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Comparison of decent work status among smallholder pig farmers in Kenya: An empirical approach using Principal Components

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Abstract

Agricultural production in Kenya is dominated by smallholder enterprises which provide up to 60 % of the country's workforce. The agrarian transition to enhance smallholder participation in neoliberal capitalistic markets demands compliance to sanitary and phytosanitary standards and with codes for worker's welfare and thus the concept of decent work. Evaluation of decent work deficits in the informal economy however remains a challenge associated with sector uniqueness and differences in socio-cultural attributes of labour. Nevertheless, there is need to build on analytical methods prescribed by the International Labour Organisation of the United Nations that make use of sector specific data and indicators. This study used 27 variables from a survey of 144 pig enterprises in three geographically and demographically distinct Counties in Kenya to develop five indices using Porter's diamond methodology. The five indices were subjected to Principal Component Analysis using SPSS statistical software to extract two components which were latent variables for decent work. The two components were then subjected to Analysis of variance with Tukey's test to separate the means. Results showed that decent work deficits were more pronounced ($p \leq 0.05$) in pig enterprises in Busia County as compared to enterprises in Nakuru or Kiambu Counties. Decent work deficits became more pronounced ($p \leq 0.05$) as the education level of household head reduced. Decent work deficits were also more pronounced ($p \leq 0.05$) in enterprises where the age of the household head was 35 years and below. The study identified enterprises in Busia County as deficient in their decent work status with low technology adoption and production efficiency, weak market access and quality control as the most important determinants of decent work status. This study recommends that approaches to address decent work deficits should focus on training farmers to improve technology use and improve production efficiency as well as enhancing surveillance for quality. For further research, the study recommends that evaluation of decent work in smallholder systems could be done through aggregation of the many indicators around the concept of competitiveness where PCA can be used for data convergence.

Keywords: Decent work, smallholders, pig production, principal component analysis, sustainable production

1 Introduction

1.1 Smallholder production and the agrarian transition in Kenya

Agriculture is the backbone of the Kenyan economy contributing approximately 29 % to the county's gross domestic product (GDP) directly and 27 % through linkages and services with other sectors (MOALF, 2017). It employs approximately 60 % of the country's labourforce at all levels of production and processing underscoring the importance of the sector in job creation and poverty reduction (Salami *et al.*, 2010). Agricultural production is dominated by smallholder farmers who own small land sizes varying between 0.5 - 5 ha. Majority of these smallholders produce for subsistence and sell their surplus produce to consumers in urban areas in close proximity. The forms of employment found in smallholder enterprises in Kenya consist mainly of own-account, task-based and temporary or seasonal wage labour.

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The current trend in increasing food demand due to rapid population growth against declining production associated with declining soil fertility, post-harvest losses, reliance on rain-fed agriculture and climate change among others, has resulted in a situation of food deficit. Economic outlook in Kenya is further dimmed by an upward surge in the youth unemployment rate. The government's policy response has been directed towards promoting creation of sustainable employment in agriculture through commercialisation of smallholder production. Among the approaches employed is to promote agro-processing, value addition, value chain development and development of export markets as stipulated in Kenya Vision 2030 (GOK, 2007). These policy interventions target to alter power relations towards greater participation of the rural poor in decision making at all levels and especially in decisions directly affecting their livelihoods. The agrarian transition to enhance smallholder participation in neoliberal capitalistic markets demands compliance to sanitary and phytosanitary standards and with codes for worker's welfare and thus the concept of decent work. However evaluation of decent work deficits in the informal economy in developing and least developed countries remains a challenge associated with sector uniqueness and differences in sociocultural attributes of labour (Gongora, 2016).

Pig production in Kenya is a popular agro-enterprise for generation of household income owing to the low demand for land and faster return on investment compared to ruminant livestock. The rising demand for pork and pork products (KNBS, 2016) associated with rising demand for high caloric diets (McDermott *et al*., 2010) presents an opportunity for value development in the sector. The quality of work in pig enterprises has not been studied and could be impeding on competitiveness of smallholder pig enterprises. The sector also provides an ideal case for evaluation of decent work in the agricultural sector due to diverse production practices and varied production environments.

1.2 The decent work concept

The International Labour Organisation (ILO) proposed the concept of decent work to counter the damages caused by the neo-liberalism. Decent work was defined as "productive work realised in freedom condition, equity, security and human dignity" (ILO, 1999). The 4 pillars of decent work include employment creation, guaranteeing rights at work, social protection and social dialogue (ILO, 2015). The 2030 global agenda for sustainable development placed emphasis on decent work in Sustainable Development Goal number 8 (SDG 8) which seeks to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by 2030. However, decent work remains a marginal concept which has not been widely applied at the international, national and local levels around the world (Lawrence *et al*., 2008). The ILO developed a set of variables that have been used in the formal sector for measurement of decent work deficits as described in ILO (2012). Different conceptualisations of decent work exist in the global policy arena resulting from the different institutional perspectives (Ruggiero *et al*., 2015).

