

Research-based Innovation for Effective Water Management and Food Production

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Outline of Discussion

- ❑ Research and Development (R&D) Strategy on Water Use in Agriculture
- ❑ Irrigation and Drainage Management
- ❑ Water Use for Food Production
- ❑ R&D perspective from SANCID as a member country of ICID



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ICID•CIID

*"One cannot reflect in
streaming water.*

*Only those who know internal
peace can give it to others."*

~ Lao Tzu

- 💧 Personal/family life
- 💧 Career/work environment
- 💧 Formal/informal education and training
- 💧 National and international involvement/contributions



Research and Development Strategy:

Key considerations

- 💧 Strategies that work (Ferreira, 2005)
 - Setting objectives/goals
 - Determining a course of action
 - Allocating resources
- 💧 Core content of good strategy (Rumelt, 2012)
 - Diagnosis of the challenges, obstacles, opportunities
 - Guiding framework for dealing with challenges
 - Set of coherent actions and resource commitments
- 💧 Leadership with developing and re-establishing strategy (Porter, 2008)
 - Specifying and explaining the direction (goals, actions, etc.)
 - Adhere to strategy as basis for trade-offs
 - Conviction and courage not to deviate from strategy

“Good strategy requires leaders who are willing and able to say no to a wide variety of actions and interests”

(Richard Rumelt, 2012)



Strategy and Business Plan for Key Strategic Area: Water Utilisation in Agriculture

- Core strategy
 - Strategic context (needs analysis, technical trends, stakeholders, research providers)
 - Scope (people in farming, sub-sectors, problems, scientific disciplines)
 - Links to WRC vision & mission
 - Contributions to WRC 'Knowledge Tree'
- Implementation plan
 - Thrusts & programmes, current & new projects
 - Research portfolio (objectives, course of research, allocation of financial resources)
 - Contribution to and links with WRC 'Lighthouses'
 - Budgets (current & new projects, total income and expenditure)

