PROBLEMS FACED AND ADVANCES MADE BY AGRICULTURAL ENGINEERS IN SOUTHERN AND EASTERN AFRICA

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Abstract. *The practice of agricultural engineering in Africa dates back to the Egyptian civilisations that depended on irrigation along the Nile River, but as a discipline, agricultural engineering is fairly recent. Agricultural engineering is commonly defined as the application of engineering knowledge to solve agricultural problems. This overview paper looks at the problems faced and advances and inroads made by agricultural engineering in southern and eastern Africa. It is shown that agricultural engineering in the region has faced a number of problems to do with identity, professional recognition, and lack of support from industry. The agricultural engineer has suffered from problems that include poor employment opportunities, low prospects for professional and career development and poor conditions of service, whilst degree programmes in agricultural engineering faced problems of lack of popularity, competition from more visible programmes and low resource endowment. Despite these problems, agricultural engineering has made advances and inroads on several fronts. The profession has gained professional recognition; it has identified its niche in society, and now there are supportive societies to push the agricultural engineering agenda. The individual agricultural engineers are now recognised as engineers in their own right; they have better employment prospects because of widening of the role of agricultural engineering, and have clearer career paths. The agricultural engineering degree programmes have expanded their programmatic philosophies; they are recognised by engineering councils and now produce a better and adaptable product. Agricultural engineering, as is or under a different name, is expected to continue to play a central role in increasing agricultural productivity into the future in the region because of the agro-based nature of the economies.*

Keywords. Agricultural productivity, irrigation, mechanisation, programmatic philosophy, curriculum, accreditation, employment prospects.

INTRODUCTION

Agricultural engineering has traditionally been defined as the application of engineering knowledge to solve agricultural problems. Agricultural engineers thus use engineering tools and practices to solve production, handling and processing problems for food and fibre along the production to consumption chain. It is generally argued that agricultural engineering is relatively new as a profession whose organised origin is the USA (Musonda, 1999) and considered as an organised reinvention of long practised activities in agriculture. The origins of agricultural engineering as a discipline can be traced to societal needs in general and farmers' requirements in particular. The forces and factors that came into play in the

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development of agricultural engineering included the need for increased agricultural production to feed growing populations, labour shortages and production costs leading to mechanisation, climatic vagaries leading to irrigation, and environmental factors leading to farm structures for animal housing, just to mention a few. To a large extent, these needs were served by civil and mechanical engineers although a gap remained that required proper marrying of engineering and biological components – hence the role of agricultural engineering.

The practice of agricultural engineering in Africa dates back to the early Egyptian civilisation that survived on irrigation practices along the river Nile (Fukuda, 1976). However in most parts of Africa, agricultural engineering is much more recent and progressed mainly as part of the agricultural mechanisation (tractorisation) drives in many countries. Thus for a long time agricultural engineering was synonymous with agricultural mechanisation (disc ploughs and tractors) and therein lay an identity problem that dogged the profession for a long time up to the present – worse in Africa context were change takes place much more slowly.

The traditional core pillars of agricultural engineering were agricultural machinery and farm power, soil and water engineering, post harvest technologies, and structures and the environment. In more recent times, there has been a discernible shift from the hard core name of agricultural engineering to one that is more encompassing. Since about the early 1990s agricultural engineering programmes in North America and Europe have been renamed to Bio-resources engineering or Bio-systems engineering or Agricultural and Biological engineering (where agriculture maintains links with the past and biological emphasises the new applications in biotechnology and environmental management) (ASAE, 1991). The name change is an adaptation that has come about as the profession of agricultural engineering attempts to remain alive and relevant to the present times and changing circumstances.

