIAL AND TECHNICAL CONSIDERATIONS DETERMINING INVESTMENTS IN GROUNDWATER IN BANGLADESH

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ABSTRACT

With a total land area the size of the state of Illinois and a population exceeding 90 million, Bangladesh has one of the highest man-land ratios in the world. Blessed with vast river systems but having such a flat topography that large-scale reservoir and gravity surface irrigation systems are not feasible, Bangladesh has been forced to turn to groundwater as a source for dry season irrigation water. Initial investmens were in low-lift pumps but now the Government of Bangladesh (GOB) is encouraging investment in hand-pumps, shallow tubewells and deep tubewells as sources for additional water for irrigation. However, to date utilization rates have been far below those predicted by national planners. The purpose of this paper is to analyze the economics of alternative groundwater extraction devices in Bangladesh and to use their results to explain present low utilization rates. Using recent data the analysis examines economic, social and technical characteristics of the alternative technologies and explains why shallow tubewells are to be encouraged over deep tubewells. Based on these results suggestions for improving utilization rates are presented.

Keywords: Groundwater, deep tubewells, shallow tubewells, conveyance losses, water users associations.

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ECOLOGICAL FACTORS OF HYDRAULIC PROCESSES IN HPP CASCADES

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SUMMARY

HPP cascades on plain and mountain rivers give rise to alterations in hydraulic processes of surface and underground run-off. Until recently in designing a HPP in a cascade mathematical models of transient processes considered only the volume of water masses. Water quality as well as peculiarities of hydrochemical and hydrobiological processes in conditions of a HPP cascade were not taken into account. However, this factor is of great importance to a number of waterconsumers, making certain demands to it. Water quality is to a great extent determined by the processes taking place in water ecological systems, which in their turn depend on structural features and operational conditions of water projects in a cascade. To optimize water resources utilization in conditions of a HPP cascade by an active control of ecological processes in water reservoire the authors suggest considering in models of hydraulic processes a number of factors, characterising the state of water ecological systems.

The paper discusses the possibility of taking into account such ecological factors as reservoir drawdown, water temperature, content of dissolved gases, eutrophiration effect etc. in models of hydraulic processes in HPP cascades.

Keywords: HPP cascades, ecological factors, water quality, reservoirs, drawdown, water temperature, content of dissolved gases, eutrophication effect, hydraulic processes, rivers basin, antropogenic factors, ecological prognostication.

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SOCIO-ECONOMIC PROFILE OF THE GANDAK IRRIGATION PROJECT AND ITS COMMAND AREA IN BIHAR, INDIA

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ABSTRACT

The study of some selected areas in the Gandak Command Area, Bihar of Eastern India, conducted in 1982-83, has highlighted different aspects of agro-economic and social conditions of the people in that region. The sample area comprised 10,083 hectares in 19 villages of East and West Champaran districts. There were 47,063 persons in 3702 households in the study area. Density of population was 4.7 persons per hectare. Average size of household was 8 persons, 14.74 % population was literate and the working population accounted for 34 %. More than 90 % of the working population was engaged in agricultural occupation. As a result of canal irrigation the utilisation of irrigation potential is low, but it has shown an increasing trend. Intensity of irrigation and cropping has increased, but maximum intensity was among marginal farmers going a big way for double and multiple cropping. Family income has increased by 20 % and saving went up to 15 to 30 %. However, big farmers were more benefited than marginal. The percentage of households under debt has declined. Traders and private agencies have come to be more popular than banks. Participation in co-operative societies remained mostly with big and medium farmers. It has been further observed that the impact of irrigation is not very significant on the living conditions of the cultivators. Practically no discernible change was noticed in facilities for education, health, drinking water, communication and other extensive services to the farmers consequent upon the introduction of irrigation.

Keywords : Agro-economic conditions, social changes, canal irrigation, irrigation potential, marginal, big and medium farmers, education, drinking water, health, communication, co-operative society.

SELF-HELP GROUPS AND NON-GOVERNMENT ORGANISATIONS IN RURAL WATER SUPPLY IMPROVEMENTS

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ABSTRACT

The range of water resource developments put forward for implementation is probably wider in the 1980s than ever before. The major projects for hydro-power irrigation still attract high priority and huge resources, but through the United Nations and within national governments there is a new emphasis on improving water supply and sanitation in rural areas. It is not true, however, that the need for many small projects is much easier to handle than the complexities of the few large projects. This paper will discuss briefly certain features of these small projects and the possible roles of self-help groups and non-government organisations (NGOs) in helping their implementation.

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ASSESSMENT AND FORECAST OF IRRIGATION WATER NEEDS IN RIO AVE BASIN AIMING WATER RESOURCES PLANNING

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SUMMARY

The Rio Ave Basin is located in the Northwest of Portugal. Both agriculture and industry are well developed in the area. Agriculture has traditional importance coming from ancient irrigated lands. Industrial development during the last decades deeply changed the sociological and environmental characteristics of rural areas meanwhile urban areas are continuously growing. In consequence there is a strong need of solving problems of competition for water resources as well as water quality improvement. Despite the importance of industrialization and urban development, agricultural water consumption remains the most important. So it was necessary to develop methodologies adequate to the evaluation of present irrigation consumptions and needs, as well as to forecast its evolution in the forthcoming years. The model built for water uses assessment is based on relevant meteorological data (evapotranspiration), cropping systems, soil characteristics, crop yields, irrigation systems, irrigation efficiencies. The model for water needs forecast uses the same regional and agricultural variables and introduces the effects of changes in agricultural and irrigation technologies according to different scenarios for agricultural development. Results show good adherence to reality and can be explored on both perspectives of water resources planning and of irrigation and agricultural development.

Keywords: Irrigation water needs, water uses assessment, water needs forecast, soil water balance, irrigation development, water resources planning.

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THE DEVELOPMENT OF WATER RESOURCES THROUGH FRESHENING RESERVOIR AT POLLUTED SALINE WATER REGION

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ABSTRACT

Topographically the standard method which constructs dam in mountain area and long canal system in plain is especially too expensive to get water resources for delta region in present. The freshening reservoir method is some time very effective one which can develop the low cost rural water resources without the disturbance of water use right occupied already by the people in the region of upstream area. But the problem which should be solved integratedly in planning becomes more difficult than standard method.

The special important items to be solved at polluted saline water region are;

1) freshening reservoir should satisfy the balance of water quantity not only for water utilization but also for desalinization release.
2) freshening reservoir should control salinity concentration to the limitation of paddy rice, upland crops and drinking use.
3) freshening reservoir should control the water quality which is one important factor of environmental problems through the improvement of hydraulic structure of reservoir and the cutting of pollutant matter from basin.

The Nakawmi freshening reservoir project which lies in Shimane prefecture Japan, has very serious situation and the counter measures could be adopted here systematically through the reasonable research works and the improvement of hydraulic structure.

The development of saline water region would be very important as a rural area water resources in 21 countries.

Keywords :
freshening reservoir
rural water resources
water quality
turbulent density flow

ADDING AN ENVIRONMENTAL DIMENSION TO COMPREHENSIVE WATER RESOURCES MANAGEMENT IN DEVELOPING COUNTRIES

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ABSTRACT

Following United States experience, developing countries have begun to incorporate natural systems and environmental assessment and valuation techniques in their water resources planning activities.

As a contribution to development of such techniques, an overall framework for natural system assessment and valuation is presented using diagrams of causal and analytical sequences of assessment and the water resources planning process. A more detailed analytical approach to assessment and valuation is shown, starting with a depiction of human activities affecting the natural system, and continuing with quantification of specific natural systems effects using appropriate models. Finally, the problem of economic valuation of natural systems effects and impacts on humans is discussed in the context of evolving techniques of valuation.

