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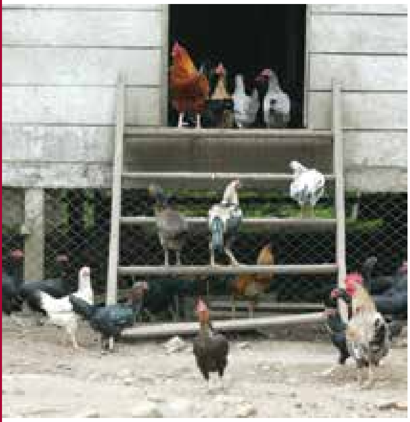

INFPDE-CONFERENCE

THE SCOPE AND EFFECT OF FAMILY POULTRY RESEARCH AND DEVELOPMENT

International Network for Family Poultry Development (INFPD)
1999

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Lead Papers

Research and Development Options for Family Poultry

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ABSTRACT

Smallholder poultry production (i.e. family poultry) is an appropriate system that makes the best use of locally available resources. Family flocks are important providers of eggs and meat as well as being valued in religious and cultural life. There are three production systems for family poultry - free range, backyard and small-scale intensive with productivity of 20 - 60, 30 - 100 and 80 - 150 eggs/hen/year, respectively. Body weight of 1.2 kg and 800 g are obtained at 32 weeks for normal size and dwarf breeds of local chickens in the free-range system. Newcastle disease is the most important health problem while breeding, feeding and marketing are equally important problems. A co-ordinated programme involving breeding, feed, health management is suggested for the development of family poultry production. The Food and Agriculture Organization (FAO) is strongly committed to family poultry development and, through the International Network on Family Poultry Development (INFPD), can co-ordinate family poultry development activities in the Special Programme for Food Security (SPFS).

INTRODUCTION

Family poultry comprises extensive and small-scale, intensive poultry production and is still important in Africa, Asia, Latin America and the South Pacific. This is merely a working definition and there are very many exceptions. For example, Aini (1990) has reported large-scale production of indigenous chickens (Ayam kampung) by means of the extensive system in Malaysia.

The contribution of family poultry to total poultry production in the areas where they occur is, with some exceptions, more than 70 per cent. Bangladesh and Nigeria are examples of countries where complete livestock census has been done within the last 10 years and detailed information on poultry population structure is available. In Bangladesh, family poultry represents more than 90% of total poultry, and 74% of the 10 million households keep poultry. Even landless families (22% of total households) keep 5-6 chickens. In Nigeria, family poultry represents about 94% of total poultry. For chickens specifically, family chickens represent 83% of the 82 million adult chickens under traditional and commercial management. Family poultry production contributes to family nutrition and income. In Bangladesh, it contributes 28% of the total protein supply, taking second place to milk products which contribute 38% and are mostly imported. In a study on income generation in transmigrant farming systems in East Kalimantan, Indonesia, it was found that family poultry production was the major source of cash income and produced about 53% of the total income. Cash income from poultry was used for food, school fees and unexpected expenses like medicines (Ramm *et al.*, 1984).

Family poultry is usually the responsibility of women. For example, Guye (1998a) has estimated that, in rural areas of sub-Saharan Africa, probably more than 70% of chicken owners are women, while pigeons traditionally belong to children. Women look after the birds and earnings from sale of eggs and chicken are often a significant source of their cash income. Development of family poultry production will not only enhance the cash income of women but can lead to their greater empowerment when they participate as poultry advisers, extension workers and vaccinators.

In Dominican Republic, family poultry contributes 13% of income from animal production (Rauen *et al.*, 1990) while in Tanzania, the relative importance of family poultry was illustrated by the fact that by the end of the fifth year, 120 kg of meat [25 adult culls (42 kg), 39 pullets and 39 cockerels (78 kg)] and 6.8 kg eggs [195 table eggs] could be obtained from a single initial pullet (Kabatange and Katule, 1990).

Keeping poultry for smallholder farmers represents a household savings, investment and insurance as the value of the birds increases over time. Buying, receiving or giving poultry and other livestock is a preferred method of investment in rural areas where few other investment alternatives exist. Poultry raising also provides employment to the farm family during the off season from crop farming. Poultry can represent significant capital. The contribution of native ducks to the income of a farm family in Indonesia was 70% of annual income from a 0.5 ha farm of irrigated paddy and mixed garden with 100 native ducks and 2 head of buffalo (Setioko, 1997).

In Africa, family poultry is truly the invisible animal as it is hardly counted in wealth ranking as cattle, sheep and goats are. Yet, they are important as providers of egg and meat (each hen produces about 30 eggs and 15 chicks every year) and the cocks find various uses in religious and cultural life. Family poultry represents a significant part of the rural economy in particular and of the national economy as a whole. In Burkina Faso, for example, Ouandaogo (1990) reported that 25 million rural poultry (made up mostly of guinea fowls) produced 15,000 tons of meat out of which 5,000 tons were exported, adding about US $ 19.5 million to annual export earnings in 1989. Similarly, Diambra (1990) reported that Cte dIvoire imported every week, 37,000 guinea fowls from Burkina Faso at a cost price in Abidjan of US $ 3.90/kg and 3,200 tons of eggs at a cost of 540 CFA/dozen. These resulted in the addition of US $ 27.1 million to the annual import bill in 1989. Family poultry in Africa as a whole represents an asset value of US $ 5.75 billion.

Family poultry plays a significant role in the cultural life of rural people in the following ways: as gifts to visitors and relatives; as starting capital to youths and newly married maidens, as sacrificial offerings in traditional worship. In recent years, family poultry has come to assume a much greater role as a supplier of meat and animal protein for both rural and urban dwellers. This is because of droughts and diseases (rinderpest and trypanosomiasis) which have greatly reduced productivity and growth of large and small ruminant animals. Since pork is counter-indicated in many religions and cultures, poultry can be seen to be the most suited as a source of meat.

Besides the provision of employment and easily disposable income for small-scale farmers, particularly in the off-season from cropping, family poultry integrates very well into other farming activities as it requires very little time and investment. There are reports (Mali, Togo, Ghana) of portable poultry systems in which the farmer carries (or grazes) the fowls along the way to the farm site (Kane, 1990; Aklobessi, 1990), tethers them while he farms and brings portions of anthills to the tethered fowls (Williams, 1990).

MANAGEMENT SYSTEMS

Poultry is an ideal livestock for small farms because of the small individual requirement for feed, water and other production inputs. There are three distinguishable systems for managing family poultry. They are the extensive systems - free-range and backyard; and the small-scale intensive system. In the free-range system there is little intervention in the life cycle of the birds. The major intervention is in the areas of feed and water supplementation, overnight housing, and to a much lesser degree, health management. The area of reproduction - selection, mating, incubation, brooding - is left strictly to the birds. In the backyard system, poultry are part-confined within a fenced yard or merely within an overnight shelter. In the small-scale intensive system, small numbers (usually more than 50 but less than 500 birds) are produced along commercial lines.

There is no doubt that the availability of resources inputs - housing, cages, feed, drugs as well as time - contribute to the choice of production system.

FLOCK STRUCTURE

Family flocks are usually integrated with crops, fishes and other livestock species such as chicken/cattle, chicken/guinea fowl, chicken/duck, chicken/turkey, duck/rice/fish, duck/pig, etc (Sonaiya, 1990a). Under the extensive systems, production cycles are continuous with poultry, unsorted by sex, at different stages present in the flock at any given time. Foundation stock is usually obtained from the market or as gifts. Flock composition is heavily skewed towards chickens in Africa (Table 1) and towards ducks in Asia and Latin America.

TABLE 1. FLOCK COMPOSITION AND SIZE IN RURAL POULTRY FLOCKS IN NIGERIA (AFTER SONAIYA, 1990A)

Poultry species	Mean Number in flock	% of respondents
Chickens	14.1	66
Guinea fowls (GF)	12.0	2
Ducks (DK)	6.5	2
Turkeys	5.0	0.6
Geese	3.0	0.4
Chickens + GF	40.0	15
Chickens + DK	22.0	7
Chickens + GF + DK	87.0	5
Chickens + Pigeons	34.0	2

Household flock size ranges from 3 to 97 in Africa, 10-31 in South America and from 50 to 2000 in Asia. Flock size is related to the objectives of the poultry enterprise. These objectives are: consumption alone, consumption and cultural reasons, income and consumption and income alone.

BREEDS

The system of management appears to have an influence on the breeds used. The free range systems uses almost exclusively local breeds as it has been found, from the fate of exotic cocks in the numerous cock exchange programmes, that exotic birds do not survive under this system. There are reports of local birds having the ability to use high fibre feeds (Diambra, 1990; El Houadfi, 1990), and for fast growth rate (Olori and Sonaiya, 1991).

The identification of birds as local is purely for convenience as there has been at least one attempt at cross breeding in most countries. This being so, the existing birds are crosses, to various degrees, of the local birds with the exotic breeds of choice for these programmes, that is: Rhode Island Red, Leghorn, Australop and Wyandotte for chicken; Aylesbury, Rouen, Indian Runner, Khaki Campbell and Pekin for ducks; and White Roman and Chinese for geese (Sonaiya, 1990b).

PRODUCTIVITY

Except in the absolute free range system, all birds receive some supplementation, based on available grains, by-products, food scraps and compounded feed. Productivity increases in direct proportion to the level of confinement and hence management. Under the free-range and backyard systems, egg production by chickens is 20-100 per year.

Under these systems, ducks produce 30-80 eggs, turkeys 60-80 eggs, and guinea fowls 100-120 eggs per year. In Mali, hatchability was reported to be uniformly high in guinea fowl (80-84%) but much lower in chickens (60-70%). In Nigeria, Ayorinde (1990) reported that because of the extreme nervousness of guinea fowl, chickens are used for hatching guinea fowl eggs and brooding keets. Body weight of about 1.2 kg (normal size) and 800 g (dwarf) is achieved in chickens in about 32 weeks. Productivity in the small-scale commercial system is similar to that of large-scale commercial poultry provided there is no disease outbreak.

DISEASE AND PREDATORS

Newcastle disease (NCD) is the most important disease recognized in virtually every country. Mortality due to NCD is however variable. Season also has an effect as severity of NCD is higher in the cold dry season in West Africa but in Ethiopia, most NCD outbreaks start at the beginning of the rainy season.

While the importance of NCD is recognized, conventional vaccination techniques are expensive to use and do not provide adequate cover and protection for rural birds which have been identified as reservoir source of infection for the commercial flocks (Bell & Mouloudi, 1988). Pilot and field studies on the use of orally fed NCD vaccines have been carried out in the Gambia, Ethiopia, Mozambique, Tanzania and Zimbabwe. Results in Africa are not really encouraging. Other diseases found in rural poultry include Gomboro, coccidiosis, fowl pox, fowl typhoid, fowl cholera, external and internal parasites. Pediculosis is a very pervasive plague of rural poultry.

Aerial (hawks, kites) and terrestrial (rats, snakes, dogs, cats, foxes and raccoons) predators account for far more mortality than is usually recognized. Prevention by means of proper housing, shelter and bush clearing is the best policy. Hunting, poisoning, trapping and the use of natural enemies of the predators are control methods available. Moreover, traditional remedies are widely used to control poultry diseases (Bizimana, 1994; Guye, 1997, 1998b)

FEEDING

On the range and in the backyard, a bird can certainly not find all the nutrients it needs for optimal production all the year round. During the dry season, poultry can quickly develop vitamin deficiency because of the scarcity of succulent vegetables on the range. There is thus a need to supplement their scavenging with sources of minerals and vitamins. Most of the materials available for scavenging are not concentrated enough in terms of energy because they contain a lot of crude fibre. There is a need to supplement scavenging poultry with energy sources. That is why grains are given to poultry in the traditional village system. It has been estimated that 35g grain supplement per hen per day is given to local chickens in the free range system in south-western Nigeria (Obi and Sonaiya, 1995). Insects and their larvae are identified as protein sources for scavenging poultry. Atteh and Ologbenla (1993) reported that maggots could make up 3% of the diets of chickens without compromising performance.

In the semi-intensive system, making well balanced feed is uncommon if not impossible for the smallholder. The feed situation for birds in this subsystem is therefore usually poorer than for birds in the extensive or fully intensive systems. Although calcium can be obtained from ground or pounded snail shell from sea and river shellfishes, or school chalk, phosphorus from burnt and ground bones and salt from the kitchen; these are hardly ever done.

Smallholders using extensive systems adopt cafeteria choice feeding of nutrients. Energy supplements such as maize, sorghum and millet are offered early in the morning and late in the evening. Birds scavenge during the day mostly for protein (insects, worms, larvae, etc.), minerals (stones, grits, shells), and vitamins (leafy greens, pepper, oil palm nuts) in-between these meals. There is evidence to show that such a cafeteria system is not inferior to the offer of complete feeds. The real need, therefore, is to determine the nutrient content of the available feed resources and to provide such nutrient sources to birds at the right time; not necessarily at the same time (Branckaert, 1990).

AVAILABLE FEED RESOURCES

The possible feed resources for smallholder poultry production are:

1. Household wastes including the waste from households which do not keep livestock. In many areas, the by-products from making artisanal beer is available and is of great importance as a feed.
2. Materials from the domestic environment including worms, snails, shellfishes and insects; grains and by-products from the harvest and subsequent processing; by-products from other local industries such as palm and tree crops, fishing, meat processing, fibres (cotton, kapok, etc); green pickings; seeds.
3. Cultivated and wild fodder materials: grasses, herbs and fodder trees, grazed or cut and carried; water plants e.g. lemna, azolla, Ipomoea aquatica.
4. "Non commercial" feed materials which fall into the following categories:
   a. Locally available sources such as cotton seed, kapok seed, rubber seed and citrus by-products which are already being utilized.

b. A group of potential sources of quality protein such as cultured snails, earthworms, termites, frogs and unicellular algae.
c. Potential sources of minerals and vitamins: snail meal and shells, shellfishes, fruits like papayas, fodder trees like Leucaena sp., Calliandra sp., Sesbenia sp., and aquatic plants.

5. Feed materials which may be available locally for purchase or by barter, such as by-products of small industrial units processing household crops and small estate crops.
6. By-products from larger industrial units such as breweries (breweries grain) and oil mills (oil cakes and meals).
7. Prepared commercial feed

The feed resources are listed in the rough order of the ease with which village families can have access to them. The basis for smallholder poultry is that producers do not have to provide all the inputs especially feed for the birds. It is therefore essential to find out what feed resource is available on the range for the birds to scavenge. Feeding poultry in the extensive and semi-intensive system depends on the possibility of scavenging. The feed resources which scavenging chickens utilize are available to even the weakest families in the community. For example, the more prosperous villagers in the rice growing areas of Bangladesh who have supplies of rice grain, rice paddy, rice bran and wheat can afford to keep ducks. The poorer villagers can only keep chickens which are able to scavenge. For the landless poor, it has been advised that they keep chicken for the market only in periods when grains can be picked up in sufficient quantities. Alternatively, chickens should only be allowed to scavenge under supervision, or when some additional source of feed could be utilized, such as aquatic weeds, snails, earthworms or cockroaches.

It is very important to know the amount of scavengeable feed available in a village and to monitor the effect of seasons on it. Any gap between scavengeable feed and the feed required is to be filled with supplemental feed. In South-east Asia, Roberts (1992, 1994) and Gunaratne and co-workers (1993, 1994) have carefully studied and classified the feed resources that may be available for scavenging which they call the Scavengeable Feed Resource Base.

UTILISATION AND SALE

Poultry products have social and spiritual benefits and play an important role in rural economy. In many customs of indigenous people, poultry is used for ceremonies, sacrifices, gifts and savings. In the Sahelian region of West Africa, guinea fowl, more than chickens are used as gifts to visitors. In cases when no poultry is available (e.g. after a NCD outbreak), in order to meet customary family obligations, the family will buy or borrow a bird. In the village, chickens are given or received to show or to accept good relationship, or to say thanks for a favour or a help. Besides, Poultry can serve as a unity of exchanges in societies where there is no circulation of money (Guye, 1998a). For example, in The Gambia five adult hens can be bartered for one sheep and 25 hens for one head of cattle.

For most socio-cultural and religious purposes, the required sex and colour of fowls are prescribed. Among the Mamprusi in Northern Ghana (van Veluw, 1987), chicken cocks are the most popular sacrificial animals. Guinea fowl cocks are not used. A red cock is sacrificed to ask for rain or a good harvest; a white cock is used when they are grateful; a black cock is for protection from evil like disease, war or quarrel. A white cockerel is given by one family to another at the moment when the accord is reached for two people to get married. Because of these customs, red, white and black cocks and cockerels have more value; sometimes the prices are doubled. Hence farmers never cull a black, white or red cock.

Poultry, particularly in the free range, provide meat, eggs, feathers, manure (convertible to fertiliser and natural gas), pest control, weed clearance, seed cleaning of grasses for mulch, scratching and foraging.

In family poultry production, egg production for sale is less significant than meat production. The consumption of eggs in the village is uncommon. In Mamprusi society, women, circumcised girls and first-born children are not allowed to eat eggs or meat. These products are only taken by elderly men, male visitors and young children (van Veluw, 1987). Women believe that their behaviour can affect their unborn child and this includes the food they eat during pregnancy. The belief is still strong that a child that regularly eats eggs will become a thief as the good taste of eggs will make the child want to eat eggs daily. In Bangladesh, eggs and meat are consumed mainly by the son, husband and guest and a little by the daughter. The women rarely eat eggs and meat themselves. The poor generally do not consume much eggs and meat. The products are mainly sold, and from the proceeds the most necessary items are purchased among which carbohydrate food is prominent.

Under normal conditions, birds are sold when the household is in need of money. The income from the sale of chickens is an additional revenue to earnings from cash crops from the field. The sale of birds and eggs takes place in the village market. Prices fluctuate during the year being low during the hungry season when the granaries are empty and the crops are still growing and every body needs ready cash. At such times, traders come to buy to resell in big cities. Sometimes, middlemen are involved. They buy the birds in the villages and sell them at the market or to traders. Poultry products which are sold contribute about 15% to the annual financial income of the household. Farmers are willing to save for agricultural equipment or other farm supplies like seeds. Livestock is used as a savings account. The offspring, like chicks, are the interest on the savings.

RESEARCH OPTIONS FOR FAMILY POULTRY DEVELOPMENT

The objective of livestock development at the national level is to attain, as much as possible, self sufficiency in animal products. At the farm level, the objective is to increase income and to utilise family labour year-round. Livestock development requires a strategy to optimize production from available feed resources. The identification and careful study of feed and animal resources are essential first steps. Resources must be examined in the context of the agro-climatic zones and their linkage with other developmental elements such as markets, institutions, incentives and policies. New technologies should be introduced during on-farm improvements. The utilization of locally available feed resources must be maximized to reduce or eliminate the importation of concentrate feed.

Livestock development efforts in the past had laid primary emphasis on rapid genetic improvement arguing that improvements in feeding will be ineffective when animals with low genetic potential are raised. In recent years, there is a growing awareness of the need to balance the rate of genetic improvement with improvement in feed availability and management. There is also an increased realization of the potential of indigenous animals suited to sustainable production systems as efficient converters of locally available resources.

The presence of flourishing industrial poultry farms does not negate the need for a parallel family poultry system in urban, peri-urban and rural areas. What is needed is to determine the level of each kind of production system that is appropriate for each situation?

What is required to maximize productivity of family poultry production systems? First the whole interlocking factors affecting family systems, their advantages and constraints must be properly understood. Vaccination against Newcastle disease increases chick survival rate by 100 per cent. What is the best way to carry out such vaccination? Simple housing and other predator protection are required for chicks and young growers. What designs and management will ensure this protection? In addition to chickens, ducks and guinea fowls, pigeons and quails are of importance. What are the possibilities for each of these poultry classes? Supplementary feeds are important. How can available feed resources on the range be reliably estimated? Family poultry is a vehicle for rural development, incomes generation and nutrition enhancement. What development strategies will generate incomes, enhance family nutrition and bring rural development in a sustainable way?

PROSPECTS FOR DEVELOPMENT

It is becoming increasingly common to assume that small-scale farmers know best what is good for them and that changes from outside do more harm than good. However, it must also be said that there are inevitable gaps in farmers indigenous knowledge resulting from isolation and lack of scientific research and expertise. In addition, where technology transfers have floundered, this has invariably been because there was no clear understanding of the target production systems, the constraints of these systems and the ways of overcoming them. The real challenge for us who care about improving poultry production and the welfare of the rural poor is to assist in obtaining and applying this information. At the same time, it is important to be realistic about expectations. In Europe and North America the widespread uptake of new methods often takes five to ten years.

BREEDS

Improvement of productivity of local chickens

Wherever the trouble has been taken, it has been found that there are highly productive indigenous birds (Mathur *et al.*, 1989; Nwosu, 1979). The task is to identify all such breeds, to determine and, if possible, alleviate factors which contribute to variability within and between them. The selected birds can then be used for crossing to improve production further.

Promotion of other poultry species

Waterfowl (ducks and geese) provide the opportunity for better utility of water and pasture resources in Africa that can generate additional food and income for rural communities. These birds are already efficiently combined with other systems such as rice and fish in Asia. They are more heat tolerant and less susceptible to disease than chickens. They use alternative natural feed resources, such as grass (especially by geese), water plants and snails.

There is, however, still a lack of information about production characteristics of locally available breeds managed under the extensive systems, and insufficient knowledge of the most suitable exotic breeds and breeding strategies.

PRODUCTIVITY

The great differences in productivity between extensive and intensive poultry production are due largely to differences in how the animals are managed. In industrial poultry, housing and management and even the breeds and strains used are fairly stereotyped whereas under extensive systems these vary enormously. For example, there are millions of smallholder family farms where mixed flocks of poultry species are kept in the same area with other livestock (as in the cattle kraal system in Africa). Many of these farmers regard poultry as, at best, a secondary or tertiary occupation, something to be done before or after the real days work (Sonaiya and Olori, 1990). Instead of compounded feeds, the birds depend on insects, worms, left over food and the few grains used mainly to ensure control. It is only in a few cases that available feed ingredients are offered in a combination which, invariably, will not be balanced and may, in fact, be deleterious if the birds are restricted and so unable to scavenge for the balance of nutrients required.

These diversities in breeds and strains, in the feed resources available and in the environmental and management systems make it difficult to develop strategies for improvement which are of widespread applicability. In addition, very little research has been undertaken to determine existing or potential levels of productivity. This is the rationale for carrying out baseline studies. To determine the "state of the art" in family poultry production. This always seems to be the right place to start in the study and amelioration of the myriads of problems facing family poultry development.

The idea of the Scavengeable Feed Resource Base (SFRB) in extensive poultry production systems developed by John Roberts of James Cook University in Australia, has opened a window to real progress in research to improve productivity. The possibility of estimating the SFRB is of immense significance to appropriate supplementation of scavenging poultry in order to enhance productivity in a sustainable way. This idea is already contributing to the work of many family poultry researchers in Africa and Latin America who read Roberts paper in the proceedings of 1995 ANRPD workshop in Addis Ababa, Ethiopia, which was published in December 1997.

DISEASE CONTROL

Family poultry suffer losses from predators and from diseases caused by viruses, bacteria and parasites. The losses attributable to morbidity are not known but it has been estimated that more than 750 million chicks, guinea keets and ducklings in Africa die each year as a result of various infections (Sonaiya, 1990c). In addition, predators particularly hawks, snakes, dogs, cats and rats kill or wound an approximate 75 million poultry every year. Surviving birds show various signs of sickness depending on the type of infection. Many lose appetite, do not grow, lay very few eggs (or do not lay), do not hatch nor brood their young, resulting in huge losses of revenue and food to the village, countries and Africa as a whole. There are further costs. Family poultry has been identified as reservoir hosts for pathogenic organisms causing NCD in industrial chickens which is more financially disastrous because of the high capital investment required in that sector. The annual cost of vaccinating all the family chickens against NCD by the conventional water route and intra-muscular injection for Nigeria has been estimated at US $ 3.8 million (Okunaiya *et al.*, 1990). These methods are geared towards birds in captivity and not in free-range systems.

The challenge is clear, that is, to develop and validate specific methods of disease diagnosis, monitoring and control that are specifically applicable to the extensive and semi-intensive systems. The various methods of vaccine application on a large scale need to be critically evaluated and if necessary modified. Unfortunately, family poultry producers cross national borders freely with their birds. Hence, poultry disease outbreaks easily spread across national borders. This makes it more difficult for individual countries to devise their own programme for family poultry disease control. Rather, regional efforts, as the current NCD campaign centred on Zimbabwe and South Africa in the SADC area, are necessary. Such regional efforts should be co-ordinated at the continental level and assisted by such bodies as the Inter-African Bureau of Animal Resources (IBAR), the International Livestock Research Institute (ILRI) section responsible for research on animal diseases (former ILRAD), the Scientific and Technical Research Committee of the Organization of African Unity (OAU-STRC) and technically supported by the FAO/IAEA.

The need is for a hardier vaccine and a more efficient route for delivery of such a hardy NCD vaccine. The I_2 V4 strain of the NCD virus developed by Peter Spradbrow and his colleagues at the University of Queensland in Australia appears to be such a hardy vaccine. However, as stated before, the results of the different trials conducted in different FAO TCP projects (Ethiopia, Gambia, Zimbabwe) have not been conclusive. This question will be examined at a workshop to be held in Harare in December 1998.

The Joint FAO/International Atomic Energy Agency Laboratory has initiated a Co-ordinated Research Project titled: "To Increase Farm-yard Poultry Production in Africa by Improving Vaccination Strategies against Newcastle and Gumboro Diseases using Nuclear based Technologies". Effective and efficient vaccination against NCD is a major step towards higher productivity for the scavenging poultry system which has demonstrated its resilience through the years and is contributing significantly to food security in fragile and marginal areas.

With adequate funding from major international and bilateral donors, a continent-wide campaign to arrest the onslaught of Newcastle disease can be developed (i.e. PANDEC - Pan African Newcastle Disease Eradication Campaign) patterned after the Pan African Rinderpest Campaign, for it will similarly require the establishment of a sero-monitoring network and development of kits for rapid field monitoring and virus neutralization.

DEVELOPMENT APPROACH

Growth is possible without development or research, but development represents true progress. Development itself involves research at all levels - from the most sophisticated laboratory to the smallest farm. There is need for a very close working relationship between scientists and neighbouring farmers in order to obtain local support within the farming communities for trying out new methods based on research. The research required at each of these levels must be clearly defined.

What is needed is a co-ordinated programme which:

- addresses the problems of breeding, feeding, housing and disease control and is specifically directed at the small farmer; and encourages research geared towards:
- understanding indigenous poultry production systems and their weakness;
- development and testing new methods which will not only overcome these weaknesses but will also be affordable and sustainable.

In short, the need is for a programme which encourages animal scientists, veterinarians, and social scientists to leave their laboratories and ally their knowledge with the local wisdom of farmers while at the same time imparting this knowledge to students and extension workers.

Examples of the activities required which are already on the way are:

- evaluating the local poultry genetic resources; e.g. The Global Data Bank for Domestic Poultry. (Contact: Animal Genetic Resources, AGAP, FAO)
- finding alternative feed ingredients; e.g. Tropical feeds available on diskette (Contact: Andrew Speedy, FAO Feed Resources Group); Special issue of World Animal Review Vol. 82 No. 1, 1995.
- developing vaccination strategies for NCD and Gomboro; e.g. FAO/IAEA Co-ordinated Research Project (Contact R.H. Dwinger).

Every effort must be made to encourage an interdisciplinary approach to solving problems. The alternative feedstuffs programme will require the support of a strong laboratory which will provide services to screen potentially useful feedstuffs for their nutritional value before these materials are used in expensive animal experiments and feeding trials. Such a laboratory centre can also serve to train poultry scientists in nutritional, statistical and extension methods that are necessary for successful projects in family poultry production and development.

The following activities should be considered in the family poultry development programme:

A. Breeding and reproduction

Evaluation and selection of indigenous breeds:

There are many types, breeds and strains of indigenous poultry which are well adapted to their environment. There is need for their genetic improvement in order to: improve their productivity within their local environment; make use of the improved indigenous birds in crossing with imported exotic birds; and conserve the desirable genes (e.g. for disease resistance) of the indigenous breed for future breeding (see report of EU project TS3*-CT92-0091 led by Prof. P. Horst, Humboldt University of Berlin).

Evaluation and adaptation of imported breeds to hot climate:

Basic breeding projects conducted in collaboration with foreign breeding firms should provide adequate data about local breeds and guidelines on the best route for genetic upgrading (contact: Prof. A. Cahaner, Hebrew University, Jerusalem; Prof. D. Flock, Lohman Tierzucht, Cuxhaven, Germany; Prof. Horst).

Developing of hatching and starting centres (coorperative or private) to produce day-old-chicks, keets, ducklings, poults and goslings and to raise them to 28 days before delivery to farmers (see Sonaiya, 1992).

B. Feed research and development

- Alternatives, substitutes and supplements must be sought in order to minimize feed and ingredient importation.
- In countries with coasts, marine animal meal potentials must be exploited (e.g. shrimp head meal, fish offal, periwinkle); in landlocked countries, slaughter house by-products must be harvested, developed and utilized (e.g. vegetable carried blood meal) (see Sonaiya, 1995).
- The growth of small-scale feed mixing concerns (either co-operative or private) is essential for real development (see Sonaiya, 1992).

C. Health management

- Regional co-operation in vaccine production to maximize the efficient use of available human and material resources on the continent (see Spradbrow, 1997).
- Training on a regional basis in disease diagnosis, epidemiology, environmental sanitation and disease prevention, must be provided.

D. Entrepreneur development

- There is need for a strong effort to nurture (incubate) entrepreneurs in input sources for poultry production: feedstuff suppliers, equipment manufacturers, hatcheries, chick starting centres, pharmaceuticals, meat and egg producers, marketers, slaughter and processing plants, caterers, financial services (see Sonaiya, 1992).
- Co-operatives are strongly indicated in an effort to involve people in production and marketing, and to develop closer links between producers, retailers and consumers of poultry eggs and meat (see Sonaiya, 1996).

E. information management

- Development, documentation and dissemination of information on the appropriate methods of data generation, collection, collation, storage, retrieval and application in the field (see Proceedings INFPD MBour Workshop, 1997; forthcoming).
- Agricultural schools, Research Institutes, Universities, Government Ministries and Parastatals, non-governmental organizations and the private sectors must be encouraged to serve as vehicles for information dissemination to the next generation.
- The information gathered can be used to promote family poultry in primary and secondary schools as well as in a poultry advisory system.

Family poultry is a good topic for international co-operative research involving scientists from Africa, Asia and Latin America. The CGIARs ILRI does not work on poultry. FAO is keenly interested in family poultry as an important focus in its Special Programme for Food Security.

To co-ordinate these five activity areas and others that will be suggested, the International Network on Family Poultry Development (INFPD) formerly African Network on Rural Poultry Development (ANRPD) appears ideally suitable as a non-governmental organization with strong backing from the FAO. INFPD has more than 300 members from all over the world and facilitates contact between its members by means of a newsletter which is now published every three months and distributed by e-mail. There are plans to create a web site on the Internet before the end of the year.

The following joint INFPD/FAO activities have already been planned up to the year 2000:

- Video Conference with participants from AIEA (Vienna) AGA/FAO (Rome) and Wageningen (The Netherlands). [Held in November, 1998]
- First Electronic Conference on Family Poultry (December 1998).
- Workshop on the use of NCD vaccines in Harare (TCP) [December 1998]
- Contribution to the two ACIAR and WPSA Web sites.
- Second Electronic Conference on Family Poultry in 1999.
- Symposium on Family Poultry during WPC 2000 in Montreal, Canada (August, 2000).
- Since November 1998, a young professional: Dr. E. Fallou Guye, has been assigned to FAO/HQ in order to co-ordinate the various joint INFPD/FAO activities.

CONCLUSIONS

In developing countries, the backyard poultry sector represents the backbone on which a sustainable well adapted semi-commercial sub-sector could be progressively developed. As sustainability assumes preservation of natural resources, as well as economic feasibility and social acceptance, this evolution should be conducted in the most appropriate socio-economic way, taking into account the specific local features and constraints to be overcome.

That means, after collecting the appropriate data for the poultry sector in specific environmental conditions, an appropriate model must be designed and tested at farm level.

Such approaches have only started recently. A successful project is presently being conducted in Bangladesh under IFAD financial support and the first results were published in the Symposium on Rural Poultry Production which was held during the XX Worlds Poultry Congress in New Delhi in September 1996.

In addition, some small trials, as indicated above, are being conducted in Africa under support from FAOs Technical Assistance Programme (TCP), and with some NGOs assistance.

It is one of the responsibilities of the International Network for Family Poultry Development (INFPD) to collect and disseminate all information that can sustainably increase the sub-sectors productivity.

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COMMENTS ON RESEARCH AND DEVELOPMENT OPTIONS FOR FAMILY POULTRY

Keith Hammond

An important common feature of animal-level data from locally adapted family poultry genetic types is the large between bird variation for most traits - with coefficients of variation of 25-50% rather than the 5-15% found in the high input types and systems. It seems that this large variability exists for both intake and output traits. Some birds are both MUCH higher in production (output) and in productivity (output per unit of input) than others under these lower input production environments. This seems to suggest an opportunity for rapid improvement of local types. Secondly, what is the significance of this high variability to flock survival?

Jonathan G. Bell

Thank you very much for an excellent review on research and development options. I was particularly interested in the part about disease control. I certainly agree that a regional approach is necessary. In this respect the Atomic Energy project is a step in the right direction. If we are to look ahead and speak about "eradication" of Newcastle disease, I think we should give consideration to a vaccine which permits monitoring of vaccinal antibodies separately from antibodies to wild-type virus. This would permit detection of infected flocks in the presence of vaccination, which is a great asset in an advanced stage of a control programme, since in practice it is almost impossible to stop vaccination to see if the wild-type vaccine persists. The sort of vaccine that would be suitable would be a recombinant vaccine expressing only one of the two surface glycoproteins of Newcastle disease virus. Such a vaccine is currently being tested in chickens in Malaysia. Although the testing of this type of vaccine is not so far advanced as the testing of other vaccines, it might still be worthwhile to start with them in a new project, since the long term benefits for the control of the disease may be greater. The recombinant vaccine could be used in conjunction with two ELISA kits for seromonitoring: one which would detect antibodies against the glycoprotein in the vaccine, and the other which would detect antibodies against the other glycoprotein, which would only be present in the wild-type virus.

Incidentally, for the name of the Newcastle disease vaccination campaign in Africa, I have always favoured "Pan African Newcastle Immunisation Campaign", which is not so ambitious in its aim, as well as having an acronym with a pleasing sense of urgency.

Saka Saheed Baba

I wish to comment on the observations of one of the subscribers Jonathan G. Bell) on the introductory paper. Though it sounds rather ambitious and imaginary, I quite agree with Dr. Bell's suggestions on "eradication of Newcastle disease" and the need to develop highly discriminative diagnostic tools that would readily differentiate between Newcastle disease virus (NDV) antibodies as a result of vaccination and those developed following natural infections by wild strains of the virus. Such tools would be useful in vaccine monitoring and disease surveillance.

A recombinant vaccine coupled with development of ELISA may resolve the problem of antibody cross-reactivity. However, the eradication protocol needs to be prioritized since there are preliminary epidemiological factors that have to be clearly defined. These include:

1. information on the current and future status (incidence/prevalence) of the disease in different parts of Africa.
2. possibility of simultaneous regional control and eradication?
3. clearly defining the roles of wild birds (in different countries) in the epidemiology of the disease and how to control the disease among the rampant wild bird populations.
4. sustainable approach to the control of the disease among scavenger village poultry (chicken, guinea fowl, duck etc). Results of preliminary trials in village poultry with the V4 thermostable vaccine have been quite promising but there still some problems.
5. determining the extent of genetic and antigenic differences and/or similarities between the available vaccine viruses used in different regions and the respective wild strains prevalent in that region.
6. cost-benefit analysis of the eradication programme should be given serious consideration whether or not it is worth the efforts.

It is after taken into account these factors, that we can start talking seriously about the development of diagnostic tools for monitoring of the control process.

Saka Saheed Baba

Our concern at the moment in the control of Newcastle disease (ND) by vaccination should not be whether or not the Malaysian/Australian V4 thermostable vaccine is protecting the African village birds. Although our preliminary trial with V4 vaccine in guinea fowls gave encouraging results, the emphasis now should be on how to make the existing ND vaccines (La Sota, Komarov etc.) thermostable for use in tropical Africa as it has been done for rinderpest (RP) by Mariner and Co-workers. Results of the field trial of the thermostable RP vaccine in Cameroon have been quite promising. Since the existing ND La Sota and Komarov vaccine strains are already adapted to this environment and constitute little epidemiological hazard, they are therefore safer than the imported naturally occurring V4 vaccine. Our Department of Veterinary Microbiology, University of Maiduguri, Nigeria, in collaboration with LANAVET, Cameroon are presently attempting at the development of thermostable varieties from the existing La Sota and Gumboro vaccines using different chemical stabilizers by varying the lyophilization cycles. However this idea does not distract the need to look into the epidemiological factors enumerated in my earlier contribution.

Prof. E.R. Orskov

This is a reply to Dr. Keith Hammond's comment (see comment 1):

As you know I am not a breeder but I think it would be wrong to think of using the variability this way. Maybe their variability is precisely why they survive under these conditions. Maybe we should select for more variability rather than less. Variability has survival value when the environment is not in control. Homogeniety can only be of advantage when the environment is controlled which it is not for scavenging chickens.

Prof. Peter Spradbrow

It concerns me that we are even contemplating the eradication of a disease that we are unable to control adequately with our present resources. The birds in village flocks are not under effective control. The introduction of new susceptibles is constant. The most sophisticated serological testing will tell us only where the virus was, not where it is. Vaccines will not stop infection with, nor excretion of, virulent virus.

We do not know what role other species of domestic birds and free-living birds play in the spread of Newcastle disease virus. Surely we could not contemplate the slaughter of healthy village chickens as part of a disease eradication program.

I believe that the mere control of Newcastle disease in village flocks will be a sufficient test of our skill and determination.

Andrew Speedy

I would like to make a general comment on the introductory paper by Sonaiya *et al.* It is an excellent review of the information on family poultry. This is recognized as an important development priority for food security and poverty alleviation. Various statistics are quoted for the importance of family poultry and it is suggested in the conclusions that "a well adapted semi-commercial sub-sector could be progressively developed".

I would like to focus a comment on the scale and importance of this point, and this conference in general. World poultry production has gone up by 15% per annum in the last 35 years and is now 6 times what is what at that time. In Latin America and China, it is now 14 and 16 times respectively what it was in 1963. And this huge increase has been almost entirely based on industrial systems feeding corn and soya, and producing vast mountains of waste. These statistics are incredible.

I believe that we do not have a well defined alternative, which we urgently need to reduce the use of grain, fossil fuel and the associated pollution.

There needs to be development of ideas, infrastructure and communication, if small scale poultry producers are to organize in such a way as to produce and supply a much greater share of the 61 million ton market.

On a different matter, the authors give a good account of alternative feeds and feeding, stressing the need for supplementation at certain times. We could add that creep feeding of young birds (both for nutrition and security) is of great importance.

I think that feed requirements need to be viewed in 2 ways. Under many scavenging systems, there are deficiencies which must be met by supplementation. But in the whole farming system, if biomass production is raised by better use of water, crops, legumes and trees in an integrated way, then the overall feed supply for chickens will be increased and they have an important role to utilize the by-products. I would be interested in contributions from those working on integrated farming systems on the role of poultry and the feed supply.

Keith Hammond

Comment 5 by Prof. E.R. Orskov is a plausible hypothesis. As suggested in my original (Comment 1), there is need for an understanding, in a genetic context, of this important issue.

Are participants aware of appropriate research results for any poultry species?

Datta V. Rangnekar and Sangeeta D. Rangnekar

We wish to compliment the authors (i.e. Sonaiya *et al.*) for excellent paper on family poultry dealing with various aspects related to research and development of family poultry. The authors, however, have received and discussed reports from Africa with some passing references from Bangladesh. Backyard poultry is traditional in al the South Asian countries - especially Pakistan, India, Sri Lanka, Myanmar - as also the East Asian countries. India is an example of rapid growth in poultry production in modern commercial sector which is hailed as a good example of growth without much Government help. While backyard poultry had major share of poultry products the position is reversed. However, the commercial poultry has benefited only a small number of families and can be adopted by those who can take risks, provided high inputs. It is a good example of mass production as against production by masses - as is traditional in South Asia with livestock and poultry (agriculture in general). Commercial poultry has very high dependence on external inputs and is not suited for rural areas and small farmers. It may be suitable for peri-urban areas and those who have access to resources and show risk taking ability.