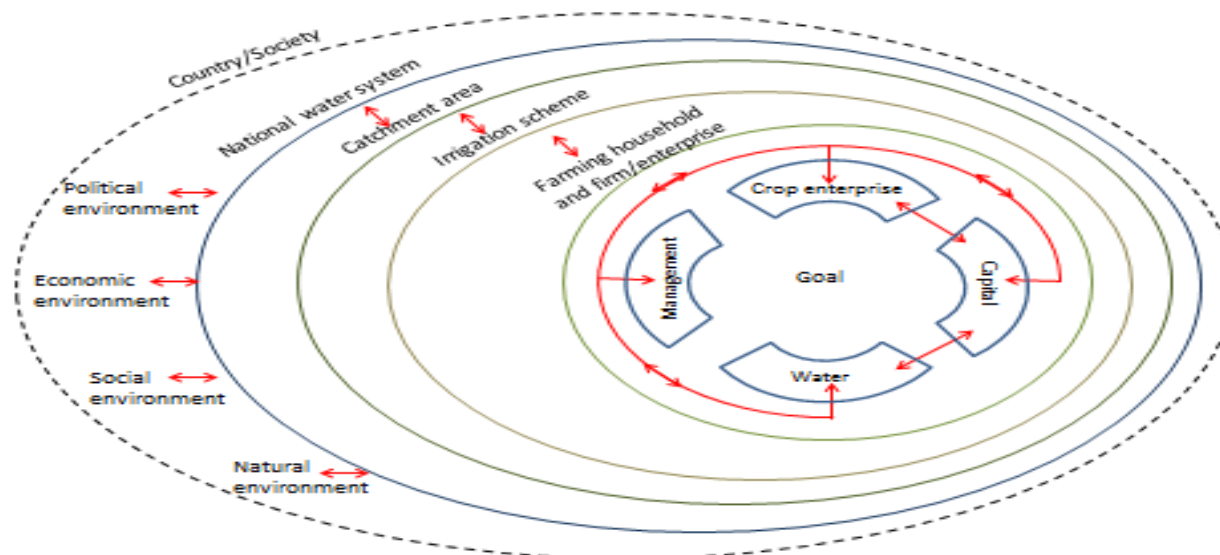
www.wrc.org.za



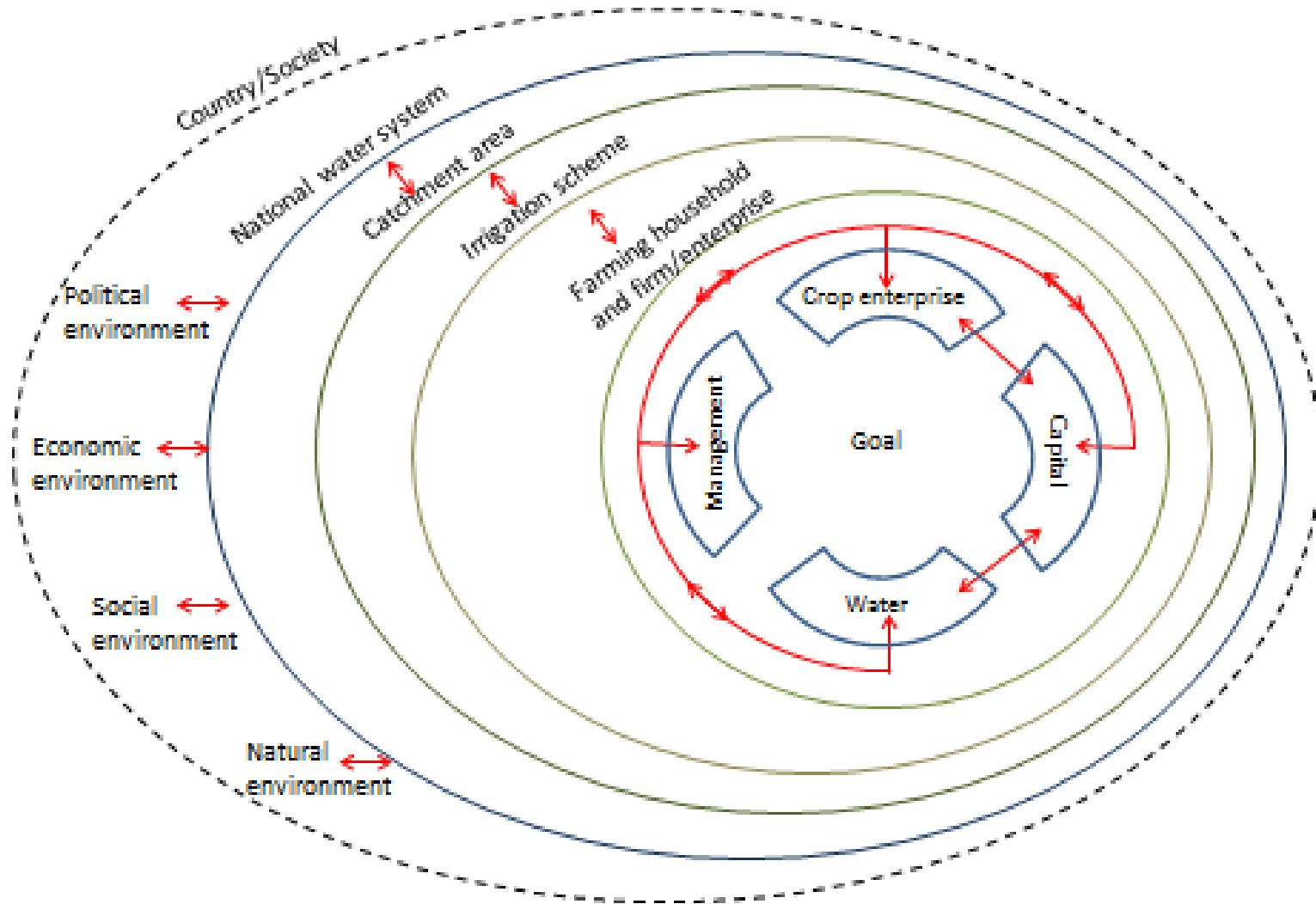
Guiding Framework:

Strategic focus and key drivers for research

- 💧 Improving knowledge of water use in the processes of production of food, forage, fibre and fuel crops
- 💧 Improving knowledge of management processes by people who are using water in the food value chain
- 💧 Improving knowledge of natural processes and people-induced impacts of water resource use
- 💧 Systems approach



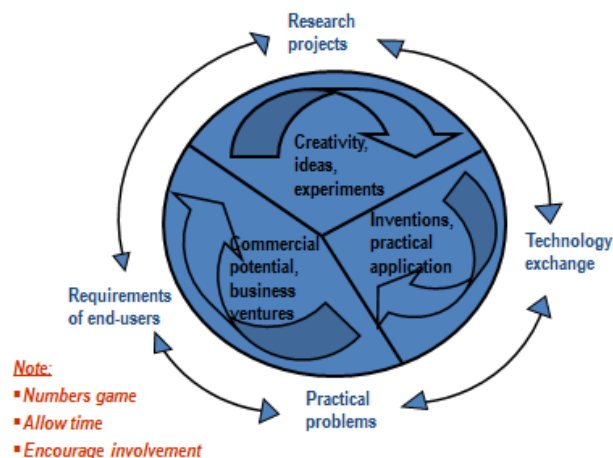
National Water System with Inter-related Sub-systems



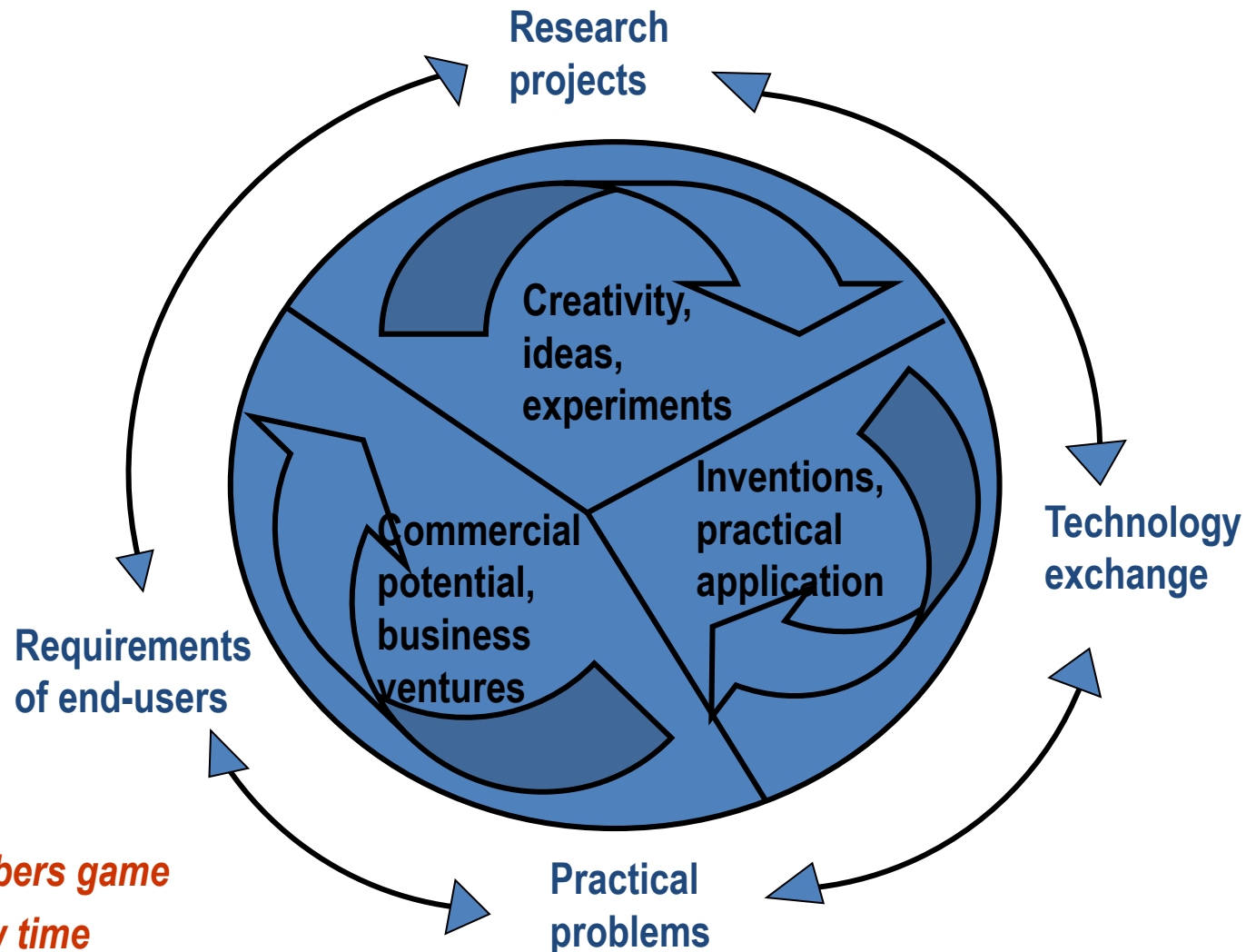
Coherent Action and Resource Commitments