ENVIRONMENTAL IMPACT OF ANTI-POLLUTION MEASURES ON AN UNPROTECTED CATCHMENT

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ABSTRACT

In conventional water resources development, catchment areas are usually situated in uninhabited locations where pollution levels are low as a consequence of which raw water quality is of a high order. With the advent of development, particularly in rural catchment areas that are being encroached upon by urbanization, the competing demands for land-use makes this "protected" catchment concept a luxury that man can ill afford. This situation arose in Singapore in 1973 when the Kranji-Pandan Scheme took shape. The water quality in the impounding reservoirs was of a relatively lower order because the runoff was from an unprotected catchment. A vast field pollution survey was carried out and the sources of pollution pin pointed besides which the contributing streams were also monitored. Based on the findings of the survey, massive anti-pollution measures were taken by restructuring the farming sector and improving human waste treatment systems. The runoff and reservoir water quality were monitored throughout and the progressive improvement was remarkable. In this paper, organic levels (represented by BOD and COD) and nutrient contents (represented by PO_4 and Total N) are analysed over a period of time. This study exemplifies the methodology of systematicaly isolating sources of pollution, taking necessary action and proving the efficacy of anti-pollution measures by means of a proper water quality monitoring programme.

Keywords: Water resources development, protected and controlled catchments, field pollution survey, water quality monitoring, organic and nutrient parameters, anti-pollution measures.

PLANNING MODEL FOR THE OPERATION OF A MULTIRESERVOIR SYSTEM

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ABSTRACT

This paper presents a methodology to obtain optimal reservoir operation policies for a large-scale reservoir system. The model yields medium-term (one-year ahead) optimal release policies that allow the planning of activities within the current water year, with the possibility of updating preplanned activities to account for uncertain events that affect the state of the system. The solution method is a sequential dynamic decomposition algorithm that keeps computational requirements and dimensionality problems at low levels. The model maximizes the system annual energy generation. The adequate fulfillment of other system functions is guaranteed via constraints on storages and releases. River flows are characterized as a multivariate autoregressive process and are forecasted using maximum likelihood estimators. The model is applied to a large-scale multireservoir system, the northern portion of the California Central Valley Project. The optimal release policies show a potential increase in the system total annual energy output with respect to heuristic schedules currently in use.

Keywords: Reservoir operation, multipurpose reservoirs, release policy, energy generation, streamflow forecasting, optimization model, sequential optimization, linear programming.

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GESTION INTEGREE DU COMPLEXE DES BARRAGES DE L'EAU D'HEURE. ETABLISSEMENT DU GRAPHIQUE DES CAPACITES OPTIMALES SUR BASE DE LA PERIODE 1969-1980

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RESUME

Le complexe des barrages de l'Eau d'Heure, mis en service en 1978, a comme principal objectif de soutenir le débit d'étiage de la Sambre.

En outre ce complexe doit remplir deux autres objectifs : la production d'électricité et le développement d'activités touristiques, objectifs qui doivent se conjuguer le mieux possible avec le premier.

En se basant sur la méthode consistant à simuler le fonctionnement du système pendant une période la plus longue possible (1969-1980) tout en y intégrant des mesures hydrologiques et météorologiques les plus récentes possible, le Service des Barrages a déterminé l'utilisation optimale de ce complexe des barrages.

Dans un premier temps, est déterminée la courbe enveloppe des capacités utiles nécessaires pour assurer un soutien d'étiage de la Sambre au débit minimum garanti de 4,5 m3/sec. (voir annexe n° 1).
Il en résulte la constatation que ce débit est le minimum que les barrages de l'Eau d'Heure peuvent garantir en cas de retour d'une période semblable à celle de 1969-1980.

Dans un second temps, en faisant la distinction entre la contenance totale des deux lacs (Eau d'Heure + Plate Taille) et leur contenance utile c'est-à-dire le volume qui peut être effectivement utilisé pour le soutien d'étiage, est déterminée un second graphique celui des capacités optimales (voir annexe n° 1).

Il en résulte qu'une série de consignes peut être prescrite à l'usage du responsable de la gestion de ce complexe, consignes qui tiennent naturellement compte des trois objectifs assignés à ce complexe.

ASSESSMENT OF YIELD OF BASINS WITH SCANTY DATA - CASE STUDY

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ABSTRACT

For planning water resources development projects in a basin, a long series of stream flow data is essential. However, the streamflow data series in most river basins is either nil or short if available. Since projects on potential basins cannot wait for data to be collected, recourse is taken to generate synthesized data series. For this purpose models categorized under explicit moisture accounting type or the implicit moisture accounting type could be adopted depending on the availability of the input data for model calibration, validation and generation of data.

An attempt is made in the paper to present the detailed studies conducted for estimating yield at Dhom and at Kanher, the mouths of the watersheds Krishna and Venna in the upper catchment of the Krishna basin in India. The Kentucky Watershed Model and the Tank Model were calibrated for three years for which concurrent data of the precipitation, streamflow and evaporation were available. The calibrated models were used for generating streamflow data, at the two sites, based on the recorded precipitation for a period of 14 years. With this limited data, a 75% dependable yield was computed.

CHOOSING THE APPROPRIATE FORECASTING TECHNIQUE

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ABSTRACT

The potential savings from precision to estimating future urban water use are obvious. And, because of the need to predict the effectiveness of potential water conservation measures, new and more responsive approaches of disaggregated demand forecasts are mandatory.

The purpose of this study is to assess current water use forecasting practice in the U.S. Army Corps of Engineers and to recommend those additional approaches which best satisfy current requirements. To accomplish these objectives, this report presents the findings of a three-prong investigation: (1) identification of current needs for improved forecasting approaches in light of the current requirements; (2) review and assessment of current forecasting approaches; and (3) recommendation of the most appropriate forecasting approaches which meet the identified needs and satisfy current requirements. Data were obtained from personal interviews with field planners in 6 districts and 3 divisions, from a questionnaire to 35 districts and 11 divisions, and from the analysis of 27 Corps studies that had forecasted demand.

THE COLLECTIVE PROVISION POTABLE WATER TO RURAL AREAS : ORGANIZATION, OPERATING COST AND DEMAND EVIDENCE FROM A MAJOR U.S. CORNBELT STATE, U.S.A.

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ABSTRACT

Substantial capital has been provided by the U.S. federal government to constuct water supply systems in the open countryside and small communities of rural America. Authorized in 1937, the capital subsidy programs initially focused on the western arid regions of the nation. Subsequent changes expanded the program to all rural regions of the U.S. This paper reports a study of the U.S. government financed rural water systems meeting the domestic water demands of farm and nonfarm residents in Illinois, a major cornbelt state in the U.S. midwest, a region not traditionally viewed as having major water problems. The study focuses on the 59 systems that do not service any towns or villages and whose customers are farmers and other residents of the open farm country. Reported are analyses of the system's operating status, and costs. Rural water service demand is analyzed using rural water system customer data and a pooled time series, cross-sectional econometric model. Theoretical consideration is given to the implications of demand analysis of goods, like water, priced using declining block rate schedules. Own price and income elasticities for rural water services are reported. These elasticities are useful in managing water supplies, the quantity of water demanded and water system revenues. Management policies and fiscal soundness have become more important in the 1980's as U.S. federal government policies under the Reagan Administration have reduced the availability of subsidized capital.

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PUBLIC WATER MANAGEMENT INITIATIVES: THREE CASE STUDIES

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ABSTRACT

Water problems and the institutions that manage water are complex. Water issues must be understood within a complex framework of social, political, legal and economic constraints which affect all levels of government and the private sector. Yet it is increasingly clear that water problems must be solved through more effective management and use of the organizations that citizens, bureaucrats, politicians, and business people have designed and will continue to create.

