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Journal Name:	**Asian Journal of Agricultural Extension, Economics & Sociology**
Manuscript Number:	**Ms_AJAEES_38312**
Title of the Manuscript:	**Analysis of Agricultural Efficiency in Burundi**
Type of the Article	**Case study**

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This journal's peer review policy states that **NO** manuscript should be rejected only on the basis of '**lack of Novelty'**, provided the manuscript is scientifically robust and technically sound.
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PART 1: Review Comments

	Reviewer's comment	**Author's comment** *(if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)*
Compulsory REVISION comments	**1.** The title is misleading. Efficiency is made up of technical and allocative efficiency. The title needs to be adjusted to show that only technical efficiency is estimated. Suggestion**: Analysis of Agricultural Technical Efficiency in Burundi.** Where applicable, the text should be adjusted to reflect this change in title. **1.** Move line 72-85 to introduction. The objectives should start in line 85: **The study aims to explore the elements….** **2.** Number all equations. **3.** What is the source of the equation between line 104 and line 105? **4.** The section line 97 to 270 can be shortened and made more precise. There is no need to include the illustrations of technical efficiency because the concept is well understood. Check how other authors have described the approach in published research for instance: **Makombe G, Namara RE, Awulachew SB, Hagos F. Ayana M & Kanjere M. (2017). An analysis of the productivity and technical efficiency of smallholder irrigation in Ethiopia. Water SA. 43(1):48-57.** The approach has been extensively used and it should be really easy to identify examples whose description of the methodology could be followed. Instead of reviewing the theory the literature review should be based on the results of studies that used similar method under similar circumstances to estimate technical efficiency for smallholders and the study results should be compared to the results from other studies. There are a lot of these including the study above.. **5.** Line 282: "There were..." or "There are..."? **6.** The section that describes the sample line 273 to 288 needs to be redone for clarity. If national statics are used (which appears to be the case) then reference should be made to the national document/s that describe the sampling procedures and data collection methods. Then a precise summary of the method should be provided in the paper. **7.** The section from 290-369 can be summarised for precision without including all the theory. See comment number 4 above: **Check how other authors have described the approach in published research.** **8.** Line 370 should read **"Results and discussion"** **9.** Round off all percentages to nearest whole number. For example **Line 373** **10.8%=11% and line 377 12.2=12%.** 10. Line 380. The sample should be mentioned once when sampling procedures are described. **11.** Line 380 and figure 3. Those not using fertilizer are 67% from figure 3. So those using fertiliser are 33% (100-67=33). However in lines 380 and 381 it is written: **"...35.2% of 1071 of households used fertilizers (Figure 3).** How can this be reconciled? **12.** Lines 386 to 388 and figure 3, 14% used 1kg to 10kg on what average area. Also reporting an average use of fertilizer with a standard deviation is more informative than a range. Better still the average fertilizer use can be reported on a per ha basis. **13. Comments for Table 1.** **a.** **"Agricultural Production in tons of equivalent cereals"** should read **" Agricultural Production in tons/ha of equivalent cereals ". What doe this mean anayway?** **b.** Explain how **"Agricultural Production in tons of equivalent**	

cereals" is converted to **"Agricultural production in tons"** and vice versa.

c. Explain how the estimates of agricultural labour were collected and computed. Assuming a 10 hour manday

7522 hours =752 mandays (I assume per ha).. This seems high and I think it is caused by outliers like the maximum of 611525.9. If outliers are controlled for then the estimates may be more reasonable. Compare the labour estimates with other studies e.g. **Makombe G, Namara RE, Awulachew SB, Hagos F. Ayana M & Kanjere M. (2017). An analysis of the productivity and technical efficiency of smallholder irrigation in Ethiopia. Water SA. 43(1):48-57.**

d. Explain what it means **"Seeds in kilograms of equivalent cereals"** and explain how it was computed. What does it mean 26515 kg of "Seeds in kilograms of equivalent cereals"? This looks like an outlier.