- 💧 Annual call for research proposals
 - Open and directed submissions
- 💧 Programmatic and thematic approach
 - Specification of available funds
- 💧 Direct and manage projects according to innovation process

Taking Research into Practice: The Innovation Cycle



Taking Research into Practice: The Innovation Cycle



Note:

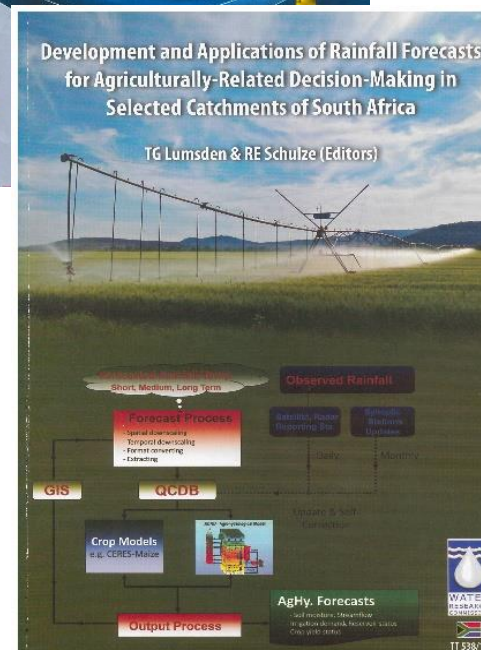
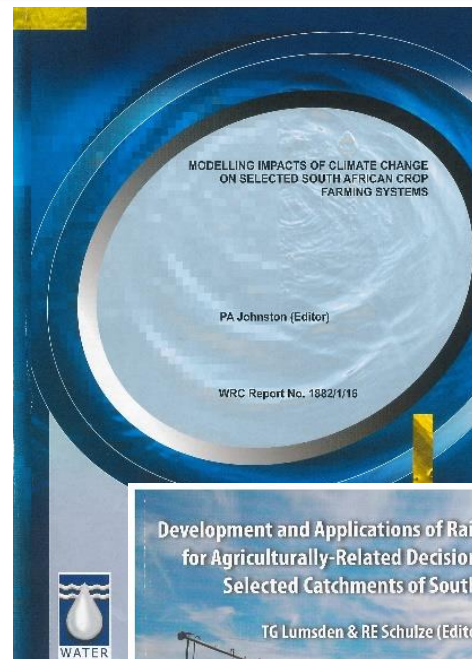
- **Numbers game**
- **Allow time**
- **Encourage involvement**



Irrigation and Drainage Management:

1. Climate change and early warning

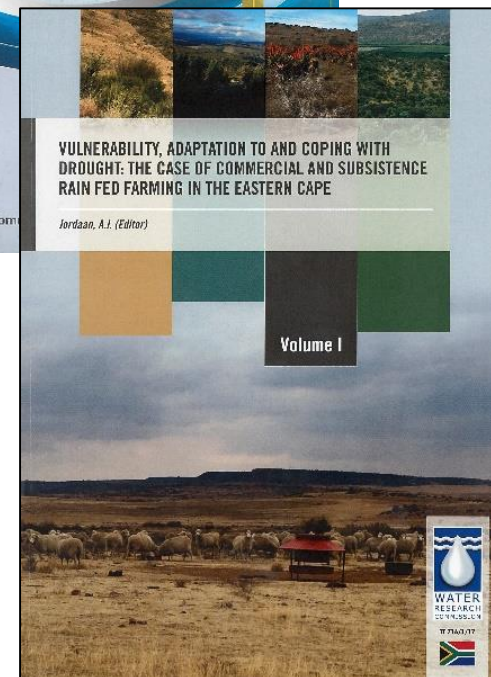
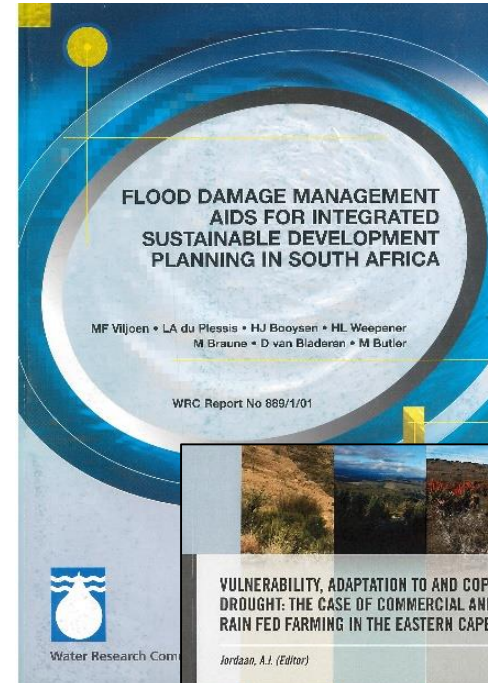
- Adaptation of farming over time
 - Crop combination and protection
 - Cash reserves and/or bridging finance
- Water use allocations of irrigation schemes
 - High or low security of supply
 - Adapt water release with change of inflow
- Early warning services e.g. rainfall forecasts
 - NAC advisory services of DAFF
 - Forecast to determine bio-physical and socio-economic response
- R&D requirements
 - Genetic modification/crop breeding
 - Linking climate, crop and farming models