Structural and technical approaches cannot solve these problems.

Change must occur in the way water resources are organized, governed and managed. If the structure exists from the "top down" necessary to effect that change, it is either ineffective or inoperative.

The growing public concern for water issues is supportive of grass-roots efforts to develop coalitions that cross bureaucratic, political and geographic boundaries.

Three such new coalitions have developed in the United States over the past two years.

THE ENVIRONMENTAL HEALTH NETWORK: A NEW TOOL FOR PROTECTING PUBLIC HEALTH

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ABSTRACT

Rural and urban health professionals do not necessarily have access to information or an understanding of the complex contaminants which are accumulating in the environment and how these substances mix with other factors such as nutrition, lifestyle and occupation, to increase the possibility of cancer or other environmentally-related illnesses and diseases. A medical doctor or an occupational health nurse may not know that some of the cases of stomach disorders they are treating are sentinel cases of well-water contamination or pesticide usage, unless they are aware of the side effects of such chemicals.

There is an institutional gap between medical/scientific research and those agencies and organizations charged with monitoring, regulation and protection of public health. Research, by its very nature, is a slow process undertaken by specialists in a narrow field of study. They do not report their findings until all evidence is conclusive. When they do comment, it is within highly specialized, technical journals which serve their particular area of study, but are not necessarily reviewed by health professionals and policy-makers.

There is a time lag of a year or more before public health professionals learn of the risk, diagnosis, implications and treatment of new environmental contaminants.

In an effort to address this institutional and time gap, the Freshwater Foundation has established a state prototype for a National Environmental Health Network.

THE REGIONALIZATION AND MANAGEMENT OF WATER RESOURCES IN PORTUGAL ITS IMPLICATIONS IN THE PROVISION OF WATER AND IN THE REJECTION OF INFLUENTS IN RURAL COMMUNITIES

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ABSTRACT

Demographic social and economic characterization of the country and its historical perspective. Socio-political alterations which occurred in the last decade, namely in the regionalization field and its consequences for the management of water resources.
Presentation of a few examples more representative on the multidisciplinary approach and intersectorial problems of water at regional level.
The contribution of the activity carried out by the Portuguese Water Resources Association for the change occurred on management policy of water resources in Portugal.

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CONJUNCTIVE USE OF SURFACE AND GROUNDWATER FOR PLANNED UTILIZATION OF WATER RESOURCES - A CASE STUDY OF PUNJAB STATE, INDIA

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SUMMARY

Conjunctive use of surface and groundwater is an important tool which must be considered while planning use of water resources. Keeping in view the above concept, eight groundwater zones have been identified on the basis of geological features, chemical quality of groundwater, piezometric conditions, hydrological boundries and water balance for planned utilization of water resources in the Punjab State. Zone I comprises Siwalik deposits of Middle Miocene to Upper Pliocene age. Zone II comprises areas of piedmont deposits of coarse bouldery and unassorted sediments with poor yields, where deep tubewells are more successful than shallow tubewells. Check dams of smaller dimensions can be constructed over the recharge area for control of floods and for making artificial recharge to groundwater. Zone III is characterized by aquifers with moderate to high yields while Zone IV includes areas which require cautious approach for groundwater development. Zone V is characterized by high water table along riverain tracts and can be exploited for transfering groundwater to saline areas using surface canal system for the benefit of rural people. Quality of groundwater is better in deeper aquifers in Zone VI. Groundwater is either marginally fit or unfit for irrigation purposes in zones VII and VIII respectively. Fresh water lenses should be exploited with caution in these zones. Conjunctive use of surface and groundwater is recommended for these zones for planned utilization of water resources.

Keywords : Piedmont deposits, artificial recharge, checkdams, recharge area.

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L'INTEGRATION DES USAGES CONFLICTUELS DU PROJET A BUTS MULTIPLES: ARCHIPEL DE MONTREAL

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RESUME

L'Archipel de Montréal fait l'objet d'une étude dans le but de proposer un plan d'aménagement cohérent qui vise à améliorer globalement la satisfaction que retire la population montréalaise de ses rapports avec les eaux. L'aménagement vise à accroître les potentiels des eaux et des rives afin d'en rendre disponibles toutes les richesses et en atténuer les inconvénients. Les objectifs de base sont formulés et leur programme de gestion renferme des aspects conflictuels dont la résolution nécessite un raffinement de ces objectifs et de redéfinition des procédures de contrôle et de régulation. Ceci est réalisé par la mise au point d'un programme d'équipement intégré et d'un plan de gestion hydraulique permettant de moduler au besoin la répartition des débits et des niveaux dans le temps et dans l'espace du système hydrique.

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GRAVITY DRAINAGE OF A STRATIFIED PROFILE

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SUMMARY

The Green and Ampt approach has been developed for the falling water table case following an initial sudden drop in the position of the water table. The analysis presents an approximate solution for one dimensional flow in saturated porous media. The formulation is based on the calculation the position of draining front with time and the cumulative outflow-time relationship for stratified profile. The Green and Ampt result are checked by using data obtained from a well proven computer-based numerical solution for unsaturated flow equation involving an implicit finite difference approach.

A DIGITAL MODEL FOR AQUIFER RESPONSE TO NATURAL RECHARGE

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ABSTRACT

The physically-based integrated models both of two- or three-dimensional finite difference and finite element techniques have been plagued with high computer cost and complex data handling for the analysis of a regional groundwater flow system. In the present study the flow system is separated into the unsaturated zone's one-dimensional infiltration model for simulating the recharge and the saturated zone's nonlinear Boussinesq equation to incorporate the response of watertable aquifer to the recharge. Results of the estimated annual Darcy's flux at various depths of the 12 m soil-column are used as the input recharge to the saturated zone along the length of the aquifer. This simplified model is solved using the implicit finite difference scheme based on the Dupuit-Forchheimer assumptions. It successfully handled the slow response of watertable to natural recharge and a good approximation of outflow discharge was compared to the integrated model of Oak Ridge National Laboratory, USA. The model, thus, would be a promising tool for predicting a long term discharge into the stream channel particularly for a less complex regional groundwater system.

THE LEARNING IMPLICATIONS OF TECHNOLOGY TRANSFER IN THE WATER SECTOR

AN ANALYSIS OF THE PROBLEM AND SOME PRACTICAL RECOMMENDATIONS FOR ACTION

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ABSTRACT

This paper applies to the rural water sector in the developing countries of the World some basic ideas about the learning implications of technology transfer which were first put together by one of the authors in a paper presented at the 12th Annual Conference of the International Federation of Training and Development Organisations held in Amsterdam from 15th - 19th August 1983.
The general conclusions recorded there had been reached in the light of the practical experience of the writers and their colleagues working as training consultants based in Britain but carrying out their assignments in both developed and developing countries throughout the world. (see Section 2 below). Their application in this paper to the rural water sector is based on direct practical experience obtained by the authors in looking at the manpower problems of the water industry in countries as diverse as Barbados, Nigeria, Nepals and Southern India and by other colleagues who have carried out similar assignments in Peru, Ecuador, Tanzania, Sri Lanka and Indonesia.
This overseas experience was itself developed as a result of the ITS being invited in the 1960s to carry out a number of consultancy and teaching assignments in the British Water Industry, ranging from the design of a comprehensive training scheme for water operatives in a large municipal water undertaking to work on general courses for instructors and training officers in the industry. Clients during this period included the British Waterworks Association and the Water Supply Industry Training Board.

