Management, Feeding and Breeding Practices of Local Chickens in the Remote Areas of Morobe Province, Papua New Guinea

Lobâo Martin[1], Ahizo Jeremiah[1], Dom Michael[2] and Pandi Janet[2]

ABSTRACT

The study focused on understanding the management, feeding and breeding practices of local chicken raised in remote areas in Papua New Guinea. A total of 173 households (HH) in 14 remote villages were studied. The high percentage of male respondents did not reflect ownership as in many societies women play greater roles in family farming. Main livestock kept were chicken, duck and pigs. Family consumption and income generation were their primary motives. Semi-extensive management is common with no or minimum interventions to improve chicken production and productivity. Whereas extensive system relies on scavenging feed resources and occasional supplementary feeding. A total of 2010 chickens were recorded, ranging 1 to 34 with mean flock size of 10.52±14.41 birds per HH. Population structure comprised of young chicks, adult hens and female pullets. An estimate of 10.8±5.28 eggs per hen was reported by respondents for the past one year period. Average clutch per hen per year was 3.7±2.13 with an estimation of 40 eggs per annum. Survival is affected mainly by theft of adult birds, predation and disease affecting mostly young chicks. There was no well-developed systematic breeding and selection practices although 35.3 % of respondents perform selective and crossbreeding mainly through exchanging, culling and isolation of birds. Breeding objectives are emphasizing on phenotypic traits due to its cultural value but less on fitness and production traits. Marketing is basically informal and highly seasonal. Local prices ranged between PGK 15 and PGK 25 per live bird.

Key words: Local chickens, Management, Feeding, Breeding practices.

INTRODUCTION

Domestic chickens (*Gallus gallus domesticus*) in Papua New Guinea (PNG) were introduced by waves of early migrants around 3,500 years ago from Southeast Asia (Quatermain, 2000). The breed types and numbers remain ambiguous but the distribution is largely populous along the coastal areas and the islands (Quartermain, 2000). Various modern breeds of chickens were introduced later during the colonial era, leading to extensive mixing with the established locally adapted chicken ecotypes. These chickens have evolved crucial abilities to adapt and survive in often harsh environmental and ecological conditions associated with their geographical settings. Their status remains unknown and interminably disregarded because of its poor economic production potential in comparison with the commercial strains. Local chickens are mainly associated with household food security, socio-cultural and religious rituals.

In the past decade there has been a renewed interest in local chicken for its contributions towards food security, poverty alleviation and enhancing gender equity among the disadvantaged communities (Ignatius and Quartermain, 2006; Kohun *et al*., 2006). The current economic prospects and growing population have also stimulated a greater demand for chicken and eggs (Kohun *et al*., 2000) resulting in a growing market demand for local chickens. Much of the local chicken population is kept under subsistence level mainly for food security, socio-cultural and religious rituals. Local communities and other ethnic groups prefer the texture and flavour of local chicken meat and eggs (Kohun *et al*., 2000).

The need to understand the status of local chickens is important to provide research and development strategies to help improve

[1]National Agriculture Research Institute, Livestock Research Program, Lae, Morobe Province, Papua New Guinea, Correspondence: martin.labao@mari.org.pg [2]School of Animal Veterinary Science, Roseworthy campus, The University of Adelaide, South Australia, Email: Michael.dom@adelaide.edu.au

their production and productivity, hence sustain the livelihood of rural poultry farmers. This paper reports on the results of a study in the remote areas in Morobe Province of PNG to understand the current management, feeding and breeding practices of local chickens.

MATERIALS AND METHODS

The study covered two districts (Huon Gulf and Bulolo) of Morobe Province (Figure 1.0). Only six villages (Gaina, Dona, Siagara, Ana, Zare and Ainse) were covered in the Morobe Rural Local Level Government (LLG) area of Huon Gulf due to logistical constraints particularly by boats and weather conditions, whereas Waria Rural LLG in the Bulolo district was accessible by air include Sipa, Kapiso, Guru, Kipu, Peira, Korepa, Wakaia, Au, Aro, Motete and Asama villages and Garaina and Garasa government stations. Waria Rural LLG is mainly mountainous and lies inland of Morobe Rural LLG which is situated along the southern coastline of the province. Morobe Rural LLG which is situated along the southern coastline of the province. Temperatures in the two areas ranged from 23 °C to 30 °C and annual rainfall distribution from 1200-1800 mm and 1200-4000mm in the coastal and hinterland respectively. The vegetation is basically rainforest sustaining the communities with fuel wood and other necessary needs.