Irrigation and Drainage Management:

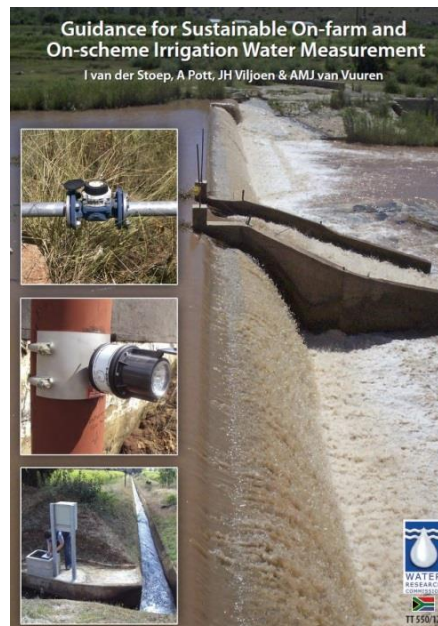
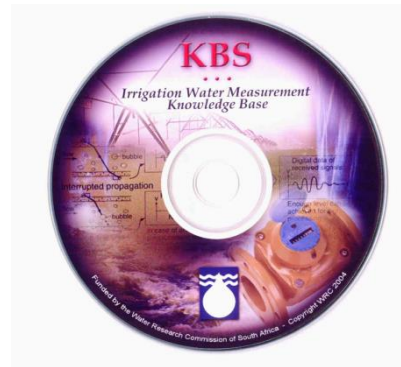
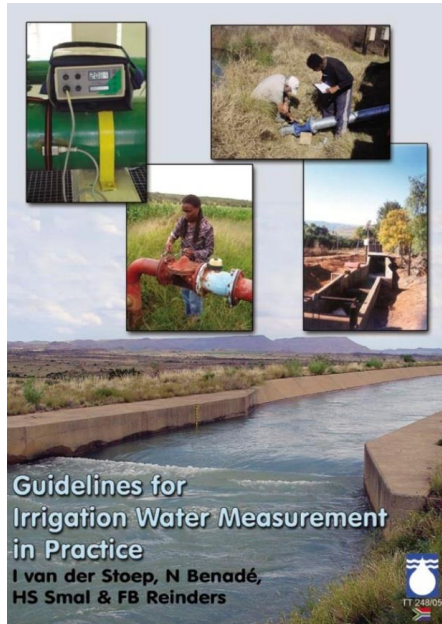
2. Extreme events of floods and droughts

- Flood damage management aids
 - Flood simulation
 - Disaster control and development planning
- Risk, vulnerability and coping with drought
 - Drought indicators
 - Drought management plans
- R&D requirements
 - Reliable forecasts
 - Efficient advisory and extension services



Irrigation and Drainage Management:

3. Water measurement for irrigation



Management

- Indirect measurement of flow-rates through electric power supply
- Direct measurement in canals and pipelines
- Irrigation water measurement knowledge base
 - Two separate research projects
 - Technology exchange and guidelines
- Training, incentives and regulation for implementation

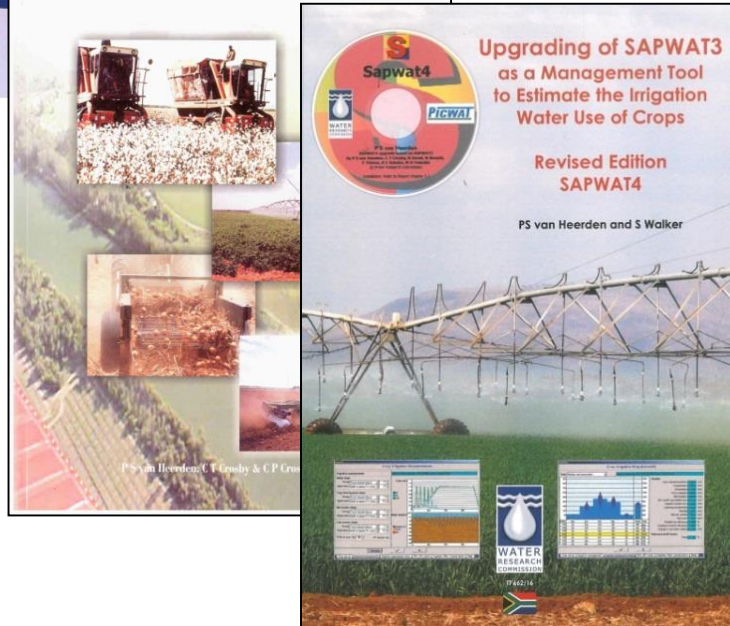
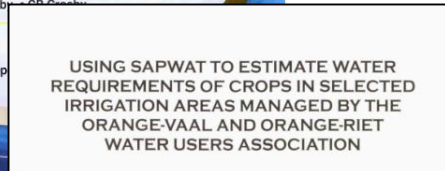
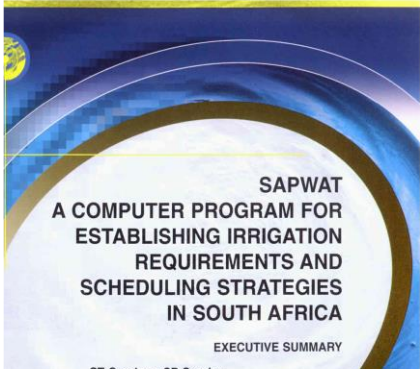