The ITS is not itself engaged directly in the Water Industry but all its assignments ranging from large urban water schemes in the North of England to rural water provision to small villages in South Asia have involved analysing the manpower and training needs of the industry by means of concepts and methods developed and refined elsewhere. This has been a particularly fruitful approach.

OPTIMAL MANAGEMENT OF LARGE AQUIFERS FOR IRRIGATION ACTIVITIES

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ABSTRACT

Optimal management of large aquifers used for water supply and irrigation is investigated using unit response functions and an iterative linear programming procedure. The procedure has been applied to a hypothetical aquifer with 150 pumpage unknowns.

Results of the procedure are compared with a global optimization approach to the same problem. Comparison of the two solutions indicates that almost identical solutions can be obtained by the iterative procedure. The iterative procedure, which decomposes the aquifer into several zones, allows the solution of a large number of unknowns at computational demands below that of the global optimum solution.

Keywords: Optimal management, large aquifers, linear systems theory, linear programming, iterative linear programming.

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INTEGRATED WATER RESOURCE MANAGEMENT IN AN ARID REGION - CASE STUDY OF THE SOUTHERN ARAVA

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SUMMARY

The Region: Area of 300 sq.km. in southern Israel; hot arid climate - maximum temperatures above 40°C in summer months; annual rainfall 25 mm. Population 21,000 - 90% in town of Eilat. Remainder in small settlements based on agriculture. Development of hinterland vital to isolated port and tourist centre. Water the key to human settlement in this desert region.

Water Use: At present 15 MCM, planned to reach 40 MCM by end of century.

Sources of Water: Annual potential supply of groundwater - 40 MCM, including controlled exploitation of reserves. Variable quality - 80% with chloride concentrations of over 400 ppm, 30% over 1000 ppm. Additional sources - reclaimed municipal sewage, desalinated water (brackish and seawater), storm water catchment.

Efficient Management of water supply in the region poses new problems to which existing legal and administrative system developed to deal with a water supply of standard quality, does not provide adequate solutions.

Licensing: Norms for water allocation to agriculture based on standard quality water are not appropriate where available supply is divided into a number of quality categories.

Optimisation requires adaption of quality to uses and creates complex problems of equity in allocation among users.

Prices and Subsidies: The Adjustment Fund, the basic tool for price and subsidy management, does not deal with brackish water, reclaimed sewage or desalinated water. The centrally operated pricing system which goes hand in hand with central planning and development of all aspects of settlement, requires redesign to take account of waters of widely differing qualities and ranges of permissible uses.

Consumer participation in decision-making and management: The complex of quantity-quality and price-subsidy relationships coupled with the sensitivity of agricultural planning and farm management to water quality, make active participation of consumers in both long-term planning and day-to-day operating decisions almost mandatory for achievement of equitable and efficient water supply. Appropriate institutions must be developed to allow for such participation without generating unproductive conflicts among consumer groups or between consumers and suppliers or government.

Relevance: The region presents in microcosm many of the problems coming onto the agenda of national water management with the absorption of "marginal" waters into the general supply system. Clarification of the problems and testing of solutions will be relevant beyond the region itself.

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THE MANAGEMENT OF WATER SERVICES IN ENGLAND AND WALES WITH SPECIAL REFERENCE TO METHODS OF MEETING DEMANDS

THE CASE FOR AND AGAINST THE PROMOTION OF A NEW MAJOR RESOURCE SCHEME : THE ARGUMENTS FOR CONSERVATION AND ECONOMY OF WATER

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ABSTRACT

This paper examines the re-organisation which has occurred in the Water Industry in England and Wales within the past decade. The several and differing types of Authorities which existed before 1974 are described. Factors which persuaded successive Governments to consider fundamental changes are discussed. These include the effects of drought and flood, increasing demands for water, pollution prevention and water quality, conflicts of interest and the need for the control of broad policy at National level.

The paper explains, in the context of reform of the industry, the objectives of water re-organisation and the Regional Water Authorities charged with the preparation and administration of a comprehensive water resource development and management plan.

The advantages of the new structure are demonstrated by example: the former and new procedures for the assessment, definition and achievement of new major water storage resources are contrasted. The strict legal procedures and the criteria to be satisfied in reservoir promotion are reviewed and the implications of environmental and other factors are discussed. Various other methods of meeting demand are tested: these include conjunctive use, artificial recharge, desalination, the implications of metering and water leakage detection and control.

The paper touches on the relationships in these contexts between the Regional Water Authorities, the national Water Authorities Association and Government Departments, and the work of Water Authorities generally.

WATER FOR RURAL AREAS AND THEIR COMMUNITIES - LESSONS FROM INDIAN EXPERIENCE

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ABSTRACT

Water resources development in India has been given the highest importance for modernizing agriculture and providing basic needs of the rural communities, but the achievements have not been satisfactory. Projects take long time in completion, development of irrigation is protracted and yields continue to be low resulting in poor returns from investments and poor realization of developmental objectives.

With the ambitious targets for the future, it is imperative that modernization of technological planning is undertaken, necessitating focus on developmental process, planning of technology in that context, and institutional-organizational modernization. Instead of the current narrow technological - economic adhoc project oriented approach, a long term systems approach is required. The central issue is planning to produce a condition for cumulative growth process. Planning should be considered as a process having energy focussing and structuralizing effect. Detailed planning and design in technological and institutional-organizational terms follows, with time being of crucial importance.

Keywords: Water resources development policy, technology policy, rural development policy.

PROBLEMS IN ESTUARINE MANAGEMENT - SOUTH WEST COAST OF INDIA

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ABSTRACT

The short and steep rivers of the South West Coast of India drain to the estuarine systems which face severe salinity intrusion and pollution problems during summer months. Most of the thickly populated areas in the coastal belt depend on the water supply schemes situated in the lower reaches of the rivers. Agriculturists in the lowland also use river water for irrigating paddy. Because of new water conservation and development schemes upstream, fresh water flow to the tidal streams has considerably decreased, causing problems to proper flushing of the estuaries. From the studies carried out in the Beypore estuary near Calicut, it is found that the salinity propagates to a distance of about 24 km from the mouth of the estuary and that the tidal flushing is not effective, resulting in severe pollution problems. The studies have been useful in understanding the dynamics of the estuary with special reference to salinity intrusion, pollution dispersion and tidal flushing. The results are expected to help in future planning and proper management of similar water bodies in the region.

Keywords: Estuarine dynamics, tidal flushing, salinity intrusion, pollution dispersion, estuarine pollution.

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UTILISATION COMBINEE DES EAUX SOUTERRAINS ET DES EAUX DE SURFACE

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RESUME

En Iran, dont la superficie est de l'ordre de 1 648 000 Km², règne une condition climatique défavorable. La précipitation moyenne annuelle est d'environ 224/5 mm. C'est seulement le parti du nord du pays qui est doté par la nature de pluie relativement importante et régulière (avec une précipitation moyenne annuelle d'environ 437 mm). L'irrigation et l'alimentation en eau sont donc les utilisations les plus importantes, et pour satisfaire aux besoins en eau, les iraniens utilisent simultanement des eaux souterraines et des eaux de surface.

Dans le passé l'exploitation des eaux souterraines se faisait par la construction des Qanats, c'est-à-dire par la construction des galeries d'exploitation des eaux souterraines. L'utilisation des eaux de surface se faisait aussi parallelement presque dans tout le pays. Depuis longtemps l'idée de faire des grand ponts nécessaires aux communications, des "ponts-barrages à vannes mobiles" permettant l'irrigation des vastes plaines, en aval de ces ponts, existait en Iran. Un très bel exemplaire de ces "ponts-barrages à vannes mobiles" iraniens est le célèbre "pont Khadjou" d'ispahan datan du milieu du XVIIe siècle. Ainsi la construction des barrages-poids et des barrages-voûte permettant la régularisation des rivières a été faite par les architectures iraniens.