e. From Table 1 it looks like there can be cases where all inputs and production are 0. In that case how can the technical efficiency of that farm be estimated? If there are such cases they should be removed from the sample because nothing happened on that farm. If there is farm where inputs are positive but production is zero then the technical efficiency of that farm is zero. There is no need to estimate it and such cases should be removed from the sample. The removed cases should be reported together with the reason for removal and the final sample, after controlling for outliers in labour and seed, should be mentioned.

f. The production system from which table 1 is derived is not adequately described. A list of crops included in this study should be given somewhere, may be where data collection is described. The production system in Burundi is not described. For example, there are two production seasons in Burundi. This should be described including which crops are grown in each season and why one season was selected over another and how was it selected. What is the problem with estimating technical efficiency for both seasons?

g. The challenges of collecting data from smallholders are well known and understood e.g. that smallholder farmers do not keep records making it very difficult to estimate inputs used because they have to be essentially done from recall e.g. it is difficult to estimate labour by the hour! How were these challenges addressed? A review of studies by Makombe et al (2001), Makombe et al (2017) and Nisrane et al (2011) given below are just a few examples where the issues of collecting data from smallholders and how they are addressed are discussed. Compare your methods with methods from these and other studies.

Makombe G, Meinzen-Dick R, Davies SP, Sampath RK. 2001. An Evaluation of Bani (Dambo) Systems as a Smallholder Irrigation Development Strategy in Zimbabwe. *Canadian Journal of Agricultural Economics* 49: 203-216.

Makombe G, Namara RE, Awulachew SB, Hagos F, Ayana M, Kanjere M. 2017. An analysis of the productivity and technical efficiency of smallholder irrigation in Ethiopia. *Water SA*, 43(1):48-57.

NISRANE F, BERHANE G, ASRAT S, GETACHEW G, TAFFESSE, AS, HODDINOTT J (2011) Sources of inefficiency and growth in agricultural output in subsistence agriculture: a stochastic frontier analysis. URL:

http://www.ifpri.org/sites/default/files/publications/esspwp19.pdf

Explain the aggregation that was used in coming up with table1. Explain how the inputs were chosen. Are there other chemicals e.g. for pest control used in the production process. If chemical are used more in other crops then the crops need a separate production function. This goes back to the thorough description of the productions system which is currently missing.

14. Line 401. No need for reference to: Source: Authors' Results, 2017. See how other researchers address this issue.
15. **Line 441:".....the age of head of household, accessibility of household to road and marketplace, extension services, access to agricultural credit have a negative effect on agricultural inefficiency in Burundi for the study period of crop season B 2011-2012"**
First the results should be discussed in terms of whether the signs are expected or unexpected then the implications of the results should be described. The authors should conjecture as to what the results mean to the production system. For instance if extension has a negative impact what is the policy implication and why? Second the results should be compared with those of other researchers. What do other researchers use as technical inefficiency effects and how do their results compare with these.
16. Lines 448-457. The interpretation of the signs of the technical efficiency effects needs to be revisited.

Remember that the model for the one-step estimation can be specified as:

$Y = f(x)\ TE(x;z)$

where:
x = the vector of inputs to produce output Y
TE(x;z) = the output-oriented measure of technical inefficiency, and
z = the vector of explanatory variables associated with the technical inefficiency (Batesse and Coelli, 1988, 1995)

Inefficiency is output oriented so in this case as age increases output decreases and inefficiency increases. You can test this by comparing the inefficiencies of young farmers vs that of older farmers from your results and because of that negative sign, I believe you will find the inefficiency of older farmers higher. This applies to the results from 433 to 488 where the signs are interpreted. Kindly test this as it will assist in your interpretation of the signs.. Older households also have more labour. How does this reconcile with your results?

It is important to compare the results with the results of other researchers.

17. Line 495: **"....which shows that the agricultural production could be doubled if the optimum technical efficiency were achieved.**"
First what is the optimum technical efficiency? Second, what are the mechanisms that could lead to the doubling of the output? This is what informs policy.
18. Line 504 reference is made to female farmers in the recommendations but gender is not significant. Where are the results that support this conclusion?
19. LINE 419: The sample should be mentioned under data collection but in the table the sample should be indicated as n=1071 when results are reported.

