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Evaluating flock demography characteristics in indigenous chicken production in a participatory research with smallholder farmers in Kenya

Key words: Indigenous chicken, Flock demography, Participatory research

1 Abstract

Objectives: **This research was carried out to evaluate effects of improved management practices on performance of Kenyan indigenous chickens in relation to flock demography at farm level.**

***Methodology*: The research involved 200 farmers in five regions across three counties (Nyandarua, Laikipia, and Nakuru) in Kenya. Four villages were selected per region and 10 farms in each village. Training and sensitisation meetings, introduction of intervention options (Housing, Feed Supplementation, Vaccination and Deworming), implementation by farmers, and monitoring and evaluation were carried out. Farmers used their own local inputs in implementing the project interventions and recorded various project activities and outputs. The project was monitored over a span of five, 3-months long periods. Results indicate that the average number of farms with records in each village was 8.7 for both interventions and demography characteristics (flock size and its dynamic factors - additions to the flock, losses, sales, consumption and gifts from the flock). Average flock sizes rose from 10 – 20 birds per farm to 20 – 30 over the project period. The flock size trends of farms in all the villages and regions are related to the levels of various flock demography dynamic characteristic. The total additions in all the five regions ranged from 53 (region 5) to 68 (region 2) birds per farm during the 5 periods. Average total reductions were only slightly less (1-5 birds) than total additions in the five regions.**

***Conclusion and Application*: Controlled reductions were real benefits and provide evidence of the resource being made use of as one livelihood strategy. The relatively low level of unplanned reductions is a good indicator of a positive effect of the treatments and the research process generally in improving productivity. Flock size levels alone are not indicative of better performance as lower flock size levels could have been due to high controlled reduction levels. However, flock size and other demography characteristics serve as important determinant factors in defining behaviour of the farms.**

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2 INTRODUCTION

In most of African region, about 80% of the population live in rural areas eking out a living from subsistence farming, often under very difficult climatic and economic conditions (Ndegwa, 2006), to meet household food requirements. Indigenous chickens are among the many local resources available in rural areas, which, if well managed, could) uplift people's livelihoods. Over 90% of rural households keep and rear indigenous chicken in small flocks of about 20 birds (Stotz, 1983; Mbugua, 1990; MOLD, 1990; Ndegwa et. al., 1999;). A number of authors have pointed out that indigenous chickens play a very significant role in rural livelihoods (Ndegwa and Kimani 1997; Kitalyi, 1998; Ndegwa *et al* 1998,; Okong'o *et al* 1998; Ndegwa et al 1999; Tuitoyet *et al*; 1999; Ndegwa et al 2001, 2005; Dolberg, 2008; FAO, 2008, 2010; SA PPLPP, 2011 and Ndegwa et al 2012)`. In Kenya, and indeed in sub-Saharan Africa, indigenous chickens comprise over 70% of total poultry populations (MOLD, 1991; Ibe, 1990). They produce about 50% of the total eggs and over 80% of the poultry meat produced in many countries in sub -Saharan Africa (Ndegwa *et al*., 1998). Hence, there exists a potential for the indigenous chickens to improve the lives of persons in the rural areas as stated by Ndegwa, (2006) who also calls for an infrastructural and institutional support in research and development activities aimed at improving productivity at farm level. Indigenous chicken system has been characterised by low productivity due to among other factors, poor management, inadequate and poor feeding regime, poor (or lack) of disease control measures, poor hygiene, inappropriate housing, negative attitudes, lack of technical knowledge and lack of institutional support in terms of policy and infrastructure (Ndegwa and Kimani, 1997). Hence the importance of creating awareness and education to overcome the hindrances (Thieme *et al* 2014). Proper harnessing of local resources of the poor people and their involvement in the research process can help bring about development of sustainable livelihoods and contribute to the fight on poverty alleviation in rural areas where the majority of the poor live (Ndegwa, 2006, 2013 and Gonsalves *et al*., 2005). Their number is mainly composed of women (Blair, 2000; Al-Sultan, 2001) who engage in subsistence agricultural activities as they struggle to survive and feed their families under often very hostile environments (Sonaiya, 1990; Ndegwa *et al*., 2000, 1998a, 1999, 1997 and Gueye, 2000). A number of authors emphasise the fact that empowering women is key to poverty reduction and to agricultural productivity (Dolberg, 2008; Pica-Ciamarra and Dhawan, 2010; Fanworth, *et al*., (2013). According to FAO (2011), the agriculture sector is underperforming in many developing countries, and one of the key reasons is that women do not have equal access to the resources and opportunities they need to be more productive. Promoting gender equality and empowering women (as stated in the Millennium Development Goal Schedule 3) in agriculture to win, sustainably, the fight against hunger and extreme poverty (MDG1) is an imperative (.FAO, 2011). Gonsalves, *et al*., (2005) write about new challenges to agricultural research and development that include shifting focus to less favourable environments, strengthening capacity of local farming communities to continuously learn and experiment ways of improving their agricultural livelihoods, research and development are no longer exclusive domain of scientist and that local stakeholders provide inputs to processes that find sustainable solutions. According to Okali *et al*., (1994) both farmers and researchers are involved at any or all points along a continuum of levels of participation. However, published peer-reviewed material regarding how benefits of participatory research are achieved in practice is scanty (Blackstock *et al*., 2007). This paper explores and explains importance of participatory research in practical terms. This farmer participatory research was carried out between 1996 and 1999 to evaluate

