

# THE PRESENT STATUS AND FUTURE PROSPECTS OF EM-TECHNOLOGY IN SOUTHERN AFRICA

G.A. Smith

University of Pretoria, South Africa

Sub-Saharan Africa holds the promise to become the breadbasket of Africa. The region has the natural resources and although the climate is not always optimal for food production, proper management and utilization of the resources would dramatically enhance the production capacity of the Southern African countries.

Though political strife often results in frightful situations of human suffering and hardship, as are now again being experienced in Sudan, a new spirit of self reliance is taking root among many Africans as they seize control of their destiny. Out of sight of our narrow focus on disaster, another Africa is rising, an Africa that work, the Africa of Mozambique and Mali, Eritrea and Ghana, South Africa and Botswana, Uganda, Benin, Ethiopia, Ivory Coast and Tanzania.

- What is new is how some nations are figuring out ways to harness their natural and human resources into working models of development, even while others can not.
- What is new is the astonishing extent to which ordinary Africans are searching out their own paths to progress.
- What is new is that the enduring example of Nelson Mandela has heartened all Africans with a fresh vision of leadership, how men of their own kind can be admired, respected even emulated.

To be successful, we do have to understand the African way, the Ubuntu principle, i.e. a complex highly nuanced percept governing the way individuals relate to the community. There are also some common lessons that any African nation can learn. One of them is that agricultural self-sufficiency starting from the bottom up, is essential for progress. It is in this respect that EM-technology and Kyusei Nature farming has a role to play.

In Africa three aspects are of extreme importance:

- Optimal utilization of resources to produce food.
- Optimal utilization of water as a critical element in society.
- Conservation of the environment

It is with this in mind that we at the University of Pretoria have such a keen interest in EM and Kyusei Nature Farming. The University of Pretoria is the largest residential university in South Africa with 26,500 students. It is the leading university with respect to agriculture and industry situated in Gauteng - the economic heartland of the country. Gauteng contributes 27% to the gross national products of Sub-Sahara Africa compared to less than 4% by countries such as Angola, Zimbabwe and Tanzania (2%).

## EM in animal production

The following trials are at present being conducted on our research farm:

### Poultry research

The first trial with the title “The effect of effective microbes (EM) on the growth performance of indigenous South African chickens fed low protein diets”, conducted by Sherri Kitney, a post-graduate student, had the objective to establish whether the inclusion of EM in diets with a low protein content would enhance the performance of the slow growing birds which are widely used in villages all over the country. In these villages protein sources are extremely expensive and often difficult to obtain.

The hypotheses was that birds on a low protein diet supplemented with EM would perform as good as birds fed a standard commercial diet with a high protein level.

The four breeds used in the study were :

Ross	a commercial broiler.	} Indigenous breeds
Lebowa-Venda		
Naked-necks		
Koekoek	a dual purpose breed	

The diets which were used had different protein levels and differed with respect to the inclusion of a growth stimulant and coccidiostat. The low protein diet supplemented with 3% EM-Bokashi had no supplement of growth stimulant or coccidiostat.

**Table 1. Diets used in indigenous chicken study.**

	Starter	Grower
Control	23% CP	18% CP
0% EM	20% CP + GS + C	15% CP + GS + C
3% EM	20% CP + 3% EM	20% CP + 3% EM

CP = Crude protein

GS = Growth stimulant

C = Coccidiostat

EM was supplied only in the feed as the birds were housed on the floor in a environmentally controlled house with bell-drinkers. Feed and water was supplied *ad lib.* and the lighting schedule was 2 hours light/ 1 hour dark.

The average daily gain and feed conversion presented in Tables 2 and 3 indicate that the addition of 3% EM-Bokashi to the diets resulted in a growth which was comparable to that of the diet with the high protein and addition of growth stimulant and coccidiostat.

From the information in Tables 1 and 3 it is evident that village chicken producers could save substantially on feed cost and eliminate the use of expensive growth stimulants and coccidiostats and still achieve results comparable tot hat being achieved on a commercial diet. This will make chicken production more economical and ensure a healthy product for the household.

