

Jack Armour - A Young Prize-Winning Researcher

It is not often that a person is known by their second name, but that is the case with Robert Jack Armour. That, however, is not the only remarkable thing about this young man. After he qualified with a B.Sc. (Agric) degree from the University of the Free State (UFS) he decided to try his hand at being manager of a pig farm and also a tourist guide in Southern Africa. But it seems as if he has found his niche in the world of Agricultural Economics, because not only did he recently obtain his M.Sc. (Agric) degree in this field *cum laude*, but he also won a prize for his dissertation from the South African Agricultural Economics Association for the best Agricultural Economics Masters dissertation in the country.

Not bad for this born Free Stater who never intended to pursue a post-graduate qualification in Agricultural Economics, but was inspired by another agricultural economist, Prof. Giel Viljoen from the UFS, who convinced him to work in this field.

MASTERS

Jack has a unique way of doing things, as is evident when one reads through his dissertation. It is not often one comes across a Masters dissertation where every chapter is introduced by a quotation from popular literature pertaining to the importance of water in agriculture; ranging from Alan Paton's *Cry the Beloved Country* to the Bible.

In the dissertation, Jack developed and applied models to determine the long-term financial and economic viability of irrigation farming in the Lower Vaal and Riet Rivers.

"With my dissertation, I wanted to evaluate the relationship between



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changing water quality, soil conditions and crop production and also determine the impact on yield, crop choice, agronomic and water management practices, expected incomes and costs. I wanted to use these findings to develop models for typical farms in different river reaches, and apply these models to test the outcome of alternative scenarios regarding internal water quality management practices and external policy measures," he summarises his study.

IRRIGATION

But what prompted his interest in this particular field of study? Jack explains: "Global climate change and the imminent threat of droughts or floods, means that irrigated agriculture is here to stay, because of the stability of supply it contributes to national food security. In Sub-Saharan Africa, the potential irrigated area is estimated at 33 million ha, with the presently irrigated area accounting for only 13% of this. With Sub-Saharan Africa by far having the highest population growth rate in the world, food shortages in this region loom in the not too distant future. Mechanised, water effi-

cient, irrigation agriculture is a potential solution to this problem. However, tremendous pressure will be placed on expanding the potentially irrigated area and increasing the productivity of existing schemes to meet nutritional needs. This could be disastrous for the environment, and consequently for the sustainability of such schemes, if the necessary precautions are not taken."

SALINITY

In his research, he mentions that irrigation water quality and particularly salinity, reaches levels in the Lower Vaal and Riet River that are harmful to certain crops. Saline irrigation water however irrigated onto soils is transpired as pure water, leaving the salts behind in the soil. These salts accumulate over the long term and reach levels rendering soils sub-optimal for crop production. One way to manage salt build-up in soils is to apply excess irrigation water to leach the accumulated salts out of the soils.

The increasing use of water, and by implication returnflows, in the course of economic growth and development, contributes to fluctuation and the gradual deterioration of water quality. This occurrence is a particular problem in the Vaal River system, where water quality worsens as river flow reduces. Even if water quality does not worsen progressively over time, it is expected that the irrigability of soils can be affected, which in turn impacts on the financial sustainability of crop production.

"The question I asked myself, and on which I based my study, was to what level the causes and consequences of fluctuating water quality could be

managed by adapting on-farm production practices and introducing policy instruments. I was also interested to find out which farm, regional and policy level management options are most suitable to address the water quality problem in the Lower Vaal and Riet Rivers," he says.

In his study, he refers to data gleaned in 1995 which claims that around 110 000 ha of irrigated land in South Africa was affected by waterlogging and/or salinisation. In the Orange Vaal Irrigation Board (OVIB) service area, which was also the area on which Jack based his research, 13% of the 8 091 ha irrigation water rights allocated in the OVIB area are slightly affected by salinisation and waterlogging to the extent that agricultural production can still take place albeit with restricted production potential and choice. However, a further 10% of the OVIB area is severely affected to such an extent that agricultural production can no longer take place without special remediation actions such as artificial drainage or gypsum being applied. That is nearly a quarter of the irrigated zone in the study area affected by salinisation and a trend of declining water quality.

SALMOD MODEL

Throughout the study, the contradiction in improved water use efficiency and increased leaching for salinity management had to be finely balanced. On the one hand, water is a scarce resource and should be preserved. On the other, a certain "wasting" of water is necessary in order to leach out salts that build up in soils through the process of irrigation. This prompted Jack to develop a financial optimisation model, named SALMOD (Salinity and Leaching Model for optimal Irrigation Development), to solve the apparent paradox between saving and wasting water.

SALMOD was constructed using GAMS (General Algebraic Modelling System) and consists of a simulation and optimisation section that calculate the optimal crop enterprise, management and resource use combinations that maximises farm returns under different water quality, management and policy scenarios.

Some interesting results were learned from the SALMOD scenarios. For instance, it showed that leaching was financially viable for most farmers used in the case studies and that accepting lower yields on soils with insufficient leaching capacity is also financially viable. Furthermore, it can be financially viable for farmers with a limited area of poorly-drained soils to install artificial drainage.

However, the worst-case scenario concerning salinity conditions showed that farmers with small plots and a limited choice of crops they can plant wouldn't easily afford artificial drainage installation costs from irrigation income alone and could go out of production.

"SALMOD is proving to be a valuable farm level salinity management tool. It is also potentially useful at regional and national level for determining the farm level financial impacts of various water quality and quantity scenarios where the farmers are affected by irrigation water salinity," Jack says proudly of the product of many long and laborious days and nights of work.

The Water Research Commission has also played a role in helping Jack to complete his dissertation. They have partly sponsored his salary for the past four years, which enabled him not only to complete his Masters, but also to travel to the United States as part of his research.

Although his dissertation can be

viewed as a significant contribution to irrigation farming in South Africa, he feels that more work needs to be done.

"The purpose of the National Water Act (39 of 1998) is to ensure that the Nation's water resources are protected, used, developed, conserved, managed and controlled. Further research to ensure the financial sustainability of irrigation schemes in South Africa is essential to ensure national food security and employment in some otherwise barren area of the country."

PH.D. AND TOURISM

Jack has already started working on his Ph.D., in which he will continue his work in this field. He feels that God has placed him in the perfect environment to continue his studies and make a real contribution to his community. He currently resides in Ficksburg in the Eastern Free State with Claire, his wife of two years, a medical doctor. Here, he has shared his knowledge with farmers in the region, giving advice and speaking at public events. He hasn't lost his enthusiasm for tourism, but is now looking for ways to combine it with his interest in agriculture.

"I would like to develop a short course in agricultural tourism. The central parts of South Africa is mainly agricultural land, and many tourists travel through it, without knowing much about what they see on the land."

Much remains to be done. But Jack's work can be summarised in the quotation from Ezekiel 47 he uses to conclude his dissertation:

"Swarms of living creatures will live wherever the river flows. There will be large numbers of fish, because this water follows there and makes the salt water fresh; so where the river flows everything will live."