effects of improved management practices on performance of indigenous chickens at farm level and most importantly, the consequences for farmer participation in the implementation of the research activities. We worked directly with farmers in their own surroundings, situations and circumstances in order to not only impart our ideas and visions, but to learn from their rich experiences. The paper focuses on the indigenous chicken flocks' demography characteristics at farm level following introduction of improved management interventions.

3 METHODOLOGY

The data used in this analysis comes from a study carried out in 5 regions across three counties (Laikipia, Nyandarua and Nakuru).and 4 villages per region (see box 1). Farms were selected based on willingness to participate (10 farms per village). Training and sensitization meetings (selected farmers and their neighbours plus frontline extension personnel), introduction of intervention options (see Box 2), implementation by farmers, and monitoring and evaluation were key elements of the study. The farmers participated fully, using their own local inputs in implementing the project interventions and recorded various project activities and outputs including some aspects of management and production. The project was monitored over a span of five, 3-months long periods. Monitoring was by a visit every three months to each farm to evaluate progress and confirm the farmer's records. This was also the time for more consultation and sharing of experiences. There was however, a six-month gap between visits 2 and 3 when there was no visit to the farms due to the security concerns at the time especially in regions 1 and 2. These factors might have therefore played a key role in the behavioural patterns of flock demography. For the purpose of this study, 'periods 1 - 5' refer to the records at the end of the period. The study deals with initial analyses of the flock demography data recorded by the farmers. The aim was to investigate effects of the introduction of a number of interventions, referred in this context as treatments to each of the 200 farms selected across 20 villages in five different regions on the characteristic behaviour of these farms and their indigenous chicken based on flock demography. The interventions were introduced through training and sensitisations services and consultations. Ten farms were initially selected in each village but some dropped out due to factors outside the scope of the study such as security concern.

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Box 1 Regions and villages

1. Laikipia Ngarua – low potential semi-arid, poor infrastructure and frequent livestock theft incidences. Selected villages (with average farm sizes) were, 1 - Kinamba (2 acres); 2 - Sipili (2.5 acres); 3 - Cheleta (10 acres); 4 - Ol Moran (1 acre).

2. Ol Kalou – low to high potential and cold with frequent frost and water logging incidences. Has impassable road network for transportation during wet seasons. The selected villages were: 1) Ol Kalou South with average farm size of 2.5 acres; 2) Passenga with 5 acres as the average farm size; 3) Mirangine with average farm size of 2 acres and 4) Kaibaga with average farm size of 1 acre.

3. Bahati – high potential with adequate rainfall and good soils for agricultural activities, with land size ranging from 5 to 0.25 acres per household and relatively good road network and market opportunities. The selected villages (with average farm sizes) were, 1) Kabazi (1.5 acres); 2) Munanda (2 acres holdings); 3) Scheme (3 acres); 4) Wanyororo (0.5 acres).