Taking a look at the African agricultural engineer and the agricultural engineering profession, one would like to ask the question; what problems have been faced by the individuals and the profession from the past to the present? A corollary to the question would be what advances and inroads have agricultural engineers and the profession made to date? This paper gives an overview of the problems faced, and the advances and inroads made, by the profession as well as the agricultural engineers in southern and eastern Africa. It will be shown that the profession and the individuals have faced a number of problems, some serious and others minor, over the years. Some of the problems are or were for real whilst others are anecdotal. Some of the problems faced include lack of recognition as a profession, lack of accreditation, poor employment and career development prospects for the agricultural engineers, lack of support to agricultural engineering degree programmes and competition from more visible engineering programmes, and slow responsiveness to changes in society and industry. Despite these problems, agricultural engineering has also made some inroads and advances over time. This has lead to agricultural engineering being recognised for what it is and what niche it fills in society and industry. Some of the advances made include professional recognition, widening of scope to include recent changes in the field, development of supportive agricultural engineering societies, improved career prospects and the general impact that the profession has made on world food production and sustainable development. The overview will enumerate

the problems and advances made with respect to the agricultural engineering profession, the agricultural engineer, and the agricultural engineering degree programmes at universities and colleges in southern and eastern Africa, because these are all closely related. Whilst the problems might appear like a litany of complaints, they serve to actually find solutions and make the agricultural engineer more effective. The discussion will also touch briefly on world developments and the role of agricultural engineering in the future.

PROBLEMS FACED BY AGRICULTURAL ENGINEERING

Agricultural engineering has faced and continues to face several problems, directly and indirectly, as well as those of its own making and others beyond its control.

Problems faced by the agricultural engineering profession

The agricultural engineering discipline has faced several problems to do with definition, identity, recognition and support.

Problem of definition and identity: As alluded to in the introduction, the origins of agricultural engineering are based in agricultural mechanisation and thus for a long time in Africa (and even elsewhere in the world), the discipline was taken to be synonymous with mechanisation and farm power. Thus the moment one talked about agricultural engineering, it was automatically perceived to be something to do with tractors and ploughs. At best, over and above mechanisation, agricultural engineering also included soil and water conservation, which was synonymous with contour pegging and construction of storm drains. The situation was not helped at all by the fact that in most government ministries and departments, research centres or institutions charged with agricultural engineering research and extension, tended to have the two units of tractors (implement development, tractor testing, etc) and soil and water conservation, and very little (if any at all) of the other agricultural engineering aspects, further cementing the wrong definition and identity of agricultural engineering. Up to this date, departments of agricultural engineering in many companies and agricultural parastatals are basically departments in charge of tractor repairs and maintenance, even though there might also be a whole section on irrigation (falling under Field or Agronomy section!). This only serves to show the poor definition and understanding of agricultural engineering.

Lack of professional recognition: Agricultural engineering was for a long time not recognised as an engineering profession in southern and eastern Africa, and in some cases this is true up to date. In olden days, the agricultural engineering profession was manned by civil and mechanical engineers plying their trade in agriculture. As a result, their allegiance was to their primary qualification rather than agricultural engineering. Thus no one slaved to put agricultural engineering on the professional map until quite recently. Society and industry did not recognise agricultural engineering and so the profession suffered from lack of goodwill investment into it. It is not surprising to find agricultural engineering excluded from competitions undertaken or awards given (e.g., civil or mechanical engineer of the year award) by industry in many countries in the region today.

Low ranking of agricultural engineering: Generally, agricultural engineering was always ranked lower than the other traditional engineering disciplines. This meant that conditions of service were always not so good implying that the profession could not employ the best. By extension, it meant the profession did not get the best of representatives to argue for it in general.

Limited opportunity to practice the trade: In most of the southern and eastern African countries, agricultural engineering was rarely practices as a profession in its' totality. Industries in the region generally did not have research and development (R & D) department, thus limiting the practice of agricultural engineering. A large proportion of African agricultural industries engaged mainly in the importation of agricultural equipment and machinery, the exception being probably Zimbabwe and South Africa because of their partial isolation from world trade (because of the politics of the time). Thus, more often than not, agricultural engineering in these industries comprised sales and marketing of machinery and equipment. In government departments, there were formal agricultural engineering posts, but these were limited to mechanisation and soil and water conservation.