**Table 2. The effect of EM in low protein diets on average daily gain of chickens 6-12 weeks of age.**

	Control (g)	0% EM (g)	3% EM (g)	Control (g)	0% EM (g)	3% EM (g)
Control	39.54	38.63	38.36	-	-	-
Lebowa- Venda	11.0	10.2	9.7	18.93	16.11	17.35
Naked-neck	10.6	10.3	10.9	17.21	16.07	18.26
Koekoek	11.7	10.4	10.9	19.49	17.64	19.75

**Table 3. The effect of EM protein diets on the feed conversion of chickens 6-12 weeks of age.**

	Control (g)	0% EM (g)	3% EM (g)	Control (g)	0% EM (g)	3% EM (g)
Control	1.95	2.13	2.10	-	-	-
Lebowa- Venda	2.57	2.67	3.09	3.27	3.92	3.88
Naked-neck	2.35	2.58	2.40	4.09	4.67	4.08
Koekoek	2.29	2.43	2.43	3.22	3.39	3.29

In a second trial with broilers conducted by Andrew Safalaoh, a PhD student of us from Malawi, which was entitled “Effect of effective microbes (EM) and antibiotic supplementation in broiler diets on growth, feed conversion efficiency, carcass yield and serum cholesterol values of broilers”.

The objectives of this study were;

- To evaluate the effect of EM on the growth, feed conversion, carcass yield and serum cholesterol levels of broilers.
- To determine the value of EM as an alternative to antibiotics in broiler diets.

Ross broilers were housed in an environmentally controlled house and fed a starter diet (1-28 days) followed by a grower diet from day 29-42. The results of the study are summarized in Table 4.

**Table 4. Combined effects of EM and antibiotic supplementation on final body weight gain, food intake and feed : gain ratio of broilers at 42 days of age.**

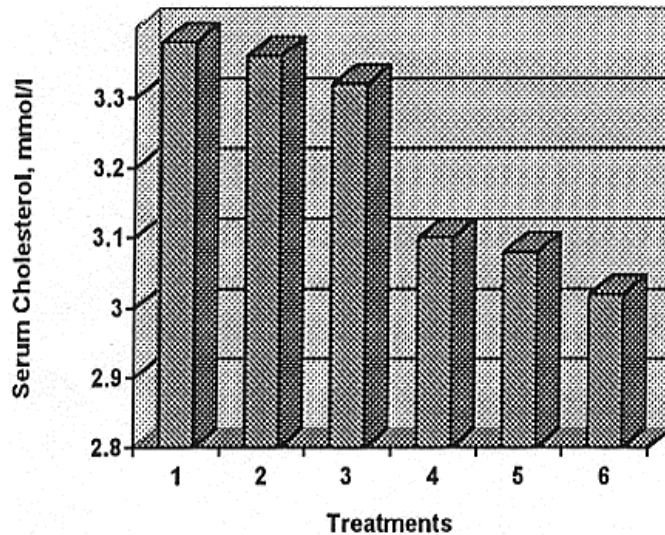
	0% EM + Antibiotic + GS	0% EM	1.5% EM + Antibiotic + GS	1.5% EM	3.0% EM + Antibiotic + GS	3.0% EM
BW gain, (g, 0-42 d)	2084.96b	2065.99d	2090.59ab	2075.75c	2095.66a	2091.70ab
Food intake, g	3737.31de	3755.15c	3733.37c	3739.13d	3769.61a	3762.47b
Dressing percentage, % of live BW	67.12b	67.26b	68.91b	68.72b	72.13a	71.80a
Abdominal fat, % of BW	0.95b	0.92b	0.76c	0.77c	0.90b	1.07a

abcd Means with no common superscripts are significantly different.

A = Antibiotics

GS = Growth stimulant

In evaluating the data it was evident that 3% EM-Bokashi inclusion in the diet supported a growth in the chickens significantly better than that obtained with a diet with antibiotic and growth stimulants. The carcass yield of the birds receiving the 3% EM-Bokashi was significantly higher than that of the treatment without EM-Bokashi. This may be attributed to the higher fat in the carcass which indicates that energy was in excess. This makes the results on the cholesterol even more interesting with the serum cholesterol level of the chickens receiving the diet with the 3% EM-Bokashi being significantly lower than those receiving diets without EM-Bokashi. The chickens receiving the 3% EM are thus to be favored from a health point of view (Fig 1).



### Effect of EM supplementation on serum cholesterol of broiler.

NB: The treatments are represented as follows:

Supplement	1	2	3	4	5	6
Effective microbe level, g/kg	0	0	15	15	30	30
Zinc bacitracin, mg/kg	500	0	500	0	500	0
Solinocox, mg/kg	333	0	333	0	333	0

**Figure 1. Effect of EM supplementation on serum cholesterol of broilers.**

The next study to be conducted in this series will be to investigate the effect of EM on the water soluble vitamin requirements of broilers.

### EM-Bokashi in layer diets

A MSc student - Amanda Jacobs, is at present conducting a study with Amberlirik replacement pullets. The title of her study is “The effect of EM on growth, production and quality of commercial layers”.