A total of 173 farmers were interviewed over six days by four trained staff members from the National Agricultural Research Institute (NARI), Lutheran Development Services (LDS), Provincial Department of Agriculture and Livestock and Bris Kanda Rural Development Inc., through communication with farmers via a structured questionnaire. Lack of production records led to use of face-to-face survey method in the study. Simple descriptive statistics was used to analyse the data and compared in percentages using the Statistical Package for Social Science (SPSS, 2001).

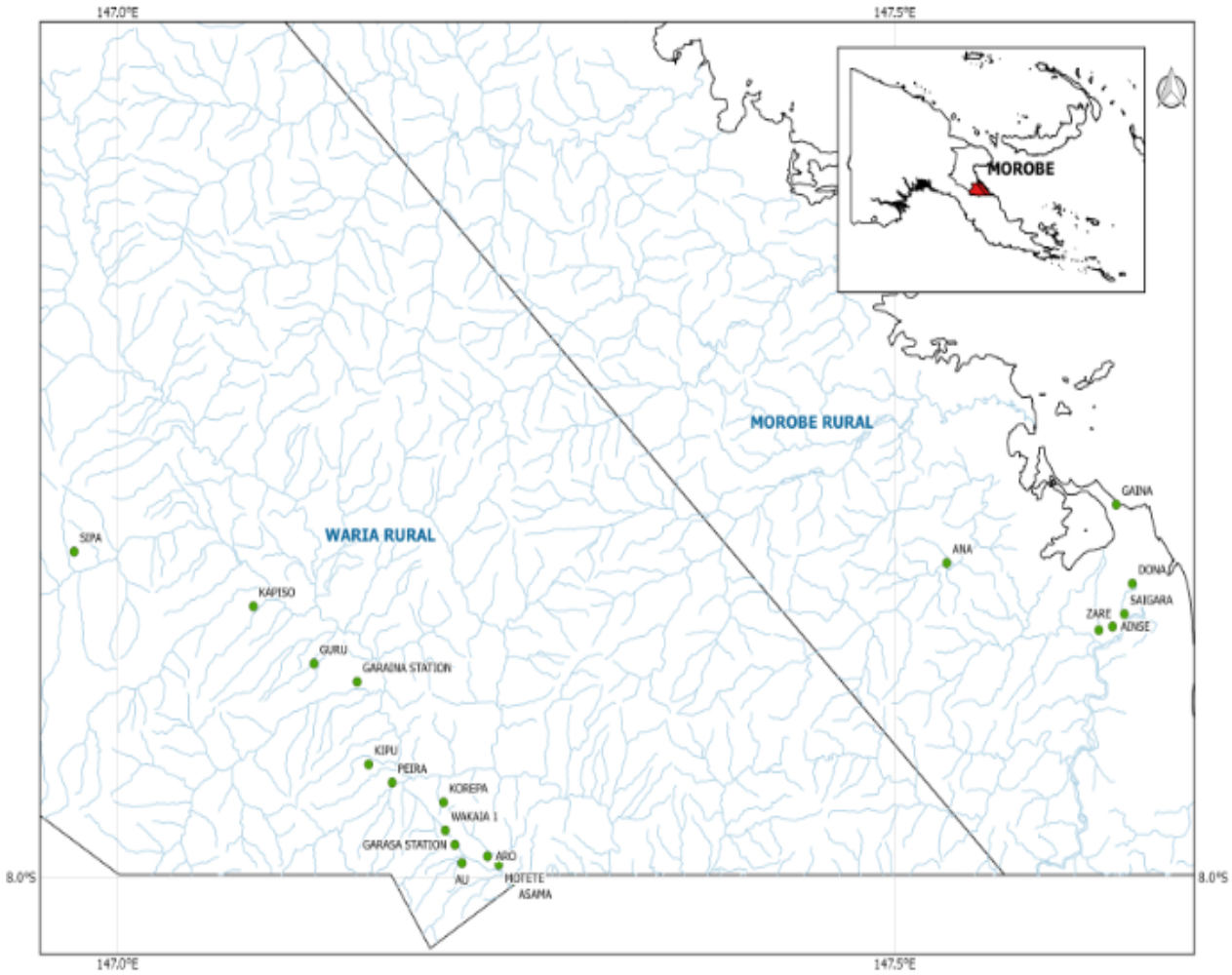

Figure 1: Map of study sites

RESULTS AND DISCUSSIONS

Profile and characteristics of local chicken farmers

Three quarters of the respondents interviewed were males and a similar proportion was married. Despite the high proportion of male farmers they may not be the principal custodians as poultry production in PNG is mostly considered a family based venture since labour input is usually shared by the family members (Kohun *et al.* 2006). In a typical Melanesian society, women are the primary caregivers to children and the primary food producers, thus it is apparent that women (including children) had to play some important roles in the day to day welfare of the animals. Primary school was the highest level of education for many (63.3 %) of the respondents. This may be beneficial for future technology dissemination programmes aimed at improving livestock production since literacy is an important determinant of technology adoption (Adesina and Chianu, 2002). The literacy level of farmers would more likely enable them to be more responsive to any agricultural improvement efforts. As many as 125 (72.3 %) had large families between four to 10 members and 17.3 % comprised additional relatives. The large family size in Melanesian societies indicates readily available farm labour supply apart from wealth, status and security. This is reflected in the size of land (>3 hectares, n=84) cultivated supposedly for subsistence gardening and cash crops (e.g. cocoa and coffee) as indicated by 48 % of the respondents. The large proportion of land holding is an important advantage for future agriculture improvements. Small family size with less land holdings may be considered as vulnerable members of community for which agricultural technologies would provide a key means for ensuring food security.

Purpose and rationale for keeping local chickens