Low value of agriculture: In the production to consumption continuum, agriculture occupies the base of the value pyramid. This means there is very little value addition (beneficiation) at this level thus limiting investment in support disciplines like agricultural engineering involved at these lower levels of production. The situation has only started to turn around as agricultural process engineering has come to be more prominent in the final stages of the production to consumption chain.

Problems faced by the agricultural engineer

Like the profession, the agricultural engineers in southern and eastern Africa also faced a plethora of problems. Some of these were aligned to the 'hazards' of the profession whilst others were more to do with societal perceptions.

Lack of recognition: Agricultural engineers were not recognised as engineers, unless if they were from the traditional disciplines of engineering. In the past, engineering accreditation was mainly through institutions in the UK or Europe and unless if one graduated from those colleges and universities, they could not be registered. Even when engineering accreditation was localised, it still proved difficulty because the rules and regulations were a simple translation of the overseas criteria. The mastery and acquisition of requisite engineering skills (Nyirenda, 1999) by agricultural engineers was always doubted. The problem was even more acute in latter years when agricultural engineers were perceived to be agriculturalists with a little engineering. This is reflected in the often quoted definition of an agricultural engineer as "*a person who prefers to talk about engineering in the presence of farmers, and about agriculture in the presence of engineers*!" The problem also pervaded language interpretations as evidenced by names such as 'ingenieur genie rural' or 'ingenieur agronome' in French – this tied the agricultural engineer to rural infrastructure, soils, agriculture and the farm setup, further clouding the fact that these people are also engineers. This link to agriculture, and also the consistent but

mediocre prestige that engineers have in the eyes of the public (AAES, 1998) meant agricultural engineers had to work hard for recognition.

Poor professional development prospects: Coupled with the lack of recognition by the society and industry, agricultural engineers suffered from poor professional development prospects. If agricultural engineering was seen as mechanisation, there was very little scope for professional growth except to become head or chief workshop mechanic, so to speak. Industry was more interested in sales and marketing thus putting to waste all the engineering knowledge that the agricultural engineer had acquired. In government research setups, the structure was generally flat, mainly research officer to senior officer and the usual chief or head of the unit. Exposure to all fields of agricultural engineering was very limited. Thus the agricultural engineer had a very narrow career development path. On the academic development front, academic growth has been frustrated by the lack of support and funds for research. In eastern Africa, when the first batch of agricultural engineering professors left the academic system, it was quite a while before the next generation of professors came through.

Lack of access to information: Developing countries are notorious for not having access to information. Likewise, agricultural engineers suffered from lack of access to recent and relevant information. Their libraries were always poorly resourced. The effect of this was that the agricultural engineer in southern and eastern Africa was somewhat always behind in information and hence technology development and the research tended not to be 'cutting edge'. Although the problem has improved slightly with the advent of internet and online information, still most agricultural engineers in the region do not have access, mainly because of poor connectivity.

Poor conditions of service: In most of southern and eastern Africa, traditional engineers (civil, mechanical, and the like) tended to get relatively good conditions of service compared to agricultural engineers. Whilst traditional engineers were given professional and retention allowances, agricultural engineers rarely got these. This problem was found both in universities, government and industry. A negative consequence of these poor conditions of service was that agricultural engineers, invariably, had to engage in side activities or private businesses such as consultancies, farming, transport services and the like. These side activities are necessary but do not add to the professional growth of the agricultural engineers. The agricultural engineer would thus lag behind in terms of research publications, engineering inventions, and so on. The poor conditions of service would also mean that academic and research institutions would have problems in recruiting experienced professors and personnel leading to the employment of young inexperienced agricultural engineers who cannot offer any mentorship to others, thus leading to further lack of professional development.