1.3 Decent work deficits in agriculture

Decent work deficits (DWDs) in agriculture can be looked at through the lenses of the 4 pillars of decent work. Under the employment and enterprise development pillar, DWDs indicators include underemployment, low productivity, low and insecure incomes, overexploitation of labour, lack of access to finance and credit. Under the social protection pillar, DWDs are reflected in lack of social and primary health protection schemes, lack of occupational safety and health enforcement and poor living conditions. Under the standards and rights pillar, DWDs are reflected as gender inequalities in respect to employment and remuneration and prevalence of child labour and worst forms of labour such as slavery. Under the social dialogue pillar, DWDs are seen in the limited organisation of agricultural workers for collective bargaining.

1.4 Evaluation of decent work status

There are several approaches that have been used in the analysis of decent work. Scherrer & Verma (2018) used qualitative approaches to evaluate decent work deficits in multiple studies on agricultural labour in plantations in Africa, Asia and South America. Thore & Tarverdan (2009) used data envelopment analysis where decent work was described as an efficiency point along an input-output function. The decent work deficit of a given country was then obtained as the difference between an observed point and its projection on the efficiency frontier. This however required large and consistent data sources. Qualitative analysis of decent work has also been widely done in the field of sociology and psychology. Pouyaud (2016) applied thematic analysis to case studies in the field of counselling psychology.

Principal Component Analysis (PCA) is a tool that is used to restructure data so as to reduce the number of variables in a process known as data reduction or dimension reduction (Pallant, 2007). PCA generates components which act as latent variables which can then be given a name and used for evaluation of a concept of interest which in this case was decent work. The objective of this study was to generate a latent variable/s from enterprise data adopted from selected statistical and legal framework indicators described by ILO

(2012) and use these to describe and compare decent work status between pig enterprises in three study areas in Kenya; Busia, Nakuru and Kiambu Counties.

2 Materials and methods

2.1 Study area and data collection

Data collection was carried out over a period of twelve months between May 2017 and April 2018. The study was carried out together with a study that evaluated pig feeding practices among smallholder farmers across different seasons of the year since these practices had some implication on enterprise productivity, an important component of decent work analysis. Three Counties were selected for the study. Busia County with a pig population of 45,300 (KNBS, 2010), majority of which are kept under the indigenous free-range or tethering systems (Kagira *et al*., 2010). Between 2002 and 2005, pigs constituted 27 % of all animals slaughtered for meat in Busia. In Nakuru County, current estimates of pig indicate a 35.9 % increase in pig population between the years 2009 and 2014. Pig production systems in this County are varied and include free range scavenging, semi-intensive and the intensive commercial systems. In Kiambu County, growth in the pig production has been encouraged by a ready urban market in Thika, Ruiru, Kiambu, Nairobi and the availability of local food processing factories such as Farmers Choice limited. Teso North and Matayos sub-Counties in Busia County, Njoro, Nakuru West and Nakuru North sub-Counties in Nakuru County and Kikuyu and Thika sub-Counties in Kiambu County were purposively selected on *a priori* basis with the help of County livestock production officers. Pig farming households were selected using a snowball sampling procedure. A survey of 144 pig enterprises was done using pretested structured questionnaires to capture household demographics and pig enterprise data.

2.2 Conceptual model and variables

The assumption of this study was that there is a correlation between decent work and economic success which is a derivative of competitiveness though there may be no causal relationship (Schützhofer, 2014). 27 variables that impact on any of the 4 primary activities of the value chain, that is, inbound logistics, production operations, outbound logistics, marketing and support services (Figure 1) were identified from the study enterprises based on a priori information on their likelihood to impact on production level, incomes and product quality. These were factors that directly affected enterprise competitiveness including factor conditions, demand conditions, related and supporting institutions, and firm's strategy as described in the Porter's diamond framework (Bakan & Dogan, 2012). The four factors also theoretically linked to each of the 4 pillars of decent work in that factor conditions were represented by work quality, demand conditions was represented by market access, related and supporting institutions played the role of quality control while firm's strategy was represented by technology employed and production efficiency. All the variables were re-coded such that their scale was one directional with a negative to positive effect scale. The variables were weighted on the same scale such that they all had they had equal contribution to the latent variable to be computed using PCA. Of the twenty seven variables, five were identified as determinants of the level of technology adoption. The variables included use of improved breeds to upgrade, use of commercially compounded feeds, access to training from any mass media channels (audio, audiovisual or print), frequency of medication against worms and treatment for ectoparasites. The variables were discrete, that is; 0 = 'No' or 1 = 'Yes'. An index ranging between 0 - 5 was computed for the percentage of affirmative responses with a higher value indicating a higher level of technology adoption. Six variables were considered under compliance to quality control measures. These included whether or not housing was provided for pigs, whether or not pigs were vaccinated in public vaccination campaigns and details on observation of pig slaughter hygiene. The variables were coded as discrete response variables and a score ranging between 0 - 5 computed with a higher score indicating higher compliance with quality requirements. Under production efficiency, three variables; sow farrowing interval, sow weaning rate and income per sow unit per day were computed. The inverse of the score for farrowing interval was however considered since a higher figure is less desirable and a score of between 0 - 5 computed. The weaning percentage for each sow was computed and a score of between 0 - 5 computed such that a score of zero (0) represented 100 % post-weaning piglet mortality and a score of 5 representing 100 % weaning rate. The score for income per sow unit per day was derived from the discounted farm-gate value of pigs sold per sow unit. The farm-gate value of sows sold in 12 months was computed by calculating the discounted value of the weight of sows sold per sow unit where the average annual inflation rate of 8.02 % (KNBS, 2017) was used as the discount rate. The production unit was considered to be one sow where it was assumed that the initial population of sows in the period was equal to the sum of sows on farm at time of study, the sows that had been sold in the previous 12 months and sows that had died in the previous 12 months. The weight of a production unit was computed as the mean weight of sows sold. The farm-gate value of sows sold per unit of production was

