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Econometric Model to predict the effect that various Water Resource Management Scenarios would have on South Africa's Economic Development

Conningarth Economists

Pretoria,
South Africa

Content of RSA Presentation

- *Overview of progress with the South African Inter-industry Model (SAFRIM) (Skip Scheepers)*
- *The linkages to the Water Satellite Model (WSM) (Skip Scheepers)*
- *SAFRIM: Technical Presentation (Gauthier Tshiwaka-Kashalala)*

Involvement of Conningarth Economists

- Company Profile
- Involvement with INFORUM

Background

Conningarth Economists was commissioned by the Water Research Commission (WRC) in 2005 to develop an econometric model that considers the role of water as input to the South African economy.

The model will ultimately be used to evaluate the role of water in the South African economy and predict the likely effect of management and policy approaches on the efficient utilization of water resources.

Progress to date

Output 1: Literature Review (Completed June 2005)
Covering the local and international experience with regard to developing the proposed model, available data sources and relationships that could be incorporated into the proposed model

Output 2: Catered scenarios (Completed October 2005)
Report on the different scenarios that will be catered for in the developed model

Output 3: Selection of an econometric model (Completed March 2006)
Report on a selection of existing econometric models that may be used for the WRC purpose

Output 4: Interface with existing data sources (Completed May 2006)
Report on the interface with existing data sources that would provide input to the model and be sources of future data updates

Output 5: Relationships between water use and production (Completed November 2006)
Report on the relationship between water use and production within defined sectors

Output 6: Structure and operation of the integrated model (Completed March 2007)

Output 7: Validation of integrated model (Completed July 2007)