About one third of the respondents keep only local chickens while 27.2 % keep a mixture of chickens, ducks and pigs (Table 1). This portrays the importance of local chickens in these parts of the province. Few of the interviewed farmers were raising Australorp chickens although this strain was reported to have poor brooding characteristics (Quartermain, 2000). The main motivations cited for keeping local chickens were for family consumption (36.4 %), income (34.1 %) and for the fact that it requires low capital inputs (20.8 %). Moreover, local chickens were preferred because they were easier to look after (30.1 %) and have a strong flavour of meat and egg (21.4 %); whereas 19.1 % consider plumage colour for cultural decorations. This suggests that cultural significance of chickens is just as important as their commercial value. The survey also revealed the resilient nature of local chickens to varied environmental and low input management conditions in PNG (Quartermain, 2000; Ignatius and Quartermain, 2006) with less consideration on hardiness (8.7 %) and genetic conservation. Local chickens are particularly vulnerable to uncontrolled mating and with no conservation strategies the threat of losing its genetic variation which otherwise be useful in the future should be considered in future poultry development programs. Awareness on conserving local chicken genotypes should also form a crucial part of any genetic improvement efforts.

Table 1: Purpose and rationale for keeping local chickens (n=173)

Variables /Attributes	Percent	Variables /Attributes	Percent
Types of livestock kept:		*Rationale for preferring local chickens:*	
Local chicken only	71.1	Easier to keep	30.1
Mix chickens, ducks and pigs combined	27.2	Taste or flavour of meat & eggs	21.4
Mix chickens and others combined	1.2	Hardiness & resistance to disease	8.7
Mix chickens and rabbit combined	0.6	Market price	17.3
Reasons for keeping local chickens:		Feather/plumage colour	19.1
Own consumption	36.4	Conservation (Diversity)	3.5
Sell for Income	34.1		
Low capital investments	20.8		
Social/Traditional obligations	3.5		
Others (prestige, low risk, etc.)	5.2		

Management and feeding

The different management and feeding systems across the study sites are presented in table 2. The dominant management systems are semi-extensive (75.7 %) and extensive or scavenging (22.0 %) systems and only four farmers confined their flocks. For these four farmers little effort in providing appropriate feed, housing and water is required to attain good production. Shelter is built on ground using thatched sago and coconut leaves for roof, and old chicken wire including bamboo as walling. Chickens of different age groups are fed together, usually on split bamboos, old plates/ dishes or on the ground. Although 25.4 % of respondents provide shelter, no purposeful feeding is evident and scavenging feed resource (SFR) is apparently the only source of feed available thereby affecting local chicken production. Roberts (1999) reported that SFR usually vary depending on various factors such as flock size, climate and season, and are often not adequate. Efforts to promote local chickens in the areas must place some emphasis on supplementary feeding and this would be possible if the farmer identifies a real value in raising them.