4. Njoro –high to medium potential with good to poor road network and market opportunities. The selected villages (with average farm sizes) were, 1) Piave (2.5 acres); 2) Gichobo (5 acres); 3) - Njokerio (0.25 acres); 4) Likia (1.5 acres).

5. Naivasha – low potential, porous volcanic soils of high infiltration. Good to poor road network especially during wet periods villages (with average farm sizes) were: 1) Karate (1.5 acres); 2) Maraigushu (2.5 acres); 3) Karai (5 acres); 4) Mirera (1 acres).

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Box 2: Indigenous chicken project improved intervention options and how farmers adapted them

1. Housing:
- majority of farmers had adopted housing interventions designed to provide shelter from heat, wind cold, rain, thieves, and predators; provide adequate ventilation , lighting and space for birds, feeders, drinkers, nests, resting rafts and for people getting in and out with ease, easy to clean and disinfect to prevent diseases, internal and external parasite infestation. Features included:
- Roofing(farmers used materials such as iron sheet, plastic sheeting, reeds (*'makuti'*) and grass)
- Walls (had to be smooth – mainly mud, some timber, others rafters)
- Floor (dry and smooth and had to be kept clean – mostly earthen, some raised timber, a few were cemented)
- Chicken run (provided scavenging area to glean feeds and exercise – farmers used chicken wire, chain link, offcut timber or droppers)
- Chick pen (high priority for chicks rearing up to 8 weeks, and which contributed to relatively very low mortality levels of 5 -20% compared to over 80% normally reported for ordinary systems(Ndegwa *et. al.,* 1999*)* – most were portable made from timber, tin, wire mesh, intertwined rafters, and reeds baskets)

2. Feeding:
- recommendation on feeding was for a free-choice system comprising both scavenging and supplementation
- almost all farmers supplemented their chicken flocks using mostly local materials (cereal grains – maize, sorghum, millet, wheat, oats, barley; boiled potatoes tubers and peelings, sweet potatoes (*Ipomeo batata*), cassava (*Tapioca*), arrow roots, beetroots, carrots; pumpkins, boiled grain and leafy *amaranthus* (*'terere'*), green vegetables, leafy weeds, grasses; full fat oilseeds – sunflower, rapeseed, 'thawani' (rapeseed family), croton megalocapus (*'mukinduri'*), groundnuts; cooked legume seeds and leafy parts – peas, beans; *leuceana*, *calliandra,* and *sesbania;* in-season fruits - avocados, plums, mangoes, pineapple, bananas; mineral sources - ground egg shells, ash, common salt*)*
- a few farmers bought external materials to feed their birds (compounded feeds, fishmeal, maize bran, cotton seed meal, soya meal, sunflower meal, bone meal, limestone, common salt, mineral and vitamin premix)
- scavenging was practised by all farmers mainly within 'runs' or enclosures during cropping and around the homestead and farm when there was no crop
- Clean and relatively cool water was also provided by all farmers in a variety of containers

3. Health management:
- to prevent and treat diseases some farmers used either or both conventional and traditional strategies:-
- almost all farmers used traditional medication and some did not use any conventional methods.
- conventional medication included:
a) vaccination against Newcastle disease;
b) drugs for respiratory, gut and other problems;
c) control and treatment of endo-parasites – *helminths* using *dewormers*
d) control and treatment of ecto-parasites - mites, fleas and lice using powders
- traditional medication was done using a variety of materials e.g. *Aloe spp.('mugwanugu', 'thukurui'*), hot pepper, garlic, *Mexican marigold* (*'mubangi'*), stinging nettle *('thabai'*), *neem*, pumpkin leaves, pyrethrum, black soot('carbon'), hot ashes;
- other strategies included maintaining clean chicken houses and use of disinfectants such as '*kerol*' or *magadi s*oda and spraying walls with *acaricides.*

4. Hatching and Brooding:
- this was a strategy to produce replacement and incremental flocks rather than buying replacement day-old chicks from a commercial hatchery as is the case with commercial poultry systems.
- the strategy also focused on minimizing flock mortality associated with unimproved systems.
Hatching (synchronized and consecutive) involved use of a cock: hen ration of 1:10 to maximize fertility,