The objective of her study is to

- Quantify the response of growing pullets on EM-Bokashi in the diet to
- Quantify the effect on egg production and egg quality.

The results reported are up to 12 weeks of age during the growing phase of the pullets . Two diets are feed during the growing phase (Table 5).

**Table 5. Composition of diets fed to the growing pullets.**

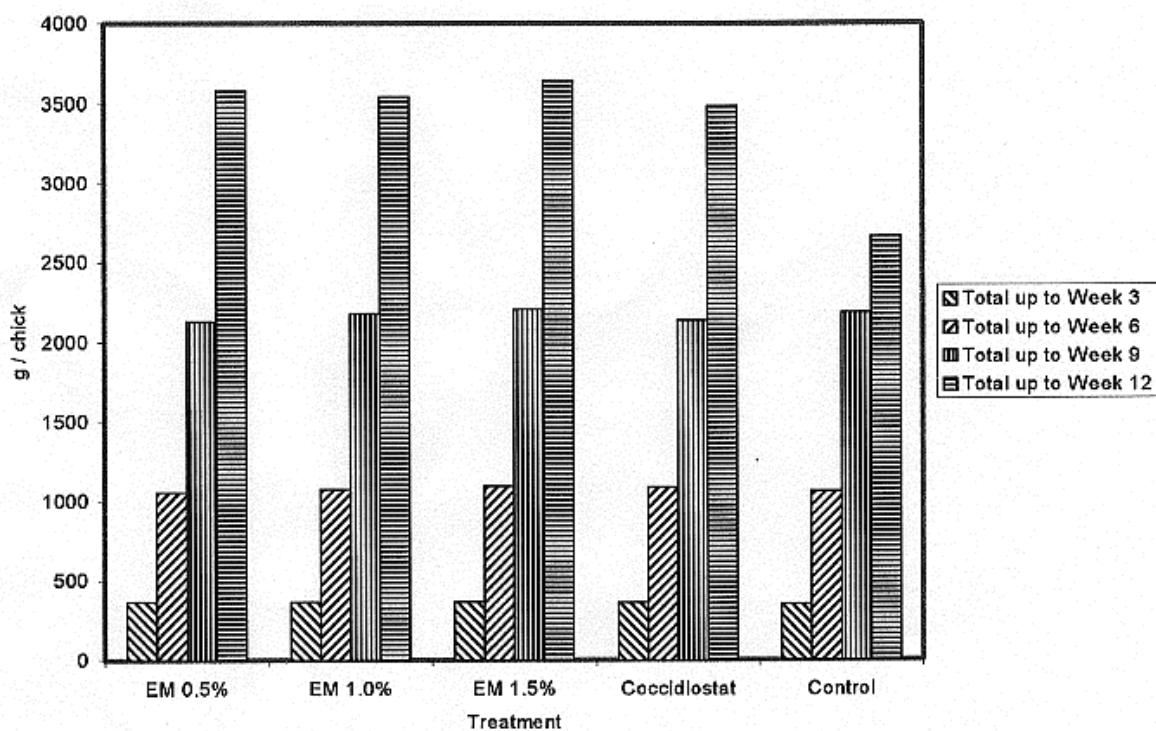
	Starter 0-6 weeks	Grower 6-18 weeks
Energy MJME.kg <sup>-1</sup>	11.92	11.92
Crude protein g.kg <sup>-1</sup>	17.0	15.0
Calcium g.kg <sup>-1</sup>	9.0	8.0
Av. phosphorus g.kg <sup>-1</sup>	4.0	3.5
Sodium g.kg <sup>-1</sup>	1.5	1.5
Lysine g.kg <sup>-1</sup>	8.0	5.6
Methionine g.kg <sup>-1</sup>	2.8	2.3

The treatments were the following (Table 6):

**Table 6. Treatment for pullets fed EM-Bokashi**

Control	Test diets			
0% EM	0.5% EM	1.0% EM	1.5% EM	Coccidiostat

The results obtained with this study are presented in Figures 2-5.