Aujourd'hui, les iraniens, comme leurs prédécesseurs, ont choisi la méthode d'utilisation combinée des eaux souterraines et des eaux de surface afin d'optimiser des ressources en eau.

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WHOLESOME QUALITY OF DRINKING WATER RESOURCES WITH SPECIAL REFERENCES TO THE EXISTING PUBLIC WATER SUPPLY SYSTEMS IN THE STATE OF BIHAR, EASTERN INDIA

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ABSTRACT

The State of Bihar in the eastern part of India has an area of 1,73,877 sq.km. and a population of 69.9 million with density of 402/ sq. km. The state may be broadly divided into two parts. The northern plain and the southern plateau area, constituting 67,546 villages and 220 towns. Out of these,hardly 2% villages and 138 towns have pipe water supply facilities.

The study extended over a period of five years(1978–1983) reveals that 86.4% of samples drawn from underground water resources of the entire north Bihar region(area 54,000 sq.km.)exceed the maximum permissible limit of iron (0.3 ppm) content for human consumption. Some places in south Bihar show serious underground and surface water pollution,owing to the indiscriminate discharge of industrial and municipal effluents. The shallow hand pump and dug wells water samples around mica mining field at Koderma indicate higher concent of fluoride (max. 2.8 ppm) and exceed the upper limit of (1.0–1.5 ppm) of the same for human consumption.

The chemically wholesome waters have been indicated to be bacteriologically highly contaminated ranging from 25.0 to 66.66 % at nine different big towns of the state at the consumers tap points and therefore are hazardous for public health.

Key words : Effluent, Wholesome,Tap point and Hazardous.

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DEVELOPPEMENTS RECENTS DES TECHNIQUES DE TRACEURS APPLIQUEES AUX PROBLEMES DE RESSOURCES EN EAU

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R E S U M E

Les problèmes de ressources en eau, qu'il s'agisse d'hydrologie, d'hydrogéologie ou de génie chimique, se rapportent généralement à la connaissance des transferts de masse (d'eau ou de substances polluantes). Les méthodes de traceurs et les différentes applications présentées dans cette communication ont essentiellement un but pratique et ont contribué à la solution de nombreux problèmes. De par leur extrême spécificité ces méthodes offrent des moyens d'investigations souvent sans équivalent mais, étant affaire de spécialistes qui ne consacrent probablement pas assez de moyens à les promouvoir ; leurs performances et leurs domaines d'applications restent encore mal connus de la plupart des responsables confrontés aux multiples problèmes de ressources en eau.

La méthodologie générale des traceurs et les exemples d'applications présentés dans ce mémoire ont pour objectif de pallier à cette situation.

Descripteurs : Traceurs, hydrologie, hydrogéologie, caractéristiques hydrodynamiques, transfert de polluants, autoépuration, relations fleuve-nappe, calage de modèles, génie civil, recherche de fuites, débit d'infiltration.

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PROPOSITION D'EXPLOITATION ET DE GESTION DES AQUIFERES POUR LES BESOINS EN EAU DE LA REGION DE BISSAU

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RESUME

Dans le grand BISSAU, 18 forages exploitent à ce jour la nappe du Maestrichtien et peuvent satisfaire les besoins en eau jusqu'à l'horizon 2000. Etant donné le caractère concentré des forages, leur exploitation risque d'entraîner à terme la perte de l'aquifère par intrusion des eaux salées.

Il est proposé une exploitation de plusieurs aquifères récoltant les eaux sur un front de nappe suffisant, afin de les sauvegarder de toute pollution.

Les différents aquifères potentiels sont décrits et leurs caractéristiques essentielles sont mentionnées.

Pour les trois aquifères majeurs, le bilan à partir des données disponibles est établi. L'infiltration et les ressources sont évaluées.

Un modèle de simulation mathématique est proposé.

SCHEMA D'EXPLOITATION POUR L'ALIMENTATION EN EAU DE LA REGION DE DJIBOUTI

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RESUME

A partir des données disponibles, on établit au mieux les potentialités aquifères de la région de DJIBOUTI. A cette fin, on se réfère largement aux données établies par la mission de la coopération hydrogéologique allemande (CHA). En fonction de l'évaluation des besoins, une stratégie d'exploitation des aquifères est établie. Celle-ci est dominée par les cycles hydrologiques secs propres au SAHEL et par la prévention contre la pollution de l'aquifère par les eaux océaniques. Une meilleure définition des aquifères et des termes du bilan hydrogéologique est préconisée ainsi que la gestion des aquifères par modèle mathématique.

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ANALYSIS OF REGIONAL WATER POLICIES IN OPEN-PIT LIGNITE MINING AREAS

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ABSTRACT

There is an apparent need for the analysis of long-term regional water policies to reconcile conflicting interests in regions with open-pit lignite mining. The most important interest groups in such regions are mining, municipal and industrial water supply, agriculture as well as the "environment". A scientifically sound and practically simple policy-oriented system of methods and computerized procedures has to be developed.

To develop such a system is part of the research work in the Regional Water Policies project carried out at the International Institute for Applied Systems Analysis (IIASA) in collaboration with research institutes in the German Democratic Republic and in other countries as well. A test area that includes typical water-related elements of mining regions and significant conflicts and interest groups has been chosen.

The first stage in the analysis is oriented towards developing a scenario generating system as a tool to choose "good" policies from the regional point of view. Therefore a policy-oriented interactive decision support model system is under development, considering the dynamic, nonlinear and uncertain systems behaviour. It combines a model for multi-objective analysis in planning periods with a simulation model for monthly systems behaviour. The used submodels for environmental and socio-economic subsystems are simple enough for there integration in a complex model system, but reflect the reality sufficiently accurately for policy making.

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THE CHEMICAL CHARACTERISTICS OF GROUNDWATERS IN THE NIGER DELTA, NIGERIA

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ABSTRACT

Chemical analyses of 26 water samples from the Niger Delta gave concentrations that reflect the influence of lithology and hydrology. Piper diamond plots of the data show that the sodium bicarbonate facies are typical of the shallow sedimentary sequences. Mg-Chloride hydrochemical facies dominate the coastal Delta while the Sodium Chloride type is typical of deeper formations. Aerosol input, infiltration and salt-water intrusion significantly influence the chemical composition of the groundwater in the region. This data base is a first step in exploring and monitoring agricultural and industrial related pollution.

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OPERATIONAL TECHNOLOGY FOR HYDROLOGY AND WATER RESOURCES DEVELOPMENT AND MANAGEMENT

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ABSTRACT

The WMO Hydrological Operational Multipurpose Subprogramme (HOMS) provides a systematic institutional framework for the transfer of proven operational technology in hydrology and in water-resource development and management. The technology available in HOMS is presented and transferred in the form of components. Each component is complete on its own for some particular use.

This paper describes HOMS in general and demonstrates in particular how the components and sequences available in HOMS can be used to meet the need for hydrological information such as the requirements of water-resource assessment and hydrological forecasting.