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proper nests (dry, clean, good litter material, quiet, with less light, isolated).
- Synchronized hatching – several hens let to get broody and provided incubation eggs at the same time.
- Consecutive hatching - a broody hen provided with incubation eggs immediately chicks are hatched repeatedly for up to 5 times.
- These strategies ensured farmers got many chicks at once hence increasing flock size several fold within a short period.
- Only a few farmers, though were able to apply synchronized and consecutive hatching

Brooding aimed at preventing chick mortalities by providing good management:
- separating chicks from mature birds – special chick housing (portable baskets, pens, isolated chick area).
- feeding good quality feed – high energy and protein, well ground
- clean cool drinking water
- protection against cold, predators, diseases,

5. Breeding:
-aimed at improving genetic potential of indigenous chickens
- maintaining of cock:hen ratio of 1:10,
- selecting high performers(eggs and growth) and good features (large body size, sturdy)
- avoiding inbreeding (removal of cocks after six months and exchanging with others farmers)

Intervention options were based on a training manual by Ndegwa *et. al.,* (1998b)

4 RESULTS AND DISCUSSION

The records on all the treatments and the flock demography characteristics were analysed for 173 farms disaggregated by region and village and are shown in Table 1. Half of the villages had their original 10 selected farms with records on flock demography and treatment characteristics. For the production characteristics, all 20 villages had less than 10 farms with the records. The average number of farms with records in each village was 8.7 for both treatments and demography characteristics. The shortfall in the number of farms with records on treatment or flock demography characteristics is mostly indicative of drop out by some from the project. This scenario points to the complexity of participatory on-farm experimentation and the need for input of statistical expertise in designing stage. To sustain enthusiasm and revive interest among the farmers, we used some persuasion and education with a good measure of success. Most kept up-to-date records even when we took a longer time to visit them and even long after the project had been phased out. This also happened in areas where serious insecurity problems had previously occurred forcing many people to temporarily flee their homes. The flock demography dynamics and the treatments characteristics had the most records and many farmers found these easier to handle. However, the number of farms with production characteristics records was fewer despite recording from only a selected number of hens among the farmers' flocks (Ndegwa, 2006). All the variables were based on farmer records. The intervention treatment included the four explanatory variables housing, vaccination, de-worming and feed supplementation, introduced through a process of training and sensitisation of farmers. Exploratory variables to investigate effects were the flock demography and the production characteristics. Application of the treatments depended on individual farms capacity, ability and time allocation. Farmers used their own local resources and new knowledge from the training to apply the treatments. Hence, the treatments were not uniform in all the farms.

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Table 1: Number of farms in 20 villages with records on flock demography

Region/Village	Number of selected farms	Flock Demography
1 / 1	10	10
1 / 2	10	10
1 / 3	10	10
1 / 4	10	7
2 / 1	10	10
2 / 2	10	8
2 / 3	10	8
2 / 4	10	7
3 / 1	10	9
3 / 2	10	10
3 / 3	10	9
3 / 4	10	6
4 / 1	10	10
4 / 2	10	7
4 / 3	10	9
4 / 4	10	3
5 / 1	10	10
5 / 2	10	10
5 / 3	10	10
5 / 4	10	10

4.1 Demography Information: Table 2 shows demographic characteristics in period 1 using a selected sample of farms, one each from the 20 villages in the 5 regions. The rest of the data is found in appendices 5.4 - 5.8 (Ndegwa, 2006). The table shows raw data as recorded by farmers for 5 periods on flock size and its dynamic factors - additions to the flock, losses, sales, consumption and gifts from the flock. The data was analysed to provide summary information about behaviour of farms using a set of tools: plots of flock trends over the periods, flock dynamics of additions and reductions, demography analysis to classify farms and use of the flock dynamics in regressions to get optimal operation models. Due to the small values of most of these factors, losses, sales, gifts and consumption were grouped broadly as reductions and this was in turn categorised either as controlled (sales, consumption and gifts) or unplanned (losses). The number of farms with records on flock sizes is less than the initial 200 farms since some had dropped out of the project mainly due to security concerns in two regions (1 and 4) and the farmers' circumstances. Flock size dynamics over the 5 periods were represented by the farm flock sizes at the beginning and flock size characteristics of change through the period (total addition, total reduction, total unplanned reduction and total controlled reduction). The trends of the flock size averaged for farms in a village over 5 periods are represented in Figure 1 with 5 plots (read from a-e) and cover all the five regions. Flock size values from 15 farms - 2 from region 2, 3 each from regions 1, 3 and 4, and 4 from region 5, were considered extremes (either too large or too small) and therefore left out from the flock trends. The flock size trends provide preview of the flock levels maintained by farmers over time. There was a general rise of flock sizes in the farms from low levels of between 10 – 20 birds per farm to mainly medium levels of 20 – 30. The flock size trends in all regions had a fall between visits 2 and 3. This corresponds with the long duration of time (6 months) between the two visits and state of high insecurity due to

