Routledge
Taylor & Francis Group

Agrekon

Agricultural Economics Research, Policy and Practice in Southern Africa

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ragr20

The measurement of agricultural productivity in Africa

Jenifer Piesse & Nick Vink

To cite this article: Jenifer Piesse & Nick Vink (2023) The measurement of agricultural productivity in Africa, Agrekon, 62:1, 1-4, DOI: 10.1080/03031853.2023.2179720

To link to this article: https://doi.org/10.1080/03031853.2023.2179720

AGREKON
2023, VOL. 62, NO. 1, 1–4
https://doi.org/10.1080/03031853.2023.2179720

The measurement of agricultural productivity in Africa

Jenifer Piesse and Nick Vink

Department of Agricultural Economics, Stellenbosch University, Matieland, South Africa

ABSTRACT
Our purpose here is to provide an introduction to the set of papers in this Special Edition on "The measurement of agricultural productivity in Africa" and to draw lessons for further research.

KEYWORDS
Agriculture; productivity; Africa

1. Introduction

In a recent review of publications on the economics of agricultural productivity in South Africa, Vink *et al*. (2022, 145) highlighted five important considerations and that can be extended to other African countries:

(1) Measurement of productivity is essential for monitoring progress with structural change in agriculture generally, and with land reform, but this is difficult when official statistics are incomplete or lack credibility. Namibia, for example, has few working weather stations left and Botswana's farm census covers only some commodities and virtually no purchased inputs.
(2) Private sector partners should be involved in data collection, but this is unlikely in the absence of trust.
(3) The level of aggregation is crucial. If this is too high, the results are meaningless as a tool for policy. There also must be continuity in coverage and methods, plus it is important to protect past investments in data collection.
(4) The construction of measures of climate change must begin now for their impact to be usefully assessed.
(5) More work needs to be done on measuring subsistence production and household food security as a vertically integrated system.

This Special Edition of Agrekon on **Measuring productivity in African agriculture** addresses these considerations. The "call for papers" specified:

> We are specifically looking for aggregate total factor productivity (TFP) and profit functions, studies of important industries (e.g. beef cattle, broadacre crop farming, deciduous fruit, citrus, table grapes, sugar cane, vegetables); irrigated agriculture; meta-frontiers spanning emerging and commercial sectors; and studies that use propensity score matching to form control groups for club data. Analyses of recent weather anomalies are also welcomed, while large panel datasets and new methods are preferred.

The call resulted in the submission of 21 papers; seven from South Africa another five from other Southern African countries, two from East Africa, three from West Africa, one that covered several North African countries, and three covering sub-Saharan Africa as a whole. As expected, some

CONTACT Nick Vink nv@sun.ac.za Department of Agricultural Economics, Stellenbosch University, Private Bag X1, Matieland, South Africa

papers did not fit the topic, and some were not suitable for Agrekon, and hence were redirected to other publications, or to Agrekon's regular editions.

It is generally accepted that one of the reasons for the failure of economic development in Africa is poor policy, frequently the result of a lack of information and effective measurement – policy-makers simply do not know what is going on. Lipton (1989) states that economies that measure economic efficiency fare better than those that do not. This requires that good, comprehensive data be collected and analysed to facilitate a rigorous approach to performance measurement. This is then used to formulate economic policy. Lipton also notes that centrally planned economies failed in this and consequently could not differentiate between success and failure. If there is no information available, policy proceeds in the dark, as its effects cannot be measured. The dual nature of the agricultural sector in Africa is evident in the availability of data and hence many studies of efficiency and productivity in commercial agriculture are reasonably sophisticated and based on data that are as good as in a developed country. By contrast, in other areas, the scraps of sample survey data available are barely sufficient to allow an appraisal of the effects of the current development programmes. Apart from the lack of data, semi-subsistence agriculture raises complex problems, as the objective functions of the farmers often differ from that of the policymakers.

For example, in the period prior to that examined in the first paper in this special issue, expenditures in support of agriculture in Botswana from 1981 to 1996 averaged over 40% of agricultural GDP. This was probably to retain people in the rural areas and slow the gravity pull of the bright lights of Gaborone (Thirtle *et al*. 2003). So, different policy objectives can outweigh those that would apply in other circumstances. In the case of Botswana, this could easily be financed from the diamond revenues, whereas in South Africa, for example, the cost of offsetting the flow of labour from the Eastern to the Western Cape in this manner would be immense.