**Figure 2. Total feed intake (gram / chicken).**

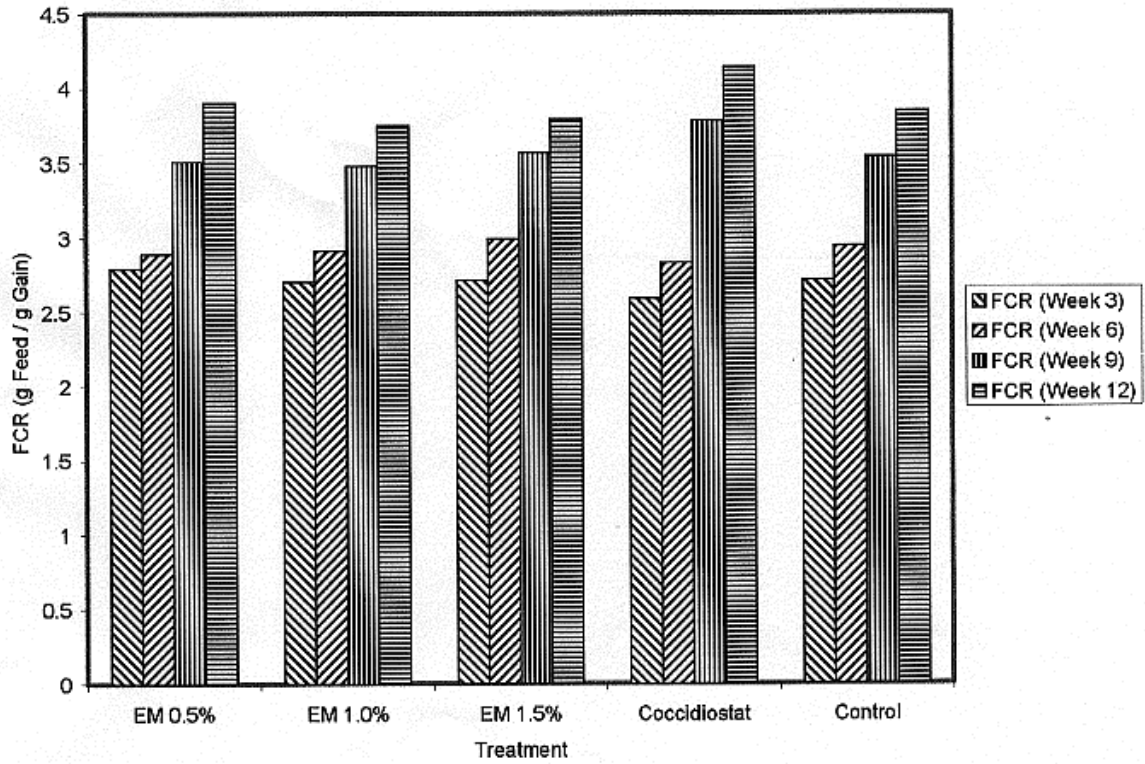


Figure 3. Feed conversion ratio (g feed / g body mass).