Irrigation and Drainage Management:

4. Estimating crop water requirements

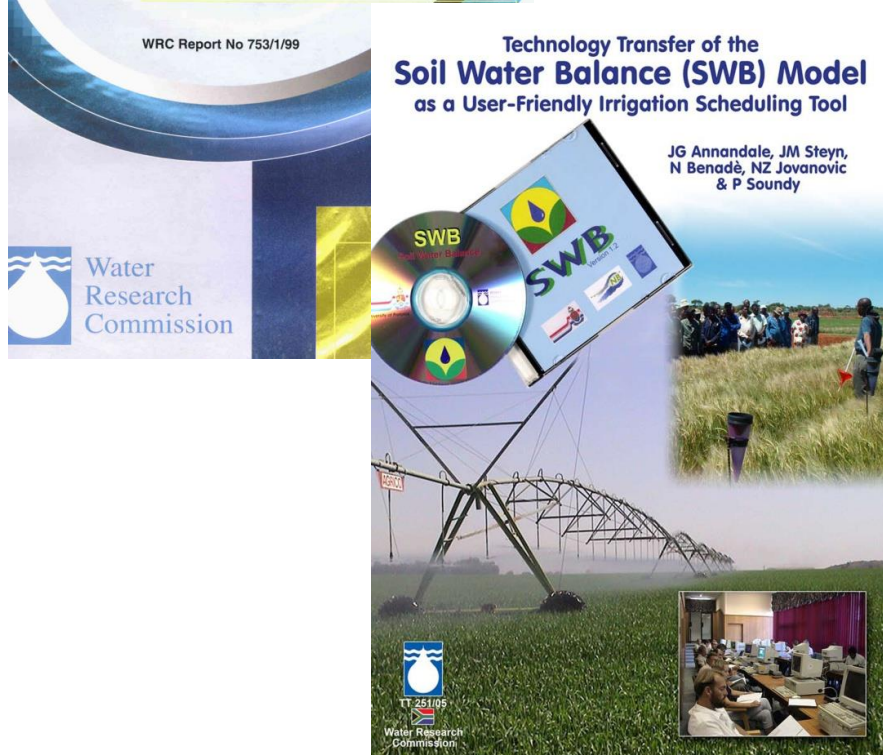
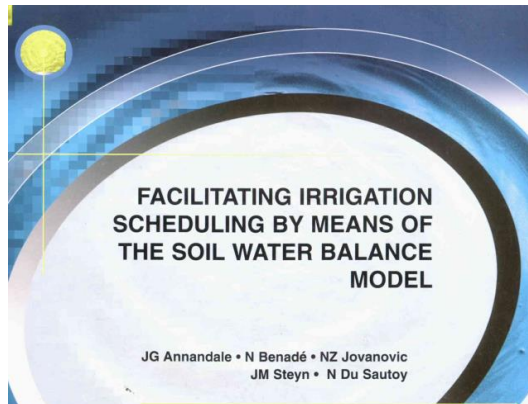
SAPWAT

- 💧 Planning and management tool
- 💧 Standardised procedure for vegetable, field, pasture and tree crops
- 💧 Facilitates interaction with advisors and farmers
 - Research
 - Technology exchange
- 💧 Application, upgrading and further development
- 💧 Verifying correctness and evaluating adoption potential
- 💧 Revising and updating SAPWAT4



Irrigation and drainage management:

5. Real-time irrigation scheduling



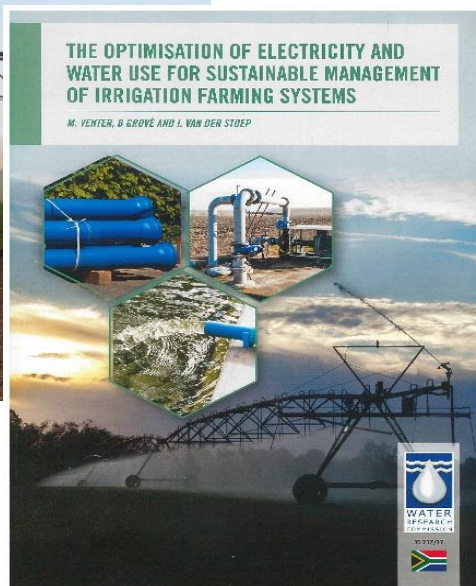
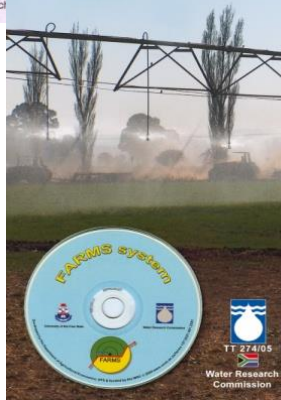
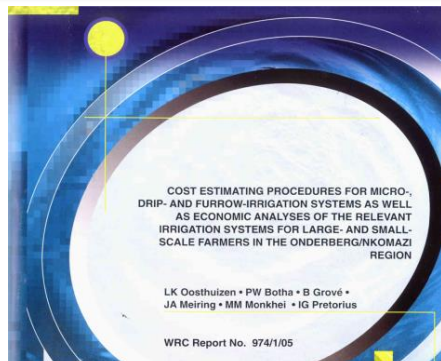
Putu, BEWAB, SWB, WFD, MyCaneSim