Table 2: Management systems, feeding and housing of local chickens (*n*=173)

	Characteristics					
System	Feed	Feed resource	Feeding practice	Housing	Type of house	Percent
Scavenging (Extensive)	No	any scavengeable feed resources in the village	scavenged	No	birds roost in trees	38 (22.0)
Semi extensive	Yes	kitchen waste, coconut waste(as is), rice bran (whole & by-products) paw-paw, white ants, commercial feed (not often)	Split bamboo, old dish and plates, thrown on ground	Yes	both low & raised shelter, sago & coconut roofs, old chicken wire & bamboo walls	87 (50.3)
	No	any scavengeable feed resources in the village	birds scavenged in the open	Yes	both low & raised shelter; sago & coconut roofs; old chicken wire & bamboo walls	44 (25.4)
Intensive	Yes	kitchen waste, coconut waste(as is), rice bran (whole & by-products) paw-paw, white ants, and occasionally fed commercial feed	Split bamboo, old dish and plates	Yes	low shelter on ground; sago & coconut roofs; old chicken wire &bamboo walls	4 (2.3)

Numbers in brackets are percentages of respondents

Flock size, structure and composition

The flock size per household, structure and composition of local chickens are presented in Table 3. A total of 2,010 local chickens were recorded and the flock size ranging from 1 to 34 birds with a mean of 10.52±4.41 observed across the sites. The small flock size is attributed to management, feeding practices, socio-cultural and possibly economic and agro-ecological factors. For instance, larger flock sizes were found in farms where chicken sheds and supplementary feeding was provided.

The average sex ratio was 1: 3 (male to females) across the study sites. The recorded population comprised of chicks of less than 12 weeks old (34.3 %), breeder hens aged over 30 weeks (28.8 %), female pullets aged between 13 to 30 weeks (18.2 %), young males aged between 13-30 weeks and roosters aged over 30 weeks with averages of 3.91±2.26, 3.62±1.84, 2.16±1.12, 1.94±1.02 and 1.85±1.47 flocks per household respectively. Quartermain (2000) reported that local chickens are vulnerable to various threats especially when housing is not provided leading to high mortality. He further specified that survival up to 16 weeks ranged from 80-100 % and reduces to 50 % by age of first drop and further 20 % at 56 weeks. The main causes of losses were due to theft and predation by dogs which accounted for 60 and 20 % losses reported. The high population of chicks observed across the sites indicates that farmers are aware of their responsibility to protect their animals from such losses by providing shelter and feed as shown in Table 3. Unlike other remote areas in PNG, the presence of community and rural services provided by NGOs (i.e. LDS and Bris Kanda Inc.) and NARI in the surveyed areas may also have contributed to better knowledge of raising poultry. In this study the high incidence of theft is reflected in the small number of pullet and adult male chickens as they are larger in size when they grow bigger. Conversely the greater numbers of hens reflected farmers' motive to ensure production of replacement flocks, egg production, household consumption and income generation.

Table 3: Flock size, structure and composition

Class	No. flocks	Mean±SD	Min	Max
Chicks (<12 wks)	689 (34.3)	3.91±2.26	1	10
Pullet male (13-30wks)	183 (9.1)	1.85±1.47	1	14
Pullet female (13-30wks)	365 (18.2)	2.16±1.12	1	18
Breeder male (>30wks)	194 (9.7)	1.94±1.02	1	5
Breeder hen (>30wks)	579 (28.8)	3.62±1.84	1	8
Overall	2010 (100)	10.52±14.41	1	34

Numbers in brackets are percentage

Performance of local chickens

In the study, farmers were requested to give estimation on the performance of their flocks for the past one year period. Data on flock number, eggs laid per clutch, number of clutch, hatchability and survival are presented in Table 4. The average number of eggs produced per hen per clutch was 10.8±5.28 eggs. The reported average number of clutch per hen in the past one year period was ranged from 1 to 5 (mean 3.7±2.13). This is estimated to be around 40 eggs produced per annum which is comparable with 44 eggs reported in Bangladesh (Burua and Yoshimura, 1997) and between 40 to 60 eggs reported in Ethiopia (Tadelle and Ogle, 2001). The averaged number of eggs hatched per hen for the past one year period was estimated at 70 % and around 50 % of birds would survive up to 12 weeks of age while an additional one percent would reach 30 weeks of age.