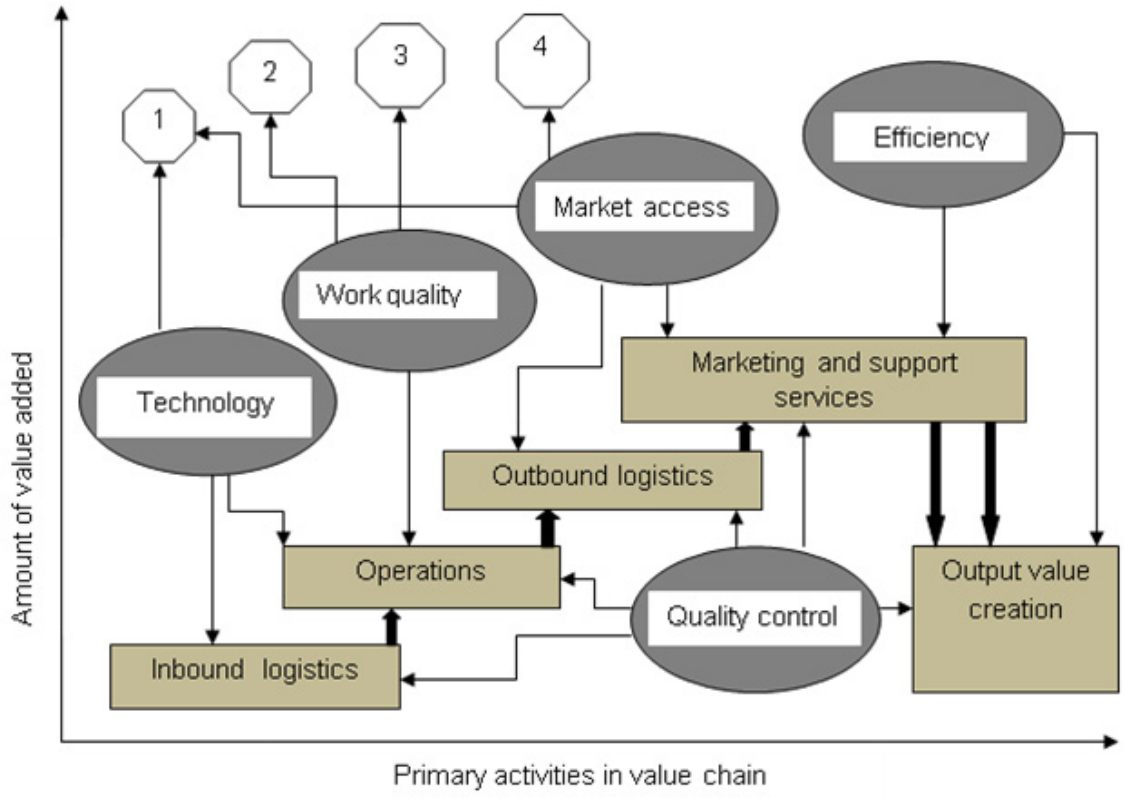

Fig. 1: *Conceptual framework used to identify determinants of decent work using value chain concept Key: Numbers indicate the 4 pillars of decent work; 1=creation of employment, 2=labour rights, 3=social security, 4=social dialogue. Source: Authors conceptualisation*

then computed by multiplying the weight of sows per unit by the farm-gate price of sows per kg. The computation of discounted farm gate value was done as follows;

$$\text{DFV} = \left\{ \frac{1}{(1+rd)^T} [FV] \right\}$$

Where, DFV = discounted farm-gate value, rd = discount rate computed as the average inflation rate of 7 %, T = period considered for discounting in years which was one year in this case and FV = farm-gate value per unit sow computed as:

FV = (Mean sales volume/unit) x (Mean weight) x (Price per kg)

The inflation discounted farm-gate value of sows sold per unit of production in 12 months was Ksh 758.30 in Busia County, Ksh 3599 in Kiambu and Ksh 3679.20 in Nakuru County. The total discounted farm-gate value per unit was then computed by adding the discounted farm-gate values of boars, growers and post-weaning piglets as described in Equation 2. The results were as shown in Table 1.