AN EVALUATION OF VARIABLES GOVERNING SOIL LOSS AND ITS IMPACT ON WATER DEVELOPMENT PROJECTS IN THE TANA BASIN IN KENYA

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SUMMARY

Sediment and water quality monitoring investigations in parts of the Upper Tana Catchment have indicated that the main factor governing rates of soil loss under given conditions is land use. Hillslope plot experiments, the universal soil loss experiments and sediment monitoring at the outlet of subcatchments in the basin indicate that sediment production increases steadily from about 20t/km^2/Yr in the undisturbed forest areas, 400t/km^2/Yr in the less steep cultivated slopes and grazed areas attaining maximum values of 4000t/km^2/Yr in the steep cultivated slopes. Soil loss increas with areas covered by Tea, Coffee, Maize attaining high values in areas under vegetables. 5-20 per cent of sediment is produced from rural roads and settlement sites. The soil loss affects not only the land in terms of lowering the producivity, pollutes the water and has given rise to rapid siltation of the reservoirs constructed in the basin as well as irrigation canals. This poses a challenge to the development of multipurpose reservoirs for enhancing the limited water available to serve the 18 million Kenyans.

POSTGRADUATE TRAINING OF ENGINEERS FOR WATER SUPPLY AND SANITATION SECTOR IN DEVELOPING COUNTRIES

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SUMMARY

Tampere University of Technology (TUT) has arranged M.Sc. courses in water supply and sanitation specially applied to the conditions of developing countries. The courses have been financed by the Finnish International Development Agency (FINNIDA). The first course of this kind took place in 1972-74 and the present course 1984-86 is the fourth one. The first part of the course (12 months) is run at TUT and the thesis period (6...7 months) normally takes place in each participant's home country. There are altogether 18 students from Ethiopia, Kenya, Tanzania and Zambia attending the present course. Because of practical arrangements for the supervision during the thesis period it has so far been possible to offer this course only to the above-mentioned countries. The course covers comprehensively the area of water supply, water resources engineering and sanitary engineering and it also includes subjects like engineering geology, soil mechanics, economics, management and leadership. Previous experiences have shown that the programme which covers the sector extensively instead of a narrow specialized programme is appropriate for the participant's future career. In spite of practical difficulties, we believe that it is beneficial to run the thesis period at least partly in each participant's home country thus giving a better contribution to the countries themselves. Cooperation with the universities and authorities in Ethiopia, Kenia, Tanzania and Zambia has been very fruitful.

Keywords: training, developing countries, water supply and sanitation

WATER HARVESTING IN A CANAL COMMAND AREA

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ABSTRACT

This study makes an attempt to assess the water supply and demand position of a Bhakra Canal irrigated Haryana Agricultural University Farm of 1000 ha cultivated area, situated in semi-arid region of Haryana State of India and having monsoonic rains concentrated over a period of three months only. It is facing a serious problem of rising brackish ground water table with a very fast rate of 1 meter per year. Within fifteen years of the introduction of the canal irrigation the mean water table has risen from 17 to within 3 meter depth. The analysis of canal water supply, rainfall and water requirement of the farm, based on existing cropping pattern, shows that the total water availability from canal and rains is in excess to the crop water requirement during July, August and September. At present there is no option but to apply excess irrigation to the farm, in the period. This leads to recharge of ground water and its rise. It has been proposed to harvest the excess water and to reuse it for presowing irrigation to crops like pulses and oilseeds or protective irrigation at critical stages of crops to increase production. The stored water may provide one irrigation of 10 cm to about 70 per cent of the total area. The expected increase in the yield of pulses or oilseeds with this practice is about 10 quintal per hectare. Thus, canal water harvesting can save the irrigated areas from a devastating problem of water table rise and can help in increasing crop production.

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THE FORECAST OF DROUGHT DISCHARGES OF THE RIVER MEUSE

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ABSTRACT

After an analysis of the drought characteristic discharges of the River Meuse upstream of Liège and a description of all the problems which could arise because of those deficiencies, we have mentioned that the solution of this problem is to build dams upstream of Liège, which could regulate the low flows by releasing the extra flow to maintain the necessary discharge.

As the water supply could take more than ten days to reach the town, the problem is to know how to forecast drought periods.

An analysis of low flows and precipitation records observed during 22 years showed that a regression equation between the discharge in drought period and the rainfall observations of the three preceeding months may be established with a rather good correlation coefficient.

The relation we have found by using a multiple linear regression equation allows us to forecast drought periods 2 or 3 weeks in advance.

Keywords : Drought discharges, River regulation, Flood control, Discharge forecasting.

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LAND USE OPPORTUNITIES FOR WASTEWATER RECYCLING ON LAND

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SUMMARY

Urban water use is characterized by primarily nonconsumptive use. Recycling urban wastewater by application to land can make the same water again available for urban or rural users. Land application occurs most often as a dual use on sites that double for some other use such as golfing or farming. Its implementation implies a unique connection between urban and rural land uses -- water use in the urban area, water recycling in a rural or open area.

Typical land uses in developing regions of the U.S. were investigated for their potential dual use as water recycling sites. Data about land use characteristics were combined with published data about operating requirements for land recycling technology. All land uses are composed of some combination of land covers: turf, forest, farmland, impermeable surfaces, etc. The structural and operational characteristics of turf and managed forest make them attractive land covers for wastewater renovation and recycling. The land covers are aggregated into functional land uses such as commercial, residential, recreation, industrial, etc. Within built-up areas, parks, airports, and highway interchanges have large blocks of turf or other open land which could be available for water recycling. Nearby rural lands -- managed farms and forests -- are available outside suburbs and small towns.

This type of evaluation of land uses can be used in examining land use patterns in a region for opportunities for land recycling. Dedicating unbuilt lands for dual use as land application sites during the urbanizing stages of regional development may assist in preserving desired open areas, at the same time that it extends the quantity and quality of a region's water resources.

Keywords: Recycling, land treatment, land application, land use, planning.

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ANALYSIS OF DEPENDENCE IN MONSOON PRECIPITATION EVENTS AND AMOUNTS OVER INDIA

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ABSTRACT

The monsoon rainfall process shows dependence on its past values upto the time scale of at least 5 days. This dependence should be taken into account in formulating improved rainfall climatology for the water resources assessment/management and in formulating rainfall (and/or runoff) forecasts needed for routine hydrological operations. In this paper the dependence in the daily rainfall point and areal process over India during the monsoon season is studied in detail. The daily rainfall data of 12 stations uniformly spread over India is used to analyse the dependence in the rainfall events and the daily rainfall averages of 10 meteorological subdivisions lying in Western and Central India are used to analyse the dependence in the rainfall amount process.

The dependence in rainfall occurrence is examined by using Bartlett's maximum likelihood principle and Akaike's information theoratic criterion (AIC) and Schwarz's Bayesian Criterion (SBC) as decision making criterion. In majority of cases third order model is found suitable by AIC and second order by SBC. The dependence in each type of event (rain/no rain) is also examined by considering the runs of dry and wet spell as alternative renewal process and fitting Markov chain models of 1, 2 and 3 order. This procedure also leads us to believe that a Markov chain model of order more than one is required to represent monsoon rain events.

Auto-regressive models of order 1 to 5 and autoregressive moving average model of order (1,1) are fitted to the daily rainfall series of 10 subdivisions by considering data of 19 years. Both Akaike's final prediction error and residual variance indicate that the higher order models do not contribute substantially to the explained variance of rainfall series over that explained by AR(1). The model is thus used to analyse the number of independent observations in the rainfall amount process.

DAILY DETERMINATION OF THE FLOOD CONTROL WATER LEVEL OF A RESERVOIR BY THE VARYING HYDROLOGIC STATISTICAL CHARACTERISTICS OF THE FLOOD

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ABSTRACT

Miyun Reservoir is the largest reservoir in the Northern China region with a total capacity of nearly forty-two hundred million cubic meters. This reservoir was designed for the multipurpose of flood control, irrigation, urban water supply, and electric power generation. Flood control operation of the reservoir used to be based on the design floods of various frequencies in the flood season, however, in the frequecy analysis, the annual maximum discharge and volume of runoff of various control period was taken as independent sample regardless of the specific times which they appear in the flood season. This amounts to that the frequency of the appearance of the design flood is regarded to be the same for the entire flood season. As a result, when this analysis was applied to the flood season operation of reservoir, the control level of the reservoir during the flood season was unneccessarily low for most of the time, and sometimes water was even forced to be abandoned.