While being associated with integrated rural development programmes (of NGOs) myself and Sangeeta studied backyard poultry production system in Tribal areas to understand the system, and more importantly, perceptions and priorities of tribal families. Research and development agenda has to be based on their priorities and problems. Keeping poultry is traditional in tribal families. However, conventional approaches in Government programmes to develop poultry production in these communities failed.

We propose to make a comprehensive note and send it in a few days.

Unfortunately very few studies are made in India on traditional poultry systems. However, there are some achievements now - especially with special emphasis on the extend of the benefits to the underprivileged people.

Dr. Ed Wethli

Under the heading "Information Management" I wanted to emphasise the importance of developing appropriate training courses for small poultry producers. There is a Links Programme among some Australian and South African universities and for one of the projects a specific curriculum was developed for teaching about small scale poultry. Dr David Farrell is a subscriber to this Family Poultry Conference and he could give more details if required.

The Poultry Management Training Centre of the KwaZulu-Natal Poultry Institute offers three- to six-month intensive, experiential courses for people, some of whom we hope will, on completion of their course, be training smaller producers.

Prof. O. B. Smith

Comments on improving family poultry productivity:

Several people both during this conference and elsewhere have highlighted the importance of family poultry enterprises, and their contribution to meeting the demand for poultry meat in many developing countries. Many have therefore made the plea that the production and productivity of these enterprises need to be improved for them to meet their full potential, through improved housing, supplementary feeding, health care and breed improvement. Sound advice and options but are they realistic, and can they be applied blindly to all producers?

Apparently the flock size of family poultry enterprises in Africa ranges for 3 to 97 (Sonaiya *et al.*, this conference), and the same authors indicated that poultry keepers have different objectives: consumption and/or income, and cultural reasons (gifts, sacrifices etc.)

I suggest that before we start applying our improved production strategies which all come with some costs and require some measure of investment, we do a classification of owners, and only target those whose flock size and production objectives would make them receptive to such improvement strategies. Otherwise, we will end up with unutilized technologies as has been the case for several other livestock species.

I was once involved with a long term research and extension programme that targeted goat producers in the humid zone of West Africa, where several communities keep goats, but not for income generating purposes. We used the same approach of improving housing, feeding and health care. We did not venture into the more problematic and unrewarding breed improvement exercise. Of course we came up with exciting and improved production systems, which served us well in our research stations, and survived on the field with the few farmers we were "subsidizing" for as long as we were willing to subsidize. My diagnosis for the failure was that the farmers we targeted were not in the business for income, and were not therefore ready to invest in such a venture. Improved housing, feeding and health care no matter how rudimentary cost money and require some investments, and if my objective is not to make money, there is no way I would put out such an investment.

Solution to this dilemma? I suggest we identify owners whose primary objective is income generation and concentrate our efforts on these and these alone. Our chances of succeeding will be greater, and if we do succeed, with such owners, others may follow and adopt the systems to make money as well.

One other issue which I would like others to comment on. The issue of breed improvement through crossing with exotic breeds. Breed improvement is a long term activity that requires long term research, funding and policy commitment. These conditions do not exist in many countries in Africa as of now, and the advent of globalization, threatens to make them even more difficult to achieve in medium term. Should we as researchers continue to focus on breed improvement as one of our options, or should we concentrate on how to ensure that our indigenous breeds express and reach their maximum genetic potential through good feeding and adequate health care?

Roger Oakeley

In response to Comment 10 on the Introductory paper, from Professor Smith, I am in full agreement with Professor Smiths' concerns over the classification of backyard poultry producers and their production priorities. The range of backyard flock size in Africa identified by Sonaiya *et al.* (this conference) of between 3 and 97 birds is clearly massive. It would undoubtedly be a mistake to aggregate the owners of these different sized flocks into one homogeneous group. I suggest that there are significant differences between them with respect to their production priorities, and the role that poultry play in their individual farming systems and livelihood strategies.

Socio-economic and production data generated by FAO's 'Emergency Assistance for the Control of Newcastle Disease' (Project TCP/ZIM/8821) during 1998 suggests that the majority of scavenge-based backyard poultry producers in Zimbabwe (average flock size of 20 mixed-age birds) operate a production system designed to be 'low input' and 'low output' (Oakeley, 1998). These producers are primarily crop farmers, while some also raise other animals invariably on a larger scale than their poultry production. One of the primary roles of these flocks is to provide readily accessible meat and eggs for household consumption, very often for social occasions and cultural events. In this sense, the scavenging flocks are not designed as direct income-generating activities, and to view them as such is to misinterpret the objectives of producers.

One can add to this picture the fact that management and husbandry of these birds is predominantly the responsibility of women and to a lesser extent children. Both these groups are constrained not only by the absolute level of other household and farming activities, but also by the timing of those activities. In particular, food preparation, child care, and schooling are all activities that take place at given times, and cannot be varied to any great degree. Poultry-related activities therefore occur around these other responsibilities, and significant increases in the management and husbandry demands of poultry production can only conflict with what are generally regarded as more important activities.

I would conclude, therefore, that 'low input' backyard poultry production strategies are entirely compatible with the farm and household system found in many areas of Zimbabwe. Obviously the system described is only one of many systems operated in Africa, Asia and elsewhere. Nevertheless, any attempt to develop this particular production system, and at the same time increase the level of management input, must be considered with extreme caution. It is therefore vital that backyard poultry systems are carefully classified, in order that any intervention is appropriate and compatible with the priorities and interests of individual producers.

Reference

Oakeley, R. 1998, Emergency Assistance for the Control of Newcastle Disease, Consultancy report for the Food and Agriculture Organization of the United Nations (Project TCP/ZIM/8821-A), Rome, December 1998

Dr. Asifo O. Ajuyah

Professor Smith's comments (i.e. comment 10 on the introductory paper)highlighted concepts that are commonly provided as reasons for low productivity with rural or small scale farmers all over the world. He proposed classification of stock owners to identify those that require assistance. It is logical if the information is lacking, however the story is slightly different in most countries in the South Pacific region, because questionnaires are designed to include most socio-economic variables. For example I came across a report yesterday stating that 92%, 94%, 100% and 100% of all the chickens in Kiribati, Marshall Islands, Tokelau and Nauru respectively are village chickens on zero input. These islands are atolls countries and therefore have intrinsic constraints on livestock production and development. What the Islanders require is comprehensive TRAINING AND SKILL DEVELOPMENT on feeding, housing, selection within the local population, disease control, etc. The role of research is to work within these confines with a proper understanding of the socio-economic, culture and tradition of the rural people. In some countries there is no anchor to the drama or even interlude because most the above basic information are lacking.

As a small boy attending boarding school in Northern Nigeria (Zaria) I used to buy local chickens with my pocket money for the kitchen staff to raise for me to take the surplus home (Jos) on holidays. My major problem then (75%) was birds of prey such as hawks, kites, etc. The cook advised me to paint all the chickens red, based on his understanding of the hawks feeding habit and that birds of prey are colour blind!, but my mother from Southern Nigeria suggested green colour to blend with the vegetation. My point is that any proposed improvement of village chickens should not remove the village from the chicken, but the farmer from the village. This is one of the major reason why many aid funded projects fail in most island countries. What we need today is a global inventory of success and failures of aid funded livestock projects to form basis for improvement.

Back to my story finally I painted the chicks green and predation from birds of prey was reduced to approximately 10-20%, may be I should have tried red colour.

Dr. E. Z. Mushi

Comments on improving family poultry productivity:

Most households in Africa keep a few chickens (Gallus domesticus) which are regarded as rural family poultry. These village chickens are also known as indigenous chickens or traditional chickens otherwise also known as backyard chickens. These chickens are usually kept on a free-range system whereby the chicken scavenges for its food and water. The flock size of family poultry ranges from 3 to 97 (Sonaiya *et al.*, 1999, this conference) while a typical flock in Southern African Development Community (SADC) countries comprises 5 to 30 birds (Anonymous, 1997). The reasons for these small flock sizes include high chick mortalities caused by predation and poultry diseases such as Newcastle disease, infectious bursal disease, fowl pox and parasitism (Guèye, 1998; Sa'Idu *et al.*, 1994).

Predators were found to be responsible for 78% of chick losses in Ethiopia (Negesse, 1993). Birds of prey including eagles, kites and buzzards fed on poultry chicks during the day whereas, the four-legged predators including wild cats and foxes posed a danger at night. These losses would be minimised by properly constructed poultry houses for the nesting chickens at night.

Among the infectious diseases, Newcastle disease is the most devastating for it is capable of wiping out all the chickens in a village (Aini, 1999, this conference). Newcastle disease, fowl pox and infectious bursal disease cause outbreaks because village chickens are usually not vaccinated against these diseases.

The birds are generally slight in weight due to food shortage and internal parasitism. Internal parasites such as Ascaridia galli, Heterakis gallinarum, Capillaria spp., Syngamus trachea and Tetrameres absorb nutrients from the gastro-intestinal tract resulting in loss of weight. Similarly external parasites such as lice, ticks and mites irritate the birds leading to loss in condition. Also, the level of productivity from the village chickens is very low due to low-input and consequently low-output. Most of the chickens are left to scavenge for their feed and supplementary feeding with poultry feed is rarely done.

In summary, the village chickens have low productivity due to inadequate feeding and lack of proper housing. The latter predisposes the chicks to predation. Also infectious diseases and parasitism are responsible for heavy losses in the chickens.

In my opinion, family poultry can be greatly improved both in quantity and quality by taking corrective measures through the poultry extension agent. Initially, the poultry extension agent should select one farmer, preferably prosperous, and use the household as a demonstration unit. The selected farmer would be encouraged to construct a simple poultry house using locally available wooden poles and grass thatch. The house would be used by the chickens during the night and by the chicks during the day. This would go a long way in reducing chick mortality due to predation. Since the chicks are housed they should be supplied with some feed and water.

Secondly, all the chickens should be dewormed with a broad spectrum anthelmintic such as mebendazole or piperazine adipate in drinking water. Birds should also be dusted with malathion to control lice, ticks and mites.

Thirdly, the birds should be vaccinated against Newcastle disease, infectious bursal disease and fowl pox, which are the most common infectious diseases of chickens.

I believe these measures will result in an increase in the number of chickens which are more productive and upon their sale, some of the costs could be recouped. Visits by the other villagers to the demonstration unit should be organised so that they may learn how to improve their poultry.

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Stephen E. J. Swan

Painting chickens red and training farmers: This is in response to Dr. Asifo O. Ajuyah's observations (see Comment 12 on the Introductory paper).

There was an FAO Livestock project in the Pacific in which I was a mission member from October 1987 to March 1989 (RAS/86/039), involving Yap, Kosrae, Truk and Pohnpei (Federated States of Micronesia), Palau, Marshall Islands, Tuvalu, Kiribati and Tonga. I carried out family and small-scale commercial poultry training programmes in regional centres for these countries, as well as for Fiji and the Cook Islands.

I am now involved (since February 1998) in a US$42 million AsDB/Danida family poultry project in Bangladesh; planning, implementing and monitoring small $40 loans (via NGOs) to marginal farmers within the framework of a very specific semi-scavenger model based on 5 local hens and 5 crossbreds (RIR x Fayoumi). This model has been evolving in Bangladesh since 1983 as an excellent example of Government-NGO cooperation.

When I was last in Bangladesh for FAO from 1980-87, (BGD/73/010 and BGD/82/003) I came across several village poultry farmers who used a commercial red dye ("555") into which they dipped their day-old White Leghorn (the only breed available in the early days of the project, and totally inappropriate for village scavenger conditions) chicks. The hawks did not know what to make of these completely unfamiliar fluorescent red streaks and left them alone.

Requirements for Family Poultry Development

A. Traoré

INTRODUCTION

In sub-Saharan Africa, livestock development policies have been strongly inspired by cattle production up to the occurrence of 1972 and 1976 terrible draught episodes in Sahelian countries. In the years 1980's, new livestock development policies with the development of short-cycle animals, especially poultry, as key elements have been launched. Besides, the commercial poultry sector, which is no longer financially viable due to its strong dependence on external inputs (drugs and food ingredients), has shown its limits. This incites policy makers and development partners to encourage and support the development of traditional or family poultry production. This subsistence sector is a privileged instrument in the struggle against food shortage (Branckaert, 1995; Traoré, 1998).

Smallholder poultry production development programs are generally accessible to the most vulnerable target groups, and some countries such as Burkina Faso and Togo have been working in building up these poultry development programs to real community promotion projects that pay special attention to «Gender-development» issues (Anonymous, 1997; Ouandaogo, 1997).

Though the great majority of these programs and projects are still being carried out, we can already learn some lessons that may be of interest to initiators of similar programs.

Based on experiences from Burkina Faso, Togo and Mali, the objective of this paper is to initiate a debate around the required conditions for a development of family poultry.

DEVELOPMENT TOOLS

a) Database

In many African countries, the problem of reliable statistics is the major constraint to appropriate planning and programming for family poultry development programs. As it was pointed out during the two latest workshops of the former ANRPD, now INFPD, in Ethiopia (1995) and Senegal (1996), the numbers and sizes of flocks per poultry species as well as the main production parameters under husbandry conditions are not well-known. The existing data on poultry are mainly limited to chickens; ducks and other poultry species are less known (Kuit *et al.*, 1986; Anonymous, 1995; FAO, 1995).

The INFPD will provide a harmonized data collection and evaluation methodologies (census, classical surveys, accelerated participatory research method). With this in view, training handbooks have already been published under the supervision of ANFPD (Aklobessi *et al.*, 1993)

b) Intervention strategy

Targeted interventions carried out under the support of development partners have been noted in many countries. These countries have asserted their firm intention to conduct appropriate national programs aiming at the development of traditional poultry farming. Such programs were successfully carried out in Burkina Faso (Ouandaogo, 1997).

Within the framework of its Special Program for Food Security, the FAO is assisting many countries in the formulation and implementation of national family poultry development policies (FAO, 1997; Traoré, 1998). These programs are generally initiated within the context of a short-cycle animal development policy.

Intervention strategies are mainly based on:

- disease control, especially the Newcastle disease;
- improvement of poultry housing with the diffusion of improved poultry houses;
- genetic improvement of local chickens by crossing with exotic breeds.

In some countries like Burkina-Faso, Togo, Guinea and Senegal, this strategy is accompanied by an important training component for peasant poultry keepers. These peasants pay for part of poultry health care costs. The programs also host activities for the empowerment of women, who are the main stakeholders and beneficiaries of family poultry development (Burkina, Togo, Mali).

ACCOMPANYING MEASURES

a) Access to services and technical support

The access to services and technical support is essential for the success and the durability of deployed actions. This access is seen in both the existence of service performers and the cost of the performed services. Technical support has so far been provided by the government through its extension services, they were free of charge for poultry keepers. Prophylactic cares (vaccination, control of parasites, etc.) and therapeutic cares are charged. These cares are given either by state agents or by private veterinarians.

The so called in some countries "village vaccinators" or "village auxiliaries", which are newly trained poultry keepers, have shown their willingness to perform poultry health cares themselves. The NGO "Vétérinaires Sans Frontières" has made valuable efforts in the training of village para-veterinarians (Senegal, Togo).

In Togo, a total of 750 "village auxiliaries" were trained between 1992 and 1996. Their intervention have caused a significant rise in vaccination figures which jumped from 20,000 in 1992 up to more than 594,000 birds in 1996 (Anonymous, 1997). It is important to notice, from the example of Togo, that these auxiliaries, which were first considered as rivals and rejected by private veterinarians, have become presently their best helpers in interventions in rural areas. The auxiliaries allow private veterinarians to reach villages birds (Traoré, 1997; Badjé and Bebay, 1998). The performing of this kind of service needs to be regulated and controlled in order to avoid possible misuse. In Togo, for instance, animal husbandry and veterinary services have reported cases of clandestine vaccinations.

Villagers have suffered heavy losses after such vaccinations, but it has never been proved that they were PNPE trained auxiliaries. The PNPE experience in Togo, shows that the most important thing in conducting such a strategy is that:

- the auxiliary should be elected by his own community;
- the geographical area of intervention must be limited;
- the technical gestures and animal species must be specified;
- the auxiliary must, if possible, work in pair with a private or governmental veterinarian.

The use of the syringe is still indispensable because of the quite exclusive use of injectable thermostable vaccines (e.g. ITA New). This may soon change with encouraging results obtained from trials carried out for the diffusion of the thermostable vaccine with ocular and nasal application (Spradbrow and Copland, 1995; Spradbrow and Grimes, 1997).

b) Problems of access to inputs

In contrast with the commercial poultry production, family poultry does not require much investment. The main inputs are medicines (e.g. vaccines and parasiticides), building materials and equipment for improved poultry houses, exotic poultry breeds and, to a lesser extent, food. The problem of access to these inputs comes up at two levels:

- the non-availability of the products and
- their cost

Taking the particular case of medicines, village veterinary drugstores have appeared in some countries such as Togo, where the training of village auxiliaries was accompanied by the creation of peasant managed veterinary drugstores (Anonymous,1997)

The increasing cost of medicines is a serious obstacle to the development of family poultry. Therefore, research efforts to develop traditional pharmacopoeia must be undertaken and/or pursued. Access to inputs will be facilitated with the setting-up of a decentralized credit policy in which rural community must be strongly involved. This may be sustained by targeted aid approaches which comes in addition to personal contributions, as was experimented in Togo (Anonymous, 1997).

FARMERS ORGANIZATION

As it is pointed out by Ouandaogo (1997) in a study on rural poultry development in Burkina Faso, the organization in family poultry production is not an easy task. The fact that this poultry production is family oriented must be taken into account. Access to services, inputs, the information and training for poultry keepers should be designed accordingly. The processing and marketing of poultry products can be the next services to be addressed by poultry keepers organizations.

The difficulty of access to services and inputs motivates the setting-up of organizations. Most village poultry development programs have therefore encouraged the emergence of "service groups", which can exploit the services of a village auxiliary as it is the case in Burkina-Faso and Togo. The management village veterinary drugstores funds, as it was initiated in Togo, has required the creation of management structures such as management and control committees.

The organization into "production groups" is particularly noticed among women and young people in villages. Poultry keeping is considered there as a "group business", the aim being principally to generate additional income. Besides the community unit, each member of the group has his own individual mixed poultry, which is generally used for his numerous social obligations (gifts, sacrifices, etc.)

Taking into account the social and cultural problems posed by the individual training of a woman in rural areas, the group approach becomes often the unavoidable strategy. This may be taken into profit to develop other activities aiming at empowering women (access to credit, alphabetisation campaign, etc.).

TRAINING OF POULTRY KEEPERS

The necessity for poultry keepers to be trained is fully acknowledged by every project and family poultry development program. Objectives are the improvement of the peasants' ability to take charge of the management related problems and the improvement of their backyard poultry production system.

In some countries like Togo and Burkina-Faso the training allows smallholders to perform technical gestures that are so far reserved to veterinarians such as the use of the syringe (vaccination against Newcastle disease). Such decisions have to be taken by governments, only after a proper evaluation of the capacity of the conventional staff (private or state veterinarians) to satisfy the demand for health care at efficient cost.

However, the practice of para-veterinarian activities must necessarily be properly regulated (i.e. statutes, "recruitment" methods, training program, etc.) and strictly controlled (i.e. intervention scale, technical support, etc.). As it is mentioned above, the application of the thermostable vaccine, which does not necessitate any injection (Spradbrow and Crimes, 1997), will probably be the solution to this delicate problem.

RESEARCH AND DEVELOPMENT ACTIVITIES

There will be a constant need for research and development activities. These activities have to continue improving and validating methodology approaches that are indispensable to correctly identify obstacles and potentials. Thus development actions can be better targeted and evaluated. INFPD can contribute to the elaboration and the diffusion of such tools.

Current efforts to develop thermostable vaccines, which are easy to administrate, must be encouraged. Because of the great importance of the Newcastle disease in avian pathology, epidemiological surveys must be pursued and extended to other species. The diffusion of improved poultry houses should take into account the acute problem of Argas sp. infestation as it was reported in Togo and Mali.

Considering the high cost of imported veterinary products, traditional pharmacopoeia should be more investigated in therapeutic research with a view to exploiting it in a larger scale, especially in the control of coccidiosis and helminthiasis as well as the control of insects in poultry houses. Interesting experimental results are reported in Benin (Songhoï project), in Senegal (Guèye, 1997) and in Togo (Amégée, 1997, personal communication).

With regard to feeding aspects, research on alternative protein (termites, maggots) and energy sources must be pursued. Regarding the evaluation of genetic resources of poultry, a systematic characterization of local types should be done. Very little work has yet been done on this field and efforts should be undertaken.

The research activities mentioned above could make profit of the important opportunity offered by existing information and research networks (e.g. INFPD), universities and their research institutes (e.g. Hohenheim, Queenland, Nigeria, etc.), international co-operation agencies (e.g. FAO, CTA, IDRC, etc.) as well as NGOs (e.g. VSF).

CONCLUSIONS

The development of family poultry production has become an important element in social and economic development strategies in many developing countries. It is particularly used in the struggle against poverty and food shortage and in policies that aim at empowering rural women.

The success of a family poultry development program requires the following conditions:

- a good database (i.e. good identification of obstacles and potentials);
- a good intervention strategy (i.e. intervention scale, intervention area, technical approach, participation of the target population, necessity to take in account «gender and development» issues);
- appropriate accompanying measures (e.g. access to technical support and to inputs, research-development and training activities, processing and marketing of poultry products).

As other favourable development factors, it is necessary to make use of national, regional and international co-operation. Information and research networks, South-South and North-South co-operation programs must also be developed and better exploited.

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COMMENTS ON REQUIREMENTS FOR FAMILY POULTRY DEVELOPMENT

Dr. Asifo O. Ajuyah

I find it quite interesting that the production constraints in the sub-Saharan continent of Africa is similar to that in the South Pacific Island countries. However apart from low productivity, poor housing and under nutrition one of our major problem is losses from predators such as dogs, cats and mortality from motor vehicles. On the average a village hen will incubate between 10 to 14 eggs, hatch 8 to 10 chicks, wean 6 to 7 chicks and only 2 to 4 birds are most likely to survive to be used as replacement, food or income for the family.

With the necessary funding our next research focus will be to compare three groups of village chickens as per the format below:

a. total confinement of hen and chicks until re-breeding stage.
b. partial confinement of hen and chicks until weaning stage.
c. zero confinement.

The following parameters will be of major interest:

- survivability.
- growth rate.
- income.
- resource utilization and management (RUM).

In the South Pacific Island countries the backyard or village chicken may represent between 60% (e.g. in Fiji) and 95% (e.g. in Samoa) of total poultry population. As a result of which it could serve as a major source of nutrition and income for rural families.

From the lead paper 1 I want to know the following:

a. average # of birds per household.
b. relationship between your disease control strategies and poor nutrition. I presume under-nutrition will negate the efforts of your village para-vet.

Dr. Adama Traore

I fully agree with the comment 1 on the lead paper 1 by Dr. Asifo O. Ajuyah regarding the levels and the causes of losses in rural family chickens, especially in growing birds.

Dr. Ajuyah's findings are consistent with values observed in most countries in sub-Saharan Africa: from 10 newly hatched chicks, only 2-3 birds probably survive up to 6-8 months. Various predators (i.e. snakes, rats, dogs, cats, etc.) and vehicles are also major causes of losses.

With regard to the average flock size, it is difficult to give an accurate and reliable figure for the sub-region. However, in Mali, the obtained data show a considerable variation, with values ranging from 1 to 50 birds per household. Number of birds per household largely depends on the production system(s) adopted and the season in which surveys were carried out. The average flock size observed in countries like Mali, Burkina and Togo is about 15-20 birds per household.

The interaction between poor nutrition and health is important. Therefore, the PNPE-project in Togo disseminates also valuable information in order to improve the nutritional status of family poultry. For example, smallholder poultry farmers were advised to use alternative feed resources such as termites and others insects as protein sources and some grains and by-products. The feeding problem is less acute in adult birds, as they usually scavenge in/and around the compounds of households, feeding on the locally available feed resources e.g. household refuse, residues from the harvest and food processing, earthworms, insects, vegetables, grits, etc.

Prof. A. J. Akakpo

I wish to compliment Dr. A. Traoré for his excellent paper (see Lead paper 1) which provides thoughts pertinent to the development requirements for family poultry. However, I would like to make some comments:

1. In the control of major poultry diseases, the author mentions only Newcastle disease. I think problems related to other diseases such as fowl pox and parasitism (i.e. coccidiosis, spirochetosis, etc.) also need to be addressed, if this is not done.
2. The access to services and technical support is crucial for the success of the deployed interventions. However, that is a problem if trained farmers perform prophylactic cares themselves. The understanding of the term "auxiliaries" is not the same for everyone, especially if their tasks can be multiform. Moreover, the author underlines that "the auxiliary may be paired with a private veterinarian". The global context of the privatization of the profession means, above all, an improvement in the quality of health cares and technical support for the farmers. Under these circumstances, it is not advisable to allow competition between two professions that do not have the same level of education. In my opinion, the "auxiliary", whether (s)he is a technician or livestock engineer or vaccinator or "village auxiliary", should always work under the supervision of a veterinarian. This may help to avoid possible misuse, unfair competition (as the farmer will always choose the lowest-cost service) and misuse of products that could be harmful to the consumer.
3. Launching farmers organization is an excellent initiative which needs to be encouraged and promoted.
4. The training of poultry keeping farmers should not allow them to perform technical gestures reserved to veterinarians. Although the number of veterinarians in our countries is low, the fact that they are assisted by "auxiliaries" may allow to satisfy the farmers' demand for health care. We should not move backwards until transforming farmers into syringe manipulators!

Stephen E. J. Swan

"Poutry para-vets, animal health auxiliaries, poultry workers"

This is a comment on Prof. A. J. Akakapo's observations (see Comment 3 on the Lead Paper 1).

The issue of non-qualified (but trained in the basic concepts and procedures) persons using syringes for vaccination of poultry is sensitive. In rural areas where there are no human doctors, such persons can come under quite desperate pressure to treat seriously ill humans. In my experience this has had serious consequences.

The use of the eye-drop inoculation pathway by the heat tolerant V4 /I_2 vaccine is a good solution in this situation. Other advantages are it's heat tolerance and simple low-tech batch production systems (Spradbrow, 1994).

In Bangladesh the Department of Livestock Services has recognised its limited resources to reach rural family poultry units with their veterinarians, and accepted that they have a role in training village-based Poultry Workers (mainly women) associated with the Smallholder Poultry Semi-scavenger (partly food supplemented) Model which the Department has developed since 1983 with assistance from several donors (FAO/UNDP, Danida, IFAD, World Bank and AsDB). The Poultry Worker uses a syringe, and is often supplied with locally produced vaccine through the Department's rural offices at sub-district (thana) level. Imports of NDV are also permitted. The Poultry Model is implemented through NGOs working in close cooperation with the Department (Alam, 1997), and micro-credit loans (about US$40 per household) have popularised the model which now reaches 1.3 million rural poor households and is planned to reach 2 million households over the next 5 years.

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Dr. Adama Traore

I totally agree with Prof. Akakpo's observations (see Comment 3 on the Lead Paper 1) which state that it is necessary to take into account pathologies other than the Newcastle disease (ND), although ND presently remains the first priority. It is essential to take into account the importance of health aspects in a given area and under the poultry husbandry systems practised. As I underlined in my recommendations for further Research and Development activities, ectoparasites such as Argas sp. constitute in some areas a major constraint and must be controlled. Fowl fox is also a significant pathological constraint in some areas. Besides, the effectiveness of the coccidiosis control, especially in chicks, will largely depend on the importance of other environmental factors, i.e. season, hygiene in the habitat, etc.

Regarding the problem related to the intervention of the auxiliaries, I am delighted with Prof. Akakpo's contribution which, hopefully, will activate again the unavoidable debate around this very complex question. It is important to find out how far it is possible to go in giving the traditional poultry keepers responsibility for the health of their birds.

First of all, the question to be answered is: Can vaccination on a large-scale basis be ensured by the existing (public or private) veterinary personnel, and at which cost?

Like Prof. Akakpo, I believe that the best approach would be that some auxiliaries intervene in support and under the technical supervision of a (public or private) veterinarian. The veterinarian will also have to provide farmers with technical support in the domains of production and health. This is the approach adopted by the PNPE (i.e. National Small Animal Development Programme) in Togo. The Veterinarian of the zone participated in the training of the auxiliary and in its supply with veterinary products. The restrictive element of such an approach resides in the weakness of veterinary manpower, in general, and private veterinarians, in particular.

Diseases in rural family chickens in South-East Asia

I. Aini

SUMMARY

Diseases are one of the important factors associated with the limited expansion of the number of village or indigenous chickens in the rural areas. Some efforts have been carried out in many countries in South-east Asia to reduce the losses due to diseases but due to unconfined type of management, disease control is very difficult. Thus, diseases remain a great threat to these chickens.

INTRODUCTION

Rural family chickens or village chickens or indigenous chickens are always associated with free-range, backyard or at most semi-intensive system of management. The types of feed used for this group of chickens and their feeding systems are also very typical to their group and different from those used for commercial breeds in intensive commercial farms. These chickens are however a very important component in the life of villagers or those living in the rural areas.

Village chickens form an integral part of village life, and have an important social value and in some countries. They are considered as an important source of income, besides providing a cheap source of protein to the village/rural people. However, diseases are among the important constraints in the expansion of this industry. In most areas, control of diseases is either lacking, very minimal or unheard of.

MAJOR INFECTIOUS DISEASES AND THEIR CONTROL

Village chickens are known to be susceptible to most diseases which affect commercial chickens. Intercurrent disease is very important. Survival rates of chicks without disease outbreak ranges from 60-70 percent. The survival rate in the rainy season is generally lower because of high humidity, strong wind, and fluctuating temperatures. These conditions also make the chicks more susceptible to infectious diseases, especially respiratory diseases, thus reducing the survival rates.

Losses resulting from infectious diseases and parasitism in the region are known to be substantial. Unfortunately, statistics on incidence, morbidity, mortalities and causes are inadequate. The outbreaks that we hear about represent only a small proportion of the total, since most of the deaths and disease outbreaks in village chickens go unreported. Whatever data reported in each country is usually as a result of one time survey or limited studies. Due to free-ranging and unconfined type of management, disease control is very difficult and expensive, thus is rarely practised by the villagers (Aini, 1990).

The reports from all countries in South-east Asia point to the main killer and the most destructive disease, which causes the highest economic losses in village chickens being Newcastle disease (Anon, 1984; Ronohardjo *et al.*, 1985; Anon, 1986; Atienza, 1987; Hussein, 1987; U Than Tint, 1987; Supramaniam, 1988). Poultry farmers share the common view that unless Newcastle disease is effectively controlled, all efforts to increase production of village chickens will be wasted. The other common diseases reported in village chickens are: infectious bronchitis, fowl pox, fowl cholera, infectious coryza, Marek's disease, lymphoid leukosis, pullorum, chronic respiratory disease, infectious bursal disease, aspergillosis and coccidiosis. Other health problems include those caused by endoparasites, ectoparasites, haemoprotozoa and to a lesser extent, microfilaria (Aini, 1990).

NEWCASTLE DISEASE (ND)

ND has been labelled as the most important viral disease of poultry in the world and is particularly serious in the South-east Asian countries. This is due to the presence of velogenic strain of the virus in the region. The effect is devastating in village chickens where vaccination is rarely practised, often destroying the entire chicken population. Appropriate vaccination programme, suitable vaccine strains, interval between vaccination and efficient route of vaccination should be established to ensure the success of village chicken production.

INFECTIOUS BRONCHITIS (IB)

The incidence of mild IB in village chickens have been reported to be high in Malaysia and Indonesia (Sani *et al.* 1987; Ronohardjo, 1984). However, most of these reports were based on the survey record, rather than the actual report of disease outbreaks. Basically, vaccination for IB is not a usual practise in village chickens, with the exception of village chickens raised semi-intensively for commercial production. In semi-intensive commercial village chicken production, a combined ND-IB vaccine is usually given, intranasally, during the first week of life followed by another dose three weeks later.

MAREK'S DISEASE (MD)

Marek's disease has also been reported in village chickens but vaccination against MD is not practised, under traditional system of farming. For the semi-intensive commercial group, vaccination against MD is given subcutaneously, at day-old.

FOWL POX (FP)

Routine vaccination against FP is practised in semi-intensive commercial group but rarely so or none at all in traditional village chicken system. FP can cause serious problem in village chickens leading to secondary bacteria infection.

FOWL CHOLERA (FC)

The incidence of fowl cholera is reported to be on the increase (Raymond, 1998). It is the most common bacterial disease encountered in village chickens. The disease can result in very high mortality, sometimes up to 80%, especially during rainy season. Routine vaccination against P. multocida is commonly practised in semi-intensive village chicken.

MYCOPLASMOSIS

Chronic respiratory disease is another common disease encountered in village chickens, especially during rainy season (Janviriyasopak *et al.*, 1992). The situation becomes worse if another intercurrent infection sets in. Tylosin is commonly used for treatment, in the semi-intensive system. Treatment for chickens under scavenging system is usually unheard of. The economic importance of this disease is associated with reduction in egg production and growth depression.

INFECTIOUS BURSAL DISEASE (IBD)

From serological surveys carried out in several countries, IBD has been shown to be present in village chickens. IBD outbreaks under the traditional system of village chickens, have been reported in China (Fa, 1993) and Indonesia (Parede, 1992).

SALMONELLOSIS

Salmonella pullorum infection in village chickens is of considerable concern to the commercial poultry industry. In many countries, pullorum is either eradicated or remain at a very low level. The presence of S. pullorum in village chickens may act as potential carriers for the spread of disease in commercial birds. Data on the economic losses in village chickens, due to S. pullorum is however not available. Usually S. pullorum infection in village chickens passed on untreated. Either the chickens survive the infection and become carriers or they die at an early age. Good sanitary measures is virtually impossible under traditional scavenging system. A high prevalence is reported in Thailand (Janviriyasopak *et al.* 1992), but low prevalence in Malaysia (Sani *et al.* 1987), and Indonesia (Istiana *et al.*, 1990). The treatment is normally through the application of antibiotics or sulphonamides.

COCCIDIOSIS

Coccidiosis is usually not a major in village chickens under field conditions. This is probably due to the free-range habit of village chickens in which access to big land area is easily available. However, if these chickens are confined, coccidiosis is one of the diseases which need to be controlled (Sani *et al.*, 1987).

PARASITISM

Ectoparasite and endoparasite infestation is very common in village chickens (Sani *et al.*, 1987; Salfina *et al.*, 1990). Their scavenging habits and constant contact with contaminated environment make them an easy prey to parasitic infestations.

The ectoparasites are known to cause damage to feathers, irritation and skin lesions, resulting in either reduced performance of adult chickens or directly harmful to young chicks. Amin-Babjee *et al.* (1998a) reported that among the ectoparasites as infesting village chickens in Malaysia are: Haemaphysalis wellingtoni, Megninia cubitalis, Menacanthus stramineus, Neoschongastia gallinarum, Menopon gallinae, Liperus caponis, Cuclotogaster heterographus, Goniodes gigas, G. dissimilis and Goniocotes gallinae. The tick, H. wellingtoni and the trombiculid, N. gallinarum, were also commonly observed in high numbers and caused skin lesions. The prevalence and degree of ectoparasites infestation were closely related to the age of the birds, with higher infestation in older birds. The high prevalence of ectoparasites observed in this study was thought due to the free-range system, which exposed the birds to more species of ectoparasites, compared to those kept under the intensive system. The free-range system provides a more sustainable environment for the parasites.

The most common cestodes reported by Amin-Babjee *et al.* (1998b) were Raillietina echinobothrida, Hymenolepis carioca and R. tetragona. The trematod Tanaisia zarudnyi was reported in the kidney of 12-week old village chickens. The intermediate hosts of cestodes, such as, flies, ants, beetles, earthworms and slugs are known to be common in a free-range environment.

CONCLUSION

In order to ensure that villagers can get access to cheap source of protein, disease prevention must be an integral part of rural family chicken production. Efforts should be made to educate farmers regarding the importance of disease control and prevention. Assistance must be given by the relevant authorities to improve the distribution of vaccines and antibiotics, so that rural family chickens are also protected against the most common diseases.

ACKNOWLEDGEMENT

The author would like to thank Ms Normadiah Sukaimi for typing the manuscript.

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COMMENTS ON DISEASES IN RURAL FAMILY CHICKENS IN SOUTH-EAST ASIA

Mr. Eng-Leong ("Jacky") Foo

I would like to thank the author, Prof. I. Aini, for her paper which provided information on the variety of diseases that rural family chickens may have.

Chickens have been around for some thousands of years and I wonder if there is any genetic changes/adaptations in them regarding disease resistance. Do village chickens change their diet when they are sick; i.e. are they clever enough to look for certain plants which will cure them? (as they might do in a Disney movie!)

From the paper: "Village chickens are known to be susceptible to most diseases which affect commercial chickens."

The living conditions of commercial chickens are certainly different from that of village chickens. Is there a group of diseases that are predominantly associated to commercial chickens and not with village chickens?

From the paper: "Due to free-ranging and unconfined type of management, disease control is very difficult and expensive, thus is rarely practised by the villagers (Aini, 1990)."

Given this condition/situation, what is the mortality rate of village chickens in Malaysia? Even though you may say that there is limited data from villagers, they do have experience that form the basis of their skills in raising village chickens. What do they say for a normal flock of village chickens?

From the paper: "The other common diseases reported in village chickens are: infectious bronchitis, fowl pox, fowl cholera, infectious coryza, Marek's disease, lymphoid leukosis, pullorum, chronic respiratory disease, infectious bursal disease, aspergillosis and coccidiosis. Other health problems include those caused by endoparasites, ectoparasites, haemoprotozoa and to a lesser extent, microfilaria (Aini, 1990)."

Are any of these diseases transferred from egg (contamination on the egg shell, egg in itself?) to the chicks so that even if a chick is isolated from all other chickens, the disease is already there?

Please excuse me for asking these basic questions which may already be answered by earlier research. It is just that Prof. Aini's paper gave me the impression that the decades of research and practice have not successfully provided an economically viable package for villagers.

From the paper: "Poultry farmers share the common view that unless Newcastle disease is effectively controlled, all efforts to increase production of village chickens will be wasted. ..."

Dr. Saka Saheed Baba

sympathize with the common view of poultry farmers as appropriately stated by Prof. I. Aini in her Lead Paper 2 that "poultry farmers share the common view that unless Newcastle disease is effectively controlled, all efforts to increase production of village chickens will be wasted ..." By achieving a sustainable control of Newcastle disease among the scavenger poultry populations, 40-50% of the goal of improving the productivity of this group of birds would have been realized.

Drs. Robyn G. Alders and Raul Fringe

We agree completely with Prof. I. Aini's observation that the control of Newcastle disease (ND) is the starting point for interventions focusing on village chickens. Farmers whose only livestock is village poultry tend to be resource-poor and must, therefore, be confident of making a return on any extra investments.

Dr. Jonathan G. Bell

Thank you very much Dr. Aini for the comprehensive overview of the disease situation in South East Asia. You mention that in most areas control of diseases is either lacking, very minimal or heard of. I suppose this is true if you could consider all the chickens in the region of a whole. However, on the other hand, I know that you in South East Asia have accomplished much pioneering work on the control of Newcastle disease, especially in Malaysia. For the benefit of those of us in those parts of the world where less has been done to control Newcastle disease in village chickens, could you give us a summary of the principle conclusions from your experiences with this work?