An index ranging from 0 - 5 was computed for TDFV such that the enterprise with the lowest TDFV had an index of 0 while the one with the highest had a score of 5 To evaluate ease of market access, nine variables were considered. Respondents were asked to indicate on a scale of 1 - 5 how each of the variables; distance to the market, price offered, buyer availability, slaughter infrastructure, amenities and consumer perception posed a challenge to marketing. The responses were coded such that 5 = 'not a problem' and 1 = 'a very serious problem'. Three other variables; taking weights of pigs during marketing, keeping enterprise records

Table 1: *Comparison of discounted farm-gate values of sold pigs per production unit.*

Pig group	*Busia (ksh)*	*Nakuru (ksh)*	*Kiambu (ksh)*	*Test of significance*
Sows	758	3679	3599	F = 5.18*
Boars	566	1393	521	F = 5.26*
Growers/porkers	399	1230	1843	F = 17.58*
Post- weaning	253	674	364	F = 4.95*
TDFV	1917	6978	6327	F = 12.95*

Key: TDFV= Total discounted farm-gate value per unit of production, *= 0.05 significance level, ksh = Kenya Shilling (100 ksh = 0.86€)

and membership to a farmer based marketing organisation were coded as discrete response variables, that is; 0 = 'No' or 1 = 'Yes' The frequencies for each response were used to compute an overall index for market access with higher values indicating more ease. To evaluate the quality of work, four variables were considered. The participation and wage ratios by gender were computed and an index ranging from 0 - 5 computed for each. Contribution to social security and health schemes were treated as discrete response variables, that is; 0 = 'No' or 1 = 'Yes' and the frequencies used to compute an index ranging between 0 - 5. The five indices derived from the twenty seven variables were weighted on the same scale such that that they had equal contribution to the latent variable computed from PCA using SPSS statistical software (IBM Corp, 2013).

3 Results

3.1 Pig enterprise features

3.1.1 Pig farmer and farm characteristics

The number of male headed households was significantly higher than female headed households (77.6 % versus 22.4 %) in the entire sample. Pig farming household heads in Kiambu County were significantly older ($p \leq 0.05$) than those in Busia County; 50.71 years versus 45.51years. However, pig farmers in Busia County had more ($p \leq 0.05$) years of experience in pig farming (6.77 ± 7.18 years) compared to either Nakuru County (2.73 ± 3.27 years or Kiambu County (3.63 ± 3.97 years). The variance in the mean size of land allocated to livestock between counties was significant. Smallholders in Busia County allocated more ($p \leq 0.05$) land to livestock (0.48 ± 0.56 hectares) compared to farmers in either Kiambu County (0.17 ± 0.21 hectares) or Nakuru County (0.25 ± 0.27 hectares). The sizes of land allocated to livestock in Nakuru and Kiambu Counties were comparable.

3.1.2 Pig production and management practices

Pig husbandry systems practiced by smallholders in Busia, Nakuru and Kiambu Counties were significantly different; $X^2 = 111.95$, $p \leq 0.05$. Tethering was the predominant husbandry system in Busia County and this was the only study area where free-range grazing was encountered. Smallholders in Nakuru County predominantly practiced intensive pig husbandry with only 6.7 % tethering their pigs. All farmers in Kiambu County practiced intensive pig keeping. A comparison of pig housing practices showed significant ($p \leq 0.05$) differences between the study areas. There were no shelters for pig in 25 % of the farms in Busia County and approximately 60 % of those present were temporary. The number of households that had no shelters for pigs in Nakuru and Kiambu Counties were negligible.

The mean number of pigs in smallholder enterprises in Busia, Nakuru and Kiambu Counties was 5.71 ± 0.78, $14{,}47 \pm 2.04$ and 16.13 ± 2.3 pigs respectively; F = 9.41, $p \leq 0.05$. Smallholders that were interviewed in Busia and Nakuru Counties had a maximum of 5 sows and 4 sows in Kiambu County. The distribution of sow population in the three study areas showed that on average, 29.5 % of smallholders had no sows in their pig enterprises. This comprised of 34.6 % of smallholders in Busia County, 23.3 % in Nakuru County and 30.6 % in Kiambu County. The mean number sows per enterprise in the three study areas was 0.94, 1.37 and 1.47 respectively, F = 3.08; $p \leq 0.05$. This difference was significant between Busia and Kiambu Counties, t (112); $p \leq 0.05$. Smallholders in Busia County predominantly kept indigenous sows while those in Kiambu predominantly kept exotic breeds. Smallholders in Nakuru County had preference for both improved crosses and exotic breeds with a bias for improved crosses. Majority (70.9 %) of smallholders had no boars in their enterprises. The mean number of boars per enterprise was 0.39 with no significant differences in the means between the study areas. Smallholders in Nakuru and Kiambu Counties did not keep indigenous breeds of boars while in Busia, smallholders predominantly kept indigenous boars.

Majority (89 %) of smallholders in all the study areas frequently dewormed their pigs but rarely kept any enterprise records. About 30 % of smallholders never used ectoparasiticides. There were significant differences in the frequency of carrying out teeth clipping ($X^2 = 46.84$; $p \leq 0.05$), castration of piglets ($X^2 = 17.79$; $p \leq 0.05$) and administration of prophylactic iron injections in piglets ($X^2 = 73.59$; $p \leq 0.05$). More than half of smallholders in Busia County never carried out these management practices while in Nakuru County, at least 80 % of smallholders did. In Kiambu County, majority of farmers (over 60 %) administered prophylactic iron injections and perfomed piglet castration while 56 % never practiced teeth clipping. Less than 10 % of smallholders in all study areas weighed their pigs either in the growth phase or during marketing.