Table 4: Performance of village chickens across the study sites

	Min	Max	Median	Mode	Mean±SD
Eggs laid/hen/clutch for the last 1 year period	3	12	10.2	10	10.8±5.28
Clutch/hen/yr	1	5	3.9	4	3.7±2.13
Eggs hatch/hen in the last 1 years period	1	12	6.9	7	6.7±3.41
Chicks survived up to 12 wks	1	10	4.7	5	5.6±2.54
Chicks survived up to 30 wks	1	7	5	5	5.3±1.29

While the estimates suggest fairly good egg production potential especially under rural condition where nutrition is inadequate it is likely an over estimation particularly when half of the respondents (*n*=76, Table 5) indicated that birds usually lay eggs in nearby bushes which are difficult to notice as well as exposed to natural predation. Local chickens are highly vulnerable to a range of threats such as predators, theft, diseases and poor management practices (Negussie, 1999; Quartermain, 2000; Tadelle and Ogle, 2001) affecting its sustainability and productivity. Much of the losses in this study were primarily associated with theft (40 %) where farmers reportedly lost adult birds (51.8 %) and pullets (24.9 %). Predation (30.6 %) was cited as the second prevailing cause of bird losses and majority (77.4 %) of the respondents indicated chicks as the most affected group.

Table 5: Flock size, structure and composition

Variables/Attributes		Percent	
Common area for laying eggs (n=156)			
Inside chicken house		41.0	
Kitchen/family home		10.3	
Bush		48.7	
Loss of flocks (n=173)			
Yes		91.3	
No		5.8	
Not stated		2.9	
Causes and class of birds lost	Percent (Overall)	Number of birds lost	
		<5 birds	6-10 birds
Theft:	83 (40.0)		
Chicks		14(16.9)	
Pullets		24(28.9)	
Adults		43(51.8)	2(2.4)
Predators :	53(30.6)		
Chicks		41(77.4)	
Pullets		9(17.0)	
Adults		3(5.7)	
Disease:	23(13.3)		
Chicks		17(73.9)	
Pullets		4(17.4)	
Adults		2(8.7)	
Others (i.e. accidents, unknown, etc):	12(6.9)		
Chicks		9(75)	
Pullets		2(16.7)	
Adults		1(8.3)	

Numbers in brackets are in percentage

Breeding and selection of local chickens

About 52.6% of the respondents reported to have purchased their initial breeding stocks; particularly from NARI, friends, neighbours and relatives (Table 6). The study also showed significant proportion (27.2 %) of respondents who acquired their breeding stocks through exchange or barter system whereas 12.1 % were supplied by NGOs and church-run agencies. The purchase and exchange of breeding stocks at the community level indicates the significant socio-cultural and economic role of local chickens in the study sites. The results further confirmed the important role of NGOs and Community Based Organisation CBOs in promoting rural development through the delivery of livelihoods projects in rural communities. With their non-rigid, locality specific, need based, beneficiary oriented and nature of services, NGOs and church agencies can effect sustainable rural poultry production far more extensively and effectively (Kitalyi, 1996). Hence, this gives confidence for partnership and collaborative efforts with such institutions to improve local chicken production in the rural communities.

Data in Table 7 further show that systematic breeding practice for local chickens is less common (64.7 %), even though 35.3 % indicated to have practiced some form of improvements on their flocks. This could be attributed to lack of knowledge on breeding and farmers' impression that native chickens can fend for themselves thus left unaided in the open leading to uncontrolled mating (Quartermain, 2000). While there is no well developed breeding practice for local chickens, the study revealed that farmers do practice selection based on their preferences. About 25% of respondents practiced selective breeding and about 18% crossbreeding. Emphasis in order of importance was placed on feather type and colour (34.4 %), ecotype (26.2 %), body size (21.3 %) and egg production (11.5 %). The results agree with Tadelle and Ogle (2001) who reported that farmers in Ethiopia also put greater selection emphasis on plumage colour, meat and egg production, live weight and other phenotypic traits such as comb type. This kind of system and preference is likely to exert stress on other important traits that contributes to the overall productivity of the animal in the long term. It is therefore important that they are aware of the risks associated with this selection practice and the long term benefits of combining of fitness (e.g. hardiness) and production traits (e.g. efficiency).