Poor employment prospects: As economies in southern and eastern Africa have moved from central command to market driven economies, employment prospects for agricultural engineers have diminished drastically (Senzanje, 1996). Instead of expecting to be employed upon completion of their studies, more and more graduate agricultural engineers have to 'walk the streets', or be engaged in entrepreneurial activities that may have absolutely nothing to do with agricultural engineering. It is

not unheard of in parts of the region to find an agricultural engineer teaching geography or bible studies at a secondary school! An engineering manpower survey in the industries of Zambia in 1992 found a total of 1695 established positions, and of these only 54 were for agricultural engineers compared top say 700 posts for mechanical engineers and 584 for electrical and electronic engineering (Lusambo, *et. al.*, 1999). This point to poor employment chances for agricultural engineers. Some of the ramifications of poor employment prospects are interesting, but somewhat saddening. In academic institutions, professors would often engage brilliant recently completed under graduates students for postgraduate research and studies leading to masters and doctorate qualifications in a short space of time. Whilst this is good, what you have at the end is a highly qualified but highly inexperienced individual in agricultural engineering – never spent a single day of their lives working in really agricultural engineering. This leads to lack of confidence and also an undesirable incestuous knowledge base between the professor, the former student and the research project they worked on!

Problems faced by agricultural engineering degree programmes

Agricultural engineering degree programmes in most of the southern and eastern African countries faced and have continued to face problems to do with support, access to resources and competition with other more visible programmes. This translates into the quality of the teaching and the product of that programme.

Lack of popularity of agricultural engineering degree: Agricultural engineering degree programmes were really never popular in this African region. The cynical argument was always, if you can get into the engineering college why not do real engineering! Thus the agricultural engineering degree programmes were dogged by low student numbers, which probably translated to less resource allocation to the programme with the consequent problems associated with poorly resourced programmes. In good institutions such as the University of Pretoria in South Africa, student intake numbers are down to less than 10 per annum in agricultural engineering. On a comparative basis, it is most likely that agricultural engineering was popular at European institutions like Silsoe College in the UK which sort of specialised in agricultural engineering. It is interesting, but sad, to note that even this world acclaimed college of agricultural engineering has since stopped offering undergraduate degrees in agricultural engineering. This is indeed a sad day for agricultural engineering – probably quietly sinking into oblivion?

Lack of support from central authorities: Low student numbers as well as lack of popularity of the agricultural engineering degree programme manifest themselves through less resource allocation from central administration of agricultural colleges and universities towards agricultural engineering. This is much more true in Africa were universities are already under funded to a large extent. As a result, agricultural engineering laboratories are rarely adequately equipped or staffed (Senzanje, 1999). The industrial base in southern and eastern Africa is also very small leading to further resource constraints in terms of donations or funded programmes from industry to agricultural engineering. The lack of support, including for research funds, is reflected in the type of research that is carried out in the region, it's mainly of an applied nature and that is good, but it is rarely breakthrough type of research. An

interesting phenomenon of lack of local research funding is that most of the agricultural engineering research is funded from overseas sources (probably over 85% of the total) that have their own research agenda, some of which might really not be critical to the problems faced by countries in southern and eastern Africa, further making agricultural engineering work irrelevant and not adopted or taken up by many.

Competition from more visible degree programmes: In the past, agricultural engineering suffered from competition from much more visible programmes such as civil or mechanical engineering, and in the not so recent past, environmental and chemical engineering. Engineering ranked and still ranks fairly low amongst the more traditional engineering disciplines. In some institutions agricultural engineering was like a specialisation in the main traditional engineering degree programmes, further clouding the identity and competitiveness of agricultural engineering.

Lack of accreditation by engineering councils and boards: It is sad to note that some engineering programmes have not been formally accredited by the appropriate engineering boards or councils in their countries. A case in point is the programme at the University of Zimbabwe which is accreditation by association with the Faculty of Engineering and other engineering programmes there. Lack of accreditation weakens the programme and limits the employment prospects of students coming out of that programme as well as their ability to be registered as engineers after serving the required professional housemanship.