- Generic, mechanistic modelling approach to scheduling
- Version for farmers, consultants and researchers
 - Research through two projects
 - Technology exchange over three phases
- Important lesson: Service desk for farmers and advisors
- Impact assessment of WRC funded research on irrigation scheduling
 - Instrumental impact
 - Conceptual impact



Irrigation and Drainage Management:

6. Cost-estimating procedures for irrigation



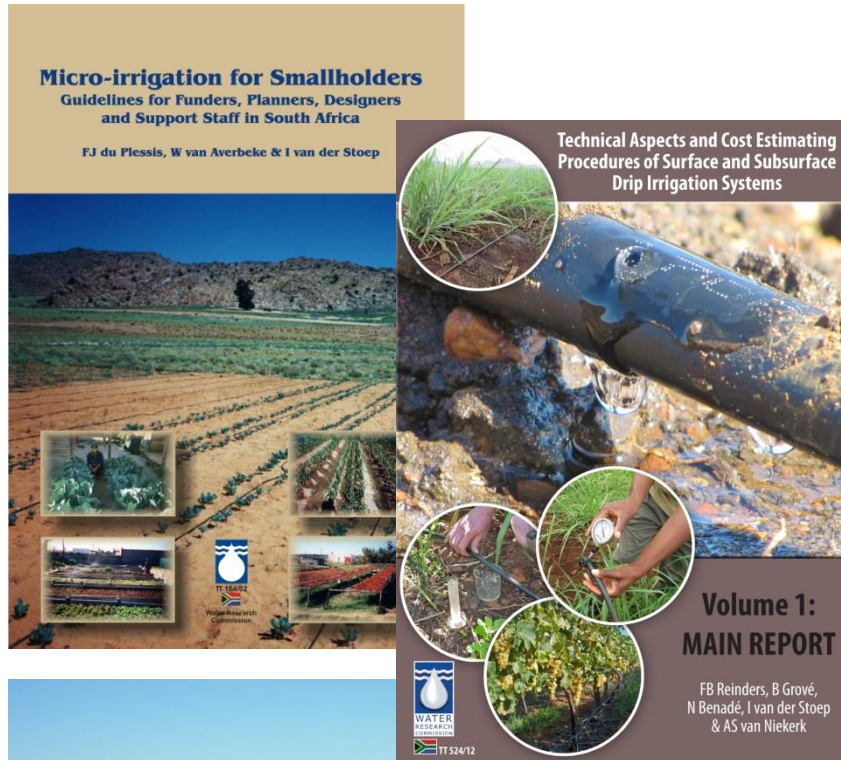
IrriCost

- 💧 Research phase
 - Centre pivot and dragline irrigation
 - Drip, micro and flood irrigation
- 💧 Application phase
 - Guidelines and technology exchange
- 💧 Important lesson: Train the trainer
- 💧 Research and development to adjust norms and standards in response to higher electricity costs



Irrigation and Drainage Management:

7. Micro and drip irrigation



Technology

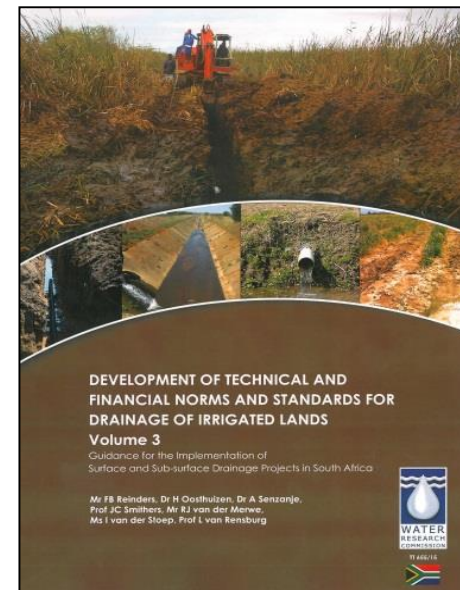
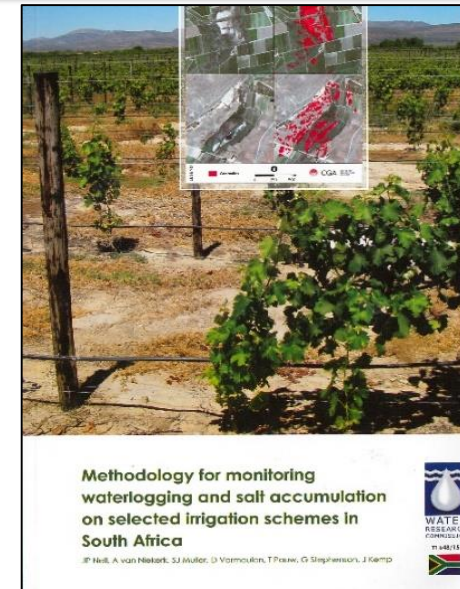
- Evaluating the appropriateness of micro-irrigation for small-scale irrigation
- Guidelines for funders, planners, designers and support staff
- Performance of surface and sub-surface drip irrigation under field conditions
- Technology exchange for training, costing and maintenance of drip irrigation

Year	Area	Method of irrigation		
		Flood	Sprinkler	Micro/drip
	ha	%	%	%
1990	1 290 132	32,8	54,4	11,8
2007	1 675 882	14,4 (23,3)	54,9	21,8



Guidelines

- 💧 Methodology to monitor the status of waterlogging and salt affected soils
- 💧 Technology exchange and management guidelines for control of salinization with precision farming
- 💧 Development of technical and financial norms and standards for drainage of irrigation lands



Water Use for Food Production:

1. Productive rainwater use

<u>Productive activity</u> <u>on:</u>	<u>Rainwater use</u> %	<u>Area land</u> ha
💧 Grazing land, woodlands and forestry	62	85 million
💧 Cropland	12	16 million
💧 Irrigated land	2.5	1.6 million