The exchange of breeding stocks among farmers (37.8 %) and culling of breeders (30.7 %) are commonly practiced.. The males are either raised in isolation together with a single and or groups of selected hens. In any case the farmer would decide to cull old breeders. The exchange of breeders usually requires some form of information sharing and enthusiasm between farmers before execution.

Table 6: Source of breeding stock, breeding methods and selection criteria

Variables/Attributes	Percent	Variables/Attributes	Percent
Source of initial breeding stock (n=173*):*		*Preferred trait during selection (n*=61*)*	
Purchase (NARI, friends, relatives, etc.)	52.6	Feather type and colour	34.4
Exchanged/Barter	27.2	Ecotype	26.2
Supplied by NGOs & LDS	12.1	Body size	21.3
Free gift/Inherited	8.1	Egg potential	11.5
Breeding practiced (n=173*):*		Not indicated	6.6
Yes	35.3		
No	64.7	*Breeding methods (n*=61*):*	
Ways of breeding (n=61*)*		Isolation of breeders	18.9
Cross breeding	18.0	Culling of breeders	30.7
Selective breeding	24.6	Exchange of breeders	37.8
Line breeding	-	Not stated	12.6
Not stated	57.4		

Market information

The results on market information are shown in Table 7. There is no formal marketing system across the sites but the informal marketing of live birds and eggs do exist as indicated by 59 respondents, and usually coincides with special events in the year. As many as 22 (37.3 %) sell directly at the farm gate and only seven farmers (12.7 %) occasionally sell at the local market organised by the community. It is during these events when farmer decide to sell their chickens (54.2 %) when they are in high demand and because of the need to buy other necessities.

Table 7: Marketing and price range for chickens and chicken products

Variable/Attributes	Percent	Variable/Attributes	Percent
Marketing of local chickens (n=173)		*Type of products sold (n=59)*	
Yes	34.1	Live birds for meat	69.5
No	32.4	Eggs	11.9
Plan to sell later	33.5	Others (e.g. for feathers)	18.6
Market sites (n=59)			
Farm gate	37.3	*Preferred birds/products for sale (n=59)*	
Village market	12.7	Eggs	15.3
Urban markets	-	Chicks	3.4
Timing and criterions for sales (n=59)		Cockerels	64.4
Festive seasons and special events	54.2	Hens	16.9
Farm input requirement	8.5		
Personal needs (food, transport, school fees, etc)	37.3		

Price range	Eggs	Chicks	Cockerels	Hens	Overall
K0.50-K1	9(100)	-	-	-	-
K2.00	-	2(100)	-	-	1(4.0)
K15-K20	-	-	21(55.3)	8(80.0)	29(58.0)
K21-K25	-	-	16(42.1)	2(20)	18(36.0)
K26-K30	-	-	1(2.6)		1(2.0)

Numbers in brackets are in percentage

Live birds (69.5 %) sold for meat consumption and presumably for its plumage value particularly during festivals are common and reflected in the type of birds preferred for sale. Other products sold are eggs (*n*=11, 18.6 %) and feathers (*n*=7, 11.9 %). Data showed that the most preferred flocks and products often placed on market were adult cockerels, hens and eggs, representing 64.4, 16.9 and 15.3 % respectively. This is also reflected in their selling prices. Most of the respondents were charging their chickens between PGK 15 to 20 (58 %) and PGK 21 to 25 (36 %). As many as 21 (55.3 %) sell cockerels between PGK 15 to 20.00 whereas 16 (42.1 %) charge slightly higher prices between PGK 21 to 25. The value of chickens and chicken products seemed to be based on the bird size and presumably on its

plumage. Reports from the survey participants indicated that birds with bright red, white and or a mixture of red and white coloured plumage are marketed or preferably sold for consumption. Higher price tags were also set based on considerations on body physique (large size) and feather type. Long and bright red or mixed coloured feathers are used headdresses for in traditional events. The black coloured or mixture of black and white birds is less regarded thus fetching lower price tags. The prices are comparable with the prices of broiler meat birds in the informal live bird market in many parts of PNG.