Slow responsiveness to change: Agricultural engineering degree programmes in southern and eastern Africa are very slow in changing and adapting to changing times. Whilst most agricultural engineering degree programmes in north America and Europe have since evolved and changed their names to modern and more encompassing ones, in this region the old name is still being used and still persists. This slowness is a problem for agricultural engineering in the region. By the time change is brought about, the names will be dated and working against properly profiling agricultural engineering.

Constrained and crowded curricula in agricultural engineering: Agricultural engineering students are expected to do a certain number of courses from departments of civil, mechanical and electrical engineering and then those from agriculture and agricultural engineering. Because of time constraints and resource constraints only half-hearted attempts are made to accomplish this and as a result the agricultural engineering degree product is some sort of a "jack of all trades and master of none!"

ADVANCES MADE BY AGRICULTURAL ENGINEERING

Despite the seemingly gloomy picture portrayed by the problems discussed so far, agricultural engineering has made some inroads and advances at both the individual and professional level. Agricultural engineering as is, or reincarnated in some other name, will continue and be expected to play a significant role in southern and eastern Africa. This is because the economies are agro-based and will continue to need basic agricultural engineering input, as opposed to industrialised nations in the north.

Agricultural engineers are now much more able to articulate their cases and define their professional niche more than before.

Advances made by the agricultural engineering profession

The agricultural engineering profession has made some inroads into areas previously reserved for or dominated by traditional engineering disciplines. Agricultural engineering has also opened up new fields for itself in areas such as process engineering, environmental engineering and management.

Recognition of the agricultural engineering profession: After some hard work in alerting and sensitising society and industry to what agricultural engineering is, it is pleasing and encouraging to note that the profession is now getting the recognition that it deserves. Over the past one or two decades agricultural engineering has come to be recognised as an engineering profession. Instead of being perceived as though it is in competition with traditional engineering disciplines, agricultural engineering is now acknowledged as being complimentary to these. It feels those gaps that these other engineering disciplines cannot do, namely the agricultural and biological aspects of engineering.

Supportive professional societies: Most, if not all, countries in southern and eastern Africa now have societies of agricultural engineers or engineering. In some countries these societies date quite a long way back, whereas in others (e.g., Zimbabwe) they are barely ten years old. One of the biggest breakthroughs at the regional level was the formation in the early 1990s of the Southern and Eastern Africa Society of Agricultural Engineers (SEASAE). The purpose of these societies being to further the agenda of the profession of agricultural engineering through meetings, academic and research discourse, exchange of ideas, lobbying, informing society and so on. It is through such efforts that agricultural engineering has made some advances in terms of recognition.

Academic – industry linkages: Of late, there have been more and more linkages between agricultural engineering institutions and industry, non-governmental organisations and international world bodies. As an example, in Zimbabwe and Namibia an Israeli drip irrigation company is running drip irrigation trials in collaboration with the institute of agricultural engineering and university, respectively. Again in Zimbabwe, the Institute of Agricultural Engineering was contracted to test treadle pump technology by the Food and Agricultural Organisation of the United Nations. In some cases, agricultural engineering research institutions and universities are being requested to undertake contract research by industry. These linkages have put agricultural engineering on the map, as it were, and help to highlight and consolidate its role and contribution to industry.

Advances into rural engineering: The agricultural engineering profession has made some inroads into areas such as rural engineering (Crosby, 1999), previously the preserve of other engineering disciplines. Such engineering tasks include rural water supply and sanitation, rural roads design and construction, design and construction of small to medium sized dams and irrigation schemes, and small process engineering plants. This is a significant advance for agricultural engineering. As development

moves towards smaller parcelled projects, the profession of agricultural engineering stands to play a significant role.

Advances made by the agricultural engineer

Agricultural engineers have also made advances in general and specific terms.

Professional recognition: After a long struggle, agricultural engineers are now recognised as engineers in their own right. It is no longer a case of a civil engineer or an agriculturalist with a bit of engineering working in agricultural engineering, but a case of a formally qualified agricultural engineer.