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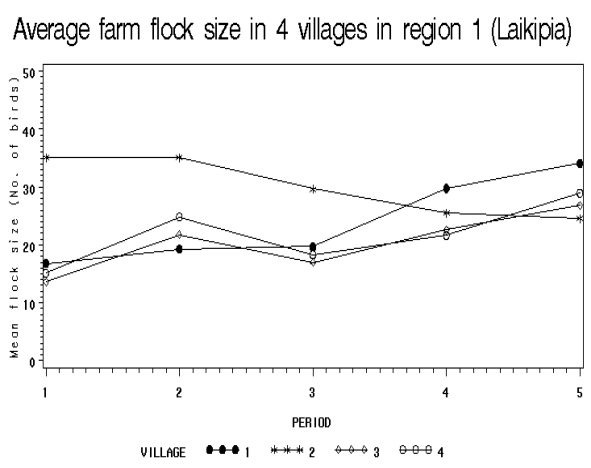
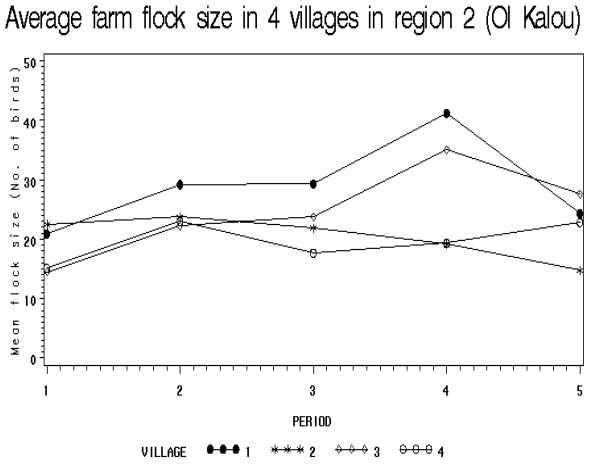
political violence associated with the electioneering mentioned earlier.

Table 2: Demography characteristics of a selected sample of farms in 20 villages in period 1

Region	Village	Farm	Flock size	Demography dynamics				
				Addition	Loss	Sale	Gift	Consumption
1	1	LK1	9	5	0	1	0	0
1	2	LS3	28	12	0	4	1	2
1	3	LC4	15	9	6	0	0	0
1	4	LO9	44	12	0	2	5	1
2	1	OS1	18	20	0	3	0	0
2	2	OP3	21	12	0	20	1	2
2	3	OM4	14	25	0	2	1	5
2	4	OK8	44	12	0	2	5	1
3	1	BK1	18	5	0	1	0	0
3	2	BM1	123	63	5	43	1	2
3	3	BS4	14	25	0	2	1	5
3	4	BW9	44	12	0	2	5	1
4	1	NP1	18	20	0	3	0	0
4	2	NG2	23	20	2	2	0	6
4	3	NN5	15	9	6	0	0	0
4	4	NL6	10	20	1	2	0	1
5	1	NSK2	20	10	0	0	0	2
5	2	NM1	24	10	2	0	1	1
5	3	NKR6	12	13	2	0	0	2
5	4	NMR5	14	15	10	5	3	1