CONCLUSIONS AND RECOMMENDATIONS

Despite the socio cultural significance and popularity of local chickens among many rural households the challenges of high bird losses due to theft, predation, and poor management, lack of housing and poor feeding are evident. The sustainability and production of local chickens will depend on minimising these losses. Systematic breeding and selection practices are less developed due mainly to lack of knowledge. The chicken population remains exposed to uncontrolled breeding under natural environments. More over the primitive selection practices carried out in some farms may pose long term risks on the adaptive capacity and productivity of the chicken population. Marketing is basically informal and is conducted during festive seasons when demand is expected to be high. The birds were priced based on physique and plumage type and colour. The study showed bright red or a mixed coloured birds are commonly sold and prices ranged between PGK 15 and PGK 25.

The following recommendations are suggested for future works to promote local chicken production in the area;

- Provision of successive trainings on improved management and husbandry practices involving women would be essential for the improvement of local chicken production in the area. The study also found that most respondents were literate and involving them in training programmes within their community would be crucial.
- The results further confirmed the important role of NGOs and CBOs in promoting rural development and delivering livelihoods projects in rural communities. With their non-rigid, locality specific, need based, beneficiary oriented and nature of services, NGOs and church agencies can effect sustainable rural poultry production far more extensively and effectively. It is therefore important for future partnership and collaborative efforts with these institutions, particularly LDS and BrisKanda Inc. to improve local chicken production in the rural communities.
- Local chickens are highly vulnerable to a range of threats such as predators, theft, diseases and poor management practices which affect its sustainability and productivity. The high incidence of theft of mostly adult birds and predation on vulnerable chicks suggest the need for a sustainable system focused on minimising bird losses.
- The local chicken population remain unknown and are often exposed to various evolutionary factors hence future research and development is necessary to understand their genetic resources and their production environment, population size, structure and dynamics. Such work should cover a wide area across the country.
- These recommendations can be further strengthened by a national policy guideline as this would provide the platform for interactions and collaboration between various stakeholders, as well as provide direction and support to livestock extension, research and development.

ACKNOWLEDGEMENTS

The study was made possible through AusAID funded Agricultural Innovation Grant Facility and PNG National Agricultural Research Institute, to which we are grateful. We acknowledged farmers, partner agencies and staffs of NARI Livestock Programme in Lae for their assistance.

REFERENCES

ADESINA, A. A. & CHIANU. J. 2002. Determinants of farmers' adoption and adaptation of alley farming technology in Nigeria. *Agroforestry Systems*, **55** (2):99-112

BARUA, A. & YOSHIMURA. Y. 1997. Rural poultry keeping in Bangladesh. *World's Poultry Science Journal*. **53**: 387-394.

IGNATIUS, S. & QUARTERMAIN, A.R. 2006. Improving scavenging poultry production in Papua New Guinea. Research Note. National Agricultural Research Institute. Lae. Papua New Guinea.

KITALYI, A. J. 1996. Socio-economic aspects of village chicken production in Africa: The role of women, children and Non-Government Organizations. XX World Poultry Congress, FAO Corporate Document. Agriculture and Consumer Protection.

KOHUN, P.K., PANDI, J., GLATZ. P. & MIAO. Z. 2006. *Survey of current feeding practices and altitudes to broiler chicken production.* Technical Bulletin No. 18. National Agricultural Research Institute, Lae, Papua New Guinea, 32 pp.

NEGUSSIE, D. 1999. Evaluation of the performance of local Rhode Island Red (RIR) and Fayoumi breeds of chicken under different management regimes in the high lands of Ethiopia. *Tropical Animal Health and Production*, **33**: 521-537

QUARTERMAIN, A.R. 2000. Non-commercial poultry production in Papua New Guinea. *Asian-Australian Journal of Animal Science*. **13**:304-307.

ROBERTS, J. A. 1999. Utilization of Poultry Feed Resources in the Villages of Developing Countries. *In*: Dolberg F. and P.H. Petersen (editors). 1999. *Poultry as a Tool in Poverty Eradication and Promotion of Gender Equality.* Workshop Proceedings. 22-26 Mar 1999. Tune Landboskole, Denmark. pp311-335.

SPSS. 2001. Statistical Procedures for Social Sciences User's guide version 11.0.1. SPSS Institute Inc., Chicago, Illinois, USA.

TADELLE, D. & OGLE, B. 2001. Village poultry production systems in the central highlands of Ethiopia. *Tropical Animal Health and Production*. **33**(6):521-537.