Note: Run-off: 8.5% of rainfall

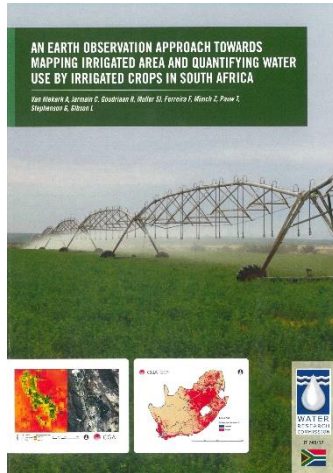
Deep percolation: 6% of rainfall

Source: Bennie, 1998; Nieuwoudt & Groenewald, 2003



Water Use for Food Production:

2. Irrigation crop water use and irrigated area



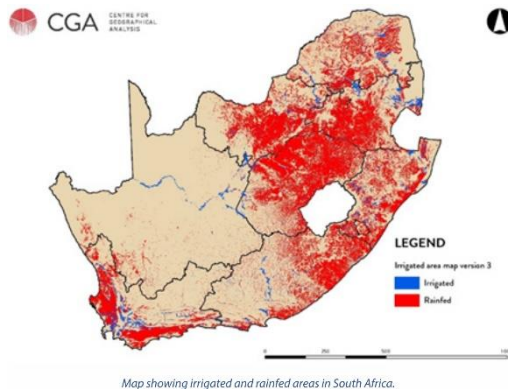
2014/15

- ET irrigation crop water use: 10 221 million m³
- Area irrigated: 1.335 million ha
- ET irrigation water use per ha: 7 659 m³



Water use by irrigated agriculture, expressed nationally and per province for the 2014/15 study period.

Region	Total Area (ha)	Cultivated Area (ha)	Irrigated Area (ha)	Irrigated Area (% of Total Area)	Irrigated Area (% of Cultivated Area)	ET (Million m ³ /yr)	ET (m ³ /ha)	ET (% of tot. Use)
Eastern Cape	16 896 600	1 355 239	152 866	0.90	11.3	1070	7000	10.5
Free State	12 982 520	3 796 784	129 077	0.99	3.4	832	6446	8.1
Gauteng	1 817 831	405 056	20 115	1.11	5.0	154	7656	1.5
KwaZulu-Natal	9 436 132	1 428 847	177 341	1.88	12.4	1518	8560	14.9
Mpumalanga	7 649 469	1 306 403	125 595	1.64	9.6	1245	9913	12.2
Northern Cape	37 288 940	272 079	144 579	0.39	53.1	1135	7850	11.1
Limpopo	12 575 390	1 251 682	218 302	1.74	17.4	1930	8841	18.9
North West	10 488 170	2 183 704	97 211	0.93	4.5	752	7736	7.4
Western Cape	12 946 220	1 947 345	269 476	2.08	13.8	1583	5874	15.5
National	122 081 272	13 947 139	1 334 562	1.09	9.57	10 221	7659	100.0



Source: Van Niekerk *et al.*, 2018

“When all people at all times have access to sufficient, safe and nutritious food to meet dietary needs for a healthy and active life”(FAO, 2001)”

💧 National food security

- Local markets, production, import and export

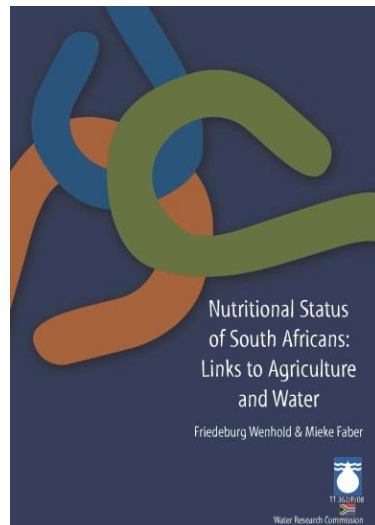
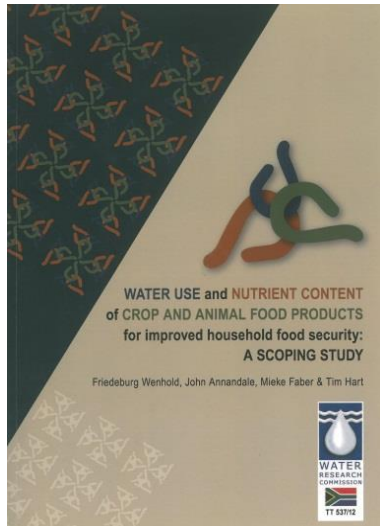
💧 Household food security

- People are buying and not growing food
- Under utilised potential of natural and human resources



Water Use for Food Production:

4. Household food and nutrition security

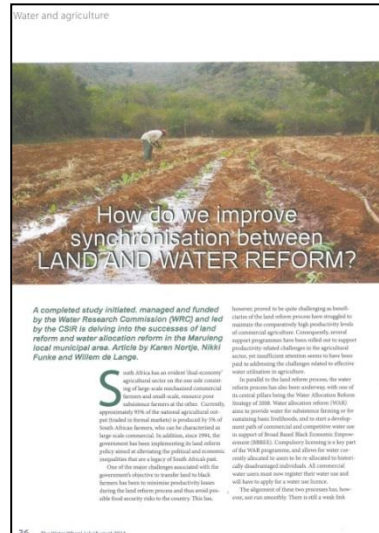
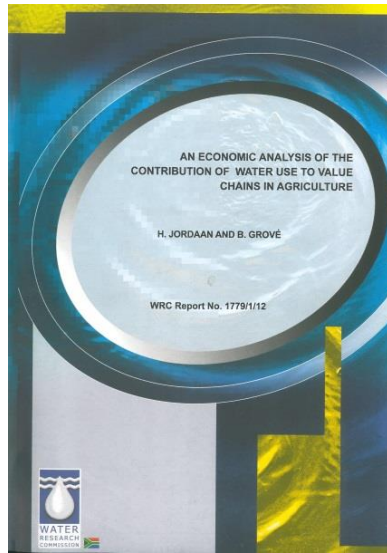