In fact, the process of flow in the flood season is not a stationary stochastic process, the statistic characteristics vary sequentially during the flood season. In order to improve the flood season operation program of Miyun Reservoir, the variations of hydrologic statistical charcteristics of the flood season for the reservoir were analysed as the basis on which the design flood hydrograph of various frequencies were determined day by day during the flood season, and the flood control level of the reservoir may be obtained on a daily basis. Compared with the original program, although the proposed program gives a similar lowest control level, it gives a raising control level from the middle of the July on, and the reservoir allowable storage may be increased by a billion cubic meters by the Aug. 10. It may be the solution of the contradiction between the function at flood control and that of utility of the said reservoir.

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WATER POLICIES: REGIONS WITH INTENSE AGRICULTURE

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ABSTRACT

This paper outlines one of the studies being carried out by the "Regional Water Policies Project" at the International Institute for Applied Systems Analysis (IIASA). It considers agricultural regions where both groundwater and surface water systems are interacting elements of the environment. For experimental purposes, it is based on an agricultural region in the Netherlands and is conducted in close collaboration with institutes in the Netherlands and the USSR.

The activities of different water users in the considered region have started to interfere with each other to such an extent that if present trends continue, tnis could could have severe repercussions not only on nature areas but also on the regional economy.

The study is focused on the analysis of regional regulation policies providing for a satisfactory balance between agricultural development and the sustainable evolution of the environment in the long run. Methodologically, it is based on the use of a two-stage decomposition analytical approach, which includes scenario analysis and policy analysis that consider the behavioural aspects of the users more explicitly. As far as implementation is concerned, the study aims at elaborating systems of interlinked mathematical models of economic and environmental processes. Embedded in an interactive computer software, these systems are designed as a supplementary tool to be used by regional decision-makers in their analyses of possible directions of regional development.

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INEXPENSIVE RENEWABLE ENERGY SYSTEM FOR RURAL AREAS

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ABSTRACT

Energy requirements of rural area can be met by alternate energy sources in an integrated system. Water as a base for energy generation in integration with solar, biomass, animal waste sources is proposed to be adopted for rural development. Technology transfer to rural areas is today's need. An integrated system of alternate energy sources with the special reference of rural India is described in the present paper.

FEASIBILITY STUDY OF TRANSPORTATION OF FRESH WATER TO SAUDI ARABIA

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ABSTRACT

Due to limited supply of natural fresh water, desalination is accepted as the major source of non-conventional fresh water in the Kingdom to meet the growing national demand. It is expected to meet 18.3 percent (1.19 billion m^3) of the total water demand of the nation by the end of this century. The water production cost through desalination varies from \$1.54 to \$4.5 per m^3. However, transportation of fresh water using second hand oil tankers also offers another alternative of non-conventional source of water. The transportation cost decreases significantly using large size vessels for short distances. Three nearby sources of fresh water around Saudi Arabia are identified, e.g. River Indus in Pakistan, River Nile in Sudan and Egypt. Transportation costs are calculated using tankers shuttle service, in which case tankers are exclusively used for transportation of fresh water between loading and unloading ports. The average water transportation costs in above three cases, i.e., Karachi to Dammam, Port Sudan to Jeddah, and Suez to Jeddah are 0.79, 0.29, and 0.61\$/m^3, respectively, in 300,000 dwt. tanker. Reported transportation cost through backhaul service (return cargo) are \$ 1 and 2\$/m^3 at worldscales of 30 and 60, respectively. Using these unit costs, four scenarios are discussed for transportation of 910,000 m^3 of water per day through different alternatives. Water transportation from Pakistan appears to be highly cost effective among other alternatives, and can be made operational at a short notice with a small capital investment.

KEYWORDS : Water, transportation, oil tankers, economic analysis, shuttle service, backhaul service, desalination, Pakistan, Egypt, Sudan, and Saudi Arabia.

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OPTIMAL IRRIGATION-DRAINAGE POLICY FOR AGRICULTURAL PURPOSES

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ABSTRACT

The optimal exploitment of an irrigated culture land assumes a right correlation of water amounts taken from emissary that are to be given to culture during vegetation periods, and of drainage operations during other periods when the water underground reserve surpasses the allowed rates. An optimal procedure of drainage wells operation is presented having as an objective function the amount of cumulated rates of deviations between the land ground and levels of water table of the aquifer through the whole interval of analysis weighted with major penalty coefficients where the water table surpasses the ground. Some considerations are given concerning the solution of unsteady flow of underground water for the same case. A numerical example finally illustrates the purpose procedure.

AGRONOMIC CONSIDERATIONS IN PLANNING DESIGN AND OPERATION OF IRRIGATION PROJECT

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SUMMARY

Irrigated agriculture is the highest consumer of water in India. Huge investments have been done to increase irrigation potential since 1951. About 80-90 percent of the developed water resources are diverted to irrigated agriculture which utilizes them with a 14-40 percent efficiency. Inspite of massive investments done on construction of irrigation projects, they are not giving expected returns because of lack of integrated approach to irrigation project planning and inefficient water management on the farm. In planning, design and operation of irrigation projects, the production objectives must be related to physical resource base particularly climate, soil and water availability inorder to ensure that yield predicted and production proposed is achieved. The important agricultural aspects that merit due consideration in the planning and design of new projects and operation of existing irrigation projects are:

- Soil survey of the commend area to determine irrigable soils, suitable land scape for conveyance of irrigation water, command area development plan and crop planning.

- Careful consideration of climate, soil and water availability for selection of suitable cropping pattern of the command on the basis of which yearly and seasonal water budget is prepared.

- Water requirement of crops in the cropping plan and irrigation water demand based on irrigation efficiency and effective rainfall.

- Water production function relating to various soil, and environmental variables to decide optimum irrigation allocation.

- Design and operation of water supply and distribution system to meet in quantity and time, the crop water needs for optimum yields depending upon land and water availability situations.

- Other agronomic considerations, farming methods, crop yield and farm economics.

An integrated approach is needed in planning, design and operation of irrigation projects for economising irrigation water use in crop production. These aspects are discussed with special reference to Indian conditions.

302 06

INVESTIGATION AND FORECASTING OF WATER STAGE REGIMES IN CLOSED SEAS AND LARGE LAKES

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ABSTRACT

In the past few years, more than once had been noted, that human interference into the regime of world's largest lakes without outflows of enclosed seas, as they are often called, may lead to very serious ecological breaches and considerable economic losses. Due to the reduction of fresh water inflow into such lakes highly productive shallow waters are drained, total salt content increases, and as a result, biological productivity of water bodies falls down to the full loss of their fish economic significance. The problem is sharpened by the falling into the lakes waters polluted by industry and agriculture. Unfavourable natural and climate changes in coastal regions grow rather quickly.

To mitigate the unfavourable influence, which follows the breach of the regime of enclosed seas, a number of compensating measures are planned to be carried out in the USSR. These measures have palliative character and cannot solve the problem of stabilisation of the regime in water bodies under consideration on the whole.

In most cases, the inflow deficiency may be replanished merely on the condition, if additional water sources are used.