There was a significant difference in feeding practices with the rate of use of commercially compounded feeds in smallholder enterprises being 7.7, 53.3 and 45.2 % ($X^2 = 14.59$, $p \leq 0.05$) in Busia, Nakuru and Kiambu Counties respectively. All enterprises in Busia County fed their pigs on alternative feed resources while in Nakuru and Kiambu Counties, 86.7 and 77.4 % of enterprises respectively fed pigs on alternative feed resources ($X^2 = 26.87$, $p \leq 0.05$). In

Table 2: *Analysis of variance between study areas comparing mean of scores of variables used to compute five indices for Principal Component Analysis.*

	County			*Significance*
Variable	Busia (N=52)	Nakuru (N=30)	Kiambu (N=62)	F
Technology adoption				
Improved breeds for upgrading?	0.06^{a}	0.33^{b}	0.58c	129.67 *
Use of concentrate feeds?	0.08^{a}	0.53^{b}	0.45^{bc}	14.59*
Access to training from media?	0.56^{a}	0.97^{b}	0.95^{b}	84.23*
Dewormed pigs in last 6 months?	1.81^{a}	1.8^{a}	1.90^{a}	0.65
Sprayed pigs in last 3 months?	1.31^{a}	1.13^{a}	1.31^{a}	0.65
*Quality control*l				
Pig housing?	0.9^{a}	1.97^{b}	1.4^{b}	57.06*
Pig vaccination campaign?	0.37^{a}	0.23^{a}	0.19^{a}	1.11
Do you slaughter pigs at home?	1.27^{a}	0.8^{b}	0.9^{b}	9.17*
Is the pork at home inspected?	0.46^{a}	1.2^{b}	1.1^{b}	22.55*
Pigs slaughtered in slabs only?	0.87^{a}	0.8^{a}	0.9^{a}	0.78
Slab workers have health certificates?	0.75^{a}	0.6a^{b}	0.24^{b}	3.14*
Production efficiency				
Sow farrowing interval	2.51^{a}	2.59^{a}	2.88^{b}	6.4*
Sow weaning rate	4.55^{a}	4.12^{ab}	4.01^{b}	5.01*
Income per unit/day	0.24^{a}	0.93^{b}	1.61^{c}	30.45*
Market access				
Distance to the market	2.1^{a}	2.63^{b}	2.81^{b}	10.97*
Price offered at the market	1.08^{a}	1.43^{ab}	1.69^{b}	4.57*
Availability of buyers	1.81^{a}	2.5^{b}	2.66^{b}	13.82**
Constrained by infrastructure?	1.5^{a}	2.77^{b}	2.6^{b}	21.39*
Constrained by amenities e.g. water?	0.55^{a}	0.07^{b}	0.05^{b}	32.44*
Constrained by consumer perception?	1.23^{a}	1.03^{ab}	1.03^{b}	3.52*
Do you weigh pigs during sale?	0.08^{a}	0.43^{b}	0.32^{b}	5.01*
Do you keep enterprise records?	0.35^{a}	0.57^{a}	0.37^{a}	1.08
Are you a member of any FBO[2]	0.1^{a}	0.13^{a}	0.16^{a}	0.52
Nature of work				
Participation ratio by gender	0.1^{a}	0.2^{a}	0.24^{a}	2.08
Wage equality by gender	0.98^{a}	0.47^{b}	0.73^{c}	68.30*
Contribution to social security scheme	0.04^{a}	0.03^{a}	0.00^{a}	1.17
Contribution to health insurance	0.04^{a}	0.07^{a}	0.02^{a}	0.78

[2]Farmer based organisation; superscripts indicate similarity where letters are similar across rows, $*p \leq 0.05$

this study, alternative feed resources included all other feeds used for feeding pigs other than standardised and commercially compounded feed available from licensed feed millers. Only 13.3 and 22.6 % of the enterprises in Nakuru and Kiambu Counties respectively fed their pigs entirely on commercially compounded feeds.

High cost of commercial feeds was the most serious barrier to their use in all study areas. In Busia County, the second and third most important barriers were high cost of transport and lack of feed stockists respectively. In Nakuru and Kiambu Counties, poor quality of feeds and high cost of transport were the second and third most important barriers to the use of commercially compounded feeds. Results on Table 2 show a comparison of computed mean scores of variables used as determinants of the indices of decent work.

3.2 Evaluation of decent work status using Principal components

The five indices were subjected to PCA. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the

Table 3: *Correlation matrix of PCA indices showing coefficients above 0.3.*

	Index			
	Technology	Quality control	Market access	Work quality
Technology	1.0			
Quality control	0.33*	1.0		
Market access	0.38*	0.32*	1.0	
Work quality	-0.4	0.06	-0.07	1.0
Efficiency	0.48*	0.11	0.18	0.01

* coefficients > than 0.3

Table 4: *Pattern and Structure Matrix with Oblimin Rotation of 2 factor solution of decent work Indices.*

	Pattern coefficients		*Structure coefficients*		*Communalities*
Index	C1	C2	C1	C2	
Quality Control	0.91*	0.38*	0.92*	0.41*	0.99
Work quality	0.09	-0.04	0.08	-0.04	0.01
Technology	-0.07	0.97*	-0.05	0.97*	0.95
Production efficiency	-0.1	0.49*	-0.08	0.49*	0.25
Market access	0.17	0.4*	0.18	0.4*	0.19

C1=component 1, C2=component 2, major loadings for each index with (*)

presence of some coefficients of 0.3 and above (Table 3). The Kaiser-Meyer-Oklin value was 0.61 indicating sufficient sampling adequacy. The Bartlett's Test of Sphericity reached statistical significance; $X^2 = 84.45$, $p \leq 0.01$, supporting the factorability of the correlation matrix (Pallant, 2007).