- Nutritional status of South Africans: Links to agriculture and water
- Scoping study on water use and nutrient content of crop and animal food products for improved household food security
- Rain-fed and irrigated production of food and potential to meet nutritional requirements
- Water use of crops and nutritional water productivity for food production, nutrition and health in poor rural communities



Water Use for Food Production:

5. Water use in food value chains



- 💧 Assessment of the contribution of water use to value chains in agriculture
- 💧 Investigation of water conservation in food value chains by beneficiaries of water allocation reform and land reform programmes in South Africa
- 💧 Analysis of food value chains in rain-fed and irrigated agriculture to include emerging farmers in the mainstream of the economy
- 💧 Water use in food value chains of indigenous crops



Water Use for Food Production:

6. Water footprints of crops in agriculture



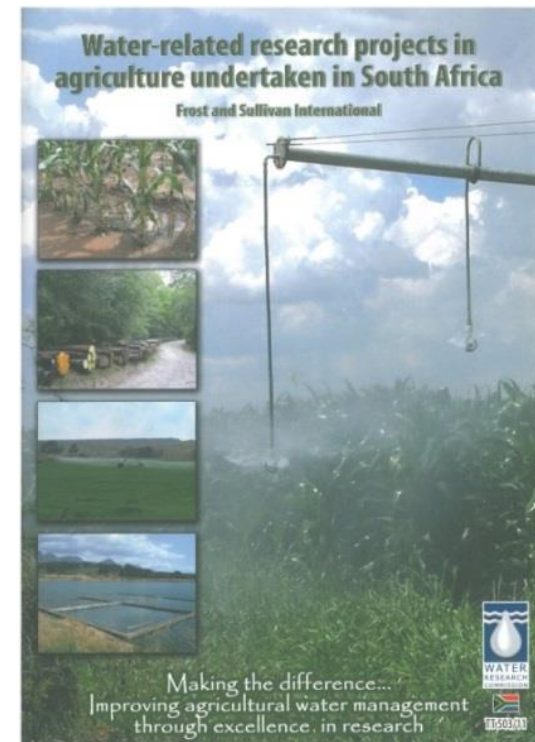
- Water footprint of selected vegetable and fruit crops produced in South Africa
- Determining the water footprints of selected field and forage crops towards the sustainable use of fresh water
- Assessing the water footprint of selected fibre and fuel crops in South Africa
- Water footprint of wine and table grapes



Perspective from SANCID and ICID:

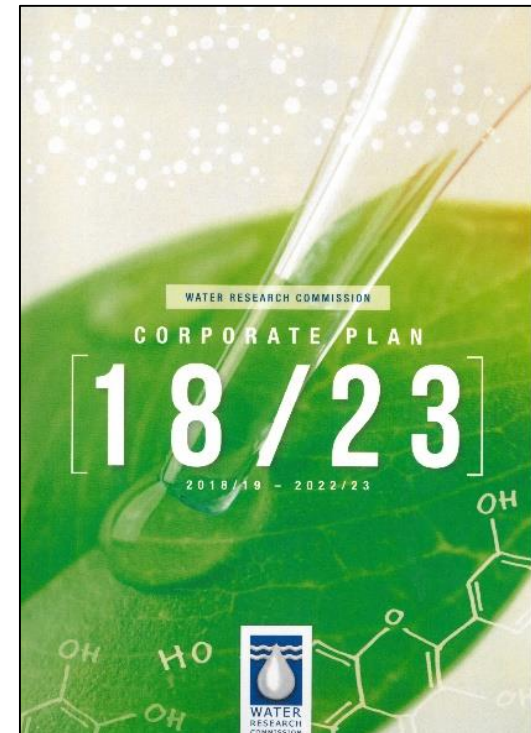
1. Research and development community in South Africa

- 💧 Wide ranging expertise in R&D
 - Universities
 - Science Councils
 - Consulting firms
 - Government departments
- 💧 Platform for discussion between different disciplines in irrigation and drainage created by SANCID
- 💧 Opportunity to share knowledge and experience internationally through ICID
 - Triennial Congress
 - Conferences and World Irrigation Forum
 - Working Groups of ICID
 - Journal “Irrigation and Drainage”



2. Mandate and functions of Water Research Commission (WRC)

- Mandate of WRC
 - Ensure that research is undertaken in collaboration with universities, science councils, government departments and private organisations
 - Disseminate knowledge regarding results of research and promote development work for the purpose of application
- Functions of WRC
 - Establishing water research needs and priorities
 - Funding water research on a priority basis
 - Enabling effective transfer of information
 - Promoting co-ordination, communication and co-operation
 - Supporting capacity development



3. Essential requirements for water productivity growth with irrigation and rain-fed farming

- 💧 Natural suitability and economic viability of water resource development and use
- 💧 Incentives through secure property rights
 - Private property
 - Common property: secure use rights
- 💧 Improving capabilities through knowledge and skills
 - Research-based knowledge dissemination
 - Practical, hands-on adult training
- 💧 Encouragement of entrepreneurial growth paths



4. Key realities and requirements for research and development application

- 💧 Investment in applied research is a risky undertaking
- 💧 Long lead time or time span from research to implementation
 - 5-10 years (Steiger, 2013: Innovation showcase – visualise the potential of the water sector)
 - 12-14 years (Holterman, 2014: Innovative ambitions for the water sector)
- 💧 Main requirements:
 - High quality research in successive projects
 - Follow research with technology exchange
 - Direct process for creation of new knowledge through research to testing of application and exploitation of benefits with implementation