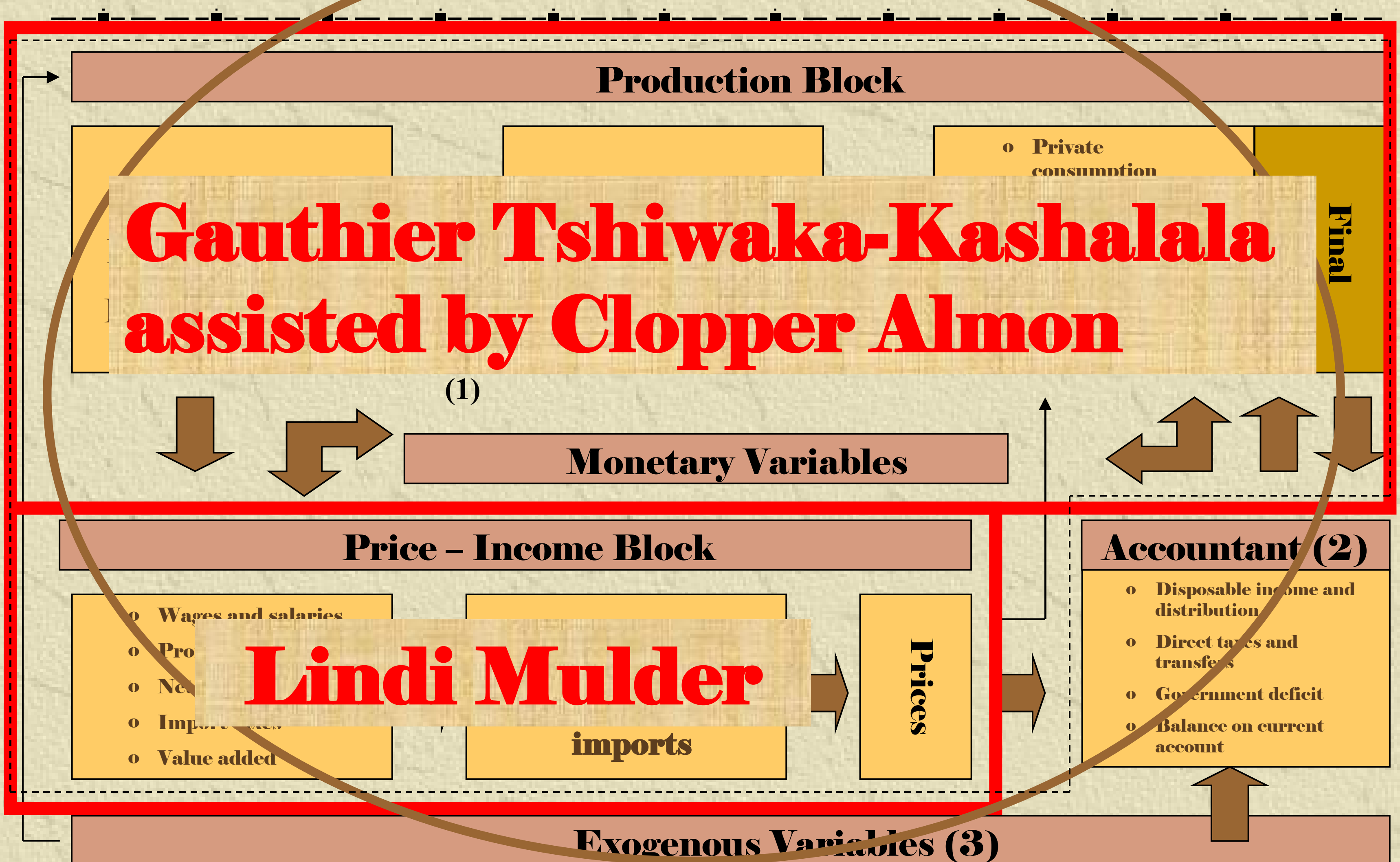
The choice of Econometric Model

Based on the outcomes of Output 1 3, the following decision was made and elaborated on in Output 4:

The INFORUM Model was chosen as the preferred modeling structure for forecasting water demand and the simulation of different water management scenarios. The INFORUM Model was validated against a set of criteria, including its ability to track historical economic developments, as well as its usability for policy impact analysis. In this regard it received high marks.

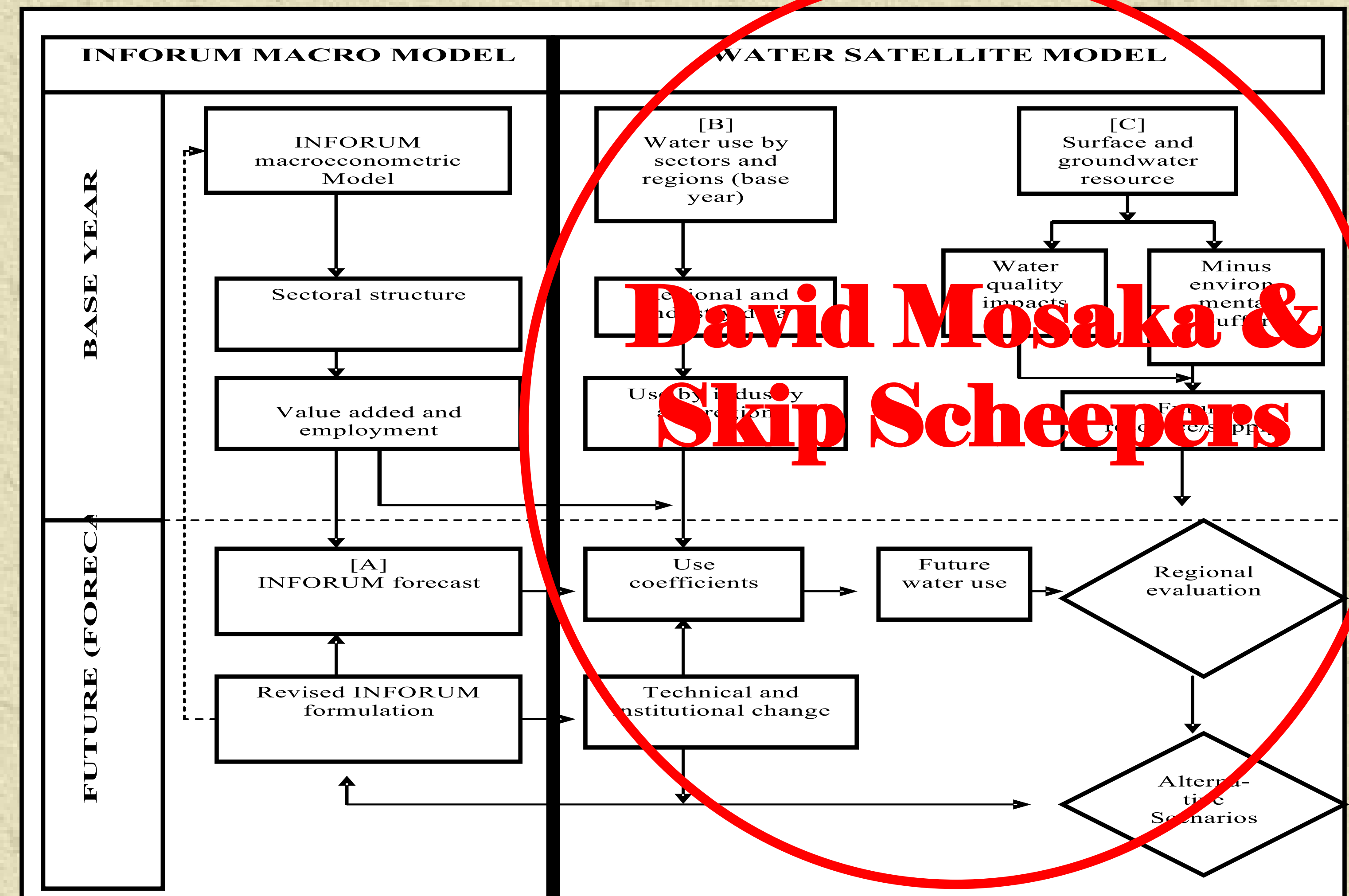
The South African Interindustry Model (SAFRIM) was established