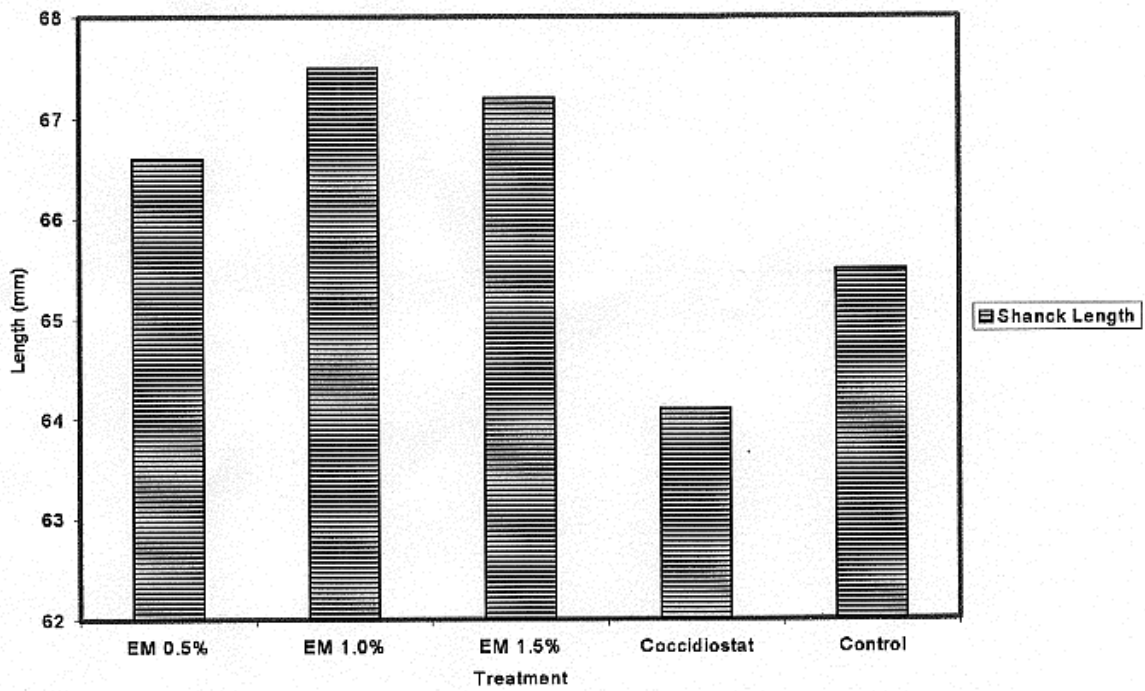
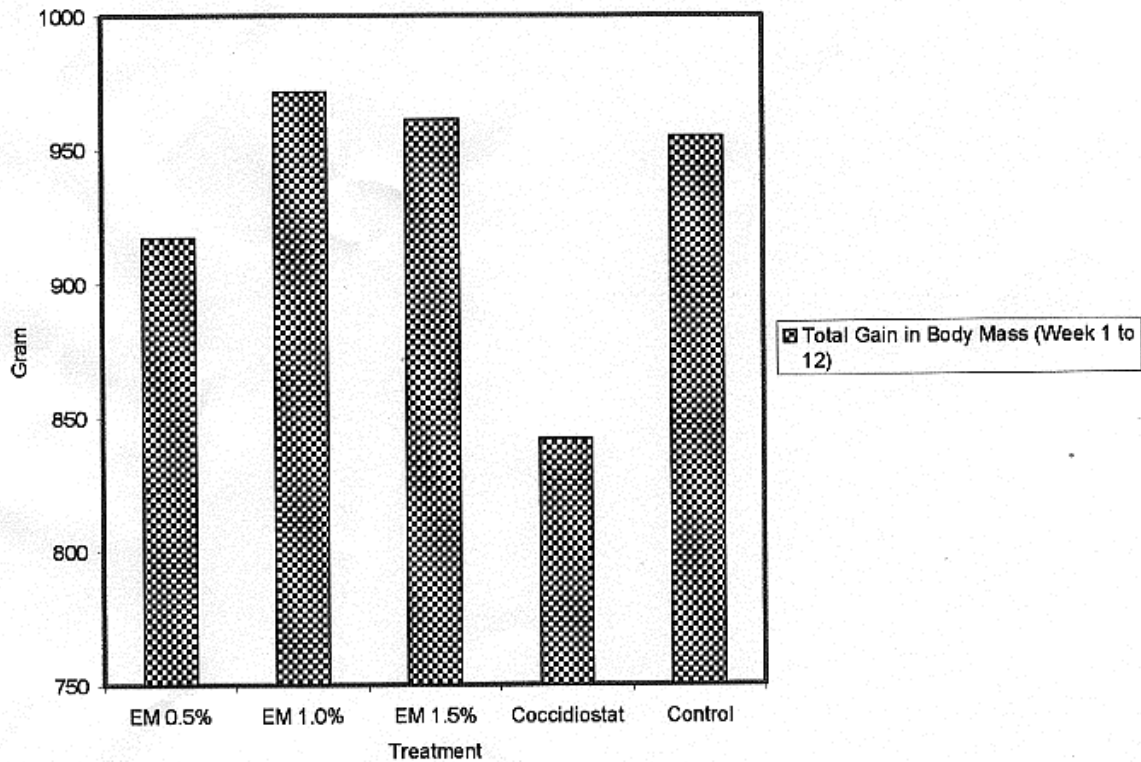


Figure 4. Total gain shanck length (week 1-12).



**Figure 5. Total gain in body mass (gram) (week 1-12).**

The growth performance to date tends to favor the 1.0% EM-Bokashi inclusion level. The very poor results obtained with the coccidiostat are difficult to explain.

The laying phase will however be of prime interest. During that phase, egg production, various egg quality parameters and cholesterol content in the eggs will be used as evaluation criteria. The results are very important as we now have 167 million commercial layers in South Africa.

### **EM-Bokashi in pig diets**

The effect of EM on the productivity of pigs is the title of a MSc study by Gerhard Pretorius. The objectives of his study are to quantify the effect of EM-Bokashi on

- The digestibility of the pigs
- The growth of the pigs and
- The carcass quality of pigs at slaughter.