With regard to Dr. Aini's comment on Newcastle disease, I would like to add my voice to those of both Dr. Saka Saheed Baba and Drs. Robyn Alders and Raul Fringe, who are all of the view that the control of Newcastle disease is a primary concern. Although it is quite possible to sample a given population at a given time and find that there is no evidence of the disease, I think that the evidence and reports that we have already do point unquestionably towards the control of Newcastle disease as a high priority. It is quite in keeping with the cyclical nature of the disease that there should be a given moment where there would be no serological trace of it, otherwise there would never be a susceptible population that could be attacked by it. The serological evidence should be taken together with what villagers report about the disease, and if we take this evidence together and add what we know from virological studies, I think we can say already that globally Newcastle disease is a very serious priority in village poultry. This is not to say that constraints such as predators and feed limitation are not also important.

Finally, I would like to comment on Mr. Eng-Leong Foo's question as to whether there is any group of diseases predominantly associated with commercial poultry. In fact, Dr. Aini has already mentioned that coccidiosis is a problem with commercial poultry, but not with village poultry. But I think that also we should not loose sight of the general association between intensification and disease. The more intensive the production the more there is a risk of the spread of infectious disease, and the more radical are the necessary medical and sanitary prophylactic measures. In intensive poultry production, at least for breeders and layers, which are kept for a reasonably long time, there is a long list of diseases against which it is necessary to vaccinate. Now for village poultry, it is not known whether the more secondary diseases are also present to the same degree, but simply masked by more lethal diseases, but it seems to me that it is possible that infectious agents such as reoviruses, for example, may be less prevalent in village poultry, where an unnatural degree of proximity does not pertain, than in the intensively kept poultry. The intensive poultry population itself may also provide the means for the selection of new pathological entities, which might not otherwise have arisen in the natural population. Take for example the new virulent form of Gumboro disease which originated in the European poultry industry, and which has now been spread around the world by this same industry, and which is, it seems, now infecting rural poultry. Would this have arisen without the ecological opportunity provided by the intensive poultry population?

Prof. Dr. Aini Ideris

These are responses to all the comments regarding Lead paper 2:

1. Genetic changes/adaptations regarding disease resistance.\
   There has been no report of genetic changes or adaptations regarding disease resistance. As far as Malaysia is concerned, we found that village chickens are susceptible to all diseases reported for commercial chickens. Disease incidence however depends on the type of management.
2. Change of diet during sickness
   When they are sick, the chickens either eat the food provided to them or they do not eat at all (Disney movie does not apply here!).
3. Disease in commercial chickens versus village chickens, as related to living conditions
   As mentioned in my earlier answer (question 1), some diseases related to intensive management may not be common in chickens kept under free-range system. Coccidiosis for example is not common in village chickens kept under free-range. As soon as these chickens are kept in crowded confinement, coccidiosis is one of the diseases which needs to be controlled. Endoparasites are common in village chickens but not so in commercial chickens, mainly because of the scavenging nature of village chickens. So, management system, as rightly so mentioned by Dr. Jonathan G. Bell plays an important role in the prevalence of a disease in a flock of chickens, rather than the breed of chickens.
4. Mortality rate of a normal village chicken flock in Malaysia
   As mentioned in my paper, there is limited data on the mortality rate for a normal flock. Losses start right from the brooding stage. Brooder losses are high, similarly with losses due to adverse conditions. In the absence of epidemic diseases, the mortality rate is around 20-30% (personal communication with farmers).
5. Control of Newcastle disease in Malaysia
   As a result of the ACIAR project on HRV4 food-pellet Newcastle disease vaccine, the villagers are more aware of the control of ND, the need for vaccination as a prevention, and the availability of the vaccine. The HRV4 vaccine has since been commercialised, however, due to the logistical problems in transporting and storing large quantities of food-pellet vaccine, the vaccine manufacturer produces the vaccine in the freeze-dried form rather than coating it onto feed. The farmers either use the HRV4 vaccine (which is cheaper) or other imported vaccines (in areas where they are more easily available). There is less report of ND outbreaks in village chickens, now, as compared to about 6-7 years ago. However, whether this is due to HRV4 vaccine or not is difficult to say, since no study has been carried out to determine it. Nevertheless, the project definitely had its impact in making the villagers more aware of the need to vaccinate chickens against ND and many are vaccinating their chickens now.

Family poultry management systems in Africa

A. J. Kitalyi

ABSTRACT

Chickens (Gallus domesticus) dominate the smallholder poultry production systems of Africa. However, the other poultry species including ducks, geese, pigeons and guinea fowls, do play varying roles in the welfare and economies of African households. The prevailing management systems are a function of social and economic changes in the region. Intensive, semi-intensive, backyard and extensive scavenging systems are found in family poultry or smallholder poultry of Africa. Improvements in areas of breeding, feeding, housing, health and disease control as well as in marketing and processing of poultry products have been introduced invariably in different countries. However, currently more than 70% of the family poultry population are the indigenous chicken types kept on low-input low-output production system.

In this paper the management systems of family poultry in Africa are presented with emphasis on bird types and flock sizes, housing, feeding, health and disease control, marketing and use of poultry products as well as socio-economic aspects.

Key words: family poultry, management systems, Africa.

INTRODUCTION

There are three poultry management systems; intensive, semi-intensive and extensive/scavenging, which are differentiated on the basis of flock sizes and input-output relationships (Sonaiya, 1990; Kitalyi, 1998). The extensive poultry production systems in Africa, where the poultry is kept on free range or scavenging is different from the more recent extensive free range poultry coming up in developed countries (Thear, 1997). The later system stemmed from concerns on need for humane conditions and respect for animals, which has been given more emphasis in developed countries than in developing countries.

The term poultry applies to a wide variety of birds of several species including chicken, guinea fowls, pigeons, ducks, geese, turkeys, swans, peafowl, ostriches, pheasants, quails and other game birds (Koeslag, 1992). The domestic fowls belong to the order Galli, which includes chickens, guinea fowls, ducks and turkeys. These different types are found in the smallholder poultry systems of Africa, defined as family poultry in this conference. These birds in their natural habitat scavenge for their food and seek shelter in the natural surroundings in trees and bushes. However, over the years there have been human interventions on the natural habitat through domestication and research, which have resulted into different management systems. Although some of the new technologies such as high yielding breeds, improved housing, concentrate feeding and disease control have been introduced in family poultry, the adoption rate has been low.

In the following sections, the three main poultry management systems in Africa, i.e. intensive, semi-intensive and extensive or scavenging system, are presented. The discussion is based on six factors, which influence the management systems. These factors are:

- bird type and flock sizes,
- housing,
- feed resource,
- health and disease control,
- marketing and product utilization, and
- socio-economic aspects.

INTENSIVE AND SEMI-INTENSIVE MANAGEMENT SYSTEM

The intensive system, which is based on specialized breeds, constitute less than 30% of the total poultry population in Africa. The system is found mainly in urban areas, where there are markets for eggs and chicken meat. In those countries, which followed a socialist policy such as Ethiopia and Tanzania, the intensive poultry production system was confined to government institutions (Katule, 1989; Tadelle, 1996). Producers in this production system, aim at using the recommended standard practices, such as breed of choice depending on production objectives, appropriate housing, feeding and health and disease control program. However, those farmers in family poultry, found in rural areas mainly cannot follow most of the standard husbandry practices due to various constraints. Production at low-input, low-output levels, termed semi-intensive is the commonest in family poultry.

The semi-intensive production system is sometimes referred to as backyard production system (Sonaiya, 1990; Ngongi, 1996). The intensive and semi-intensive production systems are based on one species and mostly the domestic chicken (Gallus domesticus). Flock sizes in intensive production system are normally in thousands, whereas the semi-intensive or backyard production system flocks range from 50 to 200 birds (Sonaiya, 1990; Kitalyi, 1998). Keeping of big flock sizes is as a result of research developments in artificial incubation, nutritional requirements and disease control.

Intensive production system developments aimed at reducing labour and housing costs per hen, which led to the introduction of cages. These developments in housing are found in some family poultry production systems. However, the high densities of multiple hen cages may not have infiltrated much into the African continent, because land and labour resources are not as limiting as in developed countries. The deeper litter system may be the most common housing system in the intensive and semi- intensive systems of family poultry in Africa. Flock densities are not strictly adhered to and high densities of less than 0.1m2 per bird are common (Huchzermeyer, 1976).

Feed resource is a major input in poultry production systems, accounting for over 60% of total production costs in commercial poultry sector (Renkema, 1992). The rising poultry feed costs and particularly those of premixes has led to use of home made rations or home mixing where concentration of commercial feed is fortified with other ingredients. Ingredients commonly used in home mixing are; oyster shells, fishmeal, bone meal, blood meal and oil seed cakes. Other ingredients are cereal grains, cereal by-products and kitchen waste (Fanuel, 1997; Kitalyi 1998).

Most producers who adopt this management system use the conventional health and disease control measures. However, the effectiveness of the system is hampered by poor infrastructure and inadequate diagnostic equipment (Yongolo, 1996). The mushrooming private veterinary services, resulting from the on-going structural adjustment programs has decreased the problem in urban areas. Marketing of products in this sector use the cold chain system, although there are cases of live birds sales to hawkers for hotels in urban and shopping centers. Where the cold system cannot be used there is a problem of marketing, particularly where there is high competition with the big commercial producers.

EXTENSIVE OR SCAVENGING MANAGEMENT SYSTEM

In the extensive or scavenging management system, different poultry species are kept. These are; chickens, guinea fowls, ducks, geese and turkeys. Chickens (Gallus domesticus) dominate in number and economic contribution (Sonaiya, 1990; Fanuel, 1997). Guinea fowls may be more popular in the flocks of West Africa, coming second to chickens (Veluw, 1987; Bourzat and Saunders, 1990; Ouandaogo, 1990; FAO, 1995). Flock sizes in this production system are highly variable. Sonaiya *et al.* (1999) give a range of 3 to 97. Kitalyi (1998) reported a wider range of 6 – 130. As noted above, bigger flock sizes are associated with more intensification in housing, feeding, disease control and marketing.

Poultry housing in this sector are quite similar across the continent. Huchzermeyer (1976) studied the traditional poultry houses in the rural poultry sector of Zimbabwe and reported three types namely saddle roofed houses, round thatched huts, boxes and basket types. A survey on poultry management systems in Nigeria reported that 40% of surveyed farmers transferred the poultry from homesteads to farms using baskets (Mathewman, 1975). Kaiser (1990) reported the use of chick cages hanged on tree branches. The housing structures in the extensive production systems are either on the ground or raised. Structures on the ground are sometimes provided with perches. In Zimbabwe a run is attached to the poultry houses and the term fowl-run in local poultry is commonly used. There are cases where the birds do not have separate houses (Hutchzermeyer, 1973; Mathewman, 1975, Kaiser, 1990; Kitalyi, 1998) and instead the birds roost in the family house, kitchen or in tree branches.

The traditional poultry housing structures are small in size. It would be difficult for a person to go into most of them. Such houses would definitely not provide a healthy environment. The poor hygienic condition of the housing result in high infestation with external parasites. In Ethiopia, the problem of external parasites ranked second to Newcastle disease (Tadelle, 1996). Kaiser (1990) reported significant decrease in external parasites (Argas persicus) and mortality from spirochetosis by improved construction of perches in Niger. In the Gambia livestock improvement program, which included improved poultry housing resulted in lower chick mortality (19%) relative to that observed in Ethiopia (66%) and Tanzania (33%), where no housing improvements were made (Kitalyi, 1998). The advantages of improved housing are noteworthy. However, such improvements should take into consideration, farmer's rationale for the small structures. Secure houses are necessary for protection from theft as well as predators.

In the smallholder poultry production system, scavenging is the main feeding system. Unfortunately, there are so far no reliable methods of estimating the scavenging feed resource quantitatively or qualitatively to enable estimation of input - output relationships in this feeding system. Roberts and Gunaratne (1992) and Tadelle (1996) have attributed much of the low performance of the birds to the poor feed resource base. Promoting use of unconventional feed resources such as termites, maggots and worms has been suggested as one of the alternatives for increasing the scavenging feed resource base. A technique for producing termites in Togo and maggots in Burkina Faso have been described by Farina *et al.* (1991) and Soukossi (1992), respectively. Other suggestions for increasing the scavenging feed resource through integrating poultry and cropping has been suggested (Baksh, 1994).

Poor understanding of disease epidemiology, poor infrastructure and inadequate diagnostic facilities compound the problem of diseases in extensive production system. The interactions of different entities, within and among the flocks such as; flock contacts while scavenging, uncontrolled introduction of new stock, exchange of live birds and transmission from wild birds (Kitalyi, 1998) limit development of sound poultry health program. Farmers are handicapped in disease control particularly with the infectious diseases such as Newcastle disease, which is most devastating (Chabeuf, 1990; Bourzat and Saunders, 1990, Bell *et al.*, 1990; Chrysostome *et al.*, 1995; Yongolo, 1996). Various local concoctions are used by farmers but not much research has been done to test the efficacy of those local treatments. Use of Aloe sp. plant leaf extract is one of the local therapy reported in The Gambia, Zimbabwe and Tanzania (Kitalyi, 1998).

With support from government and non-governmental organizations, farmers are now forming association and groups to enhance input supply and distribution in the rural areas. Success in this area depends on farmer's access to information on the disease situation and control measures.

Marketing and use of poultry products in this production system is poorly developed. Most farmers depend on hawkers or middlemen who buy the birds for urban markets. Furthermore demand within the production area, i.e. in the rural areas, is low. Rushton (1996) reported household consumption rates of one chicken and eight eggs per month in Ethiopia and one chicken and negligible eggs in two months in The Gambia. The higher consumption rates in Ethiopia were attributed to increased product utilization in traditional meals. Not much has been done in promoting value added poultry products. Like most other agricultural commodities, improving marketing system and introduction of value added products could trigger increased poultry production and its contribution to household economies.

SOCIO-ECONOMIC ASPECTS

Management of poultry has been associated with women for various historical and social factors (Bradley, 1992). This situation has changed in developed countries because of science and technological developments. In Africa the situation has not changed much. Survey in four African countries, i.e. Ethiopia, The Gambia, Tanzania and Zimbabwe, showed that women dominate most activities except for shelter construction and marketing (Kitalyi, 1998). Family poultry is easily managed within homesteads, and in rural areas this is the main resource which women farmers have more access to benefits accrued. However, various gender-based constraints such as poor access to information by women and heavy workloads on women should be addressed to meet the needs and opportunities of this gender category in this sector.

CONCLUSIONS

Family poultry management in Africa does not follow standard husbandry practices. The high variations in individual farmer circumstances call for a step-wise improvement approaches. Intensification through introducing specialized high yielding breeds should be preceded by improvements in housing, feeding and disease control. Institutional support in the dissemination of technology and information, financial services and improvement in infrastructure will facilitate improvements in poultry management in Family Poultry.

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COMMENTS ON FAMILY POULTRY MANAGEMENT SYSTEMS IN AFRICA

Dr. Keith Hammond

Dr. Kitalyi's lead paper 3 is appreciated.

Now, can contributors take her analysis even further and identify the SPECIFIC opportunities for improving poultry production and productivity FOR EACH of the different system types: Intensive, semi-intensive, backyard and extensive scavenging systems of family or smallholder poultry of Africa. Dr Kitalyi comments: "Improvements in areas of breeding, feeding, housing, health and disease control as well as in marketing and processing of poultry products have been introduced invariably in different countries." This further analysis would be best done by forming a large table, and using either a few descriptive words or scores (suggest ---- to ++++) as entries, depending upon the row title, in the body of the table. Perhaps Dr Kitalyi might start the ball rolling with a draft table - just in an e-mail body. Of course this could be done for each country but perhaps first the general table for African Family and Small-holder Poultry Systems.

So, for EACH OF THE SYSTEM TYPES (columns of the table):

1. What have been the outcomes (even guesstimated!) in terms of family output of chickens, meat, eggs from the experiences to date of implementing these different improvements / for particular combinations (specify) of improvements (rows of the table)?
2. As a further set of rows in the table: What specific opportunities are envisaged now and in the immediate future for each of these different improvements / for particular combinations (specify) of improvements, AND what would be the expected GAIN IN OUTPUT OF CHICKENS, MEAT, EGGS WHICH COULD BE SUSTAINED FROM EACH OF THESE INTERVENTIONS at the small holder / family unit level? What level of added inputs over time would be required to realise and sustain each of these estimated gains, and is this the requirement for this input once-off or repeated (continuing)?
3. Finally, what is the (guesstimated!) current contribution to family income and wellbeing of each system in the urban areas, and in the rural areas?

Dr. Aichi J. Kitalyi

Coming back to Dr. Keith Hammond's contribution (see Comment 1 on the Lead Paper 3) on the need for more analysis on input-output and opportunities for family poultry improvement, I want us to make reference to Prof. Bessei's proposal. Prof. Bessei discussing international poultry development, gave a step-wise improvement to the poultry sector as follows:

- Traditional production system (negligible input), Step 1 (water, supplementary feeding, improved shelter, preferential treatment of chicks and ND vaccine), Step 2 (Step 1 + more improvement in housing and disease control), Step 3 (Step 2 + complete diet and improved breeds). The estimated output of these levels were:-

	Traditional Scavenging	Improved Traditional		
		Step 1	*Step 2*	*Step 3*
Annual output				
Birds	2-3	4-8	10-12	25-30
Total eggs	20-30	40-60	100	160-180
Eggs for consumption or sale	0	10-20	30-50	50-60

Different output could be estimated in this step-wise improvement approach depending on the production objectives. Where there is more demand for eggs, then bird output can be lower and vice versa.

In 1996 Prof. Bessei brought the same discussion in the XX WPC and included output form the industrial/intensive system as 265 eggs. In his later presentation Prof. Bessei discussed the efficiency of feed energy utilization in the different systems. When environment issues are brought in, then integrated farming is one of the opportunities, which should be captured in the different steps.

On the guess-estimates for current contribution of poultry to family income and well being of the different systems, we can be sure the range will be very wide. Given the current state of art in most rural areas, where the importance of cash economy is increasing daily, need for diversification with the unpredictable weather changes, family poultry has a high potential. Although poultry product utilization is poor, poultry meat is found in the meat kiosks, which are common in most African urban areas and market places in rural areas. Unfortunately, there is no hard data on quantities, but no doubt there will be some contribution to the family income and wellbeing of the people through these channels. Probably, the network could suggest and/or support some studies to quantify this.

Klim Huttner

Dear Dr. Kitalyi,

Your lead paper 3 is a comprehensive review of the environment and circumstances of traditional village poultry systems. However, having worked for six years as a field veterinarian in northern Malawi, I realised that a number of traditional husbandry methods are perhaps the best possible option of keeping chickens in this environment. Despite many failures in the traditional management of chickens and high mortality rates, scavenging chickens might enjoy a much better balanced diet than chickens in intensive units.

Housing, at least in northern Malawi is simple but efficient, given that the structures are maintained (stilted, grass thatched basket type predominant). I believe that a number of Projects have focused too much on changes of the system rather than improving it. Another aspect mentioned in your paper is insufficient knowledge for instance about scavenging feed recourses. We had the same problem in Malawi. Even estimates about off-takes, hatching rates or causes of deaths were difficult to assess. Because of this and the importance of village chickens for the families we decided to undertake a detailed 15 months study in selected villages where the same flocks were visited daily. The results of this doctorate thesis provide a deep and valuable insight into chicken keeping in villages. Unfortunately, we were not yet able to publish the content.

Dr. Aichi J. Kitalyi

Dear Klim Huttner,

This is a response to your comments (see Comment 3 on the Lead paper 3). Yes, traditional husbandry methods could be the best option in the village poultry systems. However, you will agree with me there are no static production systems. Therefore, scientists have to come up with appropriate improvement technologies for rural poultry. There have been so many changes in the rural farming systems. For instance, in the past most post harvesting activities (threshing, pounding and milling) were carried out at the homestead vicinity. This allowed for more access of scavenging feed resources to the family poultry. This is no longer the case. Population increase has resulted into people leaving far from the crop fields and post-harvesting processes are carried out by machines, where some of the products go to other more intensive production systems. So change in the family poultry production systems is eminent.

As for the estimation of production parameters, I will refer you to the recent Animal Production and Health Paper No. 142. First, the farmers have to appreciate the need for record keeping, which will have to come with some intensification or transformation to any of the improvement steps suggested in the paper. I hope the Malawi work will be published. It will be interesting to share experiences from Malawi with that reported from The Gambia, Ethiopia, Tanzania and Zimbabwe in that FAO publication.

Dr. Christine Ahlers

In 1995/96, a longitudinal survey on traditional poultry keeping systems has been carried out in Northern Malawi. During this study, several interventions were carried out to increase the output of the extensive production system. After elaborating the results for a doctorate thesis (Ahlers, C., 1999: "Erkrankungen und Produktionsverluste in der traditionellen Huehnerhaltung in Nord-Malawi", Fachbereich Veterinaermedizin der FU Berlin, Germany), the data are being prepared for publication.

To answer Dr. Hammond's questions (see comment 1 on the lead paper 3) briefly, I can give a short summary of what we did and found out: 71 traditionally kept chicken flocks with a total of about 900 chickens in 4 villages were visited and examined monthly over a period of one year. Besides questionnaires on flock dynamics and productivity, blood and feacal samples were collected and single birds were checked for ectoparasites. In one of the participating villages, the birds were vaccinated against NDV. In a second village, recommendations on husbandry and management were given regularly, and baskets were promoted for the rearing of young chicks in order to avoid high losses. In the third village, all interventions were combined and chicken flocks in another village served as control group.

The examined production system is an extensive scavenging system as is described for several other African countries. In July 1995, the average flock size was 17 chickens. Although the birds are kept mainly for consumption and sale, 90% of the families had a chicken meal less than once a month. In most cases a chicken was slaughtered for guests. In this situation, the average family size was 5 persons. They shared a cockerel of maybe 1kg live-weight with one or more other persons. Eggs were mainly left for reproduction. Less than 50% of the participating farmers sold a chicken during the survey. The family output of this production system is obviously very little, the losses were about 4 times as high as the off-take.

We compared the output in the different villages and found out that the best results were obtained when all interventions were combined. In that village, on average 2.2 chickens per flock were used (consumed, sold or bartered, given away as a gift) monthly, while the average flock size had increased to 26 birds after one year. In the control group only 1.2 chickens were taken out from each flock monthly, and the average flock consisted of 22 birds after 12 month of survey.

The results of this longitudinal survey revealed the importance of socio-economic aspects in this traditional system of poultry keeping. For example, the popular custom consisting of lending chickens to a relative or good friend can reveal to be devastating in case of disease outbreaks since local farmers have no idea about incubation periods. To overcome such difficulties the socio-cultural context of the targeted production system should be known. Socio-cultural aspects showed an influence on the vaccination campaign as well as on acceptance/adoption of recommendations. The acceptance of labour-intensive or expensive interventions depends on the importance and meaning of chickens to their owners. Therefore, regularly repeated training programs and periodic control through monitoring are necessary to achieve a good acceptance/adoption of any intervention and to establish sustainable improvements.

Rural family poultry production in the South Pacific Region

A. O. Ajuyah

ABSTRACT

In most South Pacific Island countries, in particular low-lying atoll countries rural family poultry production is their primary source of animal protein. For example in Nauru and Tokelau 100% of the total chicken population are village chickens. However, production system range from little to zero-input cost, as a result of which growth rate is slow, production low and pre-weaning mortality very high. The major causes of mortality with young chicks are feral dogs, cars, rats, cat and disease; while theft account for over 60% of adult losses. To maximize production efficiency it is important to review and identify intrinsic and extrinsic constraints, which should include the village poultry farmer (owner), the village chicken (subject) and the village (environment), since all these factors interact together. In the region more research is required on 'owner-subject' interaction and less on 'subject-environment' interaction.

Key words: South Pacific Islands, village chickens, status and management.

INTRODUCTION

The South Pacific Island countries could be classified into the following three broad groups depending on their size and topography:

i. Large countries with raised islands (2,850 km2 - 27,540 km2) - Fiji, Solomon Islands, Vanuatu and Samoa
ii. Small countries with raised islands (230 km2 - 701 km2) - Tonga, the four states of the Federated States of Micronesia, Palau and Cook Islands.
iii. Low-lying atolls countries (10 km2 - 712 km2) - Marshall Islands, Kiribati, Tuvalu and Tokelau.

The importance, growth and development of the rural family poultry in each island country depend upon Eco-systems, size, resources, political, cultural and socio-economic structure. However, the per capita distribution of village chicken ranges from 0.1 in Tonga to 1.8 in Samoa and Cook Island. If only the population of the rural areas is considered with over 75% of the local chicken population, the per capita distribution may be 10fold the above figures. This observation further supports the importance of the village chicken in the nutrition and economy of the rural population.

Although, the indigenous, village or island chicken is the most prominent class of livestock in the Pacific Island countries, there has been little or no research work done in this area. It is important to note that in some countries in the region the village chicken contributes significantly to the rural economy, customs, welfare, health and nutritional needs of the people. For example approximately 100% of the total chicken population in Nauru and Tokelau are local breeds, and less than 30% of the chickens in Marshall Islands, Kiribati, Samoa, Niue, Federated States of Micronesia, Solomon Islands, Cook Islands, Vanuatu and Tuvalu are commercial breeds (Table 1). Local chickens are well adapted to normal village situations, requiring little or no input in terms of capital and specialized management skills. In addition to scavenging for insects, grubs and plants the chickens subsist mostly on farm rejects and household waste for their growth, development and reproduction.

TABLE 1: COUNTRY PROFILE

	Poultry Population			
	Local	*Commercial*	*Total*	*% Local*
Countries				
Fiji	584,468	5,200,000	5,784,468	10
Western Samoa	247,500	27,500	275,000	90
Tonga	130,740	135,960	266,700	49
Solomon Islands	43,000	17,000	60,000	72
Cook Islands	30,000	6,000	36,000	83
Vanuatu	27,000	4,000	31,000	87
Tuvalu	17,320	7,240	24,560	71
Kiribati	85,000	7,000	92,000	92
Marshall Islands	15,000	1,000	16,000	94
Niue	15,000	2,000	17,000	88
Nauru	4,000	0	4,000	100
Tokelau	3,000	0	3,000	100
FSM	34,000	5,000	39,000	87

Fiji data for 1993, Cook Islands data for 1991 and other countries for 1988

However, the major constraints affecting the development of the rural family poultry in the region include the following: breed productivity and breeding system, management systems, production unit or size, religious or cultural attitudes, the lack of continuous supply of supplementary feed and improvised marketing system.

BREED AND BREEDING SYSTEM

The village chicken is widely distributed in the region (Table 1) mainly as a source of meat and occasionally eggs. They are usually small in body size; an adult male may weigh from 1.5 to 2.5 kg and female 1.0 to 1.5 kg at 18 months. They are usually unimproved or unselected, but very hardy mainly as a result of continuous environmental selection. However meat yield (60-65% of live weight) and egg production (50 to 90 eggs per year) are usually very low, this is in addition to slow growth rate resulted partly from under-nutrition. They are mostly single combed with plumage of different patterns and colours, ranging from white through black to red with some black on the tail hackle neck and wings.

There is no planned breeding program under this system of production. Mating is naturaland usually a group of males run with the whole females. The ratio of males to females under this system varies, and may range from as high as 1:40 to as low as 1:3. This ratio depends on the time of the year (lower ratio prior to festivals), the habitat (lower ratio in semi-urban areas) and the feed availability (lower ratio with supplementary feeding). However, immediately after festivals there is heavy demand for replacement birds. In most instances inbreeding is usually high and fertility quite low because in most cases the dominant males are old, exhausted since most time is spent fighting and establishing dominance within and across flock. As a result of which they are sexually less active or mating becomes then a secondary activity.

MANAGEMENT SYSTEM

The traditional method of managing the village chickens accounts for about 95 to 98.5% of total production in some countries in the region. In fact most household in rural areas keep village chickens. The birds are usually free ranging with access to unlimited pasture and grassland, therefore stocking density is very low. The level of management and financial input range from very low to zero, for example supplementary feed and sleeping or laying accommodation are rarely provided. In most cases adult chickens sleep or roost on treetops at night. The chickens hatch their own eggs by natural incubation and the mother hen raised her young chicks until weaning. There is no record of production. Identification is done by keen observation by the traditional farmer.

FEEDING SYSTEM

The chickens roam in/around the homestead and suburbs in search of sustenance. The diet of the scavenging chicken is location specific. For example chicken around coconut meal processing unit may obtain about 70-80% of their feed from the site. Other feed includes white ants, grub, insects, kitchen leftover, farm wastes or purchased feed/grains. Usually these feed sources are unreliable during heavy rains which sometimes last for days. On the average therefore nutrition is poor, growth rate is slow and level of production or product yield is low.

PRODUCTION UNIT AND SIZE

Village chickens may be owned by individuals or group of people, which include men but mostly women and children. A person or family may own on the average between 10 to 20 chickens, and ownership and number changes frequently, in particular preceding a feast and by reproduction and replacement.

Under this system of production, chicken mortality is very high as a result of losses of birds and eggs to predators, such as rats, cats, pigs and dogs. Other sources of losses and mortality include from thieves, cars and diseases. The degree of losses depends on the intensity of predation and age of the chickens. For example losses from dogs, in particular juvenile and feral dogs, cars and rats may be as high as 40-100% for young chicks, while losses of adults birds (20 to 100%) is greatest from thieves (Table 2). The cumulative effects of all these losses is that on the average a hen might lay between 12 to 14 eggs, hatch 10 to 12 chicks, 4 to 6 might survive the growing stage and only 2 to 4 might be available for replacement, food or commerce.

TABLE 2: MITIGATING FACTORS THAT INFLUENCE VILLAGE CHICKEN NUMBER

	Age in weeks		
	0 - 6	*6 - 20*	*20+*
Factors		*% losses/mortality*	
Dogs	60 - 100	40 - 50	0 - 5
Rats	40 - 60	0 - 1	0 - 1
Cars	40 - 60	5 - 10	0 - 5
Cats	30 - 40	0 - 1	0 - 1
Disease	20 - 35	5 - 10	0 - 5
Thieves	0 - 5	0 - 5	60 - 100
Pigs	0 - 5	0 - 1	0 - 1

DISEASE STATUS

In a scavenging flock of village chickens there is no age separation as a result of which the younger chickens are the most susceptible to parasites and diseases. The complete lack of effective disease control, poor nutrition and no protection from rain, wind and sun further compromise the health status of village chickens. Infectious diseases are easily transmitted within and between scavenging flocks. Some common diseases that affect the village chickens include fowl cholera, fowl pox, coryza, coccidiosis, worms, lice and mite infection.

RELIGIOUS AND CULTURAL ATTITUDE

The consumption of village poultry is quite high in most countries in the region, in particular countries with high concentration of Indians (50% of population - Fiji); Muslims (Fiji) and members of the Seven-day Adventist (3-5% of population) who prefer chicken meat to pork and beef.

MARKETING SYSTEM

In most island countries there is little or no trade in live chickens or eggs, because they are kept mainly for domestic consumption. However, there is the occasional commerce between relatives and friends. Under these circumstances cost prices are highly variable and rarely reflect age of bird, live weight or production cost.

CONCLUSIONS

This segment of the industry plays an important role in the Region supplying the rural domestic market for social or traditional purposes such as weddings, funerals, etc, and consumption. However, the development in this sector has been hampered as a result of the following:

1. Lack of socio-economic data for project development and efficient planning;
2. Unselected genotype, lack of efficient disease control and poor nutrition, hence the level of productivity is quite low;
3. High losses from hatch to maturity, mainly as a result of zero level of management.

To maximize the potential of the rural family poultry in the South Pacific Island research addressing current problems and the involvement of government are prerequisite.

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COMMENTS ON RURAL FAMILY POULTRY PRODUCTION IN THE SOUTH PACIFIC REGION

Dr. El Hadji Fallou Guèye

wish to compliment Dr. A. Ajuyah for his excellent paper (see Lead paper 4) which provides us with key information on rural family chicken production systems in the South Pacific Island countries. However, the author focussed his contribution only on chickens. It is also relevant to have information relating to the importance of poultry species other than chickens in that region.

Dr. Asifo O. Ajuyah

This is a reply to Dr. E. F. Guèye's query (see Comment 1 on the Lead paper 4).

The only other type of poultry in the region of numerical significance is Duck, and Fiji has over 85% of the total duck population. There are 135,935 ducks distributed on 17,784 on-commercial farms in Fiji, or 7-8 ducks per farm or family. The major duck producing divisions in the country are, Western, Northern and Central divisions. However, approximately 54.4% of total farms and 50.4% of the total duck population are located in the Western division. The distribution of duck farms in the country parallels ethnicity, for example 58.9% of the farmers in the Western division are Fijian Indians, and duck curry is a prime Indian delicacy.

The three common systems of production are full confinement in urban areas, and partial confinement or free ranging in rural areas. Depending on system of production scratch feed may be provided, eggs are hatch naturally and there is very high demand for live duck by restaurants and individuals. A duck curry chicken of similar serve is 45% more expensive than chicken curry at US$ 2.50 in an average restaurant. There is a small market for duck eggs by the small Asian community (0.3% of the population of 0.8 million).

In other countries in the region, i.e. Samoa, Tonga, etc., the low distribution of duck is as a result of little demand for duck meat (no cultural affinity). However, in supermarkets in these countries there are processed frozen whole duck from USA, New-Zealand, which might indicate the possibility of a niche market.

If subscribers need more information on duck production systems and disease please let me know.

Production aspects of village chicken in the South-East Asian Region

A. H. Ramlah

ABSTRACT
Village chicken production under the free-range and semi-intensive system is still the most popular and viable production systems for rural households with little inputs. This system of production will supplement the protein intake of the rural households as well as additional income when the needs arise. The trends towards utilising crossbreds of the indigenous chickens that are suitable for free-range rearing will be the scenario in the future.

INTRODUCTION
The Asian countries contribution towards the world's chicken meat and egg production is about 33% and 50%, respectively. The production is dominated by China (47% for meat and 63% for eggs). The production of poultry meat and eggs in this region is dominated by development in relatively few countries. The total production from China, Japan, the Republic of Korea, Thailand, the Philippines, Malaysia and Indonesia made up of 75% of the region's chicken meat output and nearly 83% of the eggs output (Anonymous, 1998). The production of the poultry meat and eggs are dominated by the commercial lines of broilers and layers managed under the intensive systems. Although, the commercial production of poultry utilising the efficient commercial lines of broilers and layers has become very successful and highly competitive in these South-east Asian countries, the backyard chicken production in rural areas would still continue to contribute towards the domestic chicken meat consumption. In Malaysia, the contribution is very small but a large contribution of village based production occurs in Indonesia, Thailand and the Philippines.

PRODUCTION OF VILLAGE FOWL
In most of the South-east Asian countries, poultry keeping has been practised for centuries as a backyard operation among rural families. The practice of keeping chickens which are mainly the native or indigenous chicken and their crosses under the scavenging system of backyard farming is still popular in the rural areas. The move towards the semi-intensive system, whereby the birds are kept in enclosed areas with a shed for shelter and provided with food and scratches had been quite popular for a medium scale production in most South-east Asian countries such as Malaysia. Rarely would one find village fowl being kept under the intensive system such as the deep litter or caged system.

In Malaysia, the standing population of indigenous chicken in 1994 is estimated to be around 10 million birds which comprised of 3% of the total standing population, and the commercial broilers about 300 million birds or 97% of the total standing population. The 1994 annual production of village chicken was around 15,000 tonnes of meat and 250 million eggs compared to the commercial broilers of 450,000 tonnes poultry meat (Seri Masran, 1996). In peninsular Malaysia, it is estimated that over three-quarters of a million rural families still keep village fowl under the backyard production in flocks of 15-20 birds of various ages. This practice of keeping the indigenous fowl is still widespread in south-east Asia (Aini, 1990).

In Indonesia, figures for 1994 showed that village or native fowl population is about 26% (230 million) to the total poultry population (877 million chickens) while about 68% (592 million) are the commercial broilers and 6% (55 million) are culled layers (Soejoedano, 1996). In the Philippines, backyard poultry production is the predominant production system. The 1995 estimated total poultry population is 95.5 billion birds, and about 70% are under the backyard rearing system while the remaining 30% are reared under commercial farming. The scenario in Thailand would be similar to Malaysia where commercial broiler production is predominant, but there are about 4.6 million backyard chicken farming units in Thailand consisting of about 5-50 chickens per unit for home consumption and petty sales (Morathop and Mahantachaisakul, 1996).

FARMING SYSTEM

The traditional system of keeping the village fowl has been the backyard system whereby the birds are let loose to scavenge for food, with housing provided at night for the semi-intensive and free-range system. A study by Ramlah and Shukor (1987) showed that rural farmers in Malaysia mainly practised the free-range system (82.1%), followed by the semi-intensive system (15.4%) and the intensive cage system (1%). Over the years many semi-intensive farms have cropped up, and a few of them rearing as many as 10,000 birds. The intensive rearing of village chickens, on a similar system as those practised for the commercial broilers, in deep litter system house or the slatted floor system, has not been attempted on a larger scale for commercial production. Farmers or people in the rural areas that rear large numbers of village chickens under the semi-intensive system normally have a ready market that pays a premium price for the bird. Another practice of keeping chickens is associated with the dwellings of the rural folks. As most of the houses in the rural areas are built on stilts, some farmers usually kept the chickens enclosed during the night under their houses and sometimes also built an extension usually at the side or rear of the house made out of wooden materials, wire netting and thatched or zinc roof for keeping the birds.

In most South-east Asian countries, village fowls are generally kept to supplement the family with income and protein diet. These birds which are normally the indigenous stock are raised on the free-range system scavenging for food comprising mainly of fallen grains, worms, insects, table and kitchen scraps as well as local weeds and grasses. In Malaysia, feed supplements are sometimes provided such as wheat, paddy, rice bran, corn, coconut cake and tapioca. Chickens of various ages under both the free-range and semi-intensive systems are sometimes fed twice a day, early in the morning before the birds are released and in the evening when they come back to roost.

The breeding stocks are normally obtained from home hatching whereby the mating of males and females take place naturally and randomly, since all ages of both sexes are allowed to roam freely. Flock size varied between 20 to 50 birds with ages of between day-old to about three years. Each farmer would kept about 1-2 adult males and 3-4 adult females in their flock for breeding purposes. Hens would lay eggs in clutches of about 8-16 eggs per clutch before sitting on the eggs for hatching. Chicks are normally brooded by the broody hen or brooded in a box or cage and then the brood is left to roam for food following the mother hen after about 40-60 days until they can look after themselves. The survival rate of these chicks are low compared to chicks that are kept under the semi-intensive system.

PERFORMANCE OF VILLAGE FOWL AND THEIR CROSSES

In Malaysia, the indigenous village chicken is a dual-purpose type reared for both meat and eggs, a small body size with variable body conformations and physical characteristics and mainly reared on the semi-intensive or free-range systems. These birds are the descendants of the south-east Asian jungle fowl (Gallus bankiva) through natural mating and selection. The village fowls, normally found kept in the rural and suburban areas, are no longer a pure breed. They are the result of crossbreeding with various exotic stocks introduced into the country. Numerous crossbreds of these indigenous fowls can be seen reared extensively in almost every village and suburban areas.

Since the village chicken is a popular breed to be kept on the free-range and semi-intensive system for rural people as well as in the suburban areas, a number of studies had been carried out in Malaysia on the performance of the village fowls in term of liveweight as reported by several authors (Table 1) and egg production (Table 2).