This type of problem aside, many empirical analyses of agricultural production in Southern Africa set out to measure and explain changes in efficiency and productivity. In this Special Issue of Agrekon, the authors' use a range of approaches to analyse a selection of countries that operate in different environments, both regulatory and climatic, and with different histories that shape the current structure of the national agricultural sectors. These studies measure productivity growth and explain the nature of changes over time using variables such as R&D and extension services.

The first paper by Temoso *et al.* uses non-parametric methods (DEA) to construct the Färe-Primont index to measure TFP and decompose this into a number of components. These are technical change (movements in the production frontier), technical efficiency change (movements towards or away from the frontier), scale efficiency change (movements around the frontier surface to capture economies of scale) and mix efficiency change (movements around the frontier) to capture economies of scope. Education, extension, off farm income and larger herds all explain the results that are an improvement on previous studies.

However, one note of caution is that using animal data implies the introduction of lags. A drought can mean some of the herd have to be slaughtered and since this is a capital stock and animals are depreciated to zero at slaughter, it suggests an increase in productivity, when it fact the capital stock is being diminished so the output will fall later. Conversely, diseases like rinderpest or bovine pneumonia can reduce the capital stock without adding to output. Recovery from drought can lower output for years following and this has attracted little attention in the literature.

The next paper by Matthews *et al*. takes a different approach. Whereas the previous authors used a deterministic model, this analysis uses a stochastic meta-frontier model to estimate productivity in sheep farming in four disparate districts in the Western and Northern Cape Provinces of South Africa. This allows measures of within and between-group efficiency and while the individual group models performed adequately, the meta-model performed very well. The differences between the groups are partly due to natural resource endowments, in particular rainfall, but institutional arrangements also contribute significantly to local success. They find that to achieve rural regeneration, public–

private partnerships are necessary and State support alone is insufficient. Rather, producer organisations have a major role in promoting institutional innovation, an idea also reflected in a later paper (Kirui *et al.* (below). The interesting aspect of this paper is that whereas some data are simply not poolable, the meta-frontier can be used for diverse samples such as these.

Next, Adaku *et al.* also estimate a stochastic meta-frontier model to measure productivity using a panel dataset from Ghana, having first split their data by gender. These authors are particularly concerned with the dynamics of gender differences in farm output due to technology gaps and technical efficiency. Their sample is comprehensive and includes commercial and subsistence farmers, multiple crops, and covers a 30-year period, which provides adequate scope to investigate the dynamics of female participation in the agricultural sector. There results suggest that female farmers are more efficient than males in the production of most crops, although both genders fail to take advantage of new technology that is available. However, women appear to be on a positive path to adoption of innovations. Interestingly, this result is the reverse of the results reported by Temoso *et al.*, who found that livestock farming in Botswana was largely male-dominated.

The next three papers deal directly with labour issues in agriculture although from entirely different perspectives. Greyling *et al.* examine not the existence of the inverse relationship but the reasons for it. The authors use a stochastic frontier model with inefficiency effects to measure the productivity of smallholder dairy farmers in Eswatini. Survey data was provided in collaboration with the Eswatini Dairy Board. Their major finding is that labour management costs are the major determinant of the inverse relationship. Extension services are provided both by the Dairy Board and the government and farmers are regularly visited. However, most extension officers have a background in animal science and are competent in addressing the practical aspects of dairy farming, such as starting a dairy, fodder production, cattle feeding and breeding, calf management, milking and hygiene, and disease control, but they tend to neglect the farm management component. This explains why farmers who hire labour other than household members are less efficient, as they have poor accounting and labour management systems - surely this is easy to correct.

The second paper of this group examines ways to mitigate labour shortages in smallholder maize farming in Ghana. Cobbinah *et al.* investigate mutual labour support and how this form of collective action affects farmers' productivity and efficiency. They use a stochastic production frontier model, while accounting for sample selection bias that results from both observable and unobservable household characteristics, again with propensity score matching. Technical efficiency was higher for farmers able to access to shared labour through mutual employment agreements, although it does not eliminate inefficiency altogether. Collective action may indeed be the solution for farmers that need additional workers, and policies to support the formation of such an organisational structure could be beneficial at a national level.