**Table 7. The treatments in the EM-Bokashi study with pigs.**

Control	Treatments			
0% EM	1% EM	2% EM	3% EM	Antibiotics

Pigs were fed *ad lib.* one per pen and had free access to water. Treatments were implemented



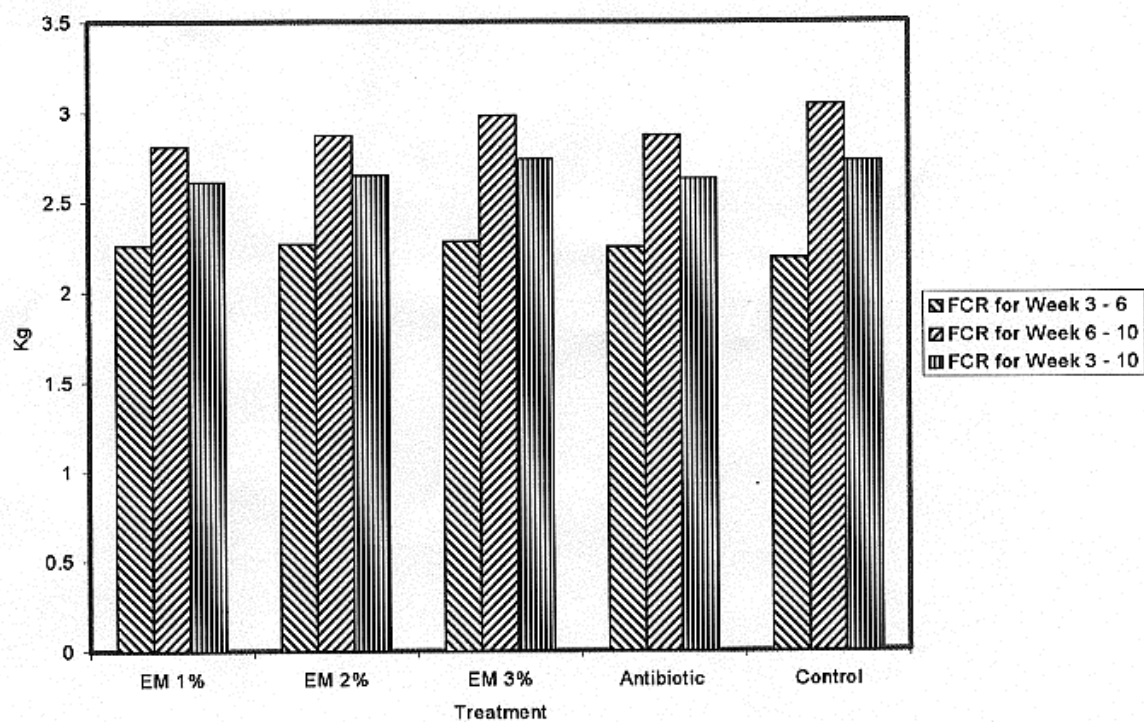
at eight weeks of age.

The composition of the test diets are given in Table 8.