TABLE 1: REPORTS OF LIVEWEIGHTS OF VILLAGE FOWL IN MALAYSIA REARED UNDER SEMI-INTENSIVE AND INTENSIVE SYSTEMS

References	**Sex**	**Age (weeks)**	**Average liveweight (g)**
Semi-intensive system			
Engku Azahan and Zainab (1980)	Mixed	10	475
Engku Azahan and Zainab (1980)	Mixed	15	525
Ramlah and Shukor (1987)	Males	15	1080
Ramlah and Shukor (1987)	Females	15	802
Engku Azahan and Zainab (1980)	Mixed	20	838
Ramlah and Shukor (1987)	Males	24	1520
Ramlah and Shukor (1987)	Females	24	1370
Intensive system			
Jalaludin et al. (1985)	Mixed	8	380
Choy (1958)	Mixed	10	670
Engku Azahan et al. (1980)	Mixed	10	802
Engku Azahan and Zainab (1980)	Mixed	10	753
Engku Azahan and Noraziah (1996)*	Mixed	10	713
Engku Azahan and Noraziah (1996)*	Mixed	12	973
Choy (1958)	Mixed	14	980

References	Sex	Age (weeks)	Average liveweight (g)
Engku Azahan and Noraziah (1996)*	Mixed	14	1112
Engku Azahan et al. (1980)	Mixed	15	1346
Engku Azahan and Zainab (1980)	Mixed	15	1100
Jalaludin et al. (1985)	Males	15	1170
Jalaludin et al.(1985)	Females	15	957
Engku Azahan and Noraziah (1992)	Mixed	16	1301
Engku Azahan and Noraziah (1996)*	Mixed	16	1215
Engku Azahan and Zainab (1980)	Mixed	20	1362

Source: Ramlah (1996a) except *

TABLE 2: REPORTS OF EGG PRODUCTION OF VILLAGE FOWL IN MALAYSIA REARED UNDER SEMI-INTENSIVE AND INTENSIVE SYSTEMS

References	Production period (weeks)	Egg production (%)	Egg weight (g)
Semi-intensive system			
Ramlah and Kassim (1992)	55	18.7	42.5
Ramlah and Shukor (1987)	50	17.1	41.1
Intensive system			
Devaraj (1958)	52	38.0	39.7
Engku Azahan (1983)	11	29.3	42.8
Engku Azahan and Noraziah (1992)	24	48.9	41.7
Jalaludin et al. (1985)	20	41.5	43.2
Yeong (1992)	40	43.6	46.0

Source: Ramlah (1996a)

These birds are normally marketed at 15-20 weeks with a liveweight of about 1.2 - 1.5 kg. A great variability was observed which could be attributed to the different varieties of village chickens and the feeds. In term of egg production, not many studies had been carried out. The village chicken had a very low egg production, with system of rearing influencing the level of production which could be attributed to the strain or varieties of birds and the level of nutrition that the birds received.

Since the popularity of keeping chickens by the rural and suburban households had been the village chickens, studies had also been carried out on the potential of keeping the crossbreds that resemble the physical characteristics of the village chickens which would have a better performance in term of growth and egg production. These studies are reported in Table 3. Although the reports showed that these birds had been kept mostly under the intensive system, its suitability for the free-range and semi-intensive system cannot be ignored. These crossbreds can achieve liveweight equivalent to that of commercial broilers at about 15-16 weeks. Most of the studies had been recent, thus no studies had been reported on the egg production of these crossbreds.

All the studies reported in Tables 1, 2 and 3 normally practised the vaccination programme that had been recommended for the commercial broilers in particular the vaccination against Newcastle Disease.

TABLE 3: REPORTS OF LIVEWEIGHTS OF VILLAGE FOWL CROSSES IN MALAYSIA REARED UNDER SEMI-INTENSIVE AND INTENSIVE SYSTEMS

References	Sex	Age (weeks)	Average liveweight (g)
Semi-intensive system			
Noraziah and Engku Azahan (1997)	Mixed	12	1230
Intensive system			
Engku Azahan and Noraziah (1996)	Mixed	10	1068*
Engku Azahan and Noraziah (1996)	Mixed	10	996**
Engku Azahan and Noraziah (1996)	Mixed	12	1381*
Engku Azahan and Noraziah (1996)	Mixed	12	1376**
Abd. Khalid (1997)	Mixed	12	1076*
Abd. Khalid (1997)	Mixed	12	1037**
Engku Azahan and Noraziah (1996)	Mixed	14	1688*
Engku Azahan and Noraziah (1996)	Mixed	14	1643**
Abd. Khalid (1997)	Mixed	15	1730*
Abd. Khalid (1997)	Mixed	12	1659**
Noraziah and Engku Azahan (1995)	Mixed	16	1423*
Noraziah and Engku Azahan (1995)	Mixed	16	1383**
Noraziah and Engku Azahan (1995)	Mixed	16	1216***
Engku Azahan and Noraziah (1996)	Mixed	16	1882*
Engku Azahan and Noraziah (1996)	Mixed	16	1841**

* village fowl (Black red variety) X French label chicken
** village fowl (Red variety) X French label chicken
*** village fowl (Red variety) X Taiwan country chicken

CONCLUSIONS

Village chicken production using mainly the crossbreds of the indigenous chickens would be popular in rural households, particularly in Malaysia where there is an emerging trend of consumer awareness towards organically grown chickens. The rearing of village chickens on the traditional feeds would be attractive for the farmers because of minimal inputs that are required. The scale of production can be small to medium, i.e. from 100-1,000 birds per farmer.

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COMMENTS ON PRODUCTION ASPECTS OF VILLAGE CHICKEN IN THE SOUTH-EAST ASIAN REGION

Dr. Asifo O. Ajuyah

In her contribution, Dr. Ramlah said that there are: "In the Philippines ... 95.5 billion birds, and about 70% are under the backyard rearing system ..."

Question: Please confirm, 95.5 billion or 95.5 million.

She said that: "The village fowls, normally found kept in the rural and suburban areas, are no longer a pure breed. They are the result of crossbreeding with various exotic stocks introduced into the country.

Question: How are the performances of the crossbreed compared to their predecessors, in terms of survivability, egg production, etc.? This is of interest to me because a member of the audience from Canada recommended selection within and across the local population instead of cross breeding. I totally agree with him for most performance or productive traits which are difficult to maintain as a result of exerting influences of multiple genes and highly variable/uncontrollable extrinsic factors.

Dr. A. H. Ramlah

This is a reply to Dr. Asifo O. Ajuyah's query (see Comment 1 on the Lead paper 5).

1. According to Abenes (1996), number 2 in the reference list, the population is 95.5 billion.

2. The village fowls in Malaysia are generally considered an adulterated descendant of the original indigenous South-east Asian fowl. Most of the birds that are reared in the rural households in the eastern part of peninsular Malaysia (Kelantan, Terengganu, Pahang states) are black or white in colour (female) and gold, red, brown and black (male), and in the southern and central parts of peninsular Malaysia (Johore, Selangor, Perak states) are mainly gold, brown and yellow (female) and gold, black and red (male).

The studies reported by the authors cited in my paper are mainly the brown, red and yellow varieties. The chicks used in the studies are obtained by buying the eggs from the villagers and incubating the eggs.

To answer question 2, in term of comparison of the performances of the village fowls to their predecessors, such a comparison is difficult to report as the birds were obtained from the villagers which normally do not carry out a systematic breeding of these village chickens.

One study by Engku Azahan and Noraziah (1996) reported mortality for the village chickens and the crossbreds (village chicken males X French country chicken females), as follows:

- village chickens: 9.7% (1-10 weeks of age), 12.2% (1-16 weeks)
- crossbreds: 7.2% (1-10 weeks of age), 11.1% (1-16 weeks)
- and other studies as follows:
  - crossbreds: 6.5% (1-12 weeks) (Noraziah and Engku Azahan, 1997)
  - village chickens: 21.5% (1-15 weeks) (Jalaludin *et al.*, 1985)

We (Ramlah and Kassim, 1992) had done a study comparing the four varieties of village chicken and the mortalities and egg production from age 22-54 weeks were as follows:

- Mortality, in %: Light Brown 25.6, Black 29.7, White 26.1 and Dark Brown 33.8
- Egg Production, in %: Light Brown 19.2, Black 21.6, White 17.4 and Dark Brown 20.4
- Liveweight, in kg (22 weeks): Light Brown 1.35, Black 1.31, White 1.30 and Dark Brown 1.68
- Liveweight, in kg (54 weeks): Light Brown 1.73, Black 1.47, White 1.42 and Dark Brown 1.68

I agree with you that we should do selection within and across the local population (village chicken) instead of crossbreeding, since the variation within the village chickens is very large and until a time when the variance is small and then only we go for crossbreeding.

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Dr. Saka Saheed Baba

I wish to make an inquire from Dr. Ramlah based on her Lead Paper 5, especially on the aspect of performances of village fowls and their crosses and her response to Dr. A.O. Ajuyah's observations. Are there reports on selection of village poultry (or any other group of poultry) for disease resistance including Newcastle disease?

Dr. A. H. Ramlah

This is a reply to Dr. Saka Saheed Baba's query (see Comment 3 on the Lead paper 5).

In Malaysia, there is no reports on selection of village poultry or other group of poultry for disease resistance. Studies related to diseases that had been done was mainly on the feed based Newcastle disease vaccination of these village chickens done by Prof. Aini Ideris of Universiti Putra Malaysia (author of Lead paper 2).

FINAL COMMENTS

George Chizyuka

Many thanks and congratulations on a very useful exercise!

Asifo O. Ajuyah

Hello Guèye,

I wish to express my sincere appreciation to you and your team (R.D. Branckaert, A.W. Speedy) for the high level of professionalism, dedication, fairness, confidence, and dexterity exhibited throughout the duration of this global Internet conference. I presume all other subscribers hold similar opinion as evidenced by their sustained interest and contributions to the conference proceeding.

This conference has enriched my mental repository in a multi-directional fashion through global peer contacts, cross-pollination of knowledge and ideas relating to the village chickens from Africa through Asia, North America and across the Pacific Island countries. I hope someday functional citation of an improved version of the proposed method on the estimation of digestibility in the village chicken will be reported in the literature.

Finally, I will presume that we all look forward to the next INFPD/FAO electronic conference in the year 2000, meanwhile keep up the good works Guèye and team; you are all truly great and deserve to be our representatives in Rome.

Tushar K. Mukherjee

Dear Dr Guèye,

You and your colleagues must be congratulated for holding a very informative electronic conference. There are many new things I learnt from the conference, especially some of the experimental results on feeding trials. I have no doubt in my mind this conference has contributed tremendously to our knowledge on disease investigation, management, nutrition and even some *in-situ* conservation.

As the marine catches are decreasing in many parts of Asia, poultry will be the main animal source for a balanced diet of well-to-do as well as poor people of the developing and developed nations of Asia. In this connection I would like to mention a few points:

1. *In-situ* and *Ex-situ* conservation of indigenous poultry breeds should receive attention from National and International planners. I make this point as the constant dilution of these breeds by commercial strains will, one day, cause the complete extinction of the original indigenous breeds. For example, in Malaysia the Cantonese chicken cannot be found anywhere today. There must be similar cases in other countries.
2. It is possible today to breed a synthetic line which will look like the typical village chicken of any country by incorporating the major genes such as Dw and Na, and a combination of specific plumage colour genes. In fact some Western European Companies are already doing this. Knowledge of this kind of breeding programme should be instilled in some national breeding programmes. People like Professor Merat of France and Professor Horst of Berlin have done lot of work in this regard.
3. Integrated breeding and nutrition work as developed in villages of Taiwan should be published in different languages and sent to respective countries. In this connection your organisation might be able to help.

Anyway you have done a very good job during the last few months. Keep up the good work.

Best wishes to you, Dr Branckaert and Dr Speedy.

Este Koster

Dear Sir,

I found that the papers contained interesting and useful information. The electronic medium made it possible to share thoughts and gain information and not having to travel a lot of miles to a conference venue.

Congratulations!

E. Babafunso Sonaiya

I have followed the proceedings of the electronic conference and would like to make some comments as it is coming to an end. I shall dwell mainly upon the points raised in Lead papers 3 and 4 by Kitalyi and Ajuyah, respectively, but also refer to other submissions presented during the conference.

I think we now have sufficient preliminary baseline information to start designing more specific studies in Family Poultry (FP) in all the regions. To do this we need to clarify some of our terms and assumptions. Family poultry is not synonymous with Local chickens as improved birds are raised by smallholder family poultry producers. Family poultry is not the same as backyard or semi-intensive or even grazing systems (as in S.E. Asia) and caretaking system (as in Africa). Many families especially in urban and peri-urban areas use exclusively improved birds in intensive systems of management (deep litter or battery cage). Family poultry is defined by the source and type of capital and labour more than land area, flock size, location or management of the birds. It is therefore important to state precisely what type of FP system is being studied or reported upon.

It is also important that we provide real data as distinct from mere figures that do not show the means, standard deviations, variances, correlations and regressions. This conference has proved beyond any reasonable doubt that we ought to move in the direction of obtaining hard data that can be used in explanation, prediction and planning policies and development projects.

We ought to focus our research on the following factors: housing, health and disease control, feed resources, marketing and product utilization, bird type and flock size. We need to ask what kind of housing to recommend for the extensive and semi-intensive systems. The housing (which does not have to be a house) will not be used all day. What is the appropriate stocking rate (0.1m2/bird of Huckzermeyer, 1976)? What is the cost effectiveness of improved housing? We must relate cost of housing (and health and feed improvement as well) to increased sales and consumption in the different management systems. Improved housing resulted in lower mortality in Gambia (19 percent) but what is responsible for the difference in mortality between Ethiopia (66 percent) and Tanzania (33 percent) where no improvements were made (Kitalyi, 1998).

In extensive systems, methods for estimating Scavengeable Feed Resource Base (SFRB) are required. Existing methods (Gunaratne, Roberts, *et al.*) are not exact but they really need not be, as the SFRB is merely a guide on the provision of supplementary feed. The bird can balance its ration if cafeteria choice feeding is used. There is a need to develop such feeding systems for scavenging birds of all species. The suggested modification of Ajuyah (free communication), and the tabulation protocol of Kitalyi for this modification, should considerably improve accuracy of estimating SFRB but will be very difficult to carry out even under research conditions.

There is no disease-free system and surely we know that the intensive, all-in all-out, broiler system is still plagued by myriads of disease conditions with the appearance of new ones like Sudden Death Syndrome, ascites, etc. Scavenging is not a sufficient reason not to develop a health programme. The new free-range systems in developed economies still have health programmes. What we must look for are effective ways of delivering conventional vaccines and new types of vaccines that can be used in the unrestricted free-range systems. We should watch carefully the results of the IAEA/FAO co-ordinated research programme on this (INFPD Bulletin Vol. 8 No.4). In addition, indigenous health remedies must be honestly studied and implemented as appropriate. Modern human and veterinary medicines started with concoctions and there are biological resources in the ecosystems of developing countries that have definite medicinal properties.

Market research must accompany other developmental research but causes (be they social, cultural or economic) of low home consumption of poultry products by family poultry producers themselves must be investigated and overcome.

Gender research in family poultry is overwhelmingly important but there are few gender experts with enough time or interest in family poultry research and development. Family poultry researchers must acquire expertise in gender analysis and use such expertise in all their research.

On the whole, this has been a very stimulating conference and the global spread of contributors and subscribers has been very impressive. Credit and thanks go to the managers of the conference in FAO and to all contributors.

I look forward to the next electronic conference later in the year or as soon as possible.

Reginald De Deken

Dear Dr E.F.Guèye and co-workers,

Congratulations for this excellent initiative. The conference offered a lot of discussion materials. We will make use of them during the "Cours International de Production et

Santé Animales Tropicales" organised by the Veterinary Department of the Institute of Tropical Medecine (ITM) of Antwerp.

Robyn G. Alders

I have enjoyed participating in this electronic conference and would like to take this opportunity to thank Dr. Guèye and co-workers as well as the FAO for facilitating this venture.

Mr. Eng-Leong ("Jacky") Foo

Dear Guèye and co-workers,

I like to congratulate you and your group for setting up and conducting this well-organised Electronic Conference. It can serve as a good model for people who are interested to start to organise Internet Conferences, and we can expect to see more of such activities in the future.

I am organising an Internet Conference on "Material Flow Analysis of Integrated Bio-Systems" next year, and so I like to invite participants from this list to join the LISTSERV list "ET-W11@segate.sunet.se", which will serve as an announcement list.

I hope that some participants from this Family Poultry Group will be able to present papers on the material flow in family poultry systems. Material flow analysis provides households with the map or plan for successful operations since it provides information on requirements, how much land and feeds are needed, how much feed you can produce and how much money you can make. For example - if you have say 30 chickens, can you draw a schematic diagram to demonstrate the material flow into such a system, i.e. on how much feeds and/or land is needed for semi-scavenging chickens? Can you cultivate or grow chicken feed e.g. earthworms, termites, maggots and how will this influence the material balance and economics? How can you integrate other farming and livestock activities with raising chickens or integrated/rotate raising chickens with a vegetable plot? How can you use industrial wastes as chicken feed? In W. Samoa for example, brewery spent grains and copra are often used as supplementary feed for scavenging family poultry.

Jonathan G. Bell

I would like to say a big thank you to Dr. Guèye for his tireless work in administrating the conference, to Dr. Branckaert for his foresight in conceiving it and diligence in bringing it to pass, and to Dr. Speedy for his technical support. I'm not quite sure how to initiate a round of applause in an electronic conference - I guess messages of appreciation replace it.

I think the conference was a big success. It was genuinely worldwide, and permitted the participation of many people who would not have been able to come to a regular conference, including a number working in other fields. It has shown the serious interest that exists in family poultry throughout the world, and I think it has made an important contribution to the establishment of the science of family poultry.

Once again, a big thank-you to our organisers (applause)!

Gavin MacGregor

Dear E. F. Guèye and co-workers,

Thank you for organising a very useful electronic conference. I have found the papers and various questions and comments to be most enlightening and useful.

Ed Wethli

Dear Dr Guèye, I would like to convey my sincere appreciation to you and your team for organising this extremely useful conference. This is certainly a creative way of holding such discussions.

I found the papers to be, on the whole, of a very high standard and particularly interesting. Even though I have been working with poultry development for many years, I acquired quite a bit of new information!

Once again, many thanks!

Klim Huttner

was impressed with the way this conference is facilitated. Thanks to the Organisers.

Aichi J. Kitalyi

I commend the conference organizers for the good work done. It has been wonderful to share knowledge and experiences on this subject. Whenever I participate in these electronic conferences, I really appreciate the privilege, because I know there are so many of my colleagues in the developing world who are craving for such an opportunity, but it has not reached them. I do hope the modernization process in our countries will go faster so that more and more scientists from the developing world will have access to such conferences. So again congratulations to all those who made the conference a success.

Christine Ahlers

Dear organisers and contributors,

I followed the First INFPD/FAO Electronic Conference on Family Poultry with huge interest. The opportunity to discuss, exchange views and share experiences, to contact people working on the same subject and get information about different projects on village chickens is very valuable. Thank you for taking the effort to organize this conference!

I have been working with about 70 small-scale poultry farmers in Malawi for one year. Many families did not understand my interest in their chickens at the beginning and the acceptance of different interventions varied. Nevertheless, any improvement was highly appreciated, because in that region chicken and fish are almost the only sources of animal protein for poorer families and women-headed households.

Changes are difficult to achieve in traditional production systems. Social and cultural aspects may have a higher priority than economic aspects. Since the losses -due to various reasons- in this production system are high and cannot be calculated it is understandable that the farmers are not very interested to invest time or money in their chickens. The success of any project is therefore depending on detailed data on constraints and productivity of the local chickens as well as on consideration of local conditions.

This electronic conference can facilitate the huge task to improve family poultry management by exchanging and discussing data and experiences. Hopefully most of the contacts and the exchange of information will persist and this conference will not be the last of its kind!

Adama Traoré

[Message translated from the original French - E.F.Guèye]

"In my opinion this conference was very successful. It made it possible to mobilize expertise in rural or family poultry development issues. I somewhat regret the low level of participation of experts from our sub-region. This situation could be explained by their limited access to the Internet. This electronic conference allowed many specialists from different countries, or even continents, to get in touch and exchange views. These contacts should not be lost after this electronic conference, they must rather be maintained and strengthened. The conference made it possible, to my mind, to identify common topics and potential fields for regional co-operation. There are, for example, two areas in which regional co-operation could be contemplated:

- Control of Newcastle disease (ND). ND has unanimously been regarded as the most important disease devastating family poultry flocks in almost all regions. Development approaches based on low-cost and sustainable vaccination schemes could be investigated and implemented.
- Integrated animal production systems. They could associate poultry and/or bee keeping.

I seize this opportunity to congratulate Dr. Guèye as well as FAO for facilitating this venture, and I urge the network to continue this form of scientific co-operation. In the future, we will be targeting more restricted fields in order to allow thorough exchanges."

Avigdor Cahaner

The importance of peri-urban, semi-intensive, sustainable poultry production:
With much interest and appreciation, I have been following the First INFPD/FAO Electronic Conference on Family Poultry. The novel concept of an electronic conference has been matched by very thorough papers and many thoughtful comments. The organizers at the FAO and INFPD, as well as all contributors, deserve many thanks from everybody who is interested in the development of poultry as a major source of food, and also as an important source of income for families in developing countries.

With regards to the objectives of family poultry production, there are a few thoughts I would like to share with the subscribers of the Electronic Conference. I am new to this subject, having been first exposed to it during the INFPD meeting in M'Bour, Senegal (December 1997). However, the different perspective (due to ignorance or naivety) of an outsider or newcomer may produce insights that might be missed by the expert. Moreover, I am currently involved in a study on the contribution of the naked neck gene to the adaptation of industrial broilers to family poultry production in hot climates near Ho Chi Minh City (Vietnam) and Calcutta (India). The observations and impressions from my visits to the project's locations helped me develop my opinion regarding family poultry.

During the meeting in Senegal, the network changed its name from ANRPD (African Network on Rural Poultry Development) to INFPD (International Network on Family Poultry Development). The change reflected an increased emphasis on family-scale poultry production in "peri-urban" areas, in addition to rural poultry production. The market demands, and relative ease of marketing, have increased family poultry production by village families in peri-urban areas. Unfortunately, due to low productivity of the scavenging chickens, this type of family poultry cannot produce large quantities of poultry products at affordable prices, and thus producers hardly benefit from the new marketing opportunities. In some cases, the urban market is supplied by large-scale industrial poultry operations, but those hardly contribute to the economic and social situation of the people.

However, between low-input (scavenging) poultry and high-input (industrial) poultry, there are plenty of opportunities for medium-input (semi-intensive) family-run sustainable poultry production. This is the essence of my comment, because the policies, research, and extension activities required to materialize this potential are very different from those needed to improve the productivity of scavenging chickens. As scientists, our duty is to define future needs and the most important objectives related to them, in order to initiate the required research as soon as possible. Therefore I encourage all subscribers in the Electronic Conference to exchange their experiences and ideas regarding the development of sustainable semi-intensive family poultry production, and to try to set up guidelines for future research, covering poultry science issues as well as economics, marketing, and social policies. I am willing to start this process with my own observations.

First, I would like to argue that people, especially in developing countries, must care for more than just food security. They should be trained (and helped) to generate enough income to secure not only food, but also education and overall development for future generations. In order to turn poultry production into a significant source of income for the family, a balanced set of inputs must be invested. Two inputs are readily available: the family's small piece of land, and the labour and attention of family members. However, in order to take maximum advantage of these resources, they must be accompanied by reasonable levels of other inputs, such as appropriate housing, productive stock, sufficient feed and veterinary assistance. Balancing the levels of these inputs in sustainable combinations is the key to successful family poultry production, hence organizational efforts and much research should be directed at this integrated objective.

Some aspects are well known, and have been discussed also during the Electronic Conference. Those and others are detailed below:

1. Interested families must start with free inputs (chicks, feed, medications) provided by GOs or NGOs, along with adequate extension services. Such a system has been applied in Sudan (described in M'Bour by Prof. Musharaf) and in India (information from Dr. Saha at the Nimpith Institute, West Bengal). Successful families use the initial income to finance their continued activities, expanding them at a rate that reflects their skills and motivation.
2. Adequate housing and equipment are required. I saw highly efficient and innovative low-cost constructions that used locally available cheap materials such as bamboo, dry corn stalk or palm leaves, used fishing nets, etc.
3. Adequate feed is required. It must be produced in professional feed mills, but with skilful (and research-based!) use of locally available low-cost raw materials.
4. Preventive medical measures should be practised, especially simple water treatments. To my surprise, mortality rate in the family-operated broiler farms I visited was rather low, partially due to lower stocking density and reduced growth rate (due to hot climate and/or sub-optimal feed). However, low mortality is mainly due to very intensive care by family members. This is the biggest advantage of family-operated poultry farms, with the family-owned chickens being kept next to the family house.
5. Except for reduced mortality, chickens of local strains exhibit a limited response to improvements in housing, feeding and sanitation, because they have never been

selected under these conditions. The genetic potential for growth rate or egg production of rural breeds is much lower than that of industrial stocks. Therefore, a balanced set of inputs applied in semi-intensive poultry production must include stocks with high potential along with special adaptations to local conditions.

In summary, when comparing scavenging poultry with semi-intensive poultry, there is no "right" or "wrong". The former is more relevant to rural communities whereas the latter should be the choice of villagers in peri-urban areas. However, they are associated with quite different research objectives and extension activities. And because resources for research and extension services are limited, 'competition' is inevitable when priorities are being set. This is a challenge for policy people, but also for poultry scientists who should weigh the two 'options' in terms of scientific feasibility as well as potential contribution to mankind. The weighing must rely on expected changes in the future, rather than on past information or current situations. Therefore more weight should be given to future research related to sustainable semi-intensive family poultry production.

James Gathumbi

Dear Dr. Guèye,

I wish to express my sincere thanks to you and your colleagues for having made this conference such a great success. I have found the exchange of information in the conference of great value.

Mmeta G. S. Yongolo

Dear Dr. Guèye,

It was unfortunate that I joined the INFPD/FAO Electronic Conference rather late when it was winding up. Thus, I received all the key papers and conference contributions. Yet, I have gone through them and found them to be very informative and educative with regard to the state of poultry production and research in developing countries. Therefore, I would like to join in expressing my congratulations to you and the co-organisers of the conference.

The current situation as highlighted by the key papers and the comments from contributors show that we have a challenge both in terms of quality and quantity of research work relevant for developing countries.

However, I feel that for a start most of information presented or made available can be used in extension packages to farmers at the moment. We have to start somewhere. For example creep feeding practices and improvised structures observed in some areas in Tanzania could be incorporated in extension packages. This could be one of the remedies to the high chick losses observed in scavenging village poultry. Apart from facilitating creep feeding they deter crawling and flying predators. It is not surprising that regions of Tanzania where such improvisations are commonly practised have paradoxically higher poultry populations. The creep feeding and improvised structures are made of simple locally available materials. Thus, they could be adopted without substantial increase in input costs to farmers.

I would also like to support what has been suggested by Prof. Sonaiya on the following:

First, it is important and urgent that the definition of FP or rural poultry is made. We have to compare and exchange experiences and results from different places and different research data. There is a need for an agreed definition of the existing different poultry systems in developing countries. The problems for the scavenging poultry system of production, which is characterised by

- very little supplementation if not accidental,
- presence of multi-aged birds in the same flock,
- free contact with other flocks night housed separately and presence in the shared environment with wild birds and other animals,
- minimal inputs and high dependency on the natural feed resource base.

Besides, problems encountered by poultry kept in village backyards are different to those found in peri-urban areas. In peri-urban areas, birds are confined, fed on concentrates, kept in similar or uniform age flocks, defined types (layers/broilers), disease control and treatment measures are practised.

Secondly I support the idea that we urgently focus on development of disease control programmes which should address the existing disease situation for the most devastating diseases. Of course, priorities will differ according to the system and which are the identified problems in specific areas. Moreover, they might change with time as the situation changes. I find this to be a necessity because experiences in Tanzania show that rural poultry keepers are always reluctant to invest in poultry or even collaborate with researchers, when they are sure that devastating epidemics are existing in their poultry population.

This underlines the importance of developing disease control programmes for any development strategy and further research activity. The birds have to survive so that they are available for research on how to improve their feeding, housing or marketing.

I am looking forward for much more active participation in the coming conferences.

Aini Ideris

Dear Dr. Guèye,

I would like to congratulate you, Dr. Branckaert, Dr. Speedy and the rest of your team members for the excellent job done with the INFDP/FAO electronic conference. We can see the great interest of researchers world-wide in family poultry. I must admit that I gained a lot from this conference and has widened my circle of researchers with the same interests. My thanks and congratulations to the contributors as well.

Well done and all the best.

Quazi M. Emdadul Huque

Dear Dr. Guèye,

I would like to express my sincere thanks to you and your team members Dr. Branckaert and Dr. A.W. Speedy for holding this type of informative conference. I specially thank to you for encouraging me to participate in this electronic conference. This conference has given a cross section knowledge on rural chicken throughout the world.

Village chickens in different regions of the world have got natural selection through years together and production and reproduction performances based on the survivability and adaptability are fully dependent on socio-economic condition of the country or areas. This conference has stimulated ideas of scientists from developing countries where food security and poverty alleviation are the most important challenges for millions of people.

I congratulate the organisers again for this excellent idea.

Best wishes to you, Dr. Branckaert and Dr. Speedy

Additional Papers

Practical workshops to teach Newcastle disease vaccine production in developing countries

S. Grimes

INTRODUCTION

The introductory paper of this conference confirms the importance of Newcastle disease (ND) as a major constraint to improving the productivity of family poultry in many countries. The author recognizes the problem of imported ND vaccines being expensive and that many of these vaccines are heat labile. This renders the vaccines ineffective for use in family poultry if a cold chain is not available, as is often the case in developing countries. Thermostable vaccines are therefore appropriate in these situations.

The Australian Centre for International Agricultural Research (ACIAR) has funded the research and development of thermostable ND vaccines. This work has been conducted over the last fifteen years and supervised by Professor Peter Spradbrow of the School of Veterinary Science and Animal Production at the University of Queensland. Two thermostable vaccine strains were developed, V4 and I_2. Thermostable V4 vaccine is now made commercially by Fort Dodge (previously Websters) and the Malaysian Technology Development Corporation.

The University of Queensland stores the freeze dried I_2 master seed which is supplied at no cost for use in developing countries for local production of thermostable ND vaccine. To date the I_2 master seed has been distributed to nine countries. The recipients of the master seed then face the challenge of producing and distributing ND vaccine on a sustainable basis. In order to transfer the skills required to make and test the vaccine and ensure its distribution to village chickens, a series of practical workshops have been convened. These workshops have been held in association with extension workshops attended by administrators and extension workers who are a vital link between the laboratory and the field. These are the people who are ultimately responsible for distributing the vaccine and organizing vaccination programs in rural villages.

Following is a brief summary of the role and outcomes of these practical laboratory workshops including details of where, when, who participated and funding source.

INTERNATIONAL COLLABORATION VIA PRACTICAL WORKSHOPS

The strategy of holding practical laboratory workshops in developing countries was devised primarily to transfer the technical skills required to produce and test ND vaccine. The organizing and convening of the workshops require considerable collaboration between the Australian veterinary research team headed by Professor Peter Spradbrow and counterparts within the host country. Communications have been greatly facilitated by the use of e-mail where possible.

This collaborative spirit is maintained throughout the workshop and fosters mutual understanding of existing technologies between the partners. Constraints to ND vaccine production and distribution are discussed and planning for overcoming these constraints initiated. The workshops are conducted in a central veterinary laboratory in the working environment of the participants. Simple low cost materials are used. Each participant receives a laboratory manual (Spradbrow *et al.*, 1998) and additional laboratory materials are supplied according to the requirements of the participating laboratory and the budget allocation. The workshops are planned to enable one Australian technician to effectively transfer skills to sixteen participants who each have the opportunity to practice the practical skills required to produce and test ND vaccine.

On completion of the workshop, participants are encouraged to maintain a working network with each other and with the Australian research team. A newsletter based on ND vaccine production in the host country has been suggested as a means of developing a team spirit and sharing information, results and problems.

The Australian team offers on-going technical assistance and advice via e-mail, fax and regular correspondence as required. A portfolio of copies of relevant research papers is prepared and supplied for perusal by the participants. Often they do not have access to a library with a collection of journals. Participants are encouraged to plan and implement efficacy trials of locally produced thermostable ND vaccine and to consider submitting the results of such trials for publication in international journals. Professor Spradbrow has offered to help with advice regarding the methodology of vaccine trials and with editorial advice for the analyse of results of the trials for publication.

WORKSHOP TRAINING OBJECTIVES

The training objectives of these workshops are as follows:

1. To prepare ND vaccine by a seed lot system. For those laboratories that have imported the I_2 master seed virus, this includes propagation of the virus in embryonated eggs and preparation of aliquots of an I_2 working seed;
2. Quantal infectivity assays of ND virus, calculations of infectivity titre using Reed Muench formula;
3. Detection and titration of ND virus haemagglutinin;
4. Detection and titration of ND haemagglutination inhibition antibodies in serum using standardized positive and negative serum;
5. Collection and processing of blood samples from chickens;
6. Application of ND vaccine to, and recovery of virus from feed;
7. Discussion of experimental methodology, recording results in laboratory day books, calculations of mean antibody titres and analysis of data collected from vaccination trials

WORKSHOP DETAILS

Practical vaccine production workshops have been held in four countries, South Africa, Tanzania, Ghana and Myanmar. Below are details of these workshops and future workshops currently being planned for Bhutan and Cambodia

1. South Africa, December 1995. Funded by ACIAR, held at the Poultry Reference Laboratory, University of Pretoria, Onderstepoort. Attended by veterinarians and technicians from fourteen African countries
2. Tanzania, December 1996. Funded by ACIAR, held at Animal Disease Research Institute, Department of Research Development, Ministry of Agriculture and Cooperatives, Dar es Salaam. Attended by veterinarians and technicians from six Regional Veterinary Centres, and one technician from Mozambique
3. Ghana, January 1997. Funded by World Bank and GRM International Pty Ltd. Attended by one veterinarian and two technicians from each of four veterinary laboratories
4. Myanmar, October 1998. Funded by FAO Food Security Project, held at Central Vaccine Laboratory, Livestock Breeding and Veterinary Department, Ministry of Livestock and Fisheries. Attended by fourteen departmental veterinarians and one academic from the Institute of Animal Husbandry and Veterinary Sciences
5. Bhutan, March 1999. A workshop funded by AusAid is currently being planned, to be held at the Vaccine Production Centre, Crop and Livestock Division, Ministry of Agriculture
6. Cambodia, mid 1999. A workshop funded by FAO is currently being planned.

OUTCOMES

Vietnam: The National Veterinary Company (NAVETCO) in Ho Chi Minh City, has used the I_2 master seed for production of thermostable vaccine. This vaccine is designated AVF/NDV-HR, AVF standing for Australian Vietnam Friendship. Prior to producing the vaccine on a larger scale for distribution to regional areas, scientists at NAVETCO carried out laboratory and village trials of I_2 vaccine for use under Vietnamese conditions (Tu *et al.*, 1998). The vaccine is now widely available in Vietnam for use in village chickens and is exported to Laos and Cambodia. This successful use of the I_2 master seed is described as a model for local and sustainable production of thermostable ND vaccine in a developing country.

Tanzania: Dr Ann Foster and colleagues conducted field trials in villages near Dodoma. They tested the efficacy of Websters V4 for use by rural farmers to improve the productivity of their chickens (Foster *et al.*, 1998). Field trials using Websters V4 vaccine were also carried out in the Mtwara and Lindi regions of the Southern zone of Tanzania (Salum *et al.*, 1997). The thermostable I_2 vaccine has been produced in Tanzania and successfully tested in village chickens kept under laboratory conditions (Wambura *et al.*, submitted for publication).

Ghana: The workshop held in Ghana was part of the Newcastle disease vaccine component of the National Livestock Services Project. During the workshop, participants monitored the serological response of chickens in a laboratory trial using Websters V4 vaccine. Dr Jonathan Amakye-Anim conducted this trial in collaboration with Dr Alders and Professor Spradbrow (Amakye-Anim *et al.*, 1998). Village trials in Ghana have been initiated and the I_2 master seed has been imported.

Myanmar: Dr Hla Myint, Advisor to the Livestock Breeding and Veterinary Department, Insein, Yangon, has indicated in a personal communication to Professor Spradbrow, that 300 000 doses of I_2 ND vaccine have been produced in the Central Vaccine Laboratory since the workshop was held. This vaccine is currently being tested at the Central Diagnostic Laboratory and the Assay Laboratory. Arrangements are being made for field trials in seven States and Divisions.

Mozambique: Mrs Amalia Mangonhela from INIVE (Central Veterinary Laboratory), Maputo participated in the Tanzanian workshop. She is involved in the production and testing of the I_2 vaccine in Mozambique in collaboration with Dr Robyn Alders who co-ordinates the ACIAR funded project "Investigations into the control of Newcastle disease in village chickens in Mozambique".

South Africa: Dr Dirk Verwoerd of the Onderstepoort Veterinary Institute co-ordinates a Newcastle disease virus programme. The I_2 master seed has been imported and wet I_2 vaccine prepared for use in field trials (Personal communication).

CONCLUSIONS

It is hoped that the workshops will play a key role in achieving local production and quality assurance of cheap thermostable ND vaccine. The importation of the I_2 master seed is promoted for use in central and regional laboratories to produce the thermostable vaccine. The vaccine can then be distributed as a wet or freeze dried vaccine. Sustainable production of vaccine is the goal. This can be achieved by the implementation of a cost recovery programme using affordable locally produced vaccine.

It is also hoped that having practised the technical skills, some of the participants will implement the small-scale production and testing of thermostable vaccine in their own laboratories. They are encouraged to describe their progress in publications devoted to family poultry such as the International Network for Family Poultry Development Newsletter. ACIAR and the University of Queensland recently launched a website titled "Improvements in rural poultry in developing countries" at the address http://www.vsap.uq.edu.au/RuralPoultry. It is hoped that those participants who have access to Internet will look at it, leave their names in the guest book and participate in the discussion forum. The Laboratory Manual used by participants of these workshops and sections of the Field Manual (Alders and Spradbrow, 1999) supplied to participants of the extension workshops can be viewed and downloaded from this website

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Feeding and nutrition of scavenging village chickens

S. P. Gunaratne

INTRODUCTION

Feed is the most important item in modern commercial (intensive) poultry production, in terms of its contribution to the costs of production. In many situations, feed costs account for about 60 to 90% of the production costs, depending on the availability of raw materials. These costs can be considered zero or negligible in scavenging chicken production. However, the importance of feed in scavenging chicken production cannot be underestimated due to its direct and indirect effects on many aspects of the production.

As the term "scavenging" implies, scavenging village chickens find their feed from surrounding environment. However, in some countries supplementation of these birds with kitchen refuse, household waste, agricultural by-products is not uncommon. Supplementation is sometimes essential during certain periods of the year, where the availability of feed resources is limited. It is understood that compounded commercial feed or purchased feed is generally not used in this system.

SCAVENGING FEED RESOURCE BASE

Importance of Scavenging Feed Resource Base (SFRB) for village chicken production is clearly demonstrated by Roberts and Gunaratne (1992) and Gunaratne *et al.* (1993). Total biomass of the flock is determined by SFRB. If the biomass of the flock exceeded carrying capacity of SFRB, some birds in the population, especially the weaker birds (young chicks) will die. Similarly survival will be more when SFRB is more than the requirement of the flocks. A natural balance is seen between SFRB and biomass of the flock in a given environment unless some intervention is made. SFRB is comprised of household waste, crop by-products, cleaning of gardens, fields and wastelands. In some environments SFRB is relatively constant through out the year and in some others SFRB will fluctuate with factors such as seasonal rainfall, agricultural activities, etc. It should also be noted that in some environments rapid urbanization, development projects and environmental changes are causing restrictions on availability and access to the SFRB. Land area available for scavenging and a distance a flock can travel to scavenge will depend on many factors such as flock size, feed availability, population density, agricultural activities, predators, etc. In addition, behavioral studies have shown that some birds (e.g. unselected) have better scavenging ability compared to others (e.g. crossbred). When crossbred birds were released to scavenging environment, they tend to restrict their scavenging area close to the household.

If the capacity of the SFRB and the seasonal variations are known, more efficient strategies for production by flocks of scavenging village chickens can be developed. Roberts and Gunaratne (1992) described two methods for estimating the capacity of the SFRB for chicken in villages and discussed application to utilize the information obtained. In one method, the following formula was proposed for the calculation of SFRB. For this calculation, measurement and identification of different components in household waste and crop content are required.

$$SFRB = \frac{H}{P} \times \frac{N}{N - X} \quad \text{where;}$$

H = amount of household waste/family/day (kg dry weight),
P = proportion of the crop content which is household waste as determined by visual inspection,
N = number of families in the community.
X = number of families in the community which do not keep chickens.

In the study of Gunaratne *et al.* (1993) the figures are:
0.200/ 0.720 x 1/0.5 x 365 = 203 kg dry weight/family/year.

The amount of protein in the SFRB can be determined from an analysis of crop content, and the ME can be determined by analysis of the crop content or by reasonable estimation. On this basis of 11.2% protein and 3,000 Kcal/kg, the SFRB has 23 kg protein and 609 Mcal metabolizable energy per year.