20. No need for table 3.
21. **Comments for Appedices**

Table 1

a. Sex of household head (dummy variable):Indicate which one is 1 and which is 0.

b. Reading and writing should be one variable. No need to separate reading and writing in Kirundi and a foreign language if they use the same alphabet. The variable cannot be used in a regression with 3 categories. Revisit the theory of the use of categorical variables in regression. If the categories are 1,2 and 3 regression assumes the difference between 1 and 2 is 1 and this is not the case. So you need to find some way to create a dummy.

c. Member of producer organisation **"...takes 0 if 's organization, and 1 if it is the head of household is member of producers organizations"** What does this mean?

d. **"A road passes through the village"** and **" Road in good condition in the community**" These two variables determine market access. However, another variable **"Access to local market"** is included. These will be collinear so it is better to use the **"Access to local market"** variable (1=good access, 0=poor access) and leave out the other 2 variables.

e. **"Accessibility of agricultural extension services in the community"** is collinear to **"Benefiting of extension (head of household"** use only one of these variables.

f. "Existing of Non-governmental organization or local associations in the community" how do these affect technical efficiency? Explain otherwise remove this variable.

g. **"Existing of producers 'organization in the community**" this is collinear to **"Member of producer organisation**" use only one of these variables.

h. **"Existing of selling shop of fertilizers in the community"** This variable should not be used in the equation. Fertiliser should be used as an explanatory variable. The actual amount of fertilizer used by a farmer should be used in the equation i.e. 0 if farmer did not use fertiliser and the actual amount of fertilizer that was used for those who used fertilizer. In figure 3 it is shown that 33 percent of the farmers used fertilizer so why is fertiliser not an explanatory variable in the production function? As discussed earlier it cannot be used as a categorical variable as indicated in figure 3. Either the exact amount of fertilizer is used as a variable or a dummy is used where 1=farmer used fertilizer otherwise 0 but in the production function not in the inefficiency effects.

i. **"The distance to the extension center"** This affects access to extension. Only one variable related to extension should be used.

j. ***"*Household income"** This is collinear to fertilizer and seed used. It should be left out of the equation.

k. **"It is the total of household agricultural production in equivalent cereals, fruit and vegetables are not included"** Explain the average allocation of area to the various crops. This will show the major crops in the production system. What does **"..equivalent cereals"** mean?

l. This table should be included when the model is described**.**

Table 2

It will be adjusted once the variable changes suggested above are taken into account.

	Table 3 *The coefficients will change once the variable changes suggested above are taken into account and the model is re-estimated.* ***General comments*** *1. More thought needs to go into model construction.* *2.* Both the methodology and results need to be compared with those of other researchers who worked with smallholders. The SFA has been widely applied and similar studies are readily available. A literature search should be performed. *3.* All tables can be included in text instead of in Appendices. *4.* The paper requires extensive language editing. For instance line 27 where it reads: **The gross domestic product per capita is among the**….it should read: **The per capita gross domestic product is among the….** Line 98**: "Efficiency farming is a kind of farming that…"** requires language editing. Line 373: **"It is noticed that there is a low access to agricultural loan in the community,…**." should read **"The results show that there is a low access to agricultural credit in the community,…..".** There are many examples of obvious grammatical improvements in the paper. A thorough language editing will improve the readability of the paper. The poor grammar distracts the reader from the content of the paper	
Minor REVISION comments	1. Line 35. What does it mean:" ...**the movement of labor and surplus to other sectors"?** 2. Line 39. Incomes do not expand. They increase. 3. Line 41: Grammar 4. Line 47. Replace "mayor" with "major" 5. Line 61. Rephrase. Who is "we"? 6. Line 62 change "affects" to "affect" 7. Delete line 64-65 **22.** Lines 389-392 can the choice of the Cobb Douglas as a functional form be justified. Also this is not part of "Results" so it needs to be moved to where the methodology is explained. **8.** LINE 408: "**The Parameter estimates** …"Should read: "**The parameter estimates….."**	
Optional/General comments		

Reviewer Details:

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