Agricultural engineer re-invented: The agricultural engineer has reinvented themselves in modern society so as to remain relevant. As in the north, we are finding slowly but surely sprinklings of bio-resources and bio-systems engineering and environmental engineering in place of traditional agricultural engineering in southern and eastern Africa. Although widely received as a new development, society is now asking 'what is a bio-resources engineer'? Hopefully we are not going to go through the whole circle again!

Better employment prospects: With an understanding of agricultural engineering and what they can do, more employment prospects are coming their way. Employment opportunities now exist in areas of water management, natural resource management, mechanisation, process engineering, environmental engineering and many others. The employment can be at the formulation, design, construction, operation, or management level. Interestingly for those who are determined, we now find agricultural engineers working in agricultural finance and management after obtaining a basic postgraduate diploma in business and financial management.

Clear career paths: With better employment prospects comes clear and diversified career and professional development paths for agricultural engineers. Instead of rising only to be chief or head of unit, agricultural engineers find themselves going all the way to the top to head departments, universities, industries and corporations. An interesting example is found in Zimbabwe were the head of one of the largest reinsurance companies in the southern Africa region is an agricultural engineer by training! A number of agricultural engineers have become project managers and are now working with banks and non-governmental organisations. The advantage of these advances by agricultural engineers is that those in higher positions open opportunities for the rest of the agricultural engineering fraternity and help to convince society on what an agricultural engineer can do.

Advances made in agricultural engineering degree programmes

Agricultural engineering degree programmes in universities and colleges in southern and eastern Africa have made some advances in terms of engineering accreditation, professional recognition of the degree and programmatic philosophy.

Advances in programmatic philosophy: Agricultural engineering degree programmes in southern and eastern Africa have become expansive in an effort to be more

encompassing and adaptable to changes in society, just like the north (ASAE, 1991). The material offered now in the degree programmes now includes more of the bio-resources and systems engineering, food engineering, environmental engineering, and some of the softer sciences like gender issues in design, and participatory approaches. An interesting example is found in the 1999 review of the agricultural engineering degree programme at the University of Nairobi in which a number of new specialisations were proposed that included environmental engineering, structures engineering, process engineering and even at one point, medical engineering (Gumbe, *et. al*., 1999).

Professional accreditation of programmes: Just like the agricultural engineer, agricultural engineering degree programmes are now accredited by local engineering councils or institutions or boards. Ready examples of this include degree programmes in Zambia, South Africa and Kenya (du Plessis, 1999; Nyirenda, 1999). These are significant advances indeed for the degree programmes. Others are still working towards formal accreditation, e.g., Zimbabwe. With accreditation come the associated benefits of recognition of the degree product (graduate), better employment prospects and better remuneration.

Quality of product: With low student numbers in agricultural engineering, this works out to be a blessing in disguise as this allows for better student to lecturer ratio and thus students get better attention in class, on project work and even when they go on field attachment, as well as follow-up after graduation. What you get overall is a better quality. This is an advantage as long as the low student numbers do not result in massive resource cuts from central administration at the university. Also with low output numbers, chances of employment are better.

AGRICULTURAL ENGINEERING AND THE FUTURE

Despite the problems of the past, globally and regionally agricultural engineers occupy a key position in the thrust for increased agricultural productivity in order to meet the foods needs of the future. The disciplines that agricultural engineering dominate are expected to play a significant role now and into the future. It is argued that sustainable agricultural development depends heavily on agricultural engineering (FAO, 2002). As was aptly put by Cuelo (2002), agricultural engineering has been one of the most effective and powerful tools of development in the last 100 years. Agricultural engineering has played a significant role in the industrialisation of world agriculture.