Alternatively, the SFRB can be calculated if the weight profile and constitution of the average flock is known, together with the growth rate and hen day production %. To the extent that there is available feed, the amount of feed consumed by the birds is determined by their energy requirement. The protein consumption and availability for maintenance, growth and egg laying, is determined by the percentage protein in the diet. The daily consumption of the flock is the SFRB, so it can be calculated using the formula,

SFRB = $\sum Ej / Es$ where;

j = the average number of birds in the family flock,
Ej = the ME requirement for the daily maintenance and production of each bird per day (kcal/kg dry weight),
Es = the ME in the scavenging feed (kcal/kg dry weight),
'j' can be determined from a census of the family flocks.
'Es' can be measured or reasonable estimated from the crop content.
'Ej' can be calculated for each bird from the production data of growth rate and egg production, using a formula such as that of the National Research Council (1984), below,

ME/bird daily = $W^{0.75}$ (173-1.95T) + 5.5 ΔW + 2.07 EE

Where;

W = body weight (kg),

T= ambient temperature (°C),

ΔW = change in body weight (g/day),

EE= daily egg mass (g).

An ambient temperature of 26 °C is assumed throughout.

The values for the SFRB calculated from published data from developing countries are;

475 kg/year in Indonesia (Kingston and Creswell, 1982),

390 kg/year in Thailand (Janviriyasopak *et al.*, 1988),

195 kg/year in Sri Lanka (Gunaratne *et al.*, 1993), which can be compared with the measured value of 203 kg, above.

High mortalities are recorded in young chickens in villages, but if measures such as creep feeding or feed supplementation are undertaken to increase the survival of the chicks, then the mortality will only be transferred to an another age group, unless the number of eggs incubated is planned to match the capacity of the SFRB. If such plans are made, then the extra eggs which are surplus to requirements for incubation, are available for sale or for consumption.

If the capacity of the SFRB varies seasonally then periods when it is high can be selected for activities such as hatching and rearing, and culling for consumption and sale can be undertaken in anticipation of a reduction in the capacity of the SFRB. On the other hand if it is desirable to maintain the population trough a lean period, then the appropriate feed supplement can be provided.

Alternative production systems can be compared e.g. Comparisons between egg and meat production, in order to optimize the nutritional return, and /or the cash return, from a SFRB of known capacity.

NUTRITIONAL VALUE OF SFRB

Nutritional value of SFRB may vary with the environment. In the study of Gunaratne *et al.* (1993), analysis of crop content similar to that quoted by Prawirokusumo (1988), but the higher ether extract and lower crude fibre of 5.4% allows more scope in choice of supplements. The proximate analysis of feed and crop content and the presence of substantial abdominal fat in all hens indicated that the availability of protein was a constraint on production in that environment. Protein rich materials such as earthworms, snails and insects were of minor proportion in the field diet, but young grass shoots, the larger constituent, could have helped to redress the protein imbalance. The levels of calcium (Ca) and phosphorus (P) in the diets were very low, as were their levels in the plasma of scavenging chickens. The plasma levels of both Ca and P increased when village chickens were maintained under intensive system on a balance diet, but the Ca levels still did not reach that of commercial chickens under the same conditions (Table 1).

TABLE 1: PLASMA CA AND P LEVELS IN GROUPS OF 15 VILLAGE AND COMMERCIAL CHICKENS

Chickens	Husbandry	Ca (mg/dl)	P (mg/dl)
Village	Scavenging	10.41± 2.46 (P≤ 0.001)	2.47± 0.41 (P≤ 0.001)
Village	Intensive	15.63± 4.58 (P≤ 0.02)	3.94± 0.78 (P≥0.05)
Commercial	Intensive	19.61± 3.02	3.59± 0.77

If the low levels were constraints on production, then Ca and P could be easily and cheaply provided in the form of shell grit and bone meal. Additional supplementation with a balanced ration would increase production further, but would be less efficient than if applied to commercial layers (Creswell and Gunawan, 1982),which can be successful in the scavenging system (Huchzermeyer, 1973). In view of the high energy requirement of scavenging activities, the final step to optimize the utilization of the SFRB could be to have a small number of hybrid layers in a pen, fed with a household waste supplemented appropriately and immunized as necessary. Such a system is unlikely to be culturally acceptable, and in any case it deprives the household of the benefit of the waste from those households which do not keep chickens.

SUPPLEMENTATION OF SFRB ON THE GROWTH AND PRODUCTION PERFORMANCE OF VILLAGE CHICKENS

Survival, growth and production in village chickens under four feeding conditions as listed below were studied in Sri Lanka.

1. Control - Normal scavenging system
2. Creep feeder - Household refuse disposed to creep feeder
3. Low supplementation - As 2 above + 35 g of supplement per flock/day
4. High supplementation - As 2 above + 25 g of supplement/bird unit (adult bird equivalent)/day.

(composition of the supplement: equal weight of fishmeal and expeller coconut meal with 2% DCP, in addition shell grit ad libitum to supply calcium)

Survival

The survival of the chicks and growers shown significant improvement by introducing the creep feeder (P≤0.05) compared to control. Addition of supplementary feed to the household refuse had further increased the chick survival. High levels of supplementation had positive impact on chick survival compared to the low level of supplementation, although the difference was not significant (P≥0.05). There was a high correlation between supplementation and chick survival. The high rate of chick survival may be due to the preferential access to household waste for young birds and reduction in predator attacks as chicks remained near creep feeder.

Growth rate

Provision of household waste in creep feeder showed negative impact on growth rate of chicks up to eight week in this study, suggesting qualitative and quantitative deficiencies in household refuse. When household refuse was supplemented at low level, growth rate significantly improved with creep feeder. Further supplementation at higher level had not shown any positive improvement.

Egg production

There was no improvement in egg production in this study with any supplementation. The point-of-lay was also not affected by the treatments. This suggests that feed resource base is not limiting egg production in the study environment. Genetic improvement may be the option available under these circumstances to improve the production. The situation may be different in some other environments as Hugue and Ukil (1993) reported increased in egg production with supplementation.

Although results of this study is location specific, some general conclusions could be drawn to suit any scavenging situation. There is positive response to supplementation as seen in improvement of survival and growth rates. However, quality and quantity of SFRB determines the degree of response. Any intervention in the form of feeding needs therefore careful consideration of SFRB. The fact that the egg production is not responding to supplementation indicates that SFRB is not a limiting factor in this environment, and production improvement needs consideration of other management aspects. Genetic improvement may be one possible option.

FEEDING VILLAGE CHICKENS UNDER INTENSIVE MANAGEMENT SYSTEM

The studies carried out in Sri Lanka to compare the performances of village chickens, their crosses (village x commercial hybrid) and hybrid layers under deep litter intensive system using commercial compounded feed and choice feeding system (Choice feeding; energy supplement, protein supplement and shell grit after point-of-lay, supplied in separate feeders). Energy supplement in this study was the crushed maize, and protein supplement was a mixture of soya bean meal + coconut meal + vitamins / mineral premixes in different proportion to suit various age groups). Performances of village chickens under choice feeding and commercial feed are given in Table 2, together with those of scavenging system for comparison.

TABLE 2: PERFORMANCE OF VILLAGE CHICKEN UNDER INTENSIVE DEEP LITTER SYSTEM WITH CHOICE FEEDING AND COMMERCIAL FEEDS

Parameter	Choice feeding	Commercial feed	Scavenging
Growth rate, g/day	14.0± 1.7	12.9± 5.2	9.14±2.63
Point-of-lay, days	143± 10	133±	197±19.0
Weight at point-of-lay, g	1,510± 64.6	1,600±	1,227±170.0
Mortality, %	8.0	7.7	40.0
Egg production, % (20 weeks)	27.0	33.0	23.0
Egg production, g/bird/day (40 weeks)	13.0± 0.09	15.0±0.1	11.3±0.06
Egg weight, g	48.2± 0.03	46.05±0.04	48.0±0.03

There was an improvement in growth rate and egg production when village chickens reared under intensive feeding system. However, this improvement needs to be matched against the additional inputs supplied under intensive system. Mortality was significantly reduced as there was no predation, which was the main cause for high chick mortality under scavenging situation.

Improvement in growth rate and egg production in village chickens under intensive feeding can be considered marginal when compared to massive increase in egg production when village chickens were crossed with hybrid layers (Table 3).

TABLE 3: PERFORMANCES OF VILLAGE CHICKENS, VILLAGE X HYBRID CROSSES AND HYBRID LAYERS IN DEEP LITTER INTENSIVE SYSTEM UNDER CHOICE FEEDING CONDITIONS

	Chickens		
Parameter	Village	Cross	Hybrid
Growth rate, g/day	14.0*± 1.7	15.3*±	15.0± 0.5
Age at point-of-lay, days	143*± 10	138±	130*± 0.4
Weight at point-of-lay, g	1,510± 64.6	1,496±	1,529± 72.6
Egg production, % (20 weeks)	27.1	53.0	76.0

* $P \leq 0.05$

These results clearly confirm the results of supplementation studies and studies of village chickens under intensive feeding, where marginal response was seen with regard to egg production, suggesting that village chickens under scavenging system performed closer to optimum in this environment. Cross breeding of village chickens with hybrid layers is a one option to improve production, but its application under field conditions needs further studies.

CONCLUSIONS

1. Scavenging is one of the most economical and sustainable feeding system to utilize feed resources in the villages for production of high quality animal proteins, i.e. meat and eggs.
2. Measurement of SFRB is important to plan the production cycle and to optimize the utilization of SFRB for better returns.
3. Any attempt to intervene the existing scavenging system by way of supplementation needs careful consideration of quality and quantity of SFRB. Suitable supplements for a given environment will depend on nutritional value of SFRB and availability of low-cost feed materials. Investigations to find out cheap nutritional supplements is desirable.

Feeding village chickens under intensive system can be recommended if village chicken products are paid premium price to justify low nutritional utilization of these birds.

Cross breeding has improved the production performances of village chickens under intensive system, but whether these crosses survive and produce under scavenging system warrant further studies.

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COMMENTS ON FEEDING AND NUTRITION OF SCAVENGING VILLAGE CHICKENS

Dr. M. D. Sanchez

This is a comment on Dr. Gunaratne's paper.

The proposal for defining and determining the Scavenging Feed Resource Base (SFRB), made several years ago, was a great contribution to the better understanding of feeding aspects in family poultry. I have personally adopted the term when referring to feed resources in these systems. A good proportion of the SFRB are constituted by unconventional feeds (i.e. worms, insects, etc.) that can be consumed only by poultry and also by wild birds.

Unfortunately, the review of the literature shows that up to now no other researchers, apart from the original authors, have taken up this term or used the methodology. Whether this is due to the simplicity or the complexity of the proposed approach is unknown.

We need to add that there are several ways of substantially increasing the SFRB, which in many situations might be the only effective way to increase poultry performance and outputs. I have seen family poultry production in areas with plenty of land, where the SFRB is not the limiting factor and the losses are mainly due to diseases, poor management and inadequate night shelters. However, there are many instances where rearing worms and termites, or attracting insects, etc. could significantly increase the survival rate of chicks. This, in turn, could greatly contribute to spare eggs for home consumption, trade or gift.

Once feed resources are increased, the question remains to which birds preference should be given if one has some control over them. The theoretical analysis of the system has led me to conclude that the chicks should be the priority followed by laying hens. Thus, it is important to adopt functional creep feeding devices.

In the light of above considerations, one question which I would like to pose to the participants of this conference is the following: Is there any evidence that chick's scavenging behaviour gets permanently affected if they are prevented from learning directly from the mother hen when they are reared in isolation during the first weeks after hatching? If this learning experience is critical, should the chick rearing enclosures be large enough to facilitate some scavenging activities? The fact that some crossbred individuals, reared without their mother, seem to have lost partially the ability of finding their own feed, suggests that lack of maternal teaching might be responsible.

If the SFRB cannot be increased and is definitely the limiting factor for production, meaning that all feed resources are consumed by the flock, then the only option to increase outputs is to identify and eliminate unproductive animals. This implies culling supported by some sort of record keeping. How can this be done in practice? Are there any examples of farmers practising this selection?

The use of thermostable Newcastle disease vaccines in Mozambique

R. G. Alders and R. Fringe

INTRODUCTION

As has been recognized by others, the control of Newcastle Disease (ND) is the starting point for improving village chicken production and hence improving household food security. With this in mind, the National Veterinary Research Institute and the Australian Centre for International Agricultural Research (ACIAR) designed a project looking at the control of ND in village chickens in Mozambique. From the outset it was recognized that the confirmation of the efficacy of live, thermostable vaccines against ND was only part of the picture. The aim was also to have efficient communication systems in place that gave farmers the best chance of success when using the ND vaccine and to ensure that sustainable cost-recovery mechanisms were developed.

MATERIALS AND METHODS

In order to control ND in village chickens in Mozambique, two field trials with live, thermostable vaccines were carried out.

Field trial 1

The field trial using the NDV4-HR live, thermostable vaccine was conducted over 12 months. Four different groups were monitored: eyedrop (single administration); drinking water (single administration); oral drench (single administration); and control (mock vaccination). Groups were allocated by a lottery conducted at a community meeting. The vaccine was diluted using clean, local water to eliminate the costs associated with the use of commercial diluent. For the drinking water group, farmers were asked to bring a clean glass or plastic container to a central location to collect the pre-prepared vaccine. It was recommended that the vaccine be placed in a non-metallic recipient in the shade. The administration of the eyedrop and oral drench was done by local extension workers or farmers. The trial commenced with the vaccination of a total of 2,057 birds and re-vaccination was done at 4-monthly intervals.

Field trial 2

The NDV4-HR vaccine is a commercial vaccine only available for purchase from Malaysia or Australia. Foreign exchange is in short supply in Mozambique and so it was thought wise to trial the local production of the I_2 ND vaccine that has been made available to developing countries free of charge by ACIAR. The field trial with the I_2 ND vaccine commenced with 670 birds and lasted for 5 months. The four groups were: eyedrop (given twice, three weeks apart); eyedrop (single administration); drinking water (given twice, three weeks apart); a control (mock vaccination).

RESULTS AND DISCUSSION

Field trial 1

Changes observed in chicken population after vaccination are shown in Table 1.

TABLE 1: CHANGE IN CHICKEN POPULATION 12 MONTHS AFTER ADMINISTERING THE NDV4-HR LIVE, THERMOSTABLE VACCINE

Route of administration	Change in chicken population (%)
Eyedrop (x1)	+144%
Drinking water (x1)	-22%
Oral drench (x1)	+25%
Control	-46%

The farmers preferred the eyedrop route even though it meant catching their birds (around 50% of which roost in trees). They said with eyedrop administration, they knew that the birds were vaccinated and also appreciated the greatly reduced mortality.

Field trial 2

The Table 2 gives overall changes in chicken population after vaccination.

TABLE 2: OVERALL CHANGE IN CHICKEN POPULATION 5 MONTHS AFTER ADMINISTERING THE I_2 ND VACCINE

Route of administration	Change in chicken population (%)
Eyedrop (x2)	+54%
Eyedrop (x1)	+50%
Drinking water (x2)	+17%
Control	-71%

Once again, the preference of farmers was for single eyedrop administration. The fact that the vaccine could be given less frequently via eyedrop was a strong point in its favour. The best participation on vaccination days was always achieved during school holidays when children were available to chase and carry chickens.

Components of a successful field ND vaccination campaign (Field trial 1 & Field trial 2)

1. An appropriate vaccine - the NDV4-HR and I_2 ND vaccines would appear to be the best options currently available. They are thermostable, easy to administer, cheap and safe to both chicken and handler.
2. An appropriate support structure which includes appropriate communication systems - the vaccines must be easily available to farmers and adequate training must be given to ensure that the farmers have a good chance of success.

3. A robust cost-recovery system - everyone handling the vaccine must feel that they are getting value for money. When the supporting project structure goes, the distribution of the vaccine will only continue if it is paying its way.

DEVELOPMENT OF EXTENSION MATERIAL FOR THE CONTROL OF ND IN VILLAGE CHICKENS

Many of village poultry farmers do not own ruminants and, consequently, will have had little or no contact with veterinary services. In addition, village poultry are frequently cared for by women, many of whom are illiterate. Special attention is required in the preparation of extension material for this target group. In Mozambique at least, many farmers are not aware that a vaccine against ND exists and can be skeptical: "how can there be a vaccine for chickens when my children don't even get vaccinated?" In response, we have enjoyed working with farmers and artists to prepare the following extension material:

1. Radio programs - a radio drama; a question and answer program; in Portuguese and four local languages;
2. A ND vaccination song - prepared by the Mozambican Musicians Association with versions in Portuguese and three local languages after visiting one of the vaccine field trial sites;
3. A pamphlet and poster in Portuguese;
4. A drama piece - written by a local theatre group with experience in community development after visiting one of the vaccine field trial sites;
5. A ND field manual - written in Portuguese; and
6. A flip chart for use by front line staff - it uses clear, largely self-explanatory line drawings with an accompanying narrative in Portuguese. Local frontline staff translate the Portuguese into the appropriate local language.

It has taken us three years to get this far but in this field we believe that "slow and steady wins the race". I would like to hear what other people's experiences have been in the area of extension material for village poultry farmers.

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Rice-duck farming in Asia: Increasing its production potentials by integration with fish and the nitrogen-fixing aquatic fern Azolla

A.G. Cagauan, R.D.S. Branckaert and C. Van Hove

ABSTRACT

Several countries in Asia practice integrated rice-duck farming. The benefits and limitations of this system are discussed. It is noteworthy that on-farm resources such as duck manure and feed waste are not adequately used and recycled in the system. There is a great potential for increasing the productivity of the integrated system which offers research opportunities. The integration of fish and the nitrogen-fixing aquatic fern Azolla are promising approaches for increasing the production potential of the rice-duck system. Fish, Azolla and ducks integrated with rice can result in nutrient enhancement, pests (weeds, insects and golden apple snails) control, feed supplementation and biological control. Some of the results of a case study on integrated rice-fish-Azolla-duck farming system conducted in the Philippines are presented.

HISTORY AND PRACTICE OF RICE-DUCK FARMING IN ASIA

In the Asian region, the majority of duck production is closely associated with wet-land rice farming, particularly in the humid tropics and sub-tropics (Farrell, 1997). The traditional practice of duck raising in ricefields in the Philippines, Thailand, Vietnam and Indonesia involves herding the birds in paddy fields after the rice harvest. In the Philippines, duck herders transfer their flocks from one farm to another depending on food availability. Herders house their flocks in sheds usually along irrigation canals where water is available for the duck. Duck pasture in ricefields after rice harvest helps economize on the high cost of feed. In the Southeastern part of the Philippines, particularly Bukidnon, Agusan and Capiz, ducks are introduced in lowland ricefields during the maximum tillering to get rid of some weeds and insects (Quisumbing, 1983) and there has been no reported damage to rice. In the central province of Thailand, enterprising duck raisers contract the care for fattening ducks to rice farmer in the area (Chandrapanya and Pantastico, 1983). After a month or so, the duck raiser comes back and pays the farmers for his services. In Taiwan, Republic of China, ducks are released in ricefields mainly to control large mud snails and weed (AICAF, 1988). Since the dramatic introduction in Southeast Asia of the herbivorous snail Pomacea canaliculata Lamarck during the early eighties, ducks can be assigned a new function in the ricefields, the control of this exotic pest.

In Japan, rice-duck farming practice was promoted 400 years ago by allowing wild ducks into ricefields (Manda, 1992). In the late 1980s, the practice was revived to fit modern agriculture by Takao Furuno, a farmer in Fukuoka prefecture, Kyushu, Japan, who has practiced organic farming for the last 12 years (Furuno, 1996). Furuno integrates rice farming with aigamo duck, a crossbred between wild and domestic duck. About seven-day old aigamo duck at 400 ducklings per ha are released in ricefields within 10 days after rice transplanting for two months. Simultaneous raising of ducks with rice helps control weeds and insects that leads to the non-application of pesticides (Furuno, 1996; Manda, 1992). Ricefields are fenced with low-voltage electric wire to keep the ducks from escaping and to protect them from intruding outside animals. Ducks are housed near the ricefield where they can freely forage. Presently, organic farming such as rice-duck system is being advocated in Kyushu, Japan.

In South Korea, organic farming such as rice-duck raising is being promoted by the Korean Rice Farming Association (Kim Bok Kwan, personal communication). Rice grown organically without pesticides commands a higher market price per kg, about 40-60%, compared to rice grown with chemicals. According to Kim (1997), the number of rice-duck farmers and areas being farmed in South Korea showed an increasing trend from 1993 to 1997. South Korea's rice-duck cultivation is basically patterned from the Japanese practice. Farmers raise a hybrid meat type duck at a density of 200-350 birds/ha released in the ricefields two weeks after rice transplanting. Azolla growing naturally in ricefields serves as food for the ducks. Apart from the on-farm feed resources consumed by ducks, supplements in the form of commercial feed, rice bran and vegetable scraps, and kitchen scraps are fed to the ducks in sheds built near the ricefields. There is a great demand for ducks in November when the weather becomes cold.

In Vietnam, there are about 10 million ducks raised annually in two ways: seasonally in ricefields and throughout the year in backyards of farm households (Men, 1997). Ducks are integrated with the growing rice and after rice harvest. Ducklings (7-day old) are driven into the ricefields at 20 days after rice transplanting until the start of flowering. Supplementary feeds consisting of rice by-products or rice grain are supplied to the ducks 3-4 times a day, depending on the availability of food in the ricefields. At the start of rice flowering, the ducks are driven out of the ricefields to canals, ditches, lakes, swamps to forage in water. Duck raising after rice harvest is for larger birds i.e. about 3-week old. During the day, the ducks are herded in the paddy fields where they forage on left-over rice grains, insects, fish, shrimps, snails and water plants. They are then driven to pens or sheds near the households for the birds to stay at night. For meat-type duck, the fallow period (time between rice harvest and next transplanting) involves limited time for the birds to forage.

Indonesia is considered as one of the countries in the world having the largest duck population with more than 30 million ducks; their contribution to the total poultry egg production is about 25% as compared to that of native chickens (15%) and improved breeds of chicken (60%) (Setioko, 1997). The traditional system of raising ducks which is most widely employed is the herding system similar to that of the Philippines.

The use of agro-chemicals in modern rice farming represents an important threat to traditional rice-duck farming (Manda, 1996; Farrell, 1997). Manda (1996) observed that there is a rapid decline in traditional rice-duck farming in Southeast and East Asia due to the introduction of western style agriculture that implies the use of chemicals and pesticides leading to environmental pollution and health hazards.

TYPES OF DUCK RAISED

Ducks can be raised for meat and egg production. Most common meat-type duck breeds are Beijing (or Peking), Rouen and Muscovy. Muscovy (Carina moschata) is more often considered as a different species. Crossbreds like aigamo, hybrids such as mule duck (Muscovy male x Mallard female) and commercial strains e.g. Cherry Valley or Grimaud are commonly used. Egg-type ducks are Mallard, Khaki Campbell, Indian Runner and commercial Hybrid strains. Meat-type ducks are popular in China, Japan, South Korea, Vietnam and Thailand. In Bangladesh and Indonesia, egg production from egg-type breeds are prevalent. The meat and egg-type ducks are raised in the Philippines but the latter is more popular. Mallard duck locally known as 'Pateros itik' (Anas platyrynchos) is commonly used by duck farmers in the Philippines. The eggs from this duck are processed to "balut" and salted eggs. "Balut" is an incubated egg with developed embryo of 17 to 19 days which is boiled and eaten with or without salt. It is a Filipino delicacy that commands a good price. Fresh duck eggs are also used to prepare a dessert called "leche flan" (egg custard).

In the Philippines, ducks rank next to chickens for egg and meat production (PCARRD, 1991). There were more than 10 million ducks in the country in 1991 (Anonymous, 1991). Some of the advantages of duck raising are as follows: they require inexpensive, non-elaborate housing facilities, little attention and less space for rearing compared to chickens. These animals are hardy and resistant to common avian diseases and feed on a variety of foods. Duck eggs are larger and more nutritious than chicken eggs as shown in Table 1.

TABLE 1: COMPARISON OF CHEMICAL COMPOSITION OF CHICKEN AND DUCK EGGS

	Chicken egg	Duck egg
Dry matter, %	26.4	30.3
Protein, %	12.9	13.5
Fat, %	10.9	14.5
Ash, %	0.9	1.0
Mean weight, g	57.0	85.0

Source: Bird, 1986

BENEFITS FROM DUCK RAISING WITH RICE

In aigamo duck-rice cultivation in Japan, total weed biomass was controlled better in aigamo plots compared to plots applied with agrochemical (Furuno, 1996; Manda, 1992). From on-station research in the Philippines, it was observed by Cagauan (1997) that the total weed biomass in the ricefield was reduced by mallard ducks by rates ranging from 52-58%. The mechanism of weed control by ducks is direct consumption of plant parts and seeds and disturbance of weed growth brought about by their feeding activity.

In Japan, the numbers of planthoppers in rice plots with aigamo ducks were observed to decrease during the early stage of rice (Manda, 1992; Furuno, 1996). In the Philippines, ducks have been reported as effective biological control for the herbivorous golden apple snail (GAS) (Rice IPM Network, 1991). Rosales and Sagun (1997) reported a decrease in the GAS abundance from 4.6 snails/m2 in the first year of cropping to 0.8-1.6 snails/m2 in the second year as a result of the continuous duck pastures in the ricefields after every rice harvest. Using 900 ducks per ha, Vega (1991) reported a 74-84% decrease of GAS abundance in ricefields, hence, less rice missing hills, due to duck pasture. However, the economic suitability of the use of such high duck density should be worth investigating.

Ducks' movements and feeding activity in the ricefields disturb the soil resulting in improvement of soil physical property, hence, better rice root systems and enhanced tillering as observed in the farm of Furuno (1996). Duck manure contributes to the fertility of the soil.

Reported improved rice grain yield from duck raising in ricefields can be attributed to the benefits previously discussed. Higher grain yield and reduced labor costs due to weeding, spraying and fertilizing contribute to better economic benefits derived from rice-duck farming. In South Korea, the increase in income derived from rice-duck farming ranged from 73-77% compared to conventional rice farming (Kim, 1997).

Duck raising in ricefields leads to organic farming with the benefits of reducing costs of fertilizers, pesticide and labour. 'Organic rice' has a higher price than ordinary rice in some Asian countries like Japan and South Korea.

LIMITATIONS AND DISADVANTAGES

Duck raising in integration with rice is limited to transplanted rice. Ducks have indeed more space to move around in transplanted ricefields than in direct seeded rice. Ducks can be affected by pesticides applied from neighbouring farms, particularly when water comes from communal irrigation canals. Ducks can either be stolen or killed by outside animals if ricefields are not fenced. Fencing adds to the high initial capital investment. Vietnamese farmers observed that ducks do not only eat harmful insects but also friendly ones.

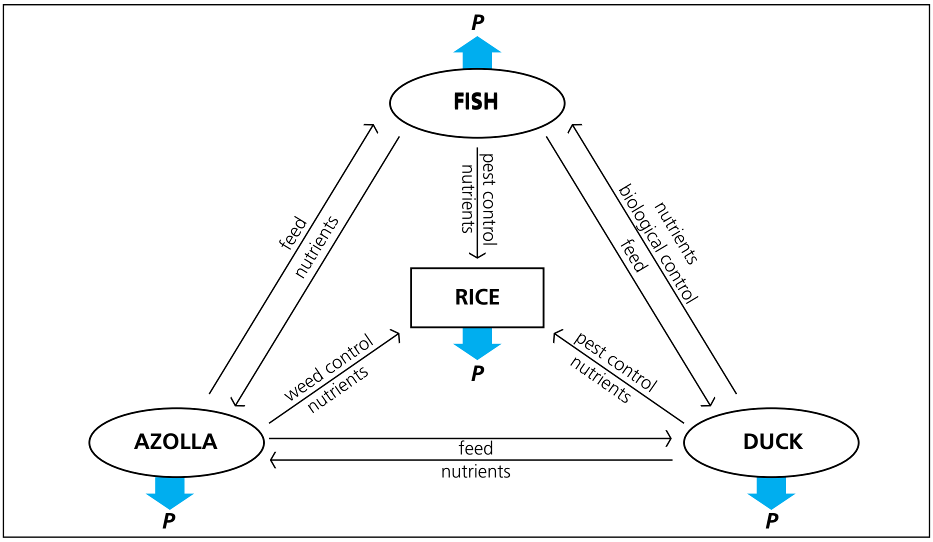
In the Philippines, China and Vietnam, duck pasture has been implicated in paddy field dermatitis. In the Philippines, rice transplanters hesitate to enter ricefields pastured with ducks for fear of skin itchiness. In some areas of Guangxi in China, field investigations and experimental observations between 1984 and 1990 indicated that the cercaria of Trichobilharzia paoi was the only aetiological agent of paddy field dermatitis found (Hu *et al.*, 1994). The authors reported that the natural final host of adult flukes is the domestic duck (Anas platyrynchos) while the intermediate hosts are the snails Radix (Lymnaea) swimhoei and Galba pervia. They further reported that the dermatitis is usually associated with such factors as duck rearing methods, seasonality, kind of paddy field and chemical fertilizer applied. The prevalence of dermatitis is during April to September, and the highest incidence occurs from April to May. Farmers in the Philippines protect their feet with automotive oil or grease while Vietnamese farmers cover their feet with plastic whenever they get into the ricefield pastured with ducks.

The practice of duck raising with rice, common to all the Asian countries, involves housing the birds in sheds near the ricefields. In this practice, there is an accumulation of duck manure and uneaten feed resulting in the fouling of the sheds. This develops an unpleasant odour and attracts flies and eventually becomes unhygienic for raising ducks. Disposal of accumulated organic matter in the ducks' sheds could be an additional labor cost. In the present practice of rice-duck raising, duck manure and spilled feed in ducks' sheds appear as wasted on-farm resources as they are not recycled.

INCREASING THE PRODUCTION POTENTIALS OF RICE-DUCK FARMING

The production from the present practice of rice-duck farming in Asia has great potential to be maximized. Rice-duck farming can be integrated with fish and the nitrogen-fixing aquatic fern Azolla. Fish is a cheap source of protein that can be grown in ricefields while the aquatic fern Azolla naturally grows in the same place. Fish, Azolla and ducks integrated with a rice farming system could result in nutrient enhancement, pests (weed, insects, golden apple snails) control, feed supplementation and biological control (Figure 1). Nutrient recycling in an integrated rice-fish-Azolla-duck farming system is better and more efficient compared to rice-duck or rice-fish farming systems (Cagauan *et al.*, 1996) resulting in higher productivity.

FIGURE 1
Schematic presentation of the roles of fish, *Azolla* and duck in integrated rice-fish-*Azolla*-duck farming system. (*P* refers to *production*)



Source: modified from Cagauan, et al., 1996

In rice-fish-Azolla-duck integration, duck houses must be constructed over the fish pond refuge which is a contiguous part of the ricefield. The floor of the duck house should have some spaces to allow the manure and spilled feed to fall directly to the fish pond. The duck manure serves as an organic fertilizer for plankton production while the spilled feed can be directly consumed by the fish. Any nutrients from the fish pond refuge may be dispersed to the ricefields by irrigation water or by the movement of fish and ducks.

The ducks can be pastured in the paddy fields after rice harvest. They should be confined in their house during land preparation until the fish is at least 2-3 weeks from stocking. In this way, any toxicity of pesticides applied at rice transplanting would have dissipated and the size of fish would be large enough to prevent predation by ducks. Ducks can either be confined or allowed to move around the ricefields until rice harvest. The animals are confined at the on-set of rice flowering to prevent any damage the ducks activity can cause the rice. The damage to rice may depend on the size and density of the ducks introduced initially and the rice variety used. During confinement, ducks should be fed with supplemental feed. In cases, when the ricefield becomes insufficient with natural food due to continuous duck foraging, supplementary feeds can also be given.

Integrated rice-fish culture has a long history in the rice growing areas of Southeast Asia. Fishes that are trapped in ricefields grow simultaneously with rice until harvesting. This traditional practice of captural rice-fish culture has evolved into an aquaculture farming system. Fish production in such a system can be augmented by naturally growing in situ Azolla feed and spilled duck feeds which fall directly to the pond. Moreover, the duck manure serves as an organic fertilizer for plankton production for the fish. For precocious spawners such as Nile tilapia (Oreochromis niloticus L.), the overpopulation results in small size fish at harvest. Ducks may serve as a biological control for tilapia reproduction if the birds are allowed to forage in the ricefield throughout the culture period.

Azolla can be utilized not only as organic fertilizer for crops but also as feed for livestock and fish (Van Hove, 1989; Van Hove and Lejeune, 1996). The utilization of this aquatic plant in aquaculture was reviewed by Cagauan and Pullin (1994). Azolla can be an inexpensive feed for tilapia grown in ricefields. Increased fish production has been demonstrated in integrated rice-fish-Azolla production systems where Azolla served as an in situ fresh feed for the macrophytophagous fish (Anonymous, 1988; Liu and Liu, 1995; Cagauan, 1995). Azolla as fresh feed in combination with a good level of natural feeding could be beneficial to fish production (Cagauan and Pullin, 1994).

Azolla was reported to be a partial replacement for rice grain-snail-shrimp basal ration for mallard duck (Alejar and Aragones, 1989). The authors added that the egg production of mallard duck fed with 20% Azolla in the ration was similar to those fed with commercial feed and the rice grain-snail-shrimp feed. Reports on the effect of Azolla on egg shell thickness of mallard duck eggs (Alejar and Aragones, 1989; Joome, 1996) are controversial. Egg shell thickness is a very important factor in the handling and processing of "balut" and salted eggs. Egg yolk coloration in mallard duck eggs (Alejar and Aragones, 1989; Joome, 1996) and chicken eggs (Anonymous, 1985) has been observed to be intensified with Azolla in the diet. The carotene content of Azolla as observed by Becerra (1994) was 366 mg/kg on a dry matter basis.

Azolla, as any other production, is submitted to various constraints depending on local ecological and socio-economic factors. Often emphasized, these constraints have been critically reviewed by Van Hove and Lejeune (1996).

CASE STUDY OF INTEGRATED RICE-FISH-AZOLLA-DUCK FARMING SYSTEM IN THE PHILIPPINES

A research project on integrated rice-fish-Azolla-duck farming system was conducted on-station in 1995-1996 at the Freshwater Aquaculture Center, Central Luzon State University, Philippines, supported by the Food and Agriculture Organization, the Catholic University of Louvain, Belgium, and the Philippine institution (Cagauan, 1997). The research investigated the production, economics and pests control (weed and golden apple snails) aspects of the integrated system. High yielding rice variety (IR 64), genetically improved Nile tilapia (GIFT strain, GIFT = acronym for "Genetically Improved Farmed Tilapia". See Eknath, A. E. 1992. Final Report: Genetic Improvement of Farmed Tilapias. International Center for Living Aquatic Resources Management, Philippines.) (Oreochromis niloticus L.) and the aquatic fern Azolla (Azolla microphylla) were cultured in lowland irrigated ricefields. Azolla was cultivated as monocrop and incorporated as basal organic fertilizer before rice transplanting. Azolla provided half of the nitrogen fertilizer requirement of the rice while the other half came from chemical fertilizer. Azolla mat developed to serve as weed suppressant and in situ feed for Nile tilapia and ducks. Nine-month old mallard duck (Anas platyrynchos) at density of 400 birds/ha (367 ready-to-lay ducks and 33 drakes) were integrated in the farming system. The birds were pastured during the fallow period after rice transplanting. A duck house made of cheap local materials was built over the fish pond refuge where ducks were confined when they were not foraging. Some of the results of the research are discussed.

Mean productions in t/ha/year of rice, Nile tilapia and mallard duck from the different production systems are summarized in Table 2. Treatment effects were highly significant for rice and fish yields but not for the total mallard duck eggs production.

TABLE 2: MEAN YIELDS OF RICE GRAIN, NILE TILAPIA (OREOCHROMIS NILOTICUS) AND MALLARD DUCK (ANAS PLATYRYNCHOS) EGGS IN DIFFERENT RICE-BASED CROPPING SYSTEMS.

	Cropping systems	Rice yield (t/ha/year)	Nile tilapia yield (t/ha/year)	Eggs production (eggs/ha/year)
1	*Rice+HM*-fallow-*Rice+HM*	5.49 e	-	-
2	*RF+HM*-fallow-*RF+HM*	6.05 de	0.39 d	-
3	*Rice*-fallow-*Rice*	5.32 e	-	-
4	*RF*-fallow-*RF*	4.32 f	0.29 d	-
5	*RA*-(fallow-*Azolla*)-*RA*	6.36 cd	-	-
6	*RD*-duck-*RD*	5.82 de	-	84,774 a
7	*RFA*-(fallow-*Azolla*)-*RFA*	7.38 b	0.55 c	-
8	*RFD*-duck-*RFD*	6.85 bc	1.26 b	89,165 a
9	*RAD*-(duck-*Azolla*)-*RAD*	8.82 a	-	87,900 a
10	*RFAD*-(duck-*Azolla*)-*RFAD*	8.69 a	1.39 a	81,607 a

* Legend: *R+HM* = rice monoculture with herbicide (*H*) and molluscicide (*M*);
RF+HM = rice-fish culture with *HM*; *R* = rice monoculture; *RF* = rice-fish;
RA = rice-*Azolla*; *RD* = rice-duck; *RFA* = rice-fish-*Azolla*; *RFD* = rice-fish-duck;
RAD = rice-*Azolla*-duck; *RFAD* = rice-fish-*Azolla*-duck.

Notes:
1. Means having common letters are not significantly different at the 5% level of significance.
2. Values are average of three replicates.
3. Yield per year consisted of two croppings (dry season and wet season 1996)
4. Egg laying period = 359 days (January - December 25, 1996)

Highest rice yields were obtained in the cropping systems RFAD-(duck-Azolla)-RFAD and RAD-(duck-Azolla)-RAD. These were followed by systems RFA-(fallow-Azolla)-RFA and RFD-duck-RFD. The rice yields from the cropping systems RA-(fallow-Azolla)-RA had higher yield compared with the conventional rice cropping system (RF+HM-fallow-RF+HM) but not with conventional rice-fish culture (RF+HM). No significant differences were observed in the rice yields from the cropping systems RA-(fallow-Azolla)-RA, RD-duck-RD and conventional rice-fish culture. The Rice-falllow-Rice cropping system had a yield not significant with RD-fallow-RD and the two conventional systems. The RF-fallow-RF system had the lowest yield among the different cropping systems. Generally, the results showed that the two-way and three-way combinations of Azolla, duck and fish gave higher rice yields compared to the conventional rice monoculture or rice-fish culture systems.

Nile tilapia yield was highest in the production system RFAD followed by RFD and RFA. The lowest yields were obtained from the production systems RF and RF+HM. The results indicated that systems with more feed available for Nile tilapia such as Azolla and spilled duck feed gave higher fish yields. Moreover, the manuring effect of duck manure increased plankton production.

Egg production did not differ significantly in the various cropping systems with ducks. Duck pasture was not observed to contribute to significant variations in egg production in the different treatments. Most of the eggs produced during the entire egg laying period belonged to medium and large sizes. Generally, the overall egg laying percentage was over 60% which is well above the country's national average of 35% for ducks under the traditional management (Alejar and Aragones, 1989). The egg laying percentage of mallard duck was highly variable, attributed to the sensitivity of the birds to changes in weather conditions and feeding from pasture to confinement. Feed given to the ducks during pasture was greatly reduced (30% and zero level) to economize on feed costs. Natural food such as aquatic plants, snails, fallen rice grains, shrimps and other on-farm resources served as feed of ducks during pasture in ricefields. Furthermore, the occasional moulting of the birds in selected plots greatly affected egg production. Eggs produced were processed to "balut" and salted eggs. Using a draft-type egg incubator, the "balut" percentage of success or per cent fertility after incubation period of 17-19 days was about 70% while infertile eggs and dead embryo were about 18% and 11%, respectively. The egg salting percentage of success was about 94%.