Basic Structure of SAFRIM



Structure of the INFORUM Model – with specific reference to the Water Impact Model

Diagram 1: Model Structure



The Formal Structure of the Water Demand Functions

Dr Skip Scheepers

The Formal Structure of the Water Demand Functions

Incorporating both average demand coefficients (water coefficients) and the price elasticities of the demand for water per sector/user, the following mathematical equation will be used for modelling purposes:

$$D = \left[a + b(\Delta T)\right]C$$

where

D	**=**	**Total use for a category**
a	**=**	**Average use per user unit**
b	**=**	**Change in unit use due to a given tariff change**
ΔT	**=**	**Change in water tariff**
C	**=**	**Total number of user units (driver/exogenous variable)**

This kind of equation is widely used internationally mainly because of its theoretically sound foundations and the fact that it has found widespread practical applications . In the next chapter an analysis is given of the theoretical origin of the main elements of the above water demand function/equation, but in particular that of the price elasticity of demand.

The Formal Structure of the Water Demand Functions - Continued

- ***Sectoral Distributions (Main sectors)***
  - **Irrigation Agriculture**
  - **Mining**
  - **Manufacturing**
  - **Construction**
  - **Wholesale and Retail etc.**
  - **Transport**
  - **Communication**
  - **Financial services**
  - **Other**
  - **Households**
  - **Total**

The Formal Structure of the Water Demand Functions - Continued

- Price Elasticities of Demand for Water
- Water Coefficients (average water use (million cubic meter) per demand unit per annum)

	A *Water coefficients (million m^3)*	*B* *Elasticities*	*AT* *Tariff Changes (p.a.)*	*∆ C* *(number of users)*
Irrigation	**0.0077**	**-0.011518**	**0.2%**	**Hectares**
Agriculture				**Hectares**
Forestry	**0.00032**	**0.00**	**0.2%**	**LSU**
Livestock	**45**	**0.00**	**0.2%**	**Stock population**
Households				**Population**
High	**101.8**	**-0.35**	**0.9%**	
Low	**20.3**	**-1.12**	**0.9%**	
Rural	**20.3**	**-0.12**	**0.9%**	
Mining	**0.00202**	**-0.01589**	**0.9%**	**Production**
Manufacturing	**0.000724**	**-0.01589**	**0.9%**	**Production**
Electricity and water supply	**0.00140**	**-0.00022**	**0.9%**	
Tertiary sector	**0.007247**	**-0.01436**	**0.9%**	**Production**
Parks	**74.64**	**-0.91**	**0.9%**	**Population**

Water Satellite Model (WSM) Results

WSM Results 2000 - 2006

- *Comparing actual with projected water demand data – Point of departure*
- *Using "drivers" from SAFRIM (projected demand)*
- *Results (Summary of 61 sectors distinguished)*

	"Actual"	Forecasted
Irrigation	2.78%	2.78%
Mining	1.95%	3.15%
Light manufacturing	3.49%	4.42%
Heavy manufacturing	3.07%	4.44%
Tertiary	4.29%	4.78%
Parks	2.17%	2.17%
Households	2.27%	2.24%
Total RSA Economy	2.83%	2.91%

Overall Summary and Conclusions

- ***SAFRIM***
- ***Water Satellite Model***
- ***Road ahead***