The third contribution concerns labour productivity and measures the impact of mechanisation for 53 African countries for the period 1961–2014. It is the only multi-country study in this Special Issue and data are at the national rather than the farm or district level. Previous studies have emphasised the importance of climate, labour productivity, the regulatory environment, infrastructure and fertiliser in boosting agricultural productivity in Africa, neglecting the importance of mechanisation to agricultural growth. The authors use a sequential Malmquist to measure agricultural TFP and then a selection of variables to explain this using panel econometric estimation. Climate change is a major problem in some of these countries, either too much rainfall or not enough. Increased use of modern inputs, including mechanisation, is found to be an integral part of the agricultural transformation process. Some countries, such as Ghana, may have reached the stage in the agricultural transformation process where labour should be released to feed the secondary and tertiary sectors. Thus, looking at agriculture in isolation and ignoring the rest of the economy is of limited value. However, as mentioned above, there is an obvious conflict here for countries that have not yet reached the point where agriculture should shed labour. Many, if not all, African countries have large amounts of surplus labour, frequently poorly educated, and thus the move to modern

inputs to increase productivity will do nothing to improve the lives of the poor. The provision of small-scale affordable tractors for smallholder farmers could contribute to improvement in welfare, although this would need to be accompanied by the appropriate training. In common with Mathews *et al.*, the authors suggest that some sort of partnership between the public and private sectors would be beneficial.

The final paper in this Special Issue is a historical analysis of wheat production in the Cape Province in 1825 by Fourie and Greyling. The data are taken from the household-level annual tax censuses, recorded in the early years of Dutch East India Company rule and continued by the British, and follow a long tradition of data being collected for purposes of taxation, starting with the Doomsday Book in the UK in 1086. A stochastic frontier model with inefficiency effects is used to estimate the productivity of wheat farmers with seed, draught animals and labour (both slave and non-slave Khoe) included in the frontier estimation. Then, wagon ownership, diversification across multiple outputs, and whether the farmer is of Huguenot heritage to introduce a cultural bias are used in the inefficiency model. Land was not included as it was essentially free in the Cape Province at that time. Despite previous assertions that the early settlers were poor and barely made a living in agriculture, this paper suggests that many farmers were prosperous and produced sufficient output to have a surplus to take to market. A particularly interesting finding relates to the relative lack of importance of slave labour in agricultural production. Slaves were certainly used for a variety of tasks, but rather than making farmers wealthy it appears that slave ownership was a consequence of being a successful farmer rather than the cause of it. Clearly, with a cross-section, causality cannot be tested statistically, but the output elasticity between slave and Khoe labour is 2.7, meaning that one Khoe worker has to be replaced by 2.7 slave workers to maintain the same output. The same measure between draught animals and the two types of labour are equally interesting. That is, if the number of draught animals is reduced by 1%, a 2.7% increase in Khoe workers are required compared to a 7.8% increase in slave labour. Slaves are clearly a valuable asset held by the rich rather than an essential agricultural requirement.

In summary, these papers address some of the considerations set out at the beginning. Measurement is central to the papers in this Special Issue but others require more work in the future. Certainly, measures of climate change are vital in any productivity models but data is a prerequisite. Allocation of public funding for data collection is important but sadly this does not always rank highly in government priorities. On the other hand, private data is frequently proprietary, but this must be challenged at every level. Finally, information that can be used to help the poorest in rural areas is extremely difficult to obtain, particularly because of the lack of trust on behalf of the respondents. Every effort must be made to reverse this, as until then policy, will not be relevant to these areas.

In closing, the success of such a Special Issue is heavily dependent on the reviewers. We take this opportunity to thank them for their sharp insights, but above all, for subjecting themselves to considerable harassment in maintaining deadlines.

ORCID

Jenifer Piesse http://orcid.org/0000-0002-6584-6678
Nick Vink http://orcid.org/0000-0002-5874-0939

References

Lipton, M. 1989. Agricultural research and modern plant varieties in Sub-Saharan Africa: Generalizations, realities and conclusions. *Journal of International Development* 1, no. 1: 168–79.

Thirtle, C., J. Piesse, A. Lusigi, and K. Suhariyanto. 2003. Multi-factor agricultural productivity, efficiency, and convergence in Botswana, 1981–1996. *Journal of Development Economics* 71, no. 2: 605–24.

Vink, N., B. Conradie, and N. Matthews. 2022. The economics of agricultural productivity in South Africa. *Annual Review of Resource Economics* 14: 131–49.