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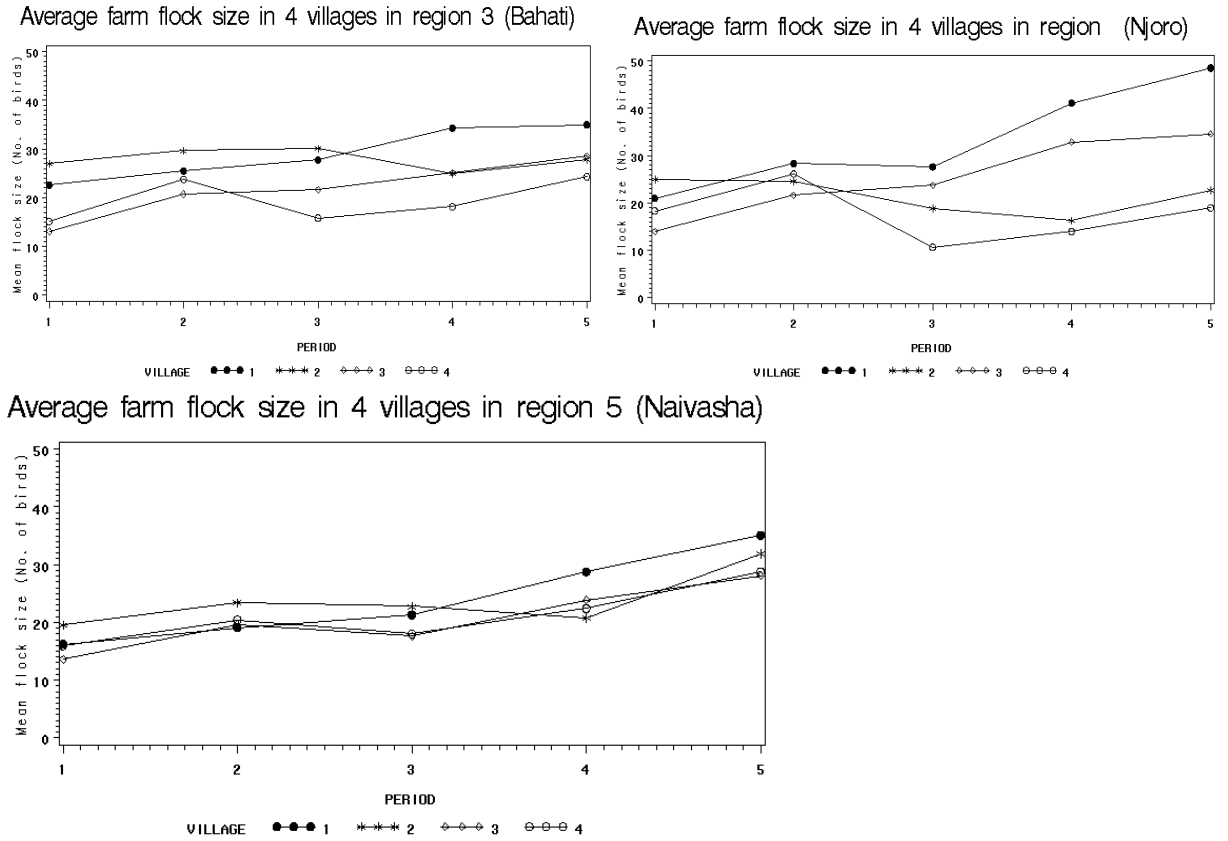

Figure 1(a-e)

Figure 1: Trends of the flock size averaged for farms in a village over 5 periods