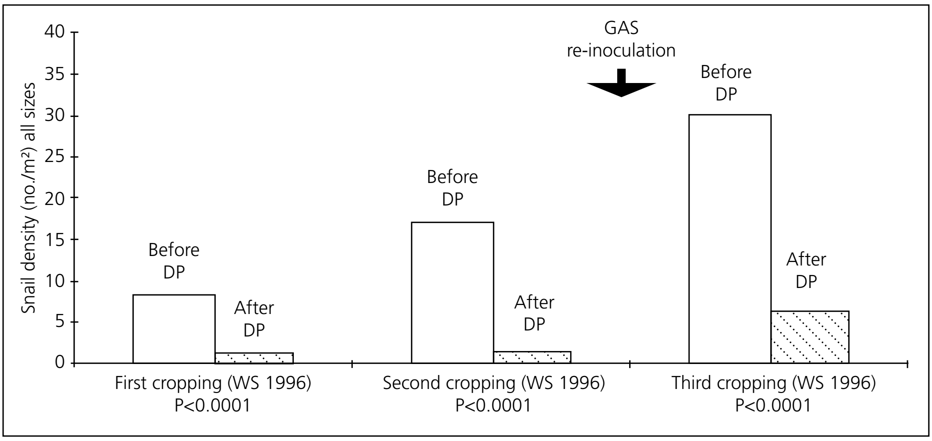
The herding of ducks not only economized on feed costs but was also very effective in controlling the herbivorous golden apple snails (GAS). Figure 2 presents the effect of mallard duck on golden apple snail density in ricefield before and after pasture during the rice fallow period in three cropping seasons. The pasture of 400 mallard ducks per ha in 30-48 days during the fallow period before rice transplanting controlled the GAS to density levels not potentially detrimental to the young rice plants. It was observed that GAS abundance was markedly decreased to 85%, 91% and 79% after DP in the first, second and third croppings, respectively. This corresponded to reduced density of 1-2 snails/m2 after DP from an initial density of 8-17 snails/m2 before DP in the first and second croppings. In the third cropping, there were 30 snails/m2 before DP and 6 snails/m2 after DP. It was observed further that densities of GAS decreased considerably after duck pastures in succeeding fallow periods from the first two cropping seasons. Hence, there was a need to re-inoculate the field with GAS before duck pasture for the next cropping season for experimental purposes. Ducks were observed to be size selective i.e. snails with shell height <4 cm were significantly controlled. According to Oya *et al.* (1986), young snails<1.5-1.6 cm shell height are too small to feed on rice seedlings but 2 cm and greater can potentially damage young rice plants depending on their density (Basilio, 1989).

As expected, duck pasture before rice transplanting seemed to effect better control of the snails than pasturing the ducks after rice transplanting for a period of 14-19 days.

Reducing the density of GAS before rice transplanting is more beneficial to newly transplanted rice which is very vulnerable to snail damage.

FIGURE 2

Effect of mallard duck (*Anas platyrynchos*) pasture (DP) during the fallow period for a period of 30-48 days in ricefield on the mean golden apple snail density (*Pomacea canaliculata* Lamarck) of all sizes in three cropping seasons in the Philippines.



Note: The P values below the cropping seasons refer to *Probability* levels of comparison between snail densities before and after DP.

The effect of Nile tilapia in controlling GAS abundance after 83-fish culture days with rice was not clear but there were indications that observed densities of small snails with shell height 2-2.9 cm decreased in the presence of Nile tilapia. It might be possible that newly hatched snails that fell on the surface of the water were consumed by tilapia which have the capacity to crush up soft-shelled mollusks.

Azolla was observed as a good feed and an effective biological attractant for the golden apple snails. Snails grouping at the Azolla mat can be an advantage to the farmers who practice hand-picking to control the snails. The use of Azolla as food attractant for the snails may be better than other plant leaves such as taro (Calocasia esculenta), papaya (Carica papaya) and ipil-ipil (Leucaena spp.). Azolla has other uses such as fresh fodder for duck and fish besides being an organic fertilizer for the rice.

The study demonstrated that higher productions can be achieved in cropping systems with integration of Nile tilapia, Azolla and mallard duck compared to the conventional systems such as rice monoculture, rice-fish culture and rice-duck farming. The assessment of the profitability of the new production system is a meaningful undertaking and ultimately a determining factor for the adoption of the new technology by farmers.

ACKNOWLEDGEMENT

We thank Dr. Roger Pullin of ICLARM for reviewing the manuscript. We also extend our deepest appreciation to the Food and Agriculture Organization, Rome, Italy; the Catholic University of Louvain, Belgium and the Freshwater Aquaculture Center, Central Luzon State University, Philippines for supporting the research project.

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Developing traditional family poultry production in tribal belt of western India

S. D. Rangnekar and D. V. Rangnekar

CONTEXT OF THE PAPER

We got interested in writing this paper after going through the 3 main papers and various comments. First of all, we wish to compliment INFPD and FAO, Rome, Italy, for this initiative, and particularly Dr. Guèye for co-ordinating this Electronic Conference, which provides excellent opportunity for exchange of information. What stimulated us to write is – (1) Absence of any paper from India or reference to poultry production in India (2) Most papers and references are based on studies and extremely few on development initiative based on studies and suggestions of farmers (3) Holistic view of production systems and perceptions of the families have taken back seat and emphasis is on 'Poultry', their genetic make up or disease problems, etc. Thus, more of a commodity approach is taken. With this paper we hope to initiate dialogue on development initiatives based on studies and farmer (women's) perceptions, priorities and suggestions.

POULTRY PRODUCTION IN INDIA

We feel it is appropriate to make brief mention about poultry production in India, since it is acclaimed as a success story of rapid growth without Government's financial support. Annual growth rate of poultry production is higher than any other agriculture commodity – about 10% for eggs and 15% for broilers. Annual production is reported to be 33,000 million eggs, which ranks fifth largest in the world. Annual broiler production has reached 530 million and is ranked 22nd in the World. For a developing country this is a laudable achievement.

The total poultry population of India is estimated to be 700 million of which about 10 to 15% are indigenous or native birds, which accounted for 50% of poultry population about 25 years ago. Around 1970 the native birds contributed almost 50% of total egg production. However, the picture varies considerably between regions and states of the country. Large commercial poultry farms are concentrated in 5 to 6 states in the country viz. Andhra Pradesh, Maharashtra, Tamilnadu, Haryana, Punjab and Delhi. There are many states where native fowl still account for 30 to 40% of egg production or poultry population.

Growth in poultry production from a development perspective. – Poultry production in India has increased rapidly in the last two decades, but this 'growth' should be delineated from 'development'. When examined against some of important development issues the growth in poultry seems have many negative characters. An attempt is made to highlight some of these aspects in Table 1 below:

TABLE 1: COMPARATIVE PICTURE OF TRADITIONAL AND MODERN POULTRY PRODUCTION IN RELATION TO DEVELOPMENT ISSUES.

Issues	Traditional System	Modern systems
1. Equity – No. of families from lower socio-economic strata benefited	Several	Very few
2. Gender – No. of women involved and directly benefited	Several	Very few
3. Sustainability and risk	Low risk, good sustainability	Risks high, sustainable for large farms only
4. Environmental impact	Positive	Most likely negative
5. Biodiversity	Promoted	Suppressed
6. Dependance on external inputs	Very little	Very high
7. Use of indigenous knowledge	Full use is made	Very little

The above mentioned aspects are not, in any way, intended to denigrate contribution of commercial poultry, its growth has contributed to domestic production. We wish to point out that the system is suitable for a relatively developed area and resource rich persons. The system is not appropriate for underdeveloped rural areas and resource poor, underprivileged families – which account for majority of rural population.

OBJECTIVES, METHODOLOGY AND AREA OF STUDIES

Being associated with Non-Government Development Organisations we have been studying production systems and issues related to various systems (Rangnekar, 1992, 1993). We learnt that systems in rainfed, underdeveloped rural areas and particularly with underprivileged resource poor families, are more complex. We also learnt that the subsystems are highly inter-linked and each activity/production is taken up or adopted with multiple objectives. It is crucial to understand the 'real objectives' and perceptions and preferences of the families. Thus, some of the objectives of the studies were to understand the 'whole system' and to learn from farmers 'what and why they are doing'. Such learning may help to decide – (a) whether there should be any intervention and, if so, (b) what kind of intervention is appropriate [to begin with] and (c) what are their preferences/suggestions. An attempt was to be made to combine the rural families experiences/perceptions and available scientific information to decide on appropriate intervention.

Tribal areas offer a challenge to development planners and managers. This is an underprivileged group, having a different way of life and customs. Tribal people have a strong clan feeling, they were hunters and gatherers, turned into producers. Special schemes and fund provisions are made by the Government to bring about 'rapid development'. Like many other schemes 'Special Schemes for Poultry Development' were thrusted on them in the past. The aspect which attracted us for undertaking studies was reports of failure of most of poultry development schemes. It was also reported that the improved birds provided to the tribal families were killed or died and that these families are not interested in poultry production. While studying production systems in tribal areas we found that almost every family has a few birds, it was difficult to find a family without poultry. The tribal women indicated that keeping poultry is traditional and very useful. Hence, it was worth studying the reasons of failure of these schemes and find out alternatives.

Methodology adopted can best be described as repeated discussions with groups and individuals, accompanied by participatory exercises (ranking, transect walk, listing, etc.). With women tactful approach was needed to get full and factual information and 'kitchen talk' and general discussion on traditional art and music was very effective. Use of forms and notebooks was avoided – since it deters them from free conversation. For free conversation, rapport and credibility are important and hence the studies were carried out in villages where the organisation is involved in development activities. Studies continued over a period of several months and information is gathered in bits and pieces and a few of the field staff were also involved. Thus this was 'Relaxed Rural Appraisal' or RRA conducted with 'Participatory Approach'. A total of more than 600 families from 5 districts were involved in the studies.

The studies were conducted in a few randomly chosen villages of five districts of tribal belt in western India which lies along the interstate boundaries of Rajasthan, Madhya Pradesh and Gujarat states. This belt lies in the Aravali hill range which has good forest cover, poor communication, very little irrigation and an average rain fall of about 700 mm (mostly in 4 months of the year). The rainfall decreases from South to northern parts of the range. Livestock-poultry are mostly non-descript. Although there are no large and modern markets in tribal belt, except at some district headquarters, there is well-established traditional system of weekly markets. There are no major industries, except mining (in a few pockets). Livestock services are sparse, with very poor coverage.

Tribals live in clusters of hutments spread out in the hills and villages with large number of houses near each other and distinct village boundaries are not seen in tribal area. Land holdings are small and spread out with considerable variation in soil structure and fertility (between valleys and hill slopes). Agriculture depends largely on animal power and human labour, since mechanisation is very limited. Most of the area is mono-cropped, however in areas with better rainfall, i.e. 900-1000 mm, two crops are tried. Mixed cropping (cereal and legumes) is traditional. Majority of farmers use seeds of local varieties of crops and adoption of hybrid seeds is very low. A few tribal farmers, having irrigation facility, have adopted cash crop cultivation i.e. spices, vegetables, fruits, etc. It is also common to see mixed livestock along with poultry. Cattle and goat are most common, while a few tribal farmers keep buffalo. Duck keeping is not common, except in high rainfall areas.

An interesting feature observed in tribal areas is the major role of women in crop-livestock production. Women not only manage the animals (and, of course, take care of the family and children) but also market the produce and animals (Rangnekar, 1992). Men have some involvement in crop production, however, majority of them migrate to developed areas in search of work. Illiteracy is high, however, women are knowledgeable about behaviour and characteristics of livestock and poultry as well as the constraints and local resources (Rangnekar, 1992). Accessibility to livestock services is very poor, tribal farmers have to depend largely on traditional systems of breeding and health care, except those in peri-urban areas (Rangnekar, 1995).

POULTRY PRODUCTION SYSTEMS IN TRIBAL BELT

Salient findings of studies and observations made during last few years will be summarised. Aspects helpful in decision making process about interventions will be mainly discussed.

Initial observations on family poultry were presented, briefly, in the XXth World Poultry Congress (Rangnekar and Rangnekar, 1996).

OWNERSHIP PATTERN

More than 90% tribal families from 35 villages in the five districts, where observations were taken, maintained backyard poultry. However, the number of adult birds raised by a family was variable. Highest number was seen in households located in peri-urban areas. In rural areas, about 60% families were found to possess 6 to 8 adult birds – with followers. However, the number varies with season and period due to several factors – like disease, sale, hatching, etc. Majority of tribal families (90%) keep native coloured birds, a few have mixed birds. A few tribal families from peri-urban areas were found to maintain hybrid birds for egg and broiler production. As mentioned earlier, poultry production in tribal families was totally women's domain, who manage production as well as selling of birds and eggs (Rangnekar, 1996).

PERCEPTIONS OF WOMEN ABOUT POULTRY KEEPING

Women indicated that poultry keeping is traditional and very useful for the family. From various participatory exercises conducted in tribal families of the study area, five most useful aspects of poultry keeping are summarised as follows:

- Source of small cash;
- Source of nutritious food to the family at very low cost;
- Enables proper celebration of important events, festivals, worship of Goddess;
- Entertaining important guests, relations, officials, etc.;
- Sport (Cock-fight).

Discussions revealed that women had specific and logical reasons for continuing to maintain native and coloured birds. Series of discussions and ranking exercises were carried out to understand women's perceptions and major reasons for preferring native coloured birds, and the outcome is reported as follows:

- Low investment, maintenance cost and risk;
- Good local demand and higher price for birds and eggs of native fowl;
- Easy to manage and handle – not much problem once the birds grow up;
- Traditional liking.

Thus, it can be seen that reasons for preference for native coloured fowl range from economic to social as well as behavioural aspects. Flocks can be raised with low investment and some women from very poor families were found to (re-)build stock (which has been wiped out) using ingenious ways. They exchange 1 or 2 adult birds, which remained with them, for a few chickens, raise them and again get more chickens – so as to possess desired number.

FEEDING PRACTICES

Birds are maintained mainly on household kitchen waste, supplementary grains and feed resources eaten by scavenging in/around the house. The kitchen waste is usually gathered in a container or a bowl placed in backyard, the birds know the time and come over to feed themselves. It is a common practice to offer some grains, in the afternoon when women are a bit free. Grains of the crops grown by the family are usually offered. However, very few families offered protein supplements. Birds usually scavenge (in their words graze) in a defined areas, in most cases, around the house or in the nearby farm plot. Women feel that scavenging is important – not only to provide nutritious feed for birds but also the specific taste and colour to meat and eggs. The insects and plant products eaten by the birds are the main contributors. They were aware that if enough scavenging material and kitchen waste is not available the health of the birds will be effected and have observed weak birds. However, they lack awareness about available supplements.

PRODUCTIVITY OF NATIVE CHICKENS

Assessment of productivity required considerable patience, time and tact. Repeated discussions based on indirect questioning could provide some ideas of egg production, number of eggs consumed, sold and hatched and number of chicks produced, mortality in chicks and the birds sold. When observations were added up a wide range was noted for egg production viz. 75 to 110 eggs in a year. However, about 75% observations were around 80 eggs a year. Laying is in clutches and not continuous. On an average 20% eggs are consumed by the family (for various purposes) about 30% are sold and 50% are hatched. Women considered sale of birds (chicks or adult birds) to be more important than sale of eggs – since they get better return for a bird. Most of the women put odd number of eggs for hatching and prefer black or dark coloured brooding hen. Varying figures were quoted for hatchability ranging from 75 to 95% - however, majority of women reported about 80% hatching. Repeated discussions also revealed that about 15% eggs are lost, since they are laid at improper places – more so in case of families who do not provide proper housing facility.

PROBLEMS ENCOUNTERED

Productivity is adversely effected by losses due to a variety of factors, which were well described by the women. The major cause of loss is mortality in chicks – which averaged 40% - more in some years and less in others. Ranikhet or Newcastle disease is the major cause of mortality. In all the five districts, major outbreaks are reported to occur every two or three years. Transect walk around various hutments gave good idea of losses, by observing chicks of different ages (which run around with hens). Coccidiosis was also reported by some veterinarians as a minor cause of mortality. The second major cause of losses is predation – by winged or four and sometimes two legged creatures. Women, however, emphatically state that native birds can protect themselves better than the white hybrid birds.

Lack of proper housing facility causes losses of eggs. Sometimes the eggs are laid in bushes or some corners of the house. However, many families do provide shelters and many were found to have innovative ways of housing the birds. Bamboo baskets are most commonly used for housing and these are placed on the floor or under the roof or on a pole (the native birds learn to climb up, not the white birds). Very few families were found to provide watering facilities which may have adverse effect on chicks.

There is lack of data and surveys/studies on disease problems in family – native chickens.

PRIORITIES FOR DEVELOPMENT ASSISTANCE

Discussions regarding developing poultry production brought forth interesting reactions which depended on location and gender.

Most men showed interest in poultry keeping when the number of birds increased, they were reserved on this aspect and their responses were location-specific. Almost all rural women keeping poultry declined when the number of birds was increasing. This indicated that they cannot manage larger flock sizes. These women have to manage the house as well as farming. Another reason is limitation of resources, particularly the feed. Women from peri-urban areas were interested in increasing the number since they feel they can earn well.

All tribal families gave highest priority to control of mortality in chicks, men and women both indicated that any development assistance should give first priority to effective disease control. According to them disease control alone can increase productivity substantially. Major cause of mortality is identified as Ranikhet or Newcastle disease and effective vaccine is available against this disease, all over the country. The vaccine is effectively and extensively used by the commercial poultry producers, since decades.

The tribal women from rural areas mentioned that they could not get the benefit of this vaccine and more than half of them were not aware that such an effective control measure is available. About 30% of women feel that the disease is God's curse and is uncontrollable. However, women from peri-urban areas were aware and have used the vaccine. The Ranikhet disease problem is a good example where technical solution is available but is not used, due to lack of proper approach to organising delivery of services. According to Government Veterinary Officers and the tribal women, reasons of the lack of effective control of Newcastle disease in rural-tribal areas are summarised as follows:

- Transport facility not easily available;
- Difficulty to maintain proper cold chain;
- Number of birds per family small and hatching dates for different families not known – hence one vaccine vial will be grossly underutilized;
- Farmers do not co-operate by bringing the chicks;
- Tribal women indicated that they are never consulted about organising vaccination campaigns;
- There is lack of awareness and confidence about the effectiveness of vaccine (Some had bad experiences).

Study of the aspects mentioned above clearly indicates need for a participatory and decentralised approach and creating awareness for effective control of Ranikhet or Newcastle disease. Unfortunately, thermostable vaccine has not been introduced/tried in India so far.

Tribal men and women from a number of villages reported use of traditional medicine, Tinospora cordifolia whenever outbreaks are reported. This is a creeper and extensively used in Ayurvedic human and animal medicine. For control of poultry diseases, the tribals crush the creeper in water and offer the water to birds. This is reported to reduce severity of disease. The report needs further study and validation.

About 1/3 of tribal women expressed need for improvement in housing and have realised that some losses can be controlled and productivity improved to some extent.

Some tribal families from peri-urban areas expressed interest in trying commercial hybrids or their crosses on a small-scale (ranging between 500 to 2000 birds). The latter figure is from those families, who maintained 4 to 500 birds and have benefited. However, most of these families prefer broiler production, in view of faster turnover.

Many families felt (about 50%) that there may be improvement by improving feeding and watering but they are not very sure about benefits. There is need to study feeding practices, feed resource base and undertake on-farm trials.

RESEARCH AND DEVELOPMENT IN INDIGENOUS POULTRY IN INDIA

Unfortunately very little attention has been paid by researchers and development planners, towards study of traditional family poultry production systems in India. Reliable baseline data is also not available on number of birds and their productivity. Khan (1999), while reviewing research work in one of the rare papers that we came across, has highlighted this lacuna. He mentions that there are 26% recognized breeds of indigenous fowl in India, but genetic studies are lacking as are done in South East Asia.

According to him, two type of indigenous fowl are to be found in India - one a heavier bird which is meat or game type and a smaller bird which lays 60-90 eggs/year. He mentions that there can be considerable improvement in egg production (up to 139 eggs a year) by selection and better feeding. However, there is need to try this under field conditions and on-farm research is lacking in livestock field. Attempts have also been made in India to develop crossbreds and synthetics by research institutes and also in private sector. Information is summarised in Table 2 below:

TABLE 2: VARIETIES DEVELOPED IN INDIA FOR RURAL POULTRY (WITH INDIGENOUS BASE)

Name	**Character**	**Place of development**
Vanaraja	Broiler-type cross	Hyderabad
Giriraja	Broiler-type cross	Bangalore
Coriler	Synthetic	Keggs-Delhi
Krishipriya	Crossbreed	Kerala
Krishna-J	Synthetic layer-type	Jabalpur

The above mentioned varieties have been introduced in different pockets of India, particularly in parts of Karnataka, Tamil Nadu and Andhra Pradesh states. However, a widespread impact is not seen. In the state of Madhya Pradesh the Krishna-J bird has shown promising results. Another native bird 'Kakaknath' very popular for its meat quality is being developed by the State Government. Some studies have been conducted on this breed and a hatchery established to propagate Kadaknath. However, in most cases there is a lack of concerted and integrated effort with due participation of farmers (particularly women). The authors know about only two projects, which are with Danish assistance, wherein specific efforts at studying traditional systems are being made and based on findings interventions are decided. These projects are in the states of Tamilnadu and Madhya pradesh and have adopted participatory approach and encourage women participation.

THE BAIF INITIATIVES AT DEVELOPING FAMILY POULTRY PRODUCTION

The BAIF Research and Development Foundation is a development NGO involved in rural development in six states of India (in selected pockets). Starting with livestock development, BAIF is slowly evolving towards integrated programme, after studying the systems, farmers' perceptions and priorities. Much of the involvement is in rainfed, underdeveloped pockets. Besides, out of about half a million families, more than 60% are underprivileged. An inverse relationship between socio-economic status and contribution from small animal and family poultry is observed and hence attention was given to understand these systems and farmer preferences. Moreover, tribal women from groups established through water resource and other development programmes started suggesting their preference for poultry development.

The studies clearly indicated the need for group action, extension measures to create awareness, encourage initiatives undertaken by women to control Ranikhet disease. Pilot efforts were initiated last year in 15 villages of tribal area of Rajasthan state and 10 villages of Gujarat state, in India, during last year (1998). The vaccination has become successful due to involvement of women group leaders. BAIF helps by maintaining stocks of vaccine and the needed cold chain. The women group leader provides information about hatching in different clusters of hamlets and vaccination is arranged through trained persons. These women groups are formed under Self Help Group Programme, aimed at developing economic activities for women (vegetable production and small animal production are some of the preferred activities). A few selected women are being provided training in poultry diseases, vaccination and health control. It is proposed that women groups would take over the activity in another one year. Seeing the effectiveness and efficiency/accessibility of services, the women are prepared to pay for it.

Women from peri-urban areas have shown interest in keeping broilers and crossbred chickens. Help is being arranged through Government's training and loan-subsidy programme for chicks and housing.

For future strategies – further studies and discussions with tribal women are initiated on three aspects:

- Feeding pattern and feed resources and possibilities of improvement using locally available supplements;
- Housing system and need for improvement;
- Marketing by women groups;

Furthermore, it is proposed:

- to extend the activity to 25 to 30 more villages – who have shown interest in organising themselves for developing family poultry.
- to set up orientation programmes for field officers and veterinarians towards skills (including participatory approach) for developing traditional poultry and similar production systems, in underdeveloped areas.
- to undertake disease surveillance in order to understand the health picture of family poultry. – to take up validation of traditional treatment methods used in poultry – especially the use of Tinospora cordifolia.

CONCLUSIONS

An attempt has been made to provide a comprehensive picture regarding traditional family poultry production in India. However, we do not claim that we could provide all the information – since we do not have very good access to literature and reports as information dissemination is poor in India – like in many other countries.

The paper would also indicate that there are many similarities between family poultry production systems in Africa and India, so also the constraints, as can be seen from papers of Sonaiya *et al.* (1999) (see Introductory paper of this electronic conference). Exchange of views and experiences, on a continuous basis, would be mutually beneficial. Results of the pilot projects of BAIF, which cover about a thousand families, would be evident by next year as also the results from other 2-3 projects by other organisations. It would be useful to exchange experiences between South Asian and African countries. Bangladesh, with its interesting projects on family poultry, can provide the lead.

Feeding systems/pattern and assessment of resources for family poultry is a useful and interesting field of applied research. While we have taken some initiatives, we would appreciate receiving references or if possible reprints of reports on such studies conducted in other countries. We wish to look for limiting factors and local supplements.

Last, but not the least, we wish to clarify that the readers should not carry the impression that we are wedded to Tradition. We recommend keeping an open mind and not to make haste for change and not to consider Traditional system as totally abstruse. Traditions and systems keep changing – but this should be slow and in stages. All aspects do not need change.

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COMMENTS ON DEVELOPING TRADITIONAL FAMILY POULTRY PRODUCTION IN TRIBAL BELT OF WESTERN INDIA

Stephen E. J. Swan

Congratulations to Datta and Sangeeta Rangnekar on a well-written paper. I wish they had come to Tune, Denmark last month, they would have made a good contribution. I comment on several paragraphs:

"Most men showed interest in poultry keeping when the number of birds increased, they were reserved on this aspect and their responses were location-specific. Almost all rural women keeping poultry declined when the number of birds was increasing. This indicated that they cannot manage larger flock sizes. These women have to manage the house as well as farming. Another reason is limitation of resources, particularly the feed. Women from peri-urban areas were interested in increasing the number since they feel they can earn well."

Is it also possible that increasing flock size implies a reduced risk from ND and that the men are thus attracted to a lower risk high-income enterprise?

"Study of the aspects mentioned above clearly indicates need for a participatory and decentralised approach and creating awareness for effective control of Ranikhet or New-castle disease. Unfortunately, thermostable vaccine has not been introduced/tried in India so far."

Here is a good opportunity for David Gibbons of "Cashpor" India which uses the Grameen Bank concept and is growing in acceptance in India. See his contribution to the Denmark, Tune workshop of March 1999.

"Some tribal families from peri-urban areas expressed interest in trying commercial hybrids or their crosses on a small-scale (ranging between 500 to 2000 birds). The latter figure is from those families, who maintained 4 to 500 birds and have benefited. However, most of these families prefer broiler production, in view of faster turnover."

We should keep in mind that broiler production is higher in profitability mainly because it is higher in risk.

Diseases in family duck farming in South-East Asia

I. Aini

ABSTRACT

Duck farming in south-east Asian countries mostly consists of backyard or subsistence type of rearing. The ducks are provided with poor quality feed and exposed to poor husbandry, thus subjected to non-infectious and infectious diseases. However, recorded information on diseases affecting these ducks is rather scarce. Commercial duck farms are as advanced as in other developed countries.

INTRODUCTION

Duck farming in south-east Asian countries mostly consist of large number of small farms and very few intensive commercial farms. Traditionally, the duck industry in the south-east Asian region was mainly a backyard activity. Ducks were mainly raised by small farmers to supplement the family income, similar to the rearing of indigenous chickens. The ducklings were hatched by traditional methods of incubation using charcoal or by individual brooding. Most of these ducks were raised in paddy field areas, near lakes, used tin-mine ponds, canals, streams or along coastal areas, because supplementary feed came from leftover rice bran and broken rice after harvesting season as well as shrimps, snails or cheap thrash fish. Sea-shells were also used as a cheap source of calcium.

In countries such as Vietnam, Philippines, Thailand, Malaysia, Hong Kong and Korea, ducks are important cuisines. In Malaysia, the main outlets for broiler ducks are Chinese restaurants and stalls selling roast ducks. The consumption of duck meat is limited; it is not common on the daily household menu. Eggs are mostly consumed as salted or preserved eggs rather than fresh eggs (Awang, 1993).

Though the duck industry has advanced much since late 1950s, the progress is not as rapid as the progress in chicken industry. The scavenging system of duck farming is still important in many south-east Asian countries. This type of free-range practice exposes the ducks to different weather changes, non-infectious and infectious diseases. The husbandry practice is generally poor and disease control is unheard of. Besides other reasons such as poor husbandry and poor feed quality, diseases bring about one of the major economic losses to the industry. The statistics on the disease outbreaks, incidence, morbidity and mortality are either not available or not reliable, as farmers do not usually report any disease outbreaks.

The other two groups of farming practice are the smallholder semi-intensive and the commercial intensive farms. The intensive commercial duck farms are increasing in number. This paper highlights the common disease problems associated with the backyard and smallholder duck farms.

NON-INFECTIOUS DISEASES

Non-infectious diseases are mostly associated with environmental effects and nutritional deficiencies. Leg weakness associated with calcium deficiency is one of the common conditions reported (Awang, 1993), besides vitamin D, phosphorus, nicotinic acid deficiencies, and physical injuries.

Aflatoxicosis is also a common cause of mortality in ducks especially when feed is not properly stored. Aflatoxicosis is important in that it affects the bird's immune system directly and indirectly.

Most of the farmers either feed the leftover food to the ducks or home-mixed feed; thus storage and quality control are very poor. Thrash fish especially tends to putrefy easily when proper storage is not provided. Wet environment encouraged mouldy growth.

INFECTIOUS DISEASES

The most common infectious diseases reported are as follows:

- Viral Diseases : Duck virus hepatitis, Duck virus enteritis
- Bacterial Diseases : Cholera, Duck Septicaemia, Colibacillosis/Colisepticaemia
- Fungal Diseases : Aspergillosis
- Parasitic Diseases : Endoparasitism

It is not uncommon to have ducks that succumbed to multiple infections, especially when the husbandry is poor. Low-grade intercurrent diseases together with stress usually result in increased susceptibility to pathogenic organisms. When mixed infections do occur, it is often difficult to treat.

Duck virus hepatitis (DVH)

DVH which is caused by picornavirus, is a highly infectious, acute disease in ducklings less than 5 weeks old. This disease has been reported in all south-east Asian countries. Though vaccine is available, small farmers seldom resort to vaccination as a method of control.

Duck virus enteritis (DVE)

DVE is also known as duck plague. It is caused by herpesvirus, which can result in an acute, highly fatal disease, or it can be a chronic infection in carrier ducks. It is often thought that migrating waterfowls are involved in disease transmission. This disease has been reported in all south-east Asian countries (Seri Masran, 1996; Tran Dinh Tu, 1995). Although vaccines are available, vaccination is commonly not practised by small farmers.

Cholera (Pasteurellosis)

Pasteurellosis is an acute or chronic disease causing severe economic losses in ducks. It is caused by Pasteurella multocida and spread by contaminated equipments or carrier birds. The disease can be prevented by vaccination or treated with antibiotics. Similarly with other diseases where vaccine is available, vaccination is seldom carried out. Pasteurellosis is one of the common diseases encountered in ducks in Malaysia (Aini, 1993).

Duck Septicaemia

Another name for duck septicaemia is Anatipestifer syndrome, which is caused by Pasteurella anatipestifer. It can cause sudden death in young ducklings, with losses due to mortality or retarded growth. It is sometimes confused with colisepticaemia, except that nervous symptoms may be present in duck septicaemia.

Aspergillosis

Aspergillosis usually causes respiratory problems in ducklings. Mouldy environment or feed is very favourable for the growth of Aspergillus.

Parasitic problems

The feeding habits of the ducks expose them to many endoparasites, such as Eimeria anatis, Tracheophilus sisowi and Hymenolepsis anatina (Jan Nari, 1979). Other diseases, which are not commonly reported, include paratyphoid, botulism, coccidiosis and leucocytozoonosis.

CONCLUSION

Ducks, which are reared under scavenging or extensive systems, are susceptible not only to infectious but also to non-infectious diseases. Adverse environmental conditions also contribute to the poor health condition of these ducks. However, the actual disease status in family ducks is unknown due to the scarcity of information. Except for DVE, DVH, pasteurellosis and colibacillosis, not much has been reported about other diseases of ducks under backyard system.

ACKNOWLEDGEMENT

The author would like to thank Ms Normadiah Sukaimi for typing the manuscript.

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Novel pairing technique for estimating feed intake and nutrient digestibility by scavenging village chickens

A. O. Ajuyah

ABSTRACT

Proper estimation of feed intake by the scavenging village chicken is an important prerequisite for improving feeding systems and management. In terms of energy expenditure it is estimated that the metabolic cost of scavenging for feed or feed procurement by the village chicken is between 40 to 90% of total energy input from all feed sources. Less than 30% of this total will be available for tissue deposition, growth and egg production. However, there is no or limited information in the literature on energy and nutrient partitioning by village chickens, neither data on quantitative and qualitative estimation of feed utilization and digestibility. Therefore, this paper proposes the use of pairing technique (one live and one dead bird) to determine feed digestibility, by relating nutrient composition of crop content to feacal excretion and ileum digesta content between different pairs of village chicken of similar age, weight and sex. The proposed method will enable us to acquire quantitative and qualitative data to facilitate the growth and development of the village poultry industry.

Key words: Crop content, feed intake, nutrient digestibility, scavenging, village chickens.

INTRODUCTION

One of the major production constraints to the development and growth of the rural family poultry in most developing countries is the estimation of feed intake and feed utilization under scavenging conditions. Such data will provide the basis for improvement in feeding management, in terms of supplementary feeding and stocking density or birds per unit scavenging area. However, scavenging areas are dependent on extrinsic factors such as feed availability, seasonal variables (e.g. temperature, humidity, rainfall, cyclones, wind speed and direction), level of predation, health and intrinsic factors such as relative position on the pecking order which is also related to scavenging behavior, age and sex. Therefore, the feeding behavior of the scavenging chicken, which is free ranging, negates data acquisition under natural conditions without partial or total confinement of the chickens. However, in terms of energy expenditure it is estimated that the metabolic cost of scavenging for feed by the village chicken is between 40 to 90% of total energy input from all feed sources, less than 30% of which may be available for tissue deposition, growth and egg production. This is in addition to the variable nature of feed quality, the cumulative effects being poor growth rate and low levels of meat and egg production.

At the University of the South Pacific, physical separation of local domestic and kitchen waste by one of our students indicates that over 70% is in a form which the scavenging chicken cannot properly utilize e.g. bone scrap, leaves, paper products, vegetable stump, liquid, fibrous garden and kitchen waste, etc. From this waste, the chicken can obtain up to 90% of daily-required energy intake. It could therefore be inferred that supplementary protein might be the most limiting nutrient in the diets of scavenging chickens, in particular for younger birds and laying hens.

Except for the recent study of Roberts and Gunaratne (1992) and Gunaratne (1999), there has been no research done in scientifically based methodology for estimating the feed intake of village chickens under natural conditions. Furthermore, the "proportion of the crop content, which is household waste determined by visual inspection" as suggested by Gunaratne (1999), is subjective and depends on the person who inspects it. Although the authors suggested that the amount of protein and energy in the Scavenging Feed Resource Base of scavenging chickens can be determined from an analysis of crop content or by reasonable estimation, this method does not provide information on apparent and true digestibility of the feed. Therefore, detailed information on the qualitative and quantitative feeding habits of the scavenging chicken would form the basis of proper feed management in particular for large size flocks (50+).

The proposed pairing technique outlined below should enable the acquisition of quantitative and qualitative data to achieve the following objectives:

a. estimation of feed intake and utilization by the village poultry – digestibility studies.
b. determination of variation within and between population on efficiency of feed utilization – scope for genetic improvement.
c. determination of the effect of supplementary feeding and feed composition on the scavenging ability and growth rate of the rural chicken – scope for improved management.

PROPOSED METHOD

The sample size for qualitative and quantitative analysis of feed utilization by scavenging village chickens should be based on total number of chickens in a pre-selected location or site. For example, given an area of about 400 m x 200 m or 80,000 m2 with 500-1000 chickens from 25 to 40 families, the sample size should be:

$$\frac{\text{(number of chickens)}}{\text{(number of families)}} \text{ multiplied or divided by 2 (male and female)}$$

In this case the sample size is 40-50 chickens, we multiplied by 2 because the above ratio is less than 5 % of the total chicken population. The birds should preferably be of similar age group, and half of the chickens (20) or one pair should serve as live control and the other half or pair slaughtered for physical and chemical examination of gut contents (negative control). All 40 experimental chickens should be firstly wing banded and the left wing flight feather clipped to unbalance the chicken during flight and for ease of capture.

The experiment should commence with all the 40 birds confined in cages and feed withdrawn for 24 hours, this is to ensure complete emptying of the gastro-intestinal tract. However, drinking water should be provided ad libitum. The next day all the chickens should be released to scavenge for feed, and at regular intervals e.g. every two hours, 4 chickens should be caught and confined in cages. The village chicken is a continuous nibbler, and stops feeding only when the crop and gizzard are filled to capacity. Nibbling resumes once ingested feed starts moving from these organs, and occurs quite often in a day. In addition, over 80% of ingested free-range feed will remain in the crop for more than 2 hours after ingestion because of their large particle sizes, quality and the amount required to fill the crop. Therefore, based on this regulatory mechanism, one pair of chickens should be immediately slaughtered for physical and chemical determination of crop and ileum digesta contents. The other pair should be fed a diet containing an indigestible and visible marker dye such as chromic oxide, and total feacal excretion is to be collected until the appearance of dye in the droppings. Total feacal excretion and total crop content should be recorded and proximate analysis including energy content carried out on oven dried samples. Calculations for apparent and true nutrient digestibility are as shown below:

a. **Apparent digestibility of nutrients, for example protein.**

$$\frac{\text{Crop protein content (dead bird) - Feacal protein content (live bird)}}{\text{Crop protein content (dead bird)}} \times 100$$

b. **True digestibility of nutrients, for example protein.**

$$\frac{\text{Crop protein content (dead bird) - Ileum digesta protein content (live bird)}}{\text{Crop protein content (dead bird)}} \times 100$$

To improve precision and reduce variability between and within flocks, birds of similar phenotype and genotype should serve as pairs. In addition adjustments should be made for differences in composition between actual feed consumed and crop content by multiplying by a pre-determined factor for the different nutrients, in particular for carbohydrates and energy, since starch digestion or hydrolysis has been initiated by ptyalin produced in the mouth. Data collected over a 24-hour period at 2 hourly interval would provide useful information on scavenging behavior of the village chicken including qualitative and quantitative characteristics of feed resources.

CONCLUSIONS

Scavenging is the main feeding system for smallholder poultry units, as a result of which village chicken production is usually classified as a low-input and low-output system (Kitalyi, 1999). However, feed procurement by the village chicken represents a significant proportion of energy expenditure and the importance of feed in scavenging chicken production is usually poorly estimated. To determine feed utilization by the village chicken, Gunaratne *et al.* (1993) analyzed crop content and reported similar results with previous study by Prawirokusumo (1988). They concluded that proximate analysis of feed and crop content and the presence of substantial amount of abdominal fat in all hens indicated that the availability of protein was a constraint on production in that environment. High abdominal fat deposition may be predisposed by multiple factors, and may also indicate inefficient nutrient utilization, including protein. Therefore, the determination of the chemical composition of crop content only is a poor indicator of nutrient utilization or digestibility.

This method suggests an indirect or pairing technique for the quantitative and qualitative estimation of feed utilization and digestibility by the village chicken, based on physical and chemical analysis of crop content in addition to chemical analysis of feacal excretion and ileum digesta content. Data obtained should provide a basis for improvement in feeding practices and feed management, based on input and output relationship. For example, it is possible that intake and availability of protein by scavenging chickens are dependent on the feeding habit of their live protein sources, worms and insects, etc., which occurs mainly at dawn and dusk or after rainfall. Therefore, to improve productivity based on efficient utilization of protein, energy supplying supplementary feed such as grains may be provided only at noon when live protein sources may be scarce or hibernating. Finally, proper understanding of nutrient utilization by the village chickens will provide information on feed conversion ratio, growth rate and therefore facilitated genetic selection and improvement in flock management.

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COMMENTS ON NOVEL PAIRING TECHNIQUE FOR ESTIMATING FEED INTAKE AND NUTRIENT DIGESTIBILITY BY SCAVENGING VILLAGE CHICKENS

Dr. Aichi J. Kitalyi

I read with keen interest the paper on estimation of feed intake and digestibility by scavenging chickens. May the author, Dr. A. O. Ajuyah, respond to the following questions/ remarks?

1. Is it possible to use the method to estimate feed intake of scavenging chickens without killing the birds?
2. Can we have more data from the work, e.g. the relationships of the different variables measured as shown in the following table?