PCA revealed the presence of two components with Eigen values exceeding 1, explaining 25 % and 23 % of the variance respectively. An inspection of the screeplot (Figure 2) revealed a break after the second component and therefore, the first two components were retained. The oblimin rotation was performed and the two component showed a strong loading for all variables with four out of five variables loading more on component 2 (C2) as shown on Table 4 and one variable (quality control) for component 1 (C1). Regression factor scores for each component were treated as new cases for the new variables represented by C1 and C2 (Pallant, 2007). Analysis of variance was computed for the two variables to compare their means between enterprises in the three study areas and Tukey's test was used to separate the means. Since the two components were latent variable for decent work, a significantly higher mean meant that decent work rating by the test was better. Results showed that the variances for means of component 1 violated the assumption of non-homogeneity and therefore, the Brown-Forsyth F-test was used for test of significance.

The model for C1 was insignificant. Results for C2 showed that the variances of the means were significantly different and the model was also significant; F = 14.76, $p \leq 0.05$, where the mean for enterprises in Busia County was the lowest. The mean for Kiambu and Nakuru Counties were comparable (Table 5). A comparison of means of the two components between gender showed that the means for C1 were insignificantly different between gender of household head. The means for male and female household heads

Table 5: *Analysis of variance comparing decent work using latent variables generated from Principal Component Analysis*

Latent variables for decent work	*County* Busia (N=52)	Kiambu (N=62)	Nakuru (N=30)	*Leven's test*	*Brown-Forsyth test*	*ANOVA F-test*
Component 1	-0.14^a	-0.01^a	0.27^a	38.69**	1.85	1.64
Component 2	-0.53^a	0.37^b	0.14^b	1.29	15.69**	14.76**

Superscripts indicate similarity where letters are similar across rows, *$p \leq 0.05$.

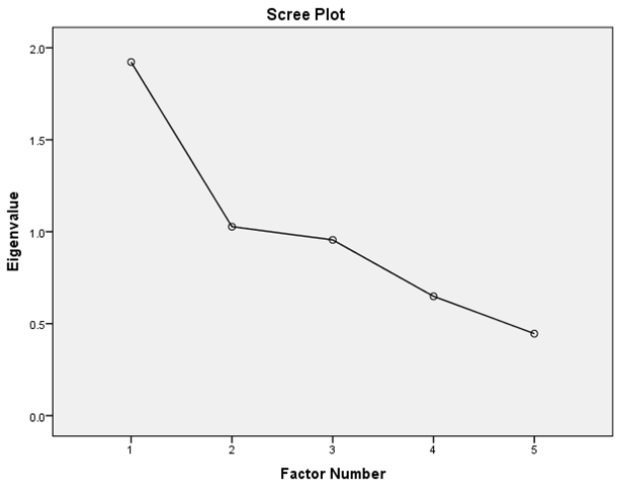

Fig. 2: *Scree plot showing 2 components with Eigen values greater than 1*

for C2 were significantly different at 0.1 and -0.39 respectively; t = 0.01, $p \leq 0.05$.

Respondents were classified into three groups according to their level of education, that is, pre-secondary school, secondary school and post-secondary school levels. Results of analysis of variance showed that there was a consistent and significant increase in the mean value of C2 with an increase in education level; F = 16.37, $p \leq 0.05$. Respondents classified into three age groups ($\leq$ 35, 36 - 50 and $\geq$ 50 years) with enterprise location as a covariate on C2 showed that the group of $\leq$ 35 years had a lower mean value than $\geq$ 50 years, F = 4.81, $p \leq 0.05$. This result is presented graphically in Fig. 3.

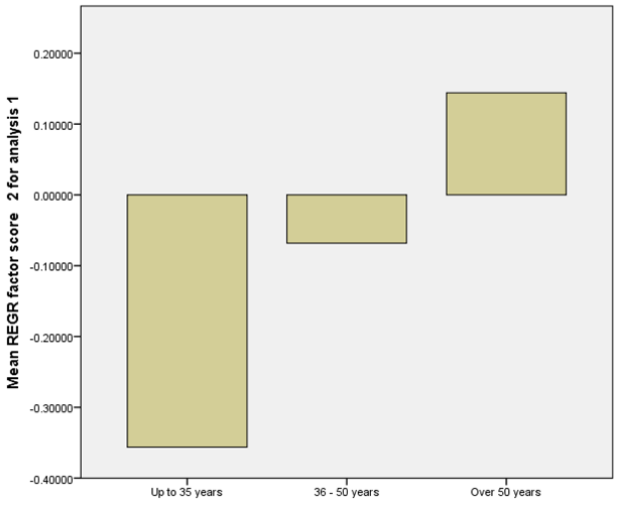

Fig. 3: *Graphical comparison of mean factor scores between age groups indicating lower decent work status with younger smallholder pig farmers*

4 Discussion

The ILO agenda for decent work was initially concerned with ethical issues around work that arose as a result of the industrial revolution (Guimaraes, 2013). Studies by Fields (2003), Ahmed (2003) and Guimaraes (2013) however demonstrated that economic development and human development contribute positively to decent work. Guimaraes (2013) concluded that work for human security is closely related to economic security. Larion (2013) emphasised the need to include the decent work agenda in pro-poor work policies in this citation;

"*For workers who face extreme poverty, decent work is the shift from subsistence to existence and it is the main means to get out of poverty*" (Andrei Popescu, 2008).