Figure 1(a) shows the flock size trends of farms in four villages in region 1. All the farm trends generally went up initially from average lows of 14 in villages 1, 2, and 3, although there was a dip between visits 2 and 3. Farms in village 4 (Ol Moran) had the sharpest fall in flock size. The trend in village 2 started high above 35 but gradually decreased to below medium low at around 20, lower than levels of the farms from the other villages. Farms in the other villages had similar flock size trends with an upward trend that started from lows of 13 – 16 and ended up with highs of 25 – 33. The flock size of farms in village 3 however started lowest and ended up lowest. The Ol Moran area was most affected by the state of insecurity, forcing at least three farmers out of their farms after period 2. However, the determination and enthusiasm of the farmers was such that they continued with project activities and their flock size trends bear this out. Generally, the flock size in region 2 increase from below 20 to near 30. The average flock size trends in villages in region 2 are shown in Figure 1(b). The general flock size trend increased steadily over the periods for farms in villages 1, 3 and 4 from just below 20 to medium levels around 25. The trend for farms in village 2 had a slight negative gradient all through the periods ending up lowest at 15 despite having started at a similar medium level (>20) with those in village 1. The flock size of the farms in village 1 remained above those of other farms except in period 5. Similar to the farm flock size trends in region 1, there was also a general drop between periods 2 and 3, in region 2, though only slightly so in the latter period. However, unlike in region 1, region 2 had a drop in flock trend between

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visits 4 and 5. Generally, the flock size in region 2 increase steadily from below 20 to above 20. Flock size trends of farms in four villages in region 3 are shown in Figure 1(c). The trends in all the farms generally were an increase from around 20 to medium levels of 25. There was, as elsewhere, a decline between periods 2 and 3 but in this case, only farms in village 4 were affected. The trend for farms in village 4 was lowest and below 20 although it was slightly above farms in village 3 in period 1 and 2. Farms in villages 1 and 2 had higher levels above the medium 25. Figure 1(d) shows the flock size trends for farms in four villages in region 4, which had an upward trend from a low level of below 20 to a medium level of below about 30. There was the characteristic dip of the flock size trend between periods 2 and 3 except in village 3. The dip was more pronounced for farms in villages 2 and 4 (Likia) with both ending up with lower flock size levels (17) than their initial level (24). The trend for farms in the other 2 villages was a rise from 18 to 38. Farms in village 4 bore the brunt of political violence and heightened insecurity problems at that time. Flock size trends for farms in four villages in region 5 are shown in Figure 1(e) with a general rise from about a low level of 17 to about a medium level of 27. The farms in this region seem to have had less variability in flock size trends and levels than in the other four regions. There was also a dip between periods 2 and 3 except for farms in village 1. These, however, were less pronounced than for farms in other regions. The farm flock sizes in all the 5 regions had generally an upward trend starting with a low level of just below 20 birds in each farm, steadily rising to a medium level of just below 30 as shown in Figure 2. An interesting observation from the flock size trends is that, in all the farms, there was a characteristic dip between visits 2 and 3.