Taking soil and water engineering, it is noted that irrigation produces nearly 40% of food and agricultural commodities on 17% of agricultural land, thus making irrigation disproportionately important to global food security (FAO, 1997). The World Bank estimates that the growth in irrigation must be between 3% and 4% per annum in order to meet the food needs of the worlds exploding population. The world's population is expected to reach almost 9.4 billion by the year 2050 and agricultural engineering is expected to come into its own to partake in food production to feed this population. In Africa alone, it is estimated that there are about 13 million ha under irrigation producing a wide variety of food and cash crops (FAO, 1995). Given the

changes in climate, and increasing incidences of drought irrigation is set to play a key role. The thrust for the future is to increase productivity per unit of water and land input (Molden, *et. al*., 2000). Apart from irrigation, efforts are also needed to make the most of rainwater through its better management and rainwater harvesting, i.e., improved water use effectiveness. Rain fed agriculture produces by far the highest proportion, over 60%, of food crops in the world. In sub-Saharan Africa it is estimated that over 90% of agricultural production is rain fed (Hatibu, 2002). Agricultural engineering is expected to play its role in these efforts.

Apart from irrigation, mechanisation (from the lowest level all the way to precision technologies) has played a key role in increasing agricultural productivity leading on to more food and cash crop production. Agricultural mechanisation has produced high gains for soybeans, cotton, groundnuts and rice (FAO, 2002). Mechanisation is set to play an important role in the future in the southern and eastern Africa region now that there is the HIV/AIDS scourge which will lead to potential labour shortages impacting on production. The future seeks appropriate mechanisation techniques that are efficient and less damaging to the environment. The job of the agricultural engineer is thus cut out for them into the future.

Agricultural engineers are expected to be involved in future efforts to value-add agricultural products before they leave the farm gate. Unprocessed produce from the farm fetches lower prices, thus depriving the producer of much needed revenue. Besides, this lack of value addition transfers the benefits to the next level up in the chain and that does not do the producer any good. Value addition of produce will surely work towards financially empowering both the commercial and the peasant farmers in the southern and eastern Africa region. Apart from processing, there is also the challenge of handling produce so as to keep its quality good for longer periods. Grain producers in eastern Africa are faced with a major problem of the large grain borer in their stored cereals. This pest is very destructive and is proving difficult to handle as it is not responding to commonly used control pesticides. Agricultural engineers need to work with other specialists to deal with this problem.

On the environment front we find that today's key environmental problems fall in areas that agricultural engineers work in. The main problems include climatic change, water scarcity, water pollution, desertification, soil erosion and air pollution (Unmussig, 2002). Agricultural engineers, together with their counterparts are expected to play their part in finding solutions to these problems as well as bringing back into production the affected areas. Agricultural engineers are positioned to lead the way in developing new research in remediation engineering (Suresh, *et. al*., 2002) and corrective measures in dealing with the impact of production practices on soil, water and air contamination.

The new areas of bio-resources and bio-systems engineering are expected to bridge the gap between the old traditional agricultural engineering and the future more diversified requirements and expectations from society. These areas will act as lifeline for agricultural engineering into the future, albeit under a different name but still applying engineering knowledge to solve problems in agriculture and the associated environment.

CONCLUDING REMARKS

Admittedly, the agricultural engineering profession and professionals in southern and eastern Africa have faced problems in the past and even up to today. Most of these problems were to do with discipline identity, professional recognition, and competition from other visible disciplines leading to poor employment opportunities, and poor professional and career development prospects. The agricultural engineering degree programmes have suffered from lack of popularity, low resource allocation, and poor support from industry.

Despite these problems, agricultural engineering in southern and eastern Africa has made some inroads and advances. Agricultural engineering will remain relevant because of the agricultural based economies in the region. Agricultural engineering has fought back to win professional recognition, identify its niche in society and industry, and established supportive societies to push its agenda. The agricultural engineer is now recognised as a bona fide engineer, employment opportunities are now much wider, and career development prospects are better. Degree programmes have expanded their programmatic philosophy, they are now accredited engineering bodies and the quality of the graduate is better.

Agricultural engineering stands at the cross roads of the past and the future with a heavy responsibility towards increasing agricultural productivity to feed the growing population considering that southern and eastern Africa has some of the highest population growth rates in the world. Opportunities are out there for agricultural engineers. With demand for cleaner production processes and protection of the environment, agricultural engineering in the region, under the same or different name, has its work cut out.

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