Decent work approach to evaluation of the quality of work has however had a fair share of criticism. In their critic, Burchell *et al*. (2014) argue that difficulties in decent work approach are related to lack of internationally compatible data to allow for comparisons, bias among researchers and a vague definition of decent work. However, there is a wide range of perspectives that have been used to address the concept of decent work. Psychological, social, legal, ethical and economic approaches have been used in evaluation of decent work deficits, thereby giving the concept different meanings but with similar outcomes (Pouyaud, 2016). Several approaches have been employed in data collection and management in evaluation of decent work. Psychological studies such as Duffy *et al*. (2017) and Haddad & Hellyer (2018) were based on respondents perceptions of their working conditions and their awareness to entitlement to labour rights. Pouyaud (2016) argued that there were difficulties in performing comparisons because workers' expectations varied widely making it difficult for employees to form a fair opinion because they tended to adapt to their poor conditions over time. Considering the above arguments, this study used qualitative and quantitative data for empirical estimation of decent work status. PCA was used to overcome the problem of multiple levels of simultaneous measurements, a common problem with decent work measurement (Pouyaud, 2016). Duffy *et al*. (2017) used a similar approach where psychological outcomes of work were used to develop a decent work scale from a 15 factor scale and 5 sub-factors corresponding to the 5 components of decent work. The scale was then used to compare 2 samples of working adults of different class and race. In the current study, to facilitate comparison of decent work status between enterprises in three study areas, PCA was used to extract two variables (C1 and C2) which were latent variables for decent work. The PCA correlation matrix resulted in a positive correlation between adoption of technology and quality control, ease of market

access and production efficiency. There was a positive correlation between quality control and market access. These relationships generally have a causal relationship in practice since use of better technology is a precursor of production efficiency and better market access while quality control improves marketability of a commodity. Data available from the National Economic Survey (Republic of Kenya, 2015) indicated that poverty level in Busia County were relatively high (66 %) compared to Kiambu County (28.9 %). The level of urbanisation in Kiambu County (60.8 %) was significantly higher than in Busia (16.4 %) and Nakuru (45.8 %) Counties. This had obvious implications on demand for pork meat and therefore, the level of investment in the enterprise. These findings corroborate Tadjeoddin (2014) who reported that the size of the informal economy positively correlates with poverty rates. The findings of this study showed that DWDs were more pronounced in pig enterprises in Busia County compared to Nakuru and Kiambu Counties. The indices that explained these differences were those that were significant for component 2, that is, low adoption of technology, low production efficiency, weak quality control and poor market access. The variables that were significant under technology adoption includes lack of use improved pig breeds for upgrading, poor choice of feeds and lack of technical information which were more pronounced in enterprises in Busia County. Weak quality control in enterprises in Busia County was associated with lower intensity of disease control practices such as proper housing and control of parasites as well as poor slaughter hygiene practices. As a result, the productivity in pig enterprises in Busia County was lower compared to enterprises in Nakuru and Kiambu Counties. This can be seen in the lower performance of sows and the reduced net income per sow unit. Where adoption of agricultural technology is low, production efficiency is often reduced with reduced productivity. This has a negative implication on enterprise development and creation of decent work opportunities; the first pillar of decent work. As a result of reduced disposable incomes, social and health security are curtailed while tendencies to engage illegal labour practices such as child labour may be observed. Ease of market access is an important determinant of price of agricultural commodities which in turn affects enterprise gross margins. Consequently, important production management and investment decisions in the enterprise hinge on ease of market access. This study finds that market access for smallholder pig farmers in Busia County was constrained by long distances to the market, low prices offered, few buyers, poor roads and lack of licensed slaughter facilities. Pigs farmers in Busia County reported that most of their pigs were bought by intermediaries who smuggled them through unofficial routes to neighbouring Uganda so as to evade statutory inspection and certification and associated costs similar to the findings of Kagira *et al*. (2011). Due to the poor roads, these buyers ferried the pigs while fastened on motorbikes and therefore preferred smaller maturing pigs which were mainly the indigenous breeds. Farmers with larger pigs such as the exotic breeds fetched low prices due to the low demand. This was complicated by the fact that local pork butcheries could not store meat for long since they did not have refrigerators. Comparatively, fewer farmers weighed their pigs at farm gate in Busia compared to either Nakuru or Kiambu Counties. Smallholder pig farmers in Kiambu and Nakuru Counties encountered fewer problems relating to market access owing to the large urban population in their proximity, multiple buyers who offered better prices and availability of good infrastructure and meat inspection services. Where market and price uncertainties are lower, farmers are less risk averse and therefore able to intensify production and increase yields through adopting better production technology such as faster maturing, more prolific breeds. This was the scenario in smallholder pig enterprises in Kiambu County where all enterprises were intensively managed. On the contrary, in a large proportion of enterprises in Busia County, pigs were tethered or on free-range with no housing provided, thereby exposing them to theft and disease; these being common causes of loss of pigs in Western Kenya (Kagira *et al*., 2010). In some regions in Kenya, growth of the pig sub-sector has been slow because of negative perceptions associated with cultural and religious beliefs (Mutua *et al*., 2010). Of interest however was the difference in pork consumers' perception where smallholders in Busia County felt that this was not a challenge for them in accessing markets. From the researchers observation, there were also many pork outlets in Busia. This presents an opportunity for upgrading along the pig value chain for smallholders in the region and therefore an opportunity for creation of decent work opportunities. Decent work conditions were significantly poorer in female headed households in the entire sample. Among the major challenges for women in this study is the gender bias in terms of participation and also wages as seen in the low scores for these variables. As such, this reduces their financial ability to invest in technology and disease control to improve on the quality of their product. The capacity to improve their quality of life through contributing to social and health security is also limited. The findings corroborate ILO (2012) and Guimaraes (2013) who reported that women work and earn less than men because of "*the precarious nature of their work as well as cultural expectations that they take care of children and the elderly family member*". The low