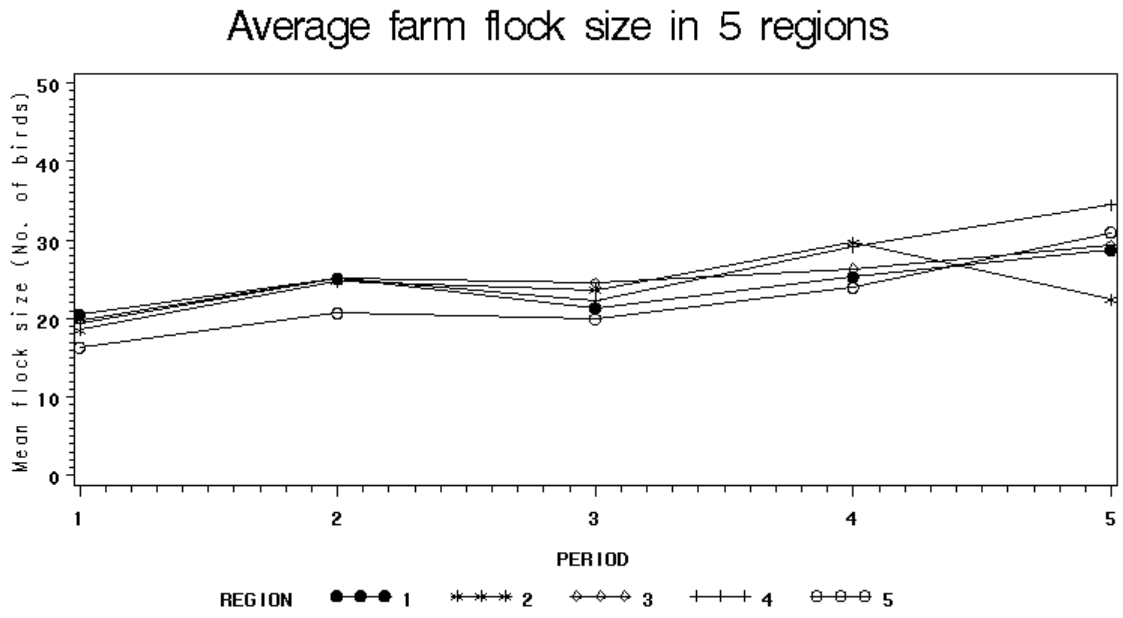

Figure 2: Farm flock sizes trends in 5 periods averaged for 5 regions

The flock demography dynamic factors summaries are provided elsewhere in Ndegwa, (2006; 2013). This shows the total additions, the total reductions, the controlled (sum of sales, consumption and gifts) and the unplanned reductions (losses from mortality or thefts). Summary values for the dynamic factors in all the five regions are shown in

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Table 3. The total additions in all the five regions ranged from 53 (region 5) to 68 (region 2) birds per farm during the 5 periods. Average total reductions were only slightly less (1-5 birds) than total additions in the five regions. Hence, the average flock size per farm increased marginally from about 20 to 25 birds. The controlled reductions levels ranged from 30 (region 5) to 46 (region 2). There were only slight regional differences with regard to the unplanned reductions, which had a range of 17 – 19 birds per farm. Generally, there seemed to be regional differences on the levels of these flock demography characteristics with region 2 having greater additions and controlled reductions.

Table 3: Average totals of flock demography dynamic characteristics for 5 periods in regions 1 – 5.

Region	Number of farms	Flock demography characteristics[1] mean total values			
		TotADD	TotRD	TotURD	TotCRD/ (%Totadd)
1	37	55	52	19	34 (60%)
2	33	68	64	18	46 (67%)
3	33	56	55	19	35 (64%)
4	26	64	60	18	42 (66%)
5	40	53	48	17	30 (58%)

[1]Flock demography characteristics totals for 5 periods: TotADD = Total flock addition; TotRD= Total reduction; TotURD = Total unplanned reduction; TotCRD = Total controlled reduction.

The controlled reductions were real benefits and provide evidence of the resource being made use of as one livelihood strategy. These were within a range of about 60 – 70 percent of the total additions. The controlled reductions consisted of birds that were used as food by the household, sold to generate some income or given out as gifts, a contribution to building up of their livelihood assets of financial and social capital. The relatively low level of unplanned reductions is a good indicator of a positive effect of the treatments and the research process generally, in the improvement in productivity.

5 CONCLUSION

The flock size trends of farms in all villages and regions are related to the levels of various flock demography dynamic characteristics. Hence, flock size levels alone are not indicative of better performance of a particular farm as lower flock size levels could have been due to high controlled reduction levels. However, flock size and other demography characteristics serve as important determinant factors in defining behaviour of the farms. This paper has dwelt on defining the flock demography characteristics but more detailed statistical analysis is available in Ndegwa, (2006) where farms have been categorised into groups or clusters with distinct flock size trends and levels. The presentation of the farmer participatory research data from the farmers' records shows the extent to which this process achieved objectives of participation. This was a result of our consulting, sensitising and training of the farmers and their active involvement in the project activities. The regular visits by the research team and continuous presence of a local extension person in each village were also critical elements for this success. The project therefore forged partnership between the parties involved. This paper has dwelt on the description of a farmer participatory research data, highlighting its nature and scope, providing summaries of various data in form of graphical presentation of trends for flock size and totals of flock demography dynamic

factors. Some farms were considered extremes and hence left out in specific analysis, while others would have no entry in some periods. Therefore, the data had to undergo a 'sifting' process at various stages of the analysis to produce a form that was usable for further more detailed statistical analysis described in Ndegwa, (2006). The problems encountered in 'sifting' the data in order to develop a coherent and precise descriptive analysis, points to the difficulties and dilemmas of undertaking farmer participatory research. In this regard, important lessons have been learnt, especially the importance of continuous regular and frequent monitoring of farmers' actions by the research team, to provide guidance and boost farmers' morale and interest.

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