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HYDROLOGIC DESIGN TOOLS FOR PLANNING WATER SUPPLY RESERVOIRS FOR SMALL COMMUNITIES

C. David Sellars[1]

ABSTRACT

Water resources planning in rural areas almost always has to be carried out with inadequate data. Daily rainfall data are sometimes available but streamflow data are generally only collected on the larger rivers. For villages in upland areas, distant from perennial rivers and with no suitable groundwater source, surface water supplies have to be developed on small catchments for which streamflow data are limited or non-existent.

This paper discusses hydrologic design tools for the planning and locating of small water supply reservoirs in areas with little or no hydrologic data. An application in the coastal region of Tanzania is demonstrated where many existing village water supply reservoirs have inadequate inflow. Many of these reservoirs dry up in the dry season and are often not adequately replenished in the following wet season.

Techniques are described for deriving regional rainfall-runoff relationships, developing reservoir inflow probability curves and preparing reservoir storage design curves for different catchment areas and design populations. For villages with no other suitable water source, hydrologic design methods are illustrated for sizing of rainwater catchment tank systems.

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WATER RESOURCES MANAGEMENT IN A DISASTER AREA

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ABSTRACT

Severe disaster has occured in the southern western districts of Punjab (India) due to change in natural hydrology of the tract caused by development of irrigation, agriculture, roads, bridges and other man made activities.

Attempt has been made in the paper to study the cause of this disaster, ameliorative measures recommended and suggestions for future research to avoid its reoccurence. All these aspects have been discussed in this paper in depth.

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SPECIAL SESSION

LOW COST WATER SUPPLY AND SANITATION AS PART OF PRIMARY HEATH CARE AND CHILD SURVIVAL AND DEVELOPMENT - THE SOCIAL APPROACH

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ABSTRACT

The International Drinking Water Supply and Sanitation Decade (IDWSSD) 1981-1990 is part of an on-going process from the side of communities and governments all over the world to help improve living conditions for their citizens. The Decade is a major promotional effort in order to stimulate the individual governments to formulate national plans, to give the appropriate priority in terms of funding, human resources and the impetus to large scale construction of facilities with the active support from a great number of external organisations, both international, regional, bilateral, non-governmental and others. A stock-taking at this mid-Decade point shows that although the investments by far do not match the figures expressing the total needs, the Decade nevertheless has made a great advance in terms of government commitments and work actually carried out as compared to the rate before its inception.

UNICEF (United Nations Children's Fund) as an integral part of the United Nations system, has as its particular objectives the improvement of health and welfare of children and mothers. Low cost water supply and sanitation are part of its activities in an integrated way for child health, nutrition, education and social welfare. Several main concerns, to a large extent are common for all these fields. The purpose of the special session at the IWRA conference is to discuss some of these concerns. Among them are the question of groundwater resources, their conservation and management, and the corresponding development and linking of technical and social approaches to community water supply and sanitation.

What can be done in order to heighten the awareness of the needs, the potentials and the resources ? What can be done to further promote action, especially for human resources development in the form of training and different educational measures ? What can be done in order to develop a well-rounded, integrated approach at the professional levels by closing the gap between the scientific, technological and social disciplines ?

There is a wealth of experiences available but there is even more to overcome, if all these activities under the International Drinking Water Supply and Sanitation Decade are to be as successful as we wish them to be. Nevertheless, it is hoped that this discussion will help in creating new contacts and spread the overall awareness of the need to join the aspects of water resources as a basis for human health and well-being with the provisions and economics of social thought and planning.

308 *9

THE PNEUMOPATHIES ASSOCIATED WITH THE PETROL-CHEMICAL INDUSTRIES; PROBLEMS OF DIAGNOSIS AND MEDICO-LEGAL COMPENSATION IN ALGERIA-/-PETROL-CHEMICAL INDUSTRIAL ZONE ARZEW .

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SUMMARY

Algeria a youg country whose industrial development is based on petro-chemicals, has seen in the last few years respiratory complaints linked to both the environment(indus--trial pollution) and to accidents at the place of work(the petro-chemical industrial area) by exposure or deflagration of petrol and gas products.

When considering this type of professional pathology we have gathered together some obvious and characteristic cases where the respiratory system has been affected and serious complications resulted.

Today in our country these patients pose problems about medical-legal compensation and re-adaptation social and pro--fessional realms.

These problems exist at a time when there is a lack of re--gulations concerning who should take the responisblity and the compensation of the patient either as an individual or for his family.

In summary, given the growth of activities in the petro--chemical industry and the intensification of secondary,it is certain that the majority of the present cases and those in the future,raise the necessity to bring up to date the legis-lation for this new professional group.

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DAILY OPTIMAL OPERATION OF SUNDERNAGAR BALANCING RESERVOIR

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Scientist 'E'	Professor	Director	Chairman
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ABSTRACT

The balancing reservoir (BR) located at Sundernagar, Himachal Pradesh is an important component of Bhakra Beas System. The objective of BR operation is to maximize the energy generation on hourly basis at Dehar hydro-electric power plant of Beas Satluj Link Project, meeting Bhakra Beas System peaks and Beas to Satluj interstream water transfer requirements. This transferred water further maximizes energy generation and supply power to rural areas at Bhakra complex and meets downstream irrigation water requirements.

Hourly case oriented research study has been carried out for preparing optimal daily schedules of regulation for this newly constructed BR. Generalized iterative optimization programme has been developed for framing schedules of regulation and forms an important sub-programme of the system medium range study. The study has achieved its objectives of optimal power generation and water transfer maintaining high levels bringing the BR to full level at the end of day and limiting the operation of control structures within specifiek limits. Compared results with so far operation records are encouraging and will improve the project operation.

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RECONSTITUTION DES DEBITS MENSUELS D'ETIAGE DE PETITS BASSINS VERSANTS

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RESUME

L'étude commence par un bref rappel des différentes approches des conditions de vidange d'un bassin versant et se poursuit par la présentation d'un modèle utilisé pour la reconstitution des débits d'étiage sur des bassins de surface inférieure à 100 km^2.

Le modèle employé est un modèle déterministe par sa fonction de production et analytique par l'identification de la réponse impulsionnelle (RI) du bassin versant.

L'entrée du modèle est constituée par les pluies "efficaces" au sens de la recharge des nappes profondes. La sortie du modèle est constituée par la série des débits minimums mensuels. La réponse impulsionnelle fonction de transfert du modèle, est identifiée par déconvolution.

Le calage effectué sur cinq bassins versants conduit à une réponse impulsionnelle plurimodale établie sur une durée de 12 à 17 mois. Le premier pic de la RI est invariant dans sa forme, mais sa valeur est directement liée à la surface du bassin.

Une discussion sur une éventuelle signification géologique des autres pics est proposée.

La définition d'une RI synthétique doit permettre d'utiliser le modèle pour la prédétermination des débits d'étiage dans le cas de bassins versants non jaugés.

Mots clefs: conditions de vidange, réponse impulsionnelle, débits minimums mensuels, réponse impulsionnelle synthétique, prédétermination des débits d'étiage.

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A NEW COMPROMISE ORIENTED MULTICRITERIA METHOD

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ABSTRACT

In this contribution a new multicriteria method, called "CONSENSUS", is presented. This method suitable to treat both discrete and continuous decision problems, can be seen as an extension of compromise programming or as an extension of Saatys eigenvalue analysis.
The method is very suitable for water resources design problems, since it is oriented towards compromise solutions. By taking explicitly into account the preferences of the different parties concerned with the consequences of the proposed actions, the politically most suitable actions are determined.

After presenting the technical aspects of the method, it is applied to the case study of the water resources planning of the Gete, a river of about 500 km² in Belgium. The results obtained with CONSENCUS are compared to the results obtained with ELECTRE I, another well known multicriteria method.

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