incomes often exclude women from contributory social security and health schemes thereby keeping them in a cycle of poverty. Larion (2013) argued that social security is a powerful tool in the fight against poverty and insecurity. Likewise, decent work conditions in enterprises where the household head had up to secondary school education were significantly poorer than in enterprises where the household head had post-secondary school education. Low levels of education have been correlated positively with higher poverty levels since literacy in general explains improvement in total factor productivity (Murage & Ilatsia, 2011). Low education level also correlates positively with lower disposable incomes, thereby imply a lower likelihood of such farmers investing in high value technology. Likewise, their ability to contribute to social security and health insurance schemes is also curtailed, therefore exposing them to precarious working conditions. Decent work deficits were more pronounced in enterprises where the farmers were youthful. More often than not, investing in agricultural technology such as improved breeds, use of quality feeds and access to veterinary inputs is demanding in terms of capital requirements. According to Afande *et al.* (2015), the youth in Kenya consider agriculture to be too risky and therefore shy away from putting resources in agricultural enterprises. There has also been a shift from agriculture to the service sector among educated youth who were also disenfranchised in management of critical assets. Most young people in Kenya do not have access to funding mainly because they do not possess collateral that is acceptable to banks and other financial institutions. A combination of these factors has been associated with lack of access/ ownership to factors of production especially land, thereby limiting their ability to make important decisions on investments. This also corroborates the finding of low participation (18 %) of the youth (35 years and below) in pig farming in this study. Approximately 50 % of smallholders were over 50 years of age. This corroborates the findings of other studies that the mean age of smallholders in rural area ranges between 49 - 62 years (Muthui *et al.*, 2014) which tends to lean towards an economically unproductive stage due to the "drudgery nature of agriculture" (Bürkert, 2016). The results of this study provide an indication that it is possible to gradually improve incomes of pig farmers and increase decent work opportunities if the underlying factors that stifle competitiveness are addressed. The nature of work in pig enterprises in Busia County is generally precarious since in its current form, it does not seem to adequately support livelihoods of participants. Most of the work is own account work without remuneration. As a result of low input, production is generally very low. As a result, the level of disposable income from pig enterprises among these workers is likely to be too low to support contribution to social welfare and healthcare schemes that are available countrywide. Wage workers in all study areas were mainly employed on task-based assignments which were dependent on the population of pigs at a particular time. It was noted that pig population in enterprises were highly variable owing to factors such as disease outbreaks and market dynamics. Working hours per day ranged from 1 - 6 hours resulting in under-employment. As a result of lack of or weak organisation in pig production in all study areas, tripartism was unobservable. The findings of this study corroborate Tadjoeddin (2014) who concluded that informal employment was prone to underemployment, low income and lacks full and productive employment. Jobs in the sector were characterised by low pay, lacking in sustainability, job security, social protection, social dialogue and dignity.

4.1 Implications for evaluation of decent work in the informal sector

The ILO manual (ILO, 2012) provides a broad framework for the decent work concept with indicators that can be used to evaluate decent work. However, due to the unique nature of different agricultural enterprises, different approaches in use of indicators can be adopted. The manual does not prescribe any statistical analytical technique that would give explanatory power to the indicators as a unit. Due to the large number of indicators that are inter-related, this study shows that PCA is a useful technique in converging data to facilitate comparison of different entities. However, to identify relevant indicators, there is need to refer to a central concept which in this study was competitiveness with indicators selected based on their ability to improve competitiveness of smallholder enterprises. However, it was assumed that the determinants of competitiveness have an equal measure of influence.

5 Conclusions and recommendations

Principal Component Analytical technique identified enterprises in Busia County as deficient in their decent work status compared to Kiambu and Nakuru Counties with low technology adoption and production efficiency, weak market access and quality control as the most important determinants of decent work status. This study recommends that approaches to address decent work deficits should focus on training farmers to improve technology use and improve production efficiency as well as enhancing surveillance for quality. For further research, the study recommends that evaluation of decent work in smallholder systems could be done through aggregation of the many indicator around the

concept of competitiveness where PCA can be used for data convergence.

Authorisation and conflict of interest

Requisite authority to conduct the study was obtained from National Commission for Science, Technology and Innovation (NACOSTI); which issued a research clearance permit number 15393. Authors state they have no conflict of interests.

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