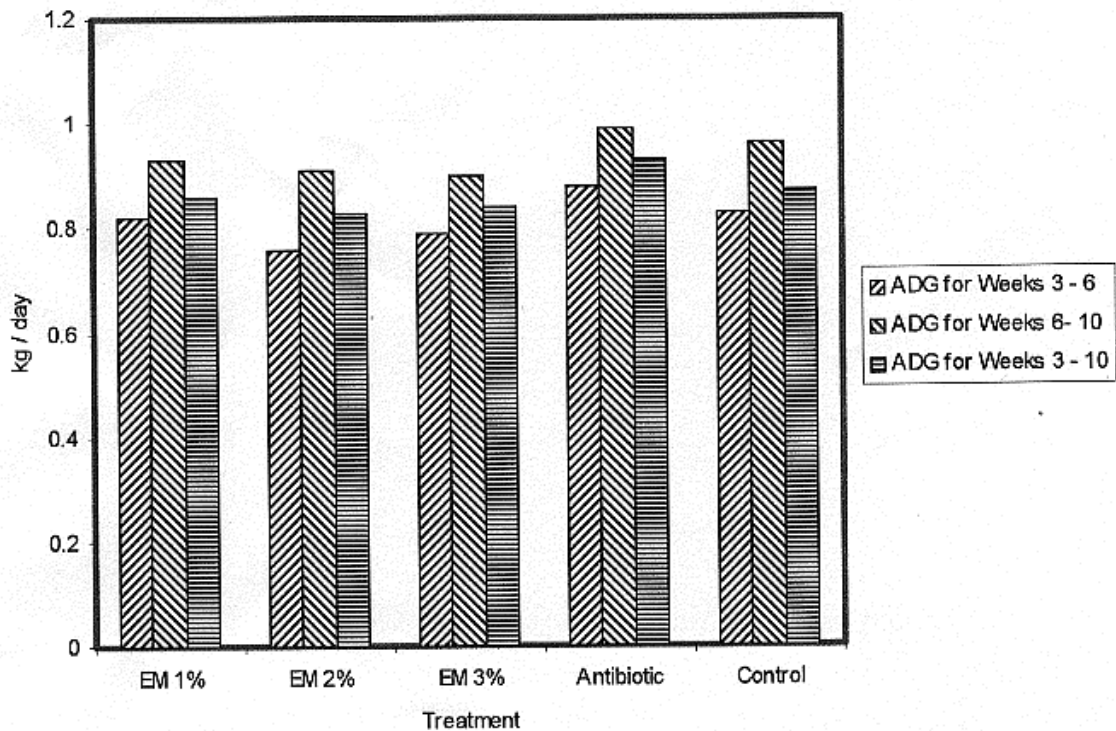
**Table 8. Composition of test diets.**

	Weaners %	Grower %
Maize meal	49.70	52.20
Wheat bran	16.30	14.20
Sunflower oil cake	10.00	15.00
Full-fat soya	20.00	15.00
Fishmeal	1.20	-
Salt	0.39	0.40
Lysine	0.24	0.24
Feed lime	1.30	1.85
Monocalcium phosphate	0.51	0.63
Vit/Min premix	0.50	0.50
Nutrient composition		
Protein	18.48	18.00
DE MJ.kg <sup>-1</sup>	13.80	13.50
Fibre	5.23	5.48

The results with respect of average daily gain and feed conversion are presented in Fig 6.



**Figure 6. Daily gain of pigs.**



**Figure 7. Feed conversion of pigs.**

The indication are that the 1% inclusion level support optimal performance as evaluated with respect to feed conversion and growth.

The digestibility studies will commence shortly and we are confident that the results of that will clarify some of the questions which exist at present.

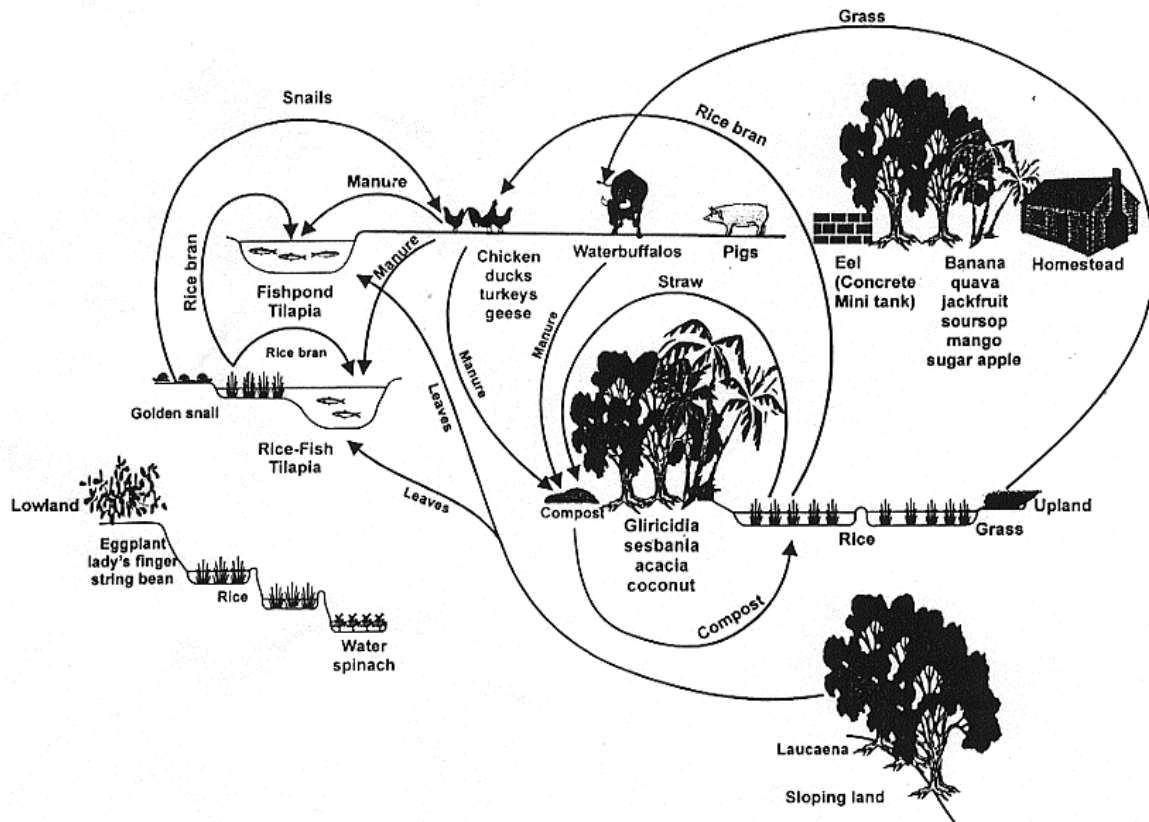
A study will also be done at a large pig farm to test the effect on the sows and litters.