VISUALIZATION OF THE RAW DATA COLLECTED

Time	2 hrs		4 hrs		6 hrs		8 hrs	
	Predig	Postdig	Predig	Postdig	Predig	Postdig	Predig	Postdig
Crop content	X	X	X	X	X	X	X	X
Ileal content	X	X	X	X	X	X	X	X
Apparent digestibility	X	X	X	X	X	X	X	X
True digestibility	X	X	X	X	X	X	X	X

Dr. Asifo O. Ajuyah

would like to thank Dr. Aichi J. Kitalyi for her comments.

In response to your questions:

- Yes, it is not possible to use the method as presented without slaughtering the second pair of chickens. This is necessary to obtain the crop and ileal digester content for digestibility studies. The crop content is an indirect estimate for feed intake which is impossible to obtain under scavenging conditions.
- Your visualization table is quite innovative and interesting, there should be another row for total faecal output. I am sorry that I cannot provide any raw data at this stage.
- The time sequence used on your table is based on the following premise:
  - The length of time that feed ingested by the chicken will take from the mouth (inlet) to the cloaca (outlet) is a function of the rate of "emptiness or fullness" of the crop and gizzard, which is dependent on feed texture. The passage might normally take 2-4 hours to empty the alimentary tract. However, this passage is expected to be longer for scavenging chickens because of feed texture (coarse, whole grain, etc.), which requires extra grinding time.

I hope I have answered your questions.

In-Situ conservation of the Black Maltese and performance evaluation under a small-scale intensive system

J. G. Mallia

SUMMARY

The Black Maltese is a rustic, egg-type breed of Mediterranean poultry that is critically endangered. An *in-situ* conservation project for this breed has managed to temporarily create a small flock of about 400 chickens, derived from three separate sub-populations of Black Maltese. The egg production potential of this breed, together with chick survivability were assessed under a 'family poultry', small-scale intensive system. Village volunteers (local women) in Malta carried out the work. The large number of eggs laid by two of the three lines, and precocious development and independent natures of the chicks were of particular interest. This breed shows several excellent traits that make it suitable for inclusion in family poultry projects. Some concerns were presented concerning the long-term viability of the *in-situ* conservation project for the Black Maltese, currently relying exclusively on short-term donors and volunteers.

Key words: Black Maltese, family poultry, poultry conservation and evaluation

INTRODUCTION

The Black Maltese was formerly widely raised in the Maltese Islands under backyard or semi-intensive conditions for its prolific production of large white eggs. Since the 1960s, the role of family poultry farms, i.e. part-time farmers that were formerly largely responsible for the local production of fresh eggs, has steadily dwindled. Local egg production has now been entirely replaced by intensively reared hybrid strains of poultry; particularly those derived from the White Leghorn and Rhode Island Red. Family part-time poultry farmers have switched to raising commercial lines of meat-type poultry. The Rhode Island Red commercial strains have also replaced the Black Maltese from the remaining backyard laying flocks in Malta, mainly because the supply of chicks is reliable, and also a shift of consumer trends towards brown eggs (Mallia, 1999).

The Black Maltese is now critically endangered, and survives in small numbers (< 50 breeding adults) as a show-bird for poultry shows (Mallia, 1999). It is a breed with 'Mediterranean characteristics', namely a light body frame, non-sitting, white egg-type chicken, and although a breed description is available (Mallia, 1999), little is know about the production potential of this population of poultry. Very little work has been done regarding the systematic characterisation and evaluation of genetic resources of local poultry, and this warranted encouragement (Traoré, 1999).

Most of the Mediterranean poultry breeds are 'egg-type' poultry; examples include the Minorca, Black Spanish and Andalusian. Contemporary specimens of these have been highly selected for specific show bird traits, often to the detriment of their egg-laying properties and rusticity. For example, the Minorca was selected for comb and lobe characteristics, compromising its egg-laying qualities (Anonymous, 1997). The (Black) Spanish was selected for particular facial features and the Andalusian for its blue, laced feathers (Brown, 1906).

Contemporary (selected) Mediterranean breeds are therefore far removed from their original role as highly efficient laying birds under family poultry management systems (i.e. backyard or free range). It is probable that unselected Mediterranean poultry, showing a greater degree of heterosis, is better adapted for egg production under challenging and variable (non-industrial) management conditions in hot and dry climates (Mallia, 1999). Investigations on the performance of indigenous birds in other parts of the world has shown that they may be highly productive (Nwosu, 1979; Mathur *et al.*, 1989), however, unselected populations of Mediterranean chickens are relatively hard to locate. The Black Maltese represents a possibly very useful relict population of relatively unselected black Mediterranean poultry. It is to be noted that black Mediterranean fowl having marked present-day 'Mediterranean characteristics' were already present in Greece and Etruria (central Italy) in the 6th century BC (Mallia, 1999).

There has been very little characterisation of this breed and assessment of population numbers, except for one report by Mallia (1999). Furthermore, no attempts to conserving the breed or evaluating its performance as a layer have been made. The main objectives of this report are to give an update on the progress in setting up an *in-situ* breeding programme for the Black Maltese, and to give some preliminary indication of the performance potential of this population of chickens raised under a small-scale intensive system.

MATERIALS AND METHODS

Sponsors to finance the project and volunteers to partake in various activities necessary to purchase and establish a breeding nucleus of Black Maltese were recruited in August 1998, and the available Black Maltese stock was initially examined in the same month. It was decided to raise the birds as 'family poultry', i.e. in a home-backyard environment by volunteers (local women), having (or who were provided with) basic knowledge on poultry breeding and rearing. Several orientation sessions on poultry raising and breeding poultry, including some opportunities for 'hands-on' experience, were provided by the author of this paper at the beginning of the study. All facts considered, a small-scale intensive system was considered to be the most appropriate form of management for this project.

PURCHASE OF STOCK, HOUSING, FEEDING AND GENERAL MANAGEMENT

The site chosen for housing the stock, pen layout and construction materials were chosen to replicate those of other small-scale intensive poultry systems in Malta, as this would favour the extrapolation of results. A stone shed in a village garden was modified by the construction of wood and wire roofed pens, allowing for the separation of three different sub-populations of Black Maltese, called Line 1, 2 and 3 respectively. Therefore a "line" consisted of a group of chickens that were known to be closely related.

The flooring was of cement, and covered in sawdust from local carpenter shops, and particular care was taken to make the shed as vermin-proof as possible from rodents and the Spanish sparrow (Passer hispaniolensis). Seven birds from each line (one male and six females) were purchased, for a total of 21 specimens. Only birds from the same line were placed in the same pen, therefore three separate pens, present in the same stone shed, housed the breeding stock. Females within the same pen were tagged with rings of different colours for easy identification. Most specimens had almost completed their moult at time of purchase in August 1998. Vegetable crates were placed for use as nest boxes, and reeds (Arundo donax) were attached across the pens to serve as perches for roosting.

Partitions had to be placed between pens as the males were unfamiliar (coming from three different localities) and would spend an inordinate amount of time fighting through the wire, rendering all the birds nervous; partitions were removed after three months. They were fed on locally produced layer mash, and supplemented with greens (mainly Oxalis pes-caprae), and fruit and vegetable scraps. A supplementary source of calcium for the hens was (inadvertently) supplied as whitewash (lime) on the pen walls.

The poultry was given a light feed once daily for the first three weeks (August 1998), then fed twice daily as the photoperiod was increased by 15 minutes daily until a total of 13 hours of light daily were supplied to stimulate ovarian activity and lay. Natural lighting in the shed was kept deliberately dim, and light was supplied by the addition of a neon tube and an attached timer-switch with variable settings. Additional light was supplied as after moulting, the Black Maltese (and chickens in general in Malta raised as family poultry) do not commence laying eggs until February-March due to the progressive shortening of the photoperiod in autumn in this region.

Eggs were collected daily, and clean, unblemished eggs were stored pointing down in a cool (16 oC), dry place for subsequent incubation. Eggs laid in the previous seven days were set in a home model incubator (Covatutto 20, Novital S.R.L. Lonate Pozzolo, VA, Italy) in an ambient temperature of 18-20 oC. Incubators were used as space did not permit the keeping of bantams, traditionally used to hatch Black Maltese (Mallia, 1999). The eggs were rotated twice daily at 12-h intervals for the first 18 days of incubation. On hatching, chicks were immediately placed in carton boxes with two 15W red light bulbs as a heat / light source, present 24 h daily.

Feed was presented within 12 h of hatch in the form of an egg-rich mash that included honey and apple (Encia Pate, NE. IT S.p.A., Milano, Italy), and water was supplied within 24 h of hatch. The chicks were also ringed for identification purposes. As chicks were hatching in the colder months of the year (daily maximum 15-18 oC, nightly minimum 8-12 oC), heat was supplied for the first three weeks of life. They were fed commercially available 'chick crumbs'. Young birds, grouped by age in various pens, were subsequently housed with the breeding adults and fed grower pellets. Dead birds were collected by participating volunteers and frozen for subsequent examination by the author.

Computerised records and statistics related to the eggs laid in the various pens, various crosses performed, ID of eggs set, hatching records, chick pedigrees and characteristics were performed on a spreadsheet (Quattro Pro, Version 5.0, Scotts Valley, CA, USA).

RESULTS

Adult characteristics

Variation within a genetic line was negligible, whereas some phenotypic differences were evident among the three lines. Recessive genes described in the breed standard (Mallia, 1999) were present in all specimens of all three lines: single comb, lack of side sprigs in comb, lack of barring of plumage, non-feathered shanks, non-broodiness and fast-feathering of chicks. Body stature and head and tail characteristics, carriage, presence of prominent strong legs and active behaviour were consistent with the breed description in all three lines.

The breed standard ascribes white skin to this breed. This dominant trait was present in all specimens of line three, but only 50 % of line 1 and 50% of line 2 had white skin and slate legs. The remainder had yellowish skins and some yellow leg scales (recessive traits). The breed standard (Mallia, 1999) also does not mention the presence of red in the hackle. However, all three males had 1-3 red hackle feathers; this 'wild-type' trait is probably dominant, and is probably masked because these feathers are removed by owners to give an even black appearance to the specimen.

The roosters were very protective of the hens in their respective harems, but also sounded a series of 'alarm clucks' if other poultry in other pens were perceived to be threatened. In line with their rustic status, the roosters are fairly territorial and very intolerant of the presence of cats and dogs. In the presence of these potential predators, the male gathers his harem and the poultry run or fly to safety. All birds actively scratched in the litter and routinely roosted several feet above the ground at night. A despot (hen), second in dominance only to the rooster, was present in each pen. The hens in a pen were hostile to any subsequent addition of new hens.

Moulting, commencement of lay and hatch

Moulting commenced around late June 1998, and was virtually complete by the end of August. Hens were kept on very low feeding levels and with low light intensity levels in August to ensure a more rapid and complete moult.

Transportation stress coupled with being placed in a new environment were other factors that contributed to a rapid and complete moult. The order of the moult pattern did not vary from that of standard poultry breeds and varieties: moulting commenced with the head, followed by the neck, breast, back, fluff, abdomen, wings and tail. The birds were agile and capable of flight at all times during the moult. The sickle feathers in the males took 4-5 months for complete growth. The supplementation of light and increased quantity of feed successfully resulted in all hens being in lay by the third week of October. Hens immediately used the wooden vegetable crates for lay, and Black Maltese roosters routinely entered the nest boxes, clucking and crouching, and simulating a laying hen.

This behaviour encouraged the hens to enter the nest boxes and lay their eggs there, and all eggs (100%) were laid inside the boxes on clean sawdust. This resulted in none (0%) of the eggs being consumed by the hens or predators. Egg colour, shape and volume varied in the three genetic lines. Line 1 had eggs that were very pale tint, with a regular shape and small, with an average [standard error, SE] volume of 42.27 [0.59]cc; line 2 produced eggs that were white, round and large, with an average volume of 57.27 [0.7]cc; line 3 produced eggs that were white and pointed, with a volume of 45.87 [0.35]cc. There was no significant difference ($P \geq 0.05$) among the number of eggs laid in December 1998, January 1999 and February 1999 for all three genetic lines. However, there was a significant difference (($P \leq 0.05$) among the egg-laying potentials of the three genetic lines: line 3 clearly laid considerably less (monthly average [SE] = 17.11 [0.14] eggs), than the other two lines (monthly average [SE] line 1 = 26.94 [0.18] eggs; line 2 = 26.89 [0.24] eggs). The hatch results for various line crosses are summarized in Table 1.

TABLE 1: BLACK MALTESE HATCH SUMMARY

Cross (FxM)*	Eggs set	DIS** (%)	Clear (%)	Hatched (hatchability, %)***	Survived (survivability, %)****
2x3	120	36 (30.0)	6 (5.0)	78 (65.0)	78 (100)
1x3	108	60 (55.6)	0 (0.0)	48 (44.4)	48 (100)
3x1	174	66 (37.9)	6 (3.4)	102 (58.6)	102 (100)
1x2	78	12 (15.4)	6 (7.7)	60 (76.9)	60 (100)
2x2	108	54 (50.0)	0 (0.0)	54 (50.0)	54 (100)
1x1	60	24 (40.0)	6 (10.0)	30 (50.0)	30 (100)
2x1	54	24 (44.4)	0 (0.0)	30 (55.6)	30 (100)
3x2	66	36 (54.5)	6 (9.1)	24 (36.4)	24 (100)
Total	768	312 (40.6)	30 (3.9)	426 (55.5)	426 (100)

* F = female, M = male, 1 = line 1, 2 = line 2, 3 = line 3
** DIS = dead in shell
*** Hatchability = % of eggs set that hatch
**** Survivability = % of chicks hatched that survive until placed in shed with breeding stock (at 3 weeks)

The overall percentage of dead in shell (DIS) was very high (>40%), and the percentage of clear eggs was suitably low (<5%). Most DIS chicks (>95%) were completely formed despite their failure to hatch. Overall hatchability was found to be 55.5 %, and chick survivability was 100% (Table 1).

Chick characteristics

The chicks were very fast-feathering and precocious, showing a rapid ability to eat, imprint and move around freely. They were very independent, with a curious, alert nature, and would scratch around in the litter for feed and roost at a few days of age. The very rapid development of the wing weathers (within the first week of age), and long, strong legs were particularly evident; these are excellent characteristics for poultry that may be raised under free-range conditions and are allowed to forage for feed. The rapidity of feathering and other characteristics are summarized in Table 2. It is to be noted that, because of the absence of a foster mother and the prevailing low ambient temperatures (day 15-18 oC, night 8-12 oC), the chicks needed supplementary heat for the first 3 weeks of life.

TABLE 2: BLACK MALTESE CHICK FEATHERING SEQUENCE

Age (days)	Chick characteristics
1	Stand on legs within hrs. of hatch; will peck for feed within 12 hr of hatch
2	Very active; walk well, drink and feed; recognize imprinted people
3	Tips of wing primaries visible
4	Tips of wing secondaries visible; chicks commence to litter-scratch
5	Tips of tail visible; posterior wing feathers very evident and unfurling
7	Anterior wing feathers very evident
9	Bastard wing feathering evident (1/4 cm)
10	Comb size, type and colour variation evident
11	Tail with more than 1 layer of feathers
16	Feathering on spine, and under wings (lateral underparts)
18	Feathering on spine, under wings: bands 1/2 cm wide
24	Head, middle third of breast, underparts and inside of thighs still downy
25	Anterior half of neck downy; back covered with furled feathers
28	Breast feathered except central area (2x2 cm)
30	Some chicks are completely feathered across the breast
31	Feathering has reached throat
43	Throat totally feathered, head (dorsal aspect) totally feathered
50	Head feathering almost complete; otherwise feathered all over, wattles 1/4 cm
55	Head and body completely feathered

Disease

In Malta, smallholder backyard or semi-intensive family poultry flocks of (mainly) Rhode Island Red and White Leghorns have a high prevalence of IB, ILT, pox, coccidiosis and infectious coryza, amongst others. An adequate vaccination programme and anticoccidial regimen is usually absent. The adult stock purchased had a high prevalence of cutaneous (dry) pox (60%), all in the final crust or scab stage on the comb only. The breeding stock was very vigorous and had no other apparent conditions. Caecal coccidiosis due to Eimeria tenella was evident in all pens with chicks of two months or less in age, and morbidity approached 100%. Although coccidiosis due to E. tenella is said to be characterized by high morbidity and mortality, with death occurring often without previous symptoms (Asdrubali, 1986), early symptoms were discernible for over a week in the Black Maltese chicks: birds were huddled and depressed, and when roosting, rump feathers were fluffed. They moved close to a heat source if one is offered, and the chicks chirped continuously. The litter was constantly very wet, although very few solid faecal droppings, if any, were present. Routine treatment at this early and easily discernible 'wet litter' stage of disease with a coccidiostat and change of litter resulted in a low incidence of mortality (3 %).

DISCUSSION

Purchase of stock, housing, feeding and general management

A small-scale intensive system was considered to be the only pragmatic way of raising this breed, being a form of management that was compatible with the type of housing available. It also allowed the best control over the stock. Theft, accidental death (motorcars) and predation were major concerns. Furthermore, raising the flock under this system allowed for better control of disease: free-ranging and unconfined type of management render disease control difficult and expensive (Aini, 1990).

The small-scale intensive system also allows for the greatest number of eggs/hen/year to be collected (Sonaiya *et al.*, 1999), a priority for this project that aimed at saving and evaluating a critically endangered poultry breed. Feed accounts for over 60% of total production costs in the commercial poultry sector (Renkema, 1992), including the small-scale intensive system we chose. This cost was felt to be warranted considering the cost of purchase of the breeding stock and the sense of urgency to rapidly establish a sizeable flock.

Adult characteristics

Although the Black Maltese appears as a very homogenous group of poultry, some degree of genetic variation is still evidently present. Genetic variation may be advantageous in a population of poultry that are raised under highly variable conditions such as those encountered in a free-range or backyard system, and to some extent in a small-scale intensive system without a precise protocol.

The phenotypic variability was evidenced by the presence of Black Maltese with yellowish skins and yellow feet scales. This breed was mainly kept for egg production. Therefore the appearance of skin colour in the plucked carcass was of little concern. It is to be noted that Mediterranean breeds such as the Minorca, Castillian and Andalusian have exclusively white skin and slate coloured legs. Yellow skin colour with yellow leg colour as well as yellow and black mottled legs is typical of Leghorns and the Ancona, respectively. However, the population of relatively unselected Black Maltese has mainly slate legs and white skin (dominant traits), but individuals with yellowish skin and legs (recessive) are also still present. Selection pressure from the relatively unselected poultry population formerly present in many Mediterranean countries to form a well-defined breed may have originated contemporary breeds such as the Minorca and Ancona.

The presence of a few red feathers in the hackle is another indication of the relatively unselected and rustic status of the Black Maltese. All breed standards (e.g. Minorca, Ancona, Andalusian) strongly discriminate against specimens carrying the original 'wild-type' genes for red in the hackle, and this gene(s) has been removed from these highly selected breeds. There is minimal variability in egg colour in the Black Maltese (white to very pale tint), but more so in egg shape and volume (size). Hens laying smaller eggs may have been retained because they possibly lay more eggs or have a greater hatchability. We were not able to analyse this statistically due to the small sample size of hens available and confounding due to variables such as power cuts during incubation, inconsistent heat and humidity. The number of eggs laid was impressive for lines 1 and 2, especially as this was during months with a short photoperiod when lay was at its lowest, but also when egg prices were at a premium.

Clearly, the Black Maltese shows substantially more variation than other contemporary Mediterranean breeds. However, genetic variability may be a useful advantage for raising this breed under certain non-industrial management systems; this is especially so if it is to be utilized in a wider range of countries, particularly those with a hot, dry climate and where family poultry plays an important role.

Moulting, commencement of lay and hatch

Black Maltese hens can easily be induced to lay by the supplementation of light. They can also be easily trained to use crates for lay, for cleaner eggs, less breakage and easy location in free-range system. The roosters also play a role in this, as they routinely encourage the hens to enter nest boxes and lay. Although the sickle feathers in the males took several months for complete growth, it evidently did not interfere with fertility.

The percentage of dead in shell (DIS) was very high (> 40%), however it is probably due to errors (inconsistent heat and humidity) and limitations of our system of incubation, rather than to intrinsic characteristics of the breeding stock. Indeed, most DIS chicks (> 95%) were completely formed despite their failure to hatch. Statistical inference was not conducted on the DIS statistics as other variables, such as presence or absence of a power cut during incubation prohibit the interpretation of the DIS chicks. A multivariate approach of data analysis would be appropriate, but the small data set did not permit this approach.

The overall hatchability using artificial incubation was rather poor (55.45 %), even lower than those reported by Sonaiya *et al.* (1999) for free-range / backyard chickens (60-70%). Clearly, incubation alternative would have greatly benefited the Black Maltese project. If raised for commercial purposes in rural areas, sitting (Asian) breeds and their crosses could be used in a family poultry scenario to incubate the eggs. The non-sitting Black Maltese was formerly raised in conjunction with other rustic, sitting poultry. The latter types of hens incubated Black Maltese eggs, allowing the advantage of these non-sitting hens - high egg production - to be fully utilized.

The range of eggs laid under a small-scale intensive is usually of 80 - 150 eggs/hen/year (Sonaiya *et al.*, 1999). The Black Maltese appears to be able to equal and exceed this range with supplementary lighting in northern latitudes, but possibly even without, if raised in the tropics where seasonal differences in the photoperiod are less marked, and winters have more natural hours of daylight. The high egg-laying potential is a strong point of interest of this breed for possible use to stock family poultry units in hot climates.

Chick characteristics

The fast-feathering properties of the chicks were also of particular interest, as they differed in order and time of appearance than those described for commercial lines (North and Bell, 1990). The wing feathers develop very rapidly, helping the young chick to run / flutter rapidly and roost at a week of age. Black Maltese chicks, except for the head, are fully feathered at 30 days. The chicks of this breed are also very precocious, and readily eat within the first day of life. Being dark and having a marked tendency to roost from a very young age, night predation from rats is minimized.

As artificial incubation was used, this study did not shed any light on chick survivability in a free-range system with a foster mother (Black Maltese hens not being broody). However, this study has shown that if chicks are given particular care in the first three weeks of life the survivability can be extremely high (100%). This is of particular interest as mortality rates for chicks raised under free-range systems are often very high. Thus, this alternative way of raising young chicks under family poultry management systems may therefore be considered when some extra resources are present. It must also be emphasized that the setting of eggs and the hatch were supervised by local women (volunteers) that did not have any particular training, save basic training at the start of the project and a written protocol as a guideline. The volunteers considered the extra resources necessary outlined in this project as very worthwhile due to the excellent chick survival rate.

Disease

Under the present system, this flock had no direct contact with other poultry, and volunteers avoided contact with other poultry. Nonetheless, the breeding adults were carriers for pox and E. tenella. Coccidiosis could be ideally minimized by treating breeding adults when purchased, and housing chickens of different ages in different sheds; the latter was not practical in this project, and would be even less so under 'regular' family poultry conditions where space is usually at a premium. It was evident that even a rustic breed such as the Black Maltese was susceptible (high morbidity) to caecal coccidiosis under a small-scale intensive system.

This is in accordance with the observations of Sani *et al.* (1987) who noted that when chickens are confined, coccidiosis needed to be controlled. The low mortality due to caecal coccidiosis may warrant a field trial to examine whether this breed is actually more resistant to E. tenella, or whether we were merely repeatedly fortunate in being able to diagnose the condition very early in its course. Of interest was the apparent lack of ill direct effects of the cutaneous form of pox and of accompanying secondary bacteria infection on the adults, or of the young housed in adjacent pens. A long-term strategy for *in-situ* conservation of the Black Maltese will have to assess and implement a vaccination programme for the breeding stock. Currently, the entire flock rests unvaccinated; therefore the stock remains vulnerable to notorious epidemics such as Newcastle Disease, present (only) in the pigeon populations of Malta.

SUSTAINABILITY OF BREED CONSERVATION AND USE OF THE BLACK MALTESE

The best long-term strategy for *ex-situ* conservation may best be achieved by the involvement of the Agricultural Research and Development Centre (Ghammieri, Malta) in maintaining a breeding flock. The institute enjoys a large premise with several large pens, and is very well staffed.

The present paper represents the first six months of an *in-situ* conservation project aimed at maintaining a breeding flock and assessing the performance of this breed. Despite the cautious success of the project so far (over 400 chickens raised in 5 months under a slightly modified family poultry management system, there are valid concerns over its long-term sustainability. The major concern lies in that funding depends on sponsors that only have a short-term involvement. Likewise, the persons involved are all on a voluntary basis.

Most of the chickens have had to be released at a cost-recovery price as maintaining funds for their keep, and an adequately large site for housing, were not available.

Therefore whereas the short-term picture of the *in-situ* conservation project for the Black Maltese is one of relative success, it is only national and international involvement that will assure its survival and maximize its potential use as an efficient layer under a family poultry management system. As stated in the introductory paper of this conference (Sonaiya *et al.*, 1999), it is very encouraging to note the Food and Agriculture Organization's strong commitment to family poultry development.

The formation of the International Network on Family Poultry Development (INFPD), a non-governmental organization with strong backing from the FAO, should also go a long way in preserving and utilizing poultry genetic resources suitable for family poultry management systems. The Black Maltese appears to be rustic, prolific and a good layer of eggs. It may therefore be a suitable candidate for preservation, multiplication and stocking of family poultry units in xyrothermic tropical and subtropical conditions such as North Africa, the Sahel and Middle East. FAO / INFPD, together with the Agricultural Research and Development Centre (Ghammieri, Malta) now have an opportunity of further assessing the breed, and if deemed suitable will have a newly- available poultry genetic resource for introduction to family poultry projects worldwide.

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Rural family poultry scenario in tribal areas of central Madhya Pradesh, India – A socio-economic analysis

V. A. Kumtakar and P. Kumtakar

BACKGROUND AND INTRODUCTION

At the outset, we wish to compliment Sonaiya *et al.* (1999) for their introductory paper to this Electronic Conference giving vividly the entire scenario of rural family poultry and various practices followed in various countries. Free communication 5 by Rangnekar and Rangnekar (1999) was also very informative and interesting.

We have been into rural family poultry and development and the women's issues contained therein in central India. Rural family poultry (RFP) which is primarily an income generating activity is an integral part of any poverty alleviation programme in the rural context in India. We cannot undermine an Indian village which is a complex land-livestock-vegetation system in which the land sub-system, the water sub-system, the livestock sub-system and the energy sub-system all interact with each other. The purpose of any development plan including RFP should be to bring about a holistic enrichment of the entire village itself without destroying the synergy between the various sub-systems. However, considering the vastness these topics involve, we are restricting this paper to RFP in the tribal areas of central Madhya Pradesh, on the basis of study conducted in 39 villages of three districts involving 300 respondents and their family members.

The time is now perhaps ripe to commence pilot projects in rural poultry development in selected areas. These pilot projects, which should be area-specific, must be carefully devised to meet specific needs of the local populations.

The state of Madhya Pradesh (M.P.) in central India occupies an important place in tribal India. The tribal population of 15.4 million in M.P. accounts for nearly one-fourth of the total tribal population of 60.7 million in India. Within the state itself, tribals constitute about 23.3 percent of the total state population of 66.1 million spread over 0.443 million square kilometres. This tribal population is scattered over nearly 41 percent (0.18 million sq. kms.) of the state area. Of the nearly 78,950 villages (459 Blocks) in M.P., 30,000 villages (176 Blocks) [38 percent] have predominantly tribal population (Hasnain, 1996; Shrivastava, 1998-99).

Of the total 60.7 million tribal population in India comprising over 500 tribes, 6.7 million 'Gonds' constitute nearly 44 percent and 3.1 million 'Bhils comprise 21 percent (Tiwari and Sharma, 1994). Madhya Pradesh has nearly 46 tribes (Anonymous, 1994); 'Gonds' within themselves have nearly 54 sub-tribes (Tiwari and Sharma, 1994; Hasnain, 1996; Shrivastava, 1998-99). Thus, the name of this area in central India, "Gondwana", derives from this situation.

The main occupation of these tribals was hunting, collecting forest products and specializing as 'Tendu Patta' (beetle leaves) collectors. With the Government restriction, the hunting activity has been curtailed. The land holding being small (with single cropping system in most rainfed areas) and reducing with each generation, the tribal households depend on non-farm activities for supplementary income that includes cattle rearing, sheep rearing, piggery and poultry. Some of them migrate to urban areas in search of wage employment for livelihood security.

Rural family poultry (RFP) are reared on a small-scale within a limited area in the backyards of village households, with a number of birds ranging from 1 to 10. Birds are raised mostly in a scavenging system. They eat anything edible available in the backyard like insects, farm and domestic waste, leaves, etc. They move in and around the compound of household like any other family member and rest wherever they find a place. More than 65 percent of tribal families have poultry in small flocks of 4-5 birds per household in low-input/low-output husbandry conditions. Indigenous coloured birds are usually reared and preferred over the exotic white birds. These coloured are offered to the family God 'Bara Deo', during the festival time or as a sacrifice to cure diseases. Chickens are also relished as a festival meal. Thus, scavenging poultry are a part and parcel of a typical tribal household touching their social, cultural and economic live.

RFP VERSUS COMMERCIAL POULTRY - A SCENARIO

Keeping RFP has been a tradition in the tribal families since time immemorial. RFP produce, being lower in quantum is almost all consumed at the village level itself. Products from both RFP and commercial exotic birds have been running parallel with its own market segment and specific clientele. But surprisingly it is only the commercial intensive poultry sector that has taken rapid strides in the post independent era. Egg production in India has increased from merely 1.83 billion eggs in 1950-51 to nearly 33 billion in 1997-98, placing the country in 5th position next only to China, USA, Japan and Russian Federation (Anonymous, 1998). Besides, India occupies the 22nd position in broiler production in the world (Sathe, 1999).

Ironically, the rural poultry scenario is dismal when compared to the commercial poultry. As per the 'All India Livestock Census', the number of indigenous 'Desi' birds less than doubled between 1961 and 1987, as against more than twelve times increase in the case of improved varieties in the same period (Rajan, 1996). The low productivity leading to low profitability in RFP was probably contributing to stagnation in rural poultry. Being a low output and less visible area of income generation, the departments and developmental agencies concentrated more on cattle rearing and crop production and, consequently, poultry development got the back seat.

All the improved technologies reached the urban populace and seeing this as a lucrative option, even the educated urbanites developed commercial poultry into a successful agri-business. On the contrary, those in the rural areas rearing traditional poultry in small flocks (i.e. 1-10 birds per household) for ages remained more or less with minimal or no development. RFP for the tribal families is like a 'reserve bank' to fall back upon in emergencies and yet they constantly live in a fear of losing the entire 'bank balance' when a disease outbreak occurs. A systematic and planned development of RFP thus holds a tremendous potential for growth in tribal areas.

IMPORTANCE AND OBJECTIVES OF STUDY

Though tribal families have a synergy in keeping poultry as a traditional custom, it has not been developed into a sustainable source of income. Besides, there has been a lack of literature, documentation or a systematic co-ordinated effort by agencies to develop this available synergy into a viable rural venture. Furthermore, basic problems that need to be addressed in RFP are:

- heavy mortality in chicks,
- disease outbreak in hens and their mortality,
- unbalanced feed for birds leading to malnutrition/undernutrition,
- low egg productivity,
- lack of veterinary services during disease outbreaks,
- lack of awareness and knowledge regarding poultry rearing practices.

It was therefore felt relevant:

- to study the existing RFP scenario in the tribal areas,
- to study the constraints in RFP rearing practices as enumerated by the rural population and their possible solutions,
- to create awareness and suggest simple low-cost management practices, feed formulation, vaccination schedules to develop RFP into a sustainable income generating activity.

METHODOLOGY OF THE STUDY

The study was conducted in the three districts of Madhya Pradesh in central India, viz. Jabalpur (Shahpura block), Mandla (Niwas block) and Chhindwara (Tamia block). These blocks were selected because of the presence of high tribal population. Three hundred respondents from 39 villages were purposively selected (100 from each district). Only persons having RFP were surveyed.

In-depth interviews were taken of the individual respondents with the help of a questionnaire. The data were systematically recorded, interpreted and analyzed.

RESULTS AND DISCUSSION

Data obtained among 100 respondents from each of the three districts revealed that 'Gond' was the predominant tribe in Jabalpur (44 percent) and Mandla (76 percent) while Chhindwara had 'Bharia' tribe (58 percent) followed by 'Gond' (38 percent). About 92 percent of the respondents kept 1-12 birds (58 percent had 1-4 birds and 34 percent kept 6-12 birds). The annual egg production per hen ranged from 30 to 60 in the area during the period of our present study, as compared to 75-110 eggs in western India (Rangnekar and Rangnekar, 1999).

RFP seemed to be an arena of women. They have total responsibility right from rearing of chicks to the sale of birds/eggs. Almost all (92-96 percent) of the procurement and sale of poultry products were done at the village level itself, market place and from farmer's house. The amounts accrued from the sale of birds/eggs, though small, were usually handled by women and were seen as a supplementary income by most respondents (82 percent). This seems similar to the tribal scenario in western India (Rangnekar, 1992). Besides, the reasons mentioned by women respondents in the three districts for not keeping a larger flock size of birds were the fear of mortality and the loss of the entire flock in the event of disease outbreak. They expressed that RFP is an activity involving minimum labour and time. Similar reasons for rearing poultry in tribal areas of both central India as well as western India were reported by Rangnekar and Rangnekar (1999). According to these authors, the reasons mentioned by RFP keepers were family consumption, sale/business (cash), celebrations/traditional rituals/sacrifices/curing diseases, interest/hobby and sport (cock fighting).

Our analysis reveal that almost all (99 percent) of respondents expressed their preference for indigenous birds over the exotic varieties, on account of following main features:

- easy availability,
- easier to look after,
- tastier and more nutritious,
- better adjustability to local environmental conditions,
- low egg production but birds are hardier in nature,
- better brooding hens,
- more demand and birds fetch higher prices,
- more familiarity for rearing indigenous birds.

Some of these features were reported in western India (Rangnekar and Rangnekar, 1998; Rangnekar and Rangnekar, 1999).

Surveyed RFP keepers expressed that they sell more cockerels (62 percent of the respondents) followed by eggs (20 percent) and lastly hens (18 percent). They treasure the eggs and hens - eggs for hatching and hens for laying and brooding. This, according to the farmers, would fetch them more revenue. However, the eggs and hens are sold in the event of emergencies. As it is, both eggs and birds of the indigenous stocks fetch a price one and a half to two times as that from the commercial exotic varieties.

The majority of respondents, ranging from 78 percent in Mandla to 97 percent in Chhindwara, fed their birds using locally available grains, viz. 'Kodo', 'Kutki' (small millets), broken rice and sorghum, while the rest offered the leftover food in the house. Feeding pattern was generally ad-hoc. It was expressed that the feeding was not with a view of giving supplementary nutrition but generally given in the evening to habituate and condition the birds to return back home. In fact, they felt that the birds manage to get sufficient food for them in the backyard.

Most respondents expressed that they spent annually between Rs. 10 to 400 (US$ 0.23 to 9.41) on poultry feed resources. They either bought out grains or calculated from their own source, using the market price. This feeding was ad-hoc. The supplementary income generated from the RFP per annum was in the range of Rs.100 -700 (US$ 2.38 to 16.47).

CONCERNS IN THE RFP

Most of respondents expressed concern about chick mortality, in the first 30 days of age. Rearing of chicks in this period seemed to be the most delicate issue for tribal families.

Malnutrition and undernutrition are seen to cause early chick mortality. An effective intervention in the rearing of chicks as well as an improvement in the nutrition of chicks would therefore be appropriate.

There were differences in the occurrence of ailments resulting in bird mortality. While Ranikhet disease (Newcastle disease) posed a major concern in Jabalpur (66 percent), the same was 22 to 25 percent in Mandla and Chhindwara. As expressed by the respondents, diarrhoea, worm load and heat stress seemed to be problems causing 32 percent (Chhindwara) to 47 percent (Mandla) mortality in birds. Large number of respondents either could not identify the diseases or expressed helplessness to combat the same. They said there was no veterinary assistance in the vicinity, and this was partly responsible for high mortality. The respondents in all three districts expressed that the predators were also causes for depletion in birds.

SUGGESTIONS OFFERED BY RESPONDENTS DURING OPEN DISCUSSIONS

During the in-depth interview sessions with the respondents, the promptness with which the following suggestions were put forth (ranking wise), were suggestive of the awareness of their long felt need for improving their present-day poultry status:

- Provision of vaccination and proper veterinary facility;
- Financial assistance for making meshed enclosures;
- Training in improved chick rearing, feed management and mortality reduction;
- Feed supplement to be made available in the village;
- Provision of higher yielding variety of ‘Desi’ (indigenous) birds.

RFP DEVELOPMENT FOR SUSTAINABLE SOURCE OF EARNING TO RURAL HOUSEHOLDS

Madhya Pradesh is a backward state with a large percentage of tribals living below the poverty line. Nearly 70-80 percent of the households maintain RFP, which is typically an arena of women. What is really needed is (i) to improve upon the existing poultry rearing practices thereby reducing the mortality in birds and, (ii) to increase the egg and meat productivity by popularizing specially developed birds that resemble the coloured indigenous breeds. These would fit well into their traditional and cultural set-up and match their preferences and liking and, at the same time, give a higher egg yield and body mass.

At this juncture, we cannot resist quoting Prof. Gunnar Myrdal in his monumental work “Asian Drama”, wherein he has rejected the thesis/strategy that the social fabric of the tribals should not be changed much. He continues, “If undue hurry will be very costly, lethargic pace will not show perceptible results. If ‘revolutionary’ changes are not desirable or possible, ‘too slow evolutionary process’ will not deliver the goods”

PROSPECTS FOR RFP DEVELOPMENT

- The existing synergy available in terms of experience, knowledge and interest in poultry rearing should be built upon;
- Systematic planning for capacity building must be developed to make the resources like medication, vaccination and low-cost feed formulation, available at the village level;

- Introduction of improved higher yielding varieties of poultry birds having physical characteristics similar to those of indigenous birds, to be popularized at the village level.

It is important to keep in mind that a tribal family looks for quick earning avenues for their livelihood security. This must be taken into account by planning a RFP project. In addition, to ensure a sustainable development for this subsistence poultry sector, a long-term objective must be adopted. We would therefore recommend the development of RFP pilot projects in tribal areas of central India in two phases:

Phase - I

Through awareness programmes/campaigns and systematic training, bring in a qualitative improvement in the existing scenario through minimum inputs, viz.

- Introduction of creep-feeding (nutrition of chicks),
- Introduction of simple chick brooding practices to reduce chick mortality due to freezing/thermal shocks in the initial stage. In this respect, covering the reverse bamboo/cane baskets with cow dung and paper can give good results. Chicks can be kept warm by lighting a lamp or burning charcoal/wood cinders underneath the raised baskets.
- Vaccination of chicks against Newcastle disease (NCD) would drastically reduce mortality in birds. Prof. Spradbrow's thermally stable I_2/V4 NCD vaccine could be useful, and till its easy availability, LaSota strain of NCD which is easily available in the market though in larger dose vials, could be made use of by maintaining a reduced temperature in thermos flasks.
- Provision of economic night shelters to keep away from predators.

This would undoubtedly bring in added revenues as a consequence of reduced chick and adult bird mortality due to NCD/predators.

Phase - II

Introduction and popularization of an improved variety of poultry birds as mentioned is recommended. The Veterinary Science Department of Jabalpur Agriculture University has developed Krishna-J, a synthetic layer bird (1983). It has an laying capacity of 110-120 eggs in free-ranging (scavenging) system with small supplementation and 200-220 eggs in the intensive system. Average egg weight is 48-52 g, with a tinted brown coloured eggshell. Body weight ranges amounts to 900-1000 g in 6-8 weeks. This bird is comparatively resistant to heat stress, spirochaetosis and coccidiosis under our conditions (Khan, 1983). Jabalpur Agriculture University is now experimenting with a cross of synthetic male with Krishna-J female, which will not only have the characteristics of high yielding variety but also have an added advantage of increased body weight and a larger shank length for improved flightiness.

Such an introduction of Krishna-J in the villages could be in 1:6 or 1:8 (male:female ratio). This would enable (1) availability of more eggs (protein) to the family, and, (2) have more chicks from the eggs through brooding by indigenous hens (obviously good layers cannot be good brooders and hence the utility of indigenous hens). Should the egg productivity go beyond the brooding capacity of local hens, an incubator that can hatch 100-120 eggs at a time and which can be operated by electricity, oil or coal/wood can be utilized. Such an incubator has been developed and tested in south India, which is priced at Rs. 8000 (US$ 188-190).