### **EM-Bokashi in cattle**

A study with EM-Bokashi fed to steers were conducted by Leon Hail, an old student of ours. This study was conducted under farm conditions where EM-Bokashi was included at 3% in the diet. The diet was a standard feedlot-type diet fed by smaller producers. Excellent growth was obtained with the cattle. This type of study will now be extended to a large feedlot in Botswana.

## EM-Bokashi in integrated systems

To utilize the available resources in Africa the most efficient on integrated systems would be the most appropriate. An example of such a system is presented in Fig 8.



**Figure 8. Bio-resource flow model of an integrated agriculture-aquaculture farm.**

EM has now been introduced in such a system where we are collaborating closely with Prof Koos Prinsloo, Director of the Aquaculture Centre at the University of the North. In the system fish, vegetables and poultry are integrated. EM is now used in the vegetable production and in the fish production section which is a water recycling system. This integrated system has tremendous potential to be established on the land available at various water purification plants in South Africa.

## EM water utilization and the environment

A small lake with water organ was created in the Hennopsriver at Centurion as a focal point of a multi million dollar new city development. Properties overlooking the lake are prestigious hotels, office complexes and a shopping mall.

Pollution from townships upstream where inadequate sanitary facilities exists as well as run-off from land with poor soil cover, bring down tons of silt after thunderstorms. This turned

this dream lake into a nightmare for the city council, as newspaper clippings testify. Millions will have to be spend to address this problem of not only silt but of bad odors as well.

We are positive that EM can contribute significantly to reduce the organic pollution in the system. EM can be introduced at the outflow of the water purification plants - upstream from the lake as well as in the townships.

EM can further be used to reduce the organic load in the sludge as well as the odor of this material which is now to be pumped to a quarry situated in a Technopark area and near an upmarket golf complex. Any bad odors will cause serious problems for the city council.

We have already had discussions with Dr. Pieter van Eeden of Ecological Services of ERWAT Laboratories. East Rand Watercare is responsible for the purification of water in several municipal areas where pharmaceutical and food processing companies are very active.

Apart from chemical water analysis this company uses biological parameters to evaluate the impact of pollution before and after the water treatment plants. An example of this is the rapid impact assessment approach in which the aquatic insect diversity and the habitats where they occur are evaluated. In the process the South African Scoring System Version 4 (SASS4) and the Habitat Quality Index (HQI) is used to derive at indexes.

An example of this approach would be the three streams evaluated by ERWAT.

- Stream 1 had a gross organic pollution, probably from human origin. Water quality as measured with pH 7.2 and turbidity 29 which was relatively good but the saturated oxygen level was low (45.5%). The Habitat Quality Index was 85 and the SASS4 value of 2.24. Only five insect families were found in this water.
- Stream 2 was a system with gross pollution from industrial origin. Only five insect families were present. Water quality was not too bad pH of 7.2 being and turbidity of 42. The saturated oxygen levels were very low (26.5%). This site had a HQI of 80 and a SASS4 value of 2.60.
- Stream 3 - Koffiespruit - had clear water and no apparent impact and is a control site. The pH was 8.1 and turbidity of 97 whilst the saturated oxygen levels were very high (96.6%). The HQI value 75 and the SASS4 value of 3.82.

The use of EM and the effect there-of on the water quality and the beneficial effect on the environment could thus be quantified by ERWAT making them a very valuable partner.

Enhancing water quality will tie in with the philosophy expressed in the White Paper on the National Water Policy in which provision has been made for the protection of river ecosystems by allocated water rights to reserves which provides for the in stream water requirements and basic human needs. In the past very little protection existed for eco-biotic water needs to ensure a prolonged water supply for natural ecosystems during drought conditions. River systems were over-utilized rendering them incapable of sustained yield and with consequent detrimental effects on the natural aquatic ecosystems. The main user was agriculture for irrigation.

## **EM Centre**

The EM Centre which is being established near Pretoria by Mr. Yoshida, is nearing completion. It will play a very important role in the training of people in the use of EM and the underlying philosophy.

Other projects which are at present receiving attention for the use of EM are the following:

- The Johannesburg and Pretoria Zoo's.
- Wine farms.
- Herb farms.
- Crocodile farms.
- Rose and carnation nurseries.
- Pig farms.
- Land reclamation at mine sites.
- Waste-dumps.

We are confident that EM will play an important role in South Africa where we see a bright future for EM technology. This prospect makes us all very excited.