FUTURE SCENARIO OF RFP

With the right intervention leading to an increased production of eggs and birds, the problem of malnutrition will be overcome and would fulfil the long felt need of quality proteins to the tribal families. However, excessive production may necessitate building up of marketing linkages to peri-urban/urban areas. A need may thus emerge to form co-operatives/ centralized marketing.

As of now, RFP is totally a woman's arena, wherein she uses the cash earned as she likes and exchanges her poultry produce for other necessary household goods (barter system). With the excessive production, it would be the menfolk who may take charge of marketing the poultry produce to peri-urban/urban areas.

Customarily, whenever there is a large amount of cash involved, the men take charge of the situation. He would receive and may retain the money earned from selling. RFP then may not totally remain a woman's domain and she may loose hold over a venture, which today she proudly claims as her business.

The brighter side of the issue is that the family will earn more cash, improve its nutritional status and jointly contribute to the venture, which will hopefully curb the migration of the families for wage employment. Success from such low investment ventures would lead to higher income generation, thereby inculcating entrepreneurship among the tribal families and motivate them to go in for higher investment opportunities like goat rearing, cattle rearing etc., leading to an improved quality of life.

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Thermostable Newcastle disease vaccines for use in village chickens

P. B. Spradbrow

ABSTRACT

The major impediment to village poultry production is Newcastle disease. Conventional vaccines are unsuitable for sustained use because of their cost, large dose presentation and thermolability. The Australian Centre for International Agricultural Research (ACIAR) has sponsored projects to develop thermostable vaccines more suited to use in village flocks. Vaccine strain V4 is now available as a commercial vaccine, and strain I_2 as seed material that can be used for local production of vaccine. Thermostable vaccines are best delivered by eye drop but they can be given in drinking water or on suitable particles of food. These vaccines, suitably applied, have proved effective in many trials under laboratory conditions and in villages. Extensive use of these vaccines should allow the development of a new science of village poultry production. However wider use of these vaccines will require further training on their production and use, and the adoption of suitable, and probably novel, extension methods.

INTRODUCTION

Village chickens

The importance of village chickens to the rural and peri-urban poor in developing countries is not contested. Another universal truth is that these flocks are poorly productive, and cost-effective remedies should be available. Many advocate a holistic approach to these problems. The author, with a virological bias, sees the pivotal problem as Newcastle disease. Genetic interventions, alterations to husbandry practices or improvements in nutrition are of no avail unless there are live chickens in the flocks. The author sees the control of Newcastle disease as the key to a new science of village chicken production. Vaccination offers the only prospect for control. Eradication of the virus is not feasible, so vaccination programmes must be continual and sustainable.

THERMOSTABLE VACCINES

Any of the usual commercial Newcastle disease vaccines will protect village chickens against Newcastle disease, if the vaccines reach the chickens in a potent form. There are special problems. Many commercial vaccines are thermolabile and sometimes extremely thermolabile. Cold chains are impossibly expensive to develop and maintain. Village flocks are small, scattered and multi-aged. The minimal unit container for a commercial vaccine is usually 1000 doses, which is expensive and inconvenient for very small flocks. Commercial vaccines require foreign exchange.

The Australian Centre for International Agricultural Research (ACIAR) has supported projects on the vaccination of village chickens since 1984. The original concept was the production of a thermostable strain of Newcastle disease virus, developed by artificial selection. This seemed to the original applicants a novel approach at the time, although manipulation of the storage medium had already been used to improve the thermostability of liquid poliomyelitis vaccine. In fact, the concept of thermostable variants of conventional viruses had a longer history. The early work in Hungary that resulted in the Bartha vaccine for Aujeszky's disease used heat selection to yield variants of reduced virulence. Other herpesviruses appear to respond similarly to heat selection. A heat-resistant rinderpest virus vaccine was described in 1992 (Provost and Borredon, 1992). Hofstad and Yoder (1963) had suggested that robust Newcastle disease vaccines might be produced by seeking strains of virus that possessed superior thermostability. Heat-resistant strains of Newcastle disease virus had actually been produced in the 1950s for use as phenotypic markers in genetic experiments (Goldman and Hanson, 1955).

Thermostability is a relative term. It has been unfortunate that thermostable vaccines have sometimes been considered as another basic commodity, like a sack of rice, that needs no special treatment. All vaccines need careful nursing. Thermostable vaccines have some viability away from the cold chain, but transport conditions should still be as cool as possible. When the cold chain ends, thermostable vaccines should be transported in wet cloth, preferably in an open weave basket. Beside the base of a water pot is often a cool storage position in a hut. One sometimes sees criticisms of agencies that have purchased thermostable vaccines and then afforded the vaccine cold storage. Such criticism is misguided.

The thermostable vaccine that has been most used is a variant of the avirulent Australian V4 strain of Newcastle disease virus, described by Simmons (1967). This virus had an inherent degree of thermostability (Kim and Spradbrow, 1978) and it responded to selection for enhanced heat-resistance (Robyn Schalkoort, 1979, unpublished data). Ideris (1989) has published detailed data on the selection of heat-resistant variants of strain V4. Heat-resistant variants of V4 are now contained in commercial vaccines. The two sources known to the author are: **Malaysian Technology Development Corporation Sdn Berhad** and **Fort Dodge Australia Pty. Ltd.**

Once V4 became a commercial vaccine, the target for vaccination became commercial chickens. Village use continued in Malaysia where the vaccine was produced. While the vaccine was supplied on food (pellets and later wheat) it was reported that Newcastle disease was largely controlled in Malaysian villages (Anonymous, 1997). Ideris (1998) noted that use of vaccine in villages declined when the commercial producers stopped supplying vaccine on food. The commercial freeze-dried vaccine in 1000 dose ampoules was not convenient for village use, but vaccine use is increasing in villages with the production of 100 dose ampoules. Further large-scale application in villages was restricted to a few countries where foreign agencies purchased the vaccine. There were however many small-scale trials.

The focus turned to local production of thermostable vaccine and the supply of seed material free of commercial ownership. ACIAR sponsored the development of a second thermostable vaccine, strain I_2, from an avirulent Australian isolate similar to V4. The selection was made after studying a collection of 42 Australian isolates (Spradbrow *et al.*, 1995). I_2, already a thermostable virus, was selected for enhanced thermostability (Bensink and Spradbrow, 1999). The seed material can be made available to laboratories in developing countries that wish to test and possibly produce vaccine locally. Successful laboratory and field trials led to strain I_2 being adopted as the vaccine for use in village chickens in Vietnam (Tu *et al.*, 1998).

Other thermostable variants of Newcastle disease have been produced – in Hungary from a local isolate, in Vietnam from La Sota and in Indonesia from a virus that is possibly mesogenic. The process is not difficult, but we know very little on the persistence of thermostability on continued passage without further selection.

Thermostable vaccines seem to be a partial answer to the problem of Newcastle disease in village chickens. In this discussion paper the author attempts to review the successful field trials from both formally published and unpublished sources. For unpublished reports I have tried to indicate a contact from whom further information could be sought. I know there will have been other trials that have not come to my attention. I would welcome information on these.

More importantly, there are sometimes reports that cast doubt on the thermostable vaccine approach. For example, Kitalyi (1998) saw the need for more on-farm research into sustainable control of Newcastle disease. Other reports contain no data, nor references to published data. As a practising editor, I recognise how difficult it is to have negative results accepted for publication. However it is urgent that unsuccessful vaccine trials are brought to notice and the reasons for vaccine failures are sought. We were successful in having some unproductive results included in a paper from Thailand (Tantaswasdi *et al.*, 1992). Failures in the preliminary experiments probably resulted from maintaining the experimental chickens on wire. Vaccination was effective when chickens were placed on a solid floor.

I solicit examples of unsuccessful trials with thermostable vaccines and analysis of the reasons for failures.

More detailed considerations of earlier trials are contained in two ACIAR publications. Copland (1987) and Spradbrow (1992) - and in a review – Spradbrow (1993/94).

ACIAR and the University of Queensland are attempting to consolidate data on village chickens in a website – http://www.vsap.uq.edu.au/ruralpoultry

THERMOSTABILITY

Liquid vaccine

Newcastle disease virus vaccines are less heat-stable in liquid form than in freeze-dried form. However, under village conditions, Newcastle disease vaccines must often be stored and transported in liquid form. Various additives are available to protect virus infectivity during freeze-drying and subsequent storage. Not all of these have been tested as protectants of viral vaccines stored in liquid form.

The Malaysian thermostable variant of V4 survived exposure at 56ºC for at least 9 hours; the parent stock was entirely destroyed after exposure for 3 hours (Ideris, 1989). The author also noted that for long-term protection (3 weeks) at 20-25ºC, polyvinyl-pyrollidone (PVP) was more effective than skim milk, gelatin, methylcellulose or carboxymethylcellulose. Claxton and Leonard (1987) reported that V4 virus lost less than 1 log_{10} unit after storage for 1 hour at 50ºC and less than 3 log_{10} units after 6 hours.

Strain I_2 had similar thermostability to V4 in tests conducted by Uruakpa (1997). In a favourable diluent (with lactose, sodium glutamate and bovine serum albumin) I_2 lost only 0.3 log_{10} units on storage for one month at 22ºC.

Freeze-dried vaccine

The thermostability of heat-resistant V4 vaccine, obtained by selection in a liquid medium, is also evident in the freeze-dried vaccine. The commercial vaccine was stable in freeze-dried form for 3 months at 18-22ºC, and lost only about 1 log_{10} on storage for a further 3 months (Heath *et al.*, 1991).

Freeze-dried I_2 vaccine lost about 1 log_{10} of infectivity when stored for 6 days at 26-32ºC (Tu *et al.*, 1998). However in the same study vaccine reconstituted after storage for 24 days at 30-35ºC still produced substantial protection in vaccinated chickens. It should be possible to reach village chickens in any part of Vietnam with this vaccine, without refrigerated transport.

Dr. Ian Wilkie confirmed that I_2 vaccine was reaching remote hill areas of Vietnam. The vaccine was apparently viable. In April 1999 he visited villages where some chickens had been vaccinated and tagged. The vaccinated chickens were surviving while unvaccinated chickens in neighbouring flocks were dying, apparently of Newcastle disease (Wilkie, 1999).

Vaccine on food

Oral vaccination of chickens with thermostable vaccines requires that the virus attaches to the food, and survives to be released on ingestion by the chicken. Not all foodstuffs are virus friendly. Problems are probably associated with substances that inactivate viruses and with binding to food lectins. The role of heat inactivation of Newcastle disease virus on food can be estimated only with the most innocuous of food carriers. Cooked white rice is possibly the best for this purpose (Samuel *et al.*, 1993).

In Malaysia commercial food pellets were coated with thermostable V4 and stored at 20-25ºC. The food vaccine was stable for at least 1 month (Ideris, 1989). Further evidence of this stability was obtained when commercial pellets coated with thermostable vaccine were sent from Malaysia to The Gambia. The vaccine was 8 days in transit, and then was kept at close to room temperature for another 14 days during transport to villages. About half the chickens receiving the oral vaccine produced antibodies suggestive of protection, while there was no antibody response in control villages (Jagne *et al.*, 1991).

In Malaysia oral vaccine was prepared in bulk with wheat grains as the carrier. Wheat in 100kg quantities was placed in a special food mixer and sprayed with liquid V4 vaccine. After air drying the vaccine-coated wheat was packaged in 100g amounts, suitable for delivery to 20 chickens. In experiments conducted by Dr. Jah Hussein (Hussein, 1991) vaccine stored for 6 or 7 weeks at room temperature still gave substantial protection. There was no advantage in storing the vaccine at 4ºC. The residue from the production of maize porridge has been used as a carrier for V4 vaccine in Nigeria. This vaccine remained viable for over 3 months on storage at 20ºC (Olabode, 1998).

The results obtained by vaccinating chickens are not always in accord with those obtained when virus is soaked from the food and titrated. It may be that chickens are better than saline solutions in removing virus, or that chickens will respond to inactivated virus given orally. Rehmani and Spradbrow (1995) presented evidence indicating that this can happen.

EFFICACY

Measuring efficacy

There are several methods in common use to measure the efficacy of vaccines. They vary in sophistication and they vary in cost effectiveness.

Circulating antibody

Chickens successfully vaccinated with Newcastle disease vaccines produce antibodies that are present in the plasma and that will react specifically with Newcastle disease virus. Various laboratory tests are available to detect and to quantify these antibodies.

The test used most commonly is the haemagglutination inhibition test. Surface glycoproteins on the envelope of Newcastle disease virus have the ability to attach to receptors on chicken red blood cells. When suspensions of red blood cells and virus particles are mixed, the red blood cells are agglutinated. Virus previously exposed to specific antibody loses its ability to haemagglutinate. Various versions of haemagglutination tests have been described. One commonly used with Newcastle disease virus is the micro-test described by Allan and Gough (1974a,b). This test is useful because the authors found that a specific titre (1 in 8 or 1 in 23) or higher gave a good indication of protection against potentially lethal challenge with virulent virus. This observation has been confirmed in subsequent field trials. Now it is not always necessary to undertake challenge experiments to obtain an indication of successful vaccination. In many village trials the moderate antibody titres induced by vaccination can be distinguished from the higher titres that result from challenge with virulent field virus. This is useful in monitoring vaccine trials.

The haemagglutination inhibition test is very useful in village studies. The requirements are simple – chickens to donate blood, anticoagulants, simple buffers and plastic microtitre trays. The test procedure is sustainable in the absence of outside funding.

Haemagglutination inhibition antibody is only one indication that a series of immune phenomena has been initiated in an infected or vaccinated chicken. The antibody that is measured is not the total immune response. However with maternal transfer of immunity, only antibody from the hen is available to the immune chick. Rehmani and Firdous (1995) showed that the levels of passively acquired antibody needed to indicate protection are higher than the levels that indicate active protection.

The most common of the other tests for antibodies against Newcastle disease virus uses ELISA technology. This test is widely used to monitor the response to vaccination of commercial chickens. ELISAs do require some expensive equipment, but they are very sensitive and require small amounts of reagents. Sufficient quantities of antibody can be obtained from whole blood dried on paper discs or from feather pulp. For use with village chickens a standard ELISA will be required and it will need to be assessed for any correlation with protection.

The virus neutralization test is regarded as the gold standard for viral serology. This test depends on the reduction in infectivity that results when infectious virus particles and specific antibody are mixed. Embryonated eggs or cell cultures are required to quantitate infectivity. Haemagglutination inhibition antibodies and neutralizing antibodies correlate well, for example as shown by Rehmani and Firdous (1995).

Other indicators of active immunity

The production of circulating antibody is not the only immune response available to the chicken. The other responses are more difficult to measure and there are no routine assays. Cell-mediated immunity has been demonstrated in chickens vaccinated with V4 vaccine (Jayawardane and Spradbrow, 1995a). The test used was leukocyte migration inhibition. Antibody responses did not correlate with cell-mediated immunity. Oral vaccination of chickens with V4 vaccine was also shown to induce the production of IgA antibody and an associated mucosal immunity (Jayawardane and Spradbrow, 1995b). The authors suggested that mucosal immunity might explain the resistance to challenge virus sometimes demonstrated in orally vaccinated chickens that had produced little or no circulating antibody.

Artificial challenge

The crucial test, and one not available when human vaccines are tested, is artificial challenge. Quality assurance protocols for avian vaccines usually include a challenge procedure in which vaccinated and unvaccinated hosts receive a defined dose of virulent challenge organism by injection. This process has usually been avoided in trials with thermostable vaccine. Challenge has nearly always been by contact. This mimics natural challenge. If the challenge virus is injected one component of the vaccinal immunity, mucosal immunity, has been bypassed. Certainly the dose of challenge virus cannot be defined in terms of 50% lethal doses (LD50). However if all control birds succumb, the challenge must be at least one 100% lethal dose (LD100).

Protection trials with thermostable vaccines conducted before 1998 have been reviewed (Spradbrow, 1993/94). There have been several subsequent projects with thermostable Newcastle disease vaccines in which protection has been demonstrated by contact challenge. These include trials in Ghana (Amakye-Anim *et al.*, 1998), Tanzania (Foster *et al.*, 1996, 1999), Ethiopia (Nasser *et al.*, 1998), Vietnam (Tu *et al.*, 1998), Zambia (Alders *et al.*, 1994) and Philippines (Fontanilla *et al.*, 1994).

Protection against disease is not protection against infection. Clinically normal chickens vaccinated with V4 vaccine and showing no clinical signs on exposure to virulent virus will excrete the virulent virus. This has been isolated from cloacal swabs and tracheal swabs for at least 14 days after challenge by Dr. Zubaida Mahmood (Mahmood, 1991). More importantly, these birds could infect susceptible in-contact chickens. Chickens with low pre-challenge antibody titres were more likely to excrete virulent virus and transmitted virulent virus more readily by contact than did chickens with high levels of vaccine-induced antibody.

As might be expected, when chickens are vaccinated under laboratory conditions, higher levels of protection are observed than under field conditions. With the thermostable vaccines, protection rates of 90 to 100% are often recorded. The technique of buy-back challenge is often used to measure field efficacy. Chickens that have been vaccinated under village conditions are purchased and subject to laboratory challenge. Selection cannot be truly random, but the purchasor should have no knowledge of any serological data that is available. The owner decides which chickens are for sale and the birds should be roughly matched for size to minimise aggression when they are housed together.

For example in Malaysia, chickens vaccinated under laboratory conditions with food-based vaccine showed better than 90% protection (Aini *et al.*, 1990a). Under simulated village conditions (Aini *et al.*, 1992) and under real village conditions with vaccine delivered by farmers (Aini *et al.*, 1990b), protection rates were about 60%.

Field challenge

It is surprisingly difficult to quantify field challenge. Constant monitoring is required to determine causes of death if disease-specific mortality is to be determined. A few such studies are available. Ronohardjo *et al.* (1988) were able to attribute losses in vaccinated and control flocks to Newcastle disease. In Tanzania Foster *et al.* (1999) had access to most of the chickens that died in vaccinated and control villages. About 70% of the deaths were attributed to Newcastle disease. Johnston *et al.* (1992) used intense serological monitoring to determine when village flocks were exposed to virulent Newcastle disease virus. He attributed the excess deaths over background levels during these periods to Newcastle disease. Effective field protection varied from 50% for adults to 78% for growers.

Census data

The collection of population data is a relatively simple way of indicating a probable response to vaccination. Where laboratory facilities are lacking, it is the only way. Consequently this approach is often used by NGOs, and the results are rarely published. There are many anecdotal accounts of vaccination being followed by an increase in the chicken population – from Timor, Myanmar, Laos, Bangladesh and Ghana. From Indonesia (Ronohardjo *et al.*, 1988), Sri Lanka (Jayawardane and Bandara, 1992) and Tanzania (Salum *et al.*, 1997) come similar observations with comparisons with unvaccinated control villages.

HOW TO APPLY VACCINE

Eye drop

The most effective way to administer thermostable Newcastle disease vaccines is by eye drop – providing the chickens can be caught. Unless the chickens are provided with some form of night housing this task becomes horrendous. There will usually be an antibody response to a single application of vaccine, and the vaccinator can be relatively certain that each chicken has received vaccine. Vaccine can then be applied by trained village vaccinators, or by the owners of the chickens. However, training is essential. When eye drop vaccination of commercial chickens can result in instances where only 40-50% of the birds receive properly applied vaccine (Anonymous, 1998), the need for proper vaccination technique is essential.

Plastic dropper bottles are relatively cheap. In parts of Vietnam thermostable vaccine is supplied in such bottles. In some countries the supply of dropper bottles is scarce. Tanzanian villages wishing to vaccinate chickens by this route apply the vaccine to the eye on the tip of a chicken feather. They use a similar technique for introducing medication to the eyes of their children.

Nose drop and mouth drop

The chicken eye is a small and mobile target for a novice vaccinator. It is simpler to apply a drop of vaccine to a nostril and to see it inhaled. This technique may be less effective than eye drop application because the lymphoid tissue of the Harderian gland is not exposed to the vaccine.

Application of thermostable vaccine by mouth drop has also proved effective in Indonesia (Darminto and Daniels, 1992) and Malawi (Sagild and Spalatin, 1982). Dr. Urasri Tantaswasdi has suggested that vaccine could be diluted and placed in the mouth in larger volumes (1.0 ml) to reduce errors by unskilled vaccinators.

Drinking water

Drinking water is not an option for vaccination in all areas. In the wet tropics chickens find their own sources of water. Where surface water is unavailable or where chickens are confined, application of thermostable vaccines in drinking water is possible.

Vaccination through the drinking water usually gives good results, sometimes similar to those obtained with eye drop vaccine. Examples of this approach can be found in Tu *et al.* (1998), Foster *et al.* (1999) and Tantaswasdi *et al.* (1992).

It might be incorrect to regard drinking water as a form of oral vaccination. The vaccination virus may infect through nasal or pharyngeal mucosal surfaces, rather than through various parts of the digestive tract. The quality of the drinking water and the type of container will influence the results.

Food carriers

The initial studies with thermostable Newcastle disease vaccines concentrated on oral delivery. This was because the village chickens in Malaysia at that time were seldom provided with housing. A food-based vaccine was the only feasible approach. It was realised that food vaccines would not be as effective as, for example, eye drop vaccine. The expectation was that once villagers found that Newcastle disease could be controlled, husbandry practices would improve. The improvements would include housing and chickens could then be caught for more effective vaccination.

The author is convinced that eye drop application is the most effective way to deliver thermostable vaccines. However, the final decision on vaccination methods will depend on the national veterinary authorities and on the villagers who should always be consulted.

Most of the investigations of food carriers for thermostable Newcastle disease vaccine have been undertaken in Asia and Australia. There have been fewer studies on the foodstuffs, and especially the grains, that are available in Africa.

In Ethiopia, parboiled barley was shown to be a suitable carrier for I_2 vaccine. Untreated barley, and parboiled or untreated sorghum were not effective (Nasser *et al.*, 1998). In laboratory trials in Ghana, wheat bran was an effective carrier for V4 vaccine, while millet, maize meal, corn chaff and mill waste were not (Amakye-Anim *et al.*, 1998). Vaccine supplied on boiled sorghum to village chickens in central Tanzania gave only low levels of protection, although this substrate had proved successful in earlier laboratory trials (Foster *et al.*, 1996). In further trials with V4 vaccine in southern Tanzania, dried cassava granules were found to be an adequate food carrier (Salum *et al.*, 1997).

In Asia suitable food carriers have been paddy (unhusked) rice, cooked white rice and cooked parboiled rice. Uncooked white rice is not a suitable food carrier. A detailed review is available (Spradbrow 1993/94). Sufficient food vaccine must be supplied so that each chicken in a feeding group has a chance of receiving vaccine. For most grains this is 7-10 g per chicken. For cooked white rice some 20 g is required for each chicken.

An innovation that deserves further investigation is the production of pellets that each contains a single bird dose of thermostable vaccine. Rehmani *et al.* (1995) described experimental lactose-based pellets that were effective. They suggested that such pellets could be suitably diluted in other chicken foodstuffs. If vaccine was produced in a central location, it would be easier to carry pellet vaccine (one pellet per dose) than grain vaccine (10 g per dose).

Sprays and aerosols

Conventional Newcastle disease vaccines have sometimes been applied to confined village chickens as sprays. This technique has not been tested with thermostable vaccines in villages. However, under experimental conditions V4 vaccine has been effective as an aerosol (Schalkoort and Spradbrow, 1980).

Lateral spread

The thermostable variants of Newcastle disease virus, strains V4 and I_2, spread readily between groups of chickens confined on solid floors. Spread is uncertain, or does not occur, when chickens are maintained on wire. This indicates the importance of oral/faecal spread with these viruses. Similar spread from vaccinated chickens to village chickens has been demonstrated under village conditions (Tu *et al.*, 1998). Probably the conditions of night housing or of congregation around food and watering points will influence the efficacy of spread.

WHAT NEXT

Local production of vaccine

Thermostable vaccines can protect village chickens against Newcastle disease. Most of the scientific studies that were needed have been done. Why are these vaccines not being widely used? The residual problems are in part commercially based. These are commercial vaccines. They come in large dose formats, inappropriate for small village flocks, and they must be paid for in foreign currencies.

An attractive answer to this problem would seem to be local production of thermostable vaccine. Many countries now make avian vaccines for commercial chickens in their central laboratories. They do not usually use specific-pathogen-free (SPF) eggs. Could simple vaccines for village chickens also be made in these same central laboratories, or even in district laboratories. My group, supported by ACIAR, believes this is possible.

What are the requirements? A seed vaccine. We have produced thermostable strain I_2 and seed material is available without cost to countries that wish to test, and possibly produce, the vaccine. We ask only that seed lot procedures be followed and that there is a policy of cost recovery, but not of exploitation of the village poultry producer. We believe that if eggs are obtained locally for vaccine production, no new infectious agents will be introduced into the area. The vaccines are produced from allantoic fluid, not from embryonic tissues. They are not injected into chickens.

We advocate the production of vaccine in a liquid form (wet vaccine) consisting of allantoic fluid in a suitable diluent. This avoids the expense of freeze-drying and the purchase of refined ampoules and labels. Wet vaccines can be distributed in volumes appropriate for flock size.

The other requirement is appropriate training. We have conducted dual workshops in African and Asian countries for ACIAR, GRM International and World Bank and FAO. Another is planned for AusAid. One workshop is designed for administrators and extension workers. It considers such topics as village chickens, Newcastle disease, thermostable vaccines, gender aspects of poultry production and extension activities.The second workshop is for laboratory workers who are given practical training in the skills of egg inoculation, harvesting allantoic fluid, bleeding chickens, preparation of serum and red blood cells and serology. These are the skills required for the production and testing of simple thermostable vaccines. Dr. Robyn Alders and the author usually present the administration/extension workshop and Ms. Sally Grimes the laboratory workshops. The latest versions of the workshop manuals – Alders, R. and Spradbrow, P.: Newcastle Disease in Village Chickens. A Field Manual. and Spradbrow, P., Bensink, Z. and Grimes, S.: Laboratory Manual. Small Scale Production and Testing of Newcastle Disease Vaccine. – are available on our rural chicken website: http://www.vsap.uq.edu.au/ruralpoultry.

Extension

The production of thermostable Newcastle disease vaccines and their testing under laboratory conditions were relatively easy tasks. Pilot village trials were more difficult. Delivering the vaccine to villages over whole regions on a regular basis will be extremely difficult. An infrastructure for the delivery of vaccine will have to be developed. Either farmers or village vaccinators will have to be trained to administer the vaccine. Systems for cost recovery must be developed. However the major task will be with the extension workers who must explain the concept of vaccinating chickens and have the concept accepted. The extension workers have the task of working with the very poorest people – people who are often illiterate, sometimes innumerate, and whose spoken language may have no word for vaccine or no written form.

Participatory rural appraisals, especially those involving women's groups, will often focus on village chickens and the problem of Newcastle disease. Village chicken projects will sometimes not proceed when the problems with Newcastle disease are realised, or are abandoned because of outbreaks of Newcastle disease. These projects are more likely to succeed if vaccination becomes part of the planning. The establishment of vaccination programs will depend on effective extension.

Some non-conventional extension approaches are being investigated by Dr. Robyn Alders. As well as simple pictorial flipcharts and radio broadcasts, she has commissioned a vaccination song to spread the vaccine message. Dr. Alders has also promoted a play dealing with the vaccination of village chickens. This was written and is performed by a troupe of professional actors who first attended meetings in villages.

A new science of village chicken production

With the control of Newcastle disease in village chickens, all aspects of village chicken production become available for scientific investigation. If village chicken production can be optimised, there will be major benefits in terms of poverty alleviation and human nutrition. No animal industry in the developing world has greater potential for improvement than the production of village chickens.

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COMMENTS ON THERMOSTABLE NEWCASTLE DISEASE VACCINES FOR USE IN VILLAGE CHICKENS

Dr. Jonathan G. Bell

agree with Professor Spradbrow that the control of Newcastle disease is the key to the science of village chicken production and an indispensable condition for other interventions. I would like to thank him for his excellent review on thermostable vaccines.

I was interested to read of the non-conventional extension approaches. I wonder whether it would be possible to download the vaccination song so that we could all hear it?

Dr. Anders Permin

I agree with Professor Spradbrow that the control of Newcastle disease is necessary and important, but I would also like to attract the attention to other diseases. To my knowledge no studies have followed larger rural chicken populations for longer periods and simply done post mortems. This means that in fact we do not know what diseases are causing the high mortality in rural chickens. Newcastle disease (ND) is one of them, but the high mortality in chicks up to 3 months of age is not explained by ND only. Here we might be talking about bacterial and parasitic diseases. Studies in Tanzania and Nicaragua, where the chickens were immunized against Newcastle disease (not published yet), have indicated that the mortality is still high. Again this supports the fact that ND is not the only disease in rural chickens.

Prof. Madundo M. A. Mtambo

First of all I would like to commend Prof. Spradbrow for his nice review on thermostable Newcastle disease (ND) vaccine in village chickens. I agree that thermostable vaccines are important in village conditions because of poor cold chain facilities. It is true that control of ND is essential since the disease may wipe out whole flocks during outbreaks. Nevertheless, our recent findings indicate that very high mortalities occur in chicks up to 6 weeks of age but the main cause has never been determined. Thus I agree with Dr. Anders Permin that the control of ND should go hand in hand with the control of other chicken diseases. Studies to establish the major causes of chick mortalities should be established so as to devise appropriate control measures of chicken diseases in village situations.

Tadelle Dessie

I am totally in agreement with Professor Spradbrow that the control of Newcastle disease is necessary and important, but I am also attracted with the ideas of Dr. Anders Permin who underlines that the need of attention to other diseases.

According to the survey conducted by Tadelle and Ogle (1996) in three villages in the highlands of Ethiopia, disease was cited as the most important problem by most of members of the community with whom it was discussed, reducing both the number and productivity of the birds. Some farmers have given up rearing poultry because of an increase in disease problems after villagization (i.e. resettlement in villages) (1984-86), because of the higher level of contact between birds in the more densely populated areas facilitated the spread of diseases from flock to flock.

The close contact of different flocks from different households thereby facilitated transmission of communicable diseases, in addition to the problem of increased competition for the limited feed resources, which is the Scavenging Feed Resource Base (SFRB). The relationship between disease and flock density is apparent in the rural areas and some farmers in non-villagized areas have not had any experience of recurrent disease outbreaks, and consider that their birds are more vigorous and productive than the flocks in the larger villages (my personal observation).

The general feeling of the villagers is that the problem is getting worse and many people said that they had not encountered such problems prior to their resettlement. The symptoms of the common diseases as perceived by the community in the three villages are loss of appetite, reduction in drinking and eating, watery and yellowish droppings, paralysis and, consequently, death. This disease entity, which is probably Newcastle disease, is acute, lasting for only 3-5 days, and usually results in the death of the whole flock because transmission is very rapid. Newcastle disease is the most important disease in rural poultry production in the tropics.At this point I have a question to all participants, is this disease entity only ND or is there other diseases in cover of ND or is that a complication of different diseases at the same time and place? Because I had a bad experience of very high mortality even after vaccinating the whole flock in the village for ND.

The other problem is the prevailing of this high mortality of local birds under on-station and confinement conditions after they were vaccinated against "all" important poultry diseases in the area. This condition was reported at least three times from different parts of the country in different research stations and by different researchers. In six months time I am also planning to collect eggs from different parts of the country and start a new study on "Identification, characterization and evaluation of different strains of local birds for egg and meat production potentials in Ethiopia" (that is for my PhD), and I am worried about the problem I mentioned earlier. At this point I badly need ideas of all the experienced researchers in the area of rural poultry production to control this high mortality observed in local birds under confinement.

Dr. Jonathan G. Bell

This is a reply to comment 4 on free communication 10 by Tadelle Dessie.

It is of course normal that there should be an increase in disease in the chicken flocks when nomads become sedentary and the birds are kept in closer confinement to each other. It is the same phenomenon that we see in the transition from village chickens to industrialised ones, but probably more intense. The disease you describe certainly sound like ND. If you do autopsies on the birds, you can see if they have haemorrhages on the proventriculus. This is extremely suggestive of ND in the absence of vaccination, although it does not prove it.

In the village where you vaccinated the whole flock:

- What vaccine was used?
- What administration route was used?
- How was the vaccine transported?
- Was it kept cold?
- How long after vaccination did the disease occur?

- Were antibodies to ND measured after vaccination?
- If so what were the titres?

The answers to these questions could give us an idea whether what happened was a failure in vaccination or another disease, which seem to me to be the two possibilities.

Parasites, Gumboro disease, mycoplasma and bacterial infections can complicate ND and turn an infection by an avirulent strain like Lasota into a pathogenic infection. In general, ND is a very acute disease, and the virulent strains that are prevalent in Africa are quite sufficient to kill all the chickens on their own. In this case the presence of the secondary infections is not relevant.

If it is another disease, one possibility might be fowl typhoid. It would be quite easy to answer the question definitively in the field by taking blood samples to measure antibodies against ND, doing autopsies, and taking bacteriological and possibly virological samples.

A lot of people doing zootechnical studies on African village poultry have had the problem of losing much of their stock through diseases, which is of course exacerbated by bringing birds together in confinement. However, a rigorous vaccination programme against ND, and some biosecurity measures including disinfection, etc., should go a long way towards controlling it.

Dr. Robyn G. Alders

In response to Tadelle Dessie's question regarding whether mortalities in village chicken flocks are due to Newcastle disease (ND) only, it is my opinion that there are a range of diseases that occur in village flocks. But I would qualify my response by saying that until villagers are sure that their chickens will not die regularly and in large numbers from ND, it is unlikely that they will be willing to make the necessary investments required to control these other diseases.

Regular outbreaks of ND probably help to interrupt the cycle of other diseases. With the control of ND, further research will be required to diagnose and rank other problems (diseases, nutrition, etc.). Coming up with cost-effective and appropriate solutions to these problems will keep us busy for some time.

Nutrition is clearly an area that requires more research, especially that of young chicks. Cost-efficient ways of providing supplementary feed to young chicks will almost certainly improve their survival rate and their response to vaccination.

I have enjoyed participating in this electronic conference and would like to take this opportunity to thank Dr. Guèye and co-workers as well as the FAO for facilitating this venture.

Prof. P. B. Spradbrow

Thanks for the comments.

Of course there are other infectious diseases affecting village poultry. The studies in which they become obvious are those that involve observations on flocks vaccinated against Newcastle disease. To a large extent these are over future flocks, not our current flocks. These are our future problems, not our current problems. Studies in vaccinated flocks, such as those of Anders Permin in Tanzania or of the GTZ group in Thailand show us that Newcastle disease will not be the last of our problems. Our present focus must be on the diseases that kill chickens, and that kill them in large numbers. If Newcastle disease is uncontrolled, other diseases are eclipsed. I expect that the next urgent problems will also be acute, fatal diseases. My guesses would be fowl cholera, infectious bursal disease, salmonellosis, fowl pox and leucocytozoonosis in some areas.

The other current pressing problem is the massive losses that occur during brooding. The causes have yet to be specified. One problem is that the dead chicks are not found or not examined. They go to the "lost" or "disappeared" columns on surveys, and we know that these columns are essential in collecting village poultry data. However when workers intervene with provision of creep feeding and shelter, these brooding losses are greatly reduced. This suggests that the brooding losses are associated with starvation, exposure and predation and could be controlled by improved husbandry. Villagers seem unwilling to make these changes while infectious disease will deprive them of their increased flock after brooding. Our current extension objectives target both Newcastle disease prevention (not only vaccination) and improved husbandry to reduce brooding losses.

The innovative extension methods that I mentioned derive from the enterprise of Dr. Robyn Alders in Mozambique. We must ask her to try to make a video of the vaccination play. The vaccination song has not been performed professionally in English although there was an informal premiere by an ad-hoc 40-voice choir at a recent meeting in Tune, Denmark. The English translation is attached. The recorded version is performed in Portuguese, Changana, Nyanja, Sena and Macua. This electronic Luddite was not aware that songs could be put on websites. A cassette is on its way to Rome (by conventional mail). All this superb technology in some fields, and we still have problems vaccinating village chickens!

On a recent visit to Vietnam I spoke with colleagues about a possible version of the vaccine play for a puppet theatre. This might be a culturally appropriate medium in some other Asian countries as well. Robyn Alders has suggested utilising the talking drums in western Africa. FAO at one time had a series of projection slides, I think for use in Bangladesh. Any other suggestions? Vaccination kites? Vaccination dances?

English translation of the vaccination song prepared by The Association of Mozambican Musicians:

NEWCASTLE DISEASE

Lyric
The chickens I'd bred have died from sickness
The ritual chicken is dead
The rough sheep* chicken is also dead
Even the one I borrowed from neighbours died.

Chorus
What should I do?
In this hunger season?
What to do folks?

Dialogue
"Nooh. What ...... this is a bad omen to my ancestors."
"What's wrong neighbour?"
"See my chickens are dying"
"How did they die?"
"Well, I don't know. But they start like getting cold. Then they look like they're wearing a coat and sleepy, then die."
"That's a chicken disease called Newcastle"
"Pity me. I'm in deep trouble. What should I do?"
"Go to Rural Extension. They will give you vaccine to apply in the eyes or in the water they drink. They won't die any longer."
"I see. But I don't know the place."
"I will take you there"
"How kind. Let's go."

Lyrics by Hortencio Langa and Wizzie Masuke.
Arranged by Wizzie Masuke in 3 idioms; Xangaan, Sena, Portuguese.
Translated by Ali Faki in Macua.
Music by Hortencio Langa.

* A term referring to chickens with the frizzle feather gene.

The recorded version features vocalists Hortencio Langa, Wizzie Masuke, Elidio Manica and Ali Faki and instrumentalists Hortencia Langa, Celso Paco and Manuel de Jesus.

Tadelle Dessie

These are answers to Dr. Bell's questions (see comment 5 on free communication 10).

In the village where I vaccinated the whole flock:

- What vaccine was used? It was La Sota
- What administration route was used? Drinking water
- How was the vaccine transported? Using thermoflask
- Was it kept cold? Yes
- How long after vaccination did the disease occur? It was after 5 to 6 days
- Were antibodies to ND measured after vaccination? I did not measure it
- If so what were the titres? No

Dr. Jonathan G. Bell

With reference to Tadelle Dessie's reply to my questions regarding ND vaccination in Ethiopia (see comment 8 on free communication 10), the fact that the disease occurred only 5 to 6 days after vaccination suggests that it was indeed ND. The incubation period for ND is about 4 days. That means that the chickens would have been infected only one day after vaccination, when the vaccine would not yet have had any immunoprotective effect.

If there are birds in the flock that are immunologically naive with respect to ND, La Sota vaccine is a relatively virulent one to use. It could cause vaccinal reactions, especially if there were concurrent mycoplasma and bacterial infections. This is all the more true in a village population, which is necessarily a multi-aged one including young chicks. La Sota is not used for a first vaccination in industrial poultry. A village population could already have sufficient antibody levels to allow effective use of it, but you can't be sure of this - there are situations when the chickens have no antibodies against NDV.

A general review on some important diseases in free-range chickens

A. Permin and M. Bisgaard

INTRODUCTION

Poultry production has undergone rapid changes during the past decades due to the introduction of modern intensive production methods, new breeds and improved biosecurity and preventive health measures. Moreover, these intensive production methods place high demands on proper health, hygiene and management and require only a small, but very skilled labour force. In developing countries, however, adoption of this type of production has been limited due to the high inputs as listed above. The progress in industrial poultry production methods has thus had little effect on subsistence poultry production in the rural and peri-urban areas. In these areas access to poultry meat and eggs depends on village-level poultry production. Although poultry production is considered as secondary to other agricultural production systems it has an important role in supplying villagers with additional income and high quality protein. This system provides valuable protein through a low input system, now representing 30% or more of the protein consumed (FAO, 1998).

Almost all families in developing countries keep a chicken flock with an average size of about 10 adult chickens, varying from 5 to 50 animals. The majority of these animals are kept in free-range scavenging systems, where the birds scavenge around the house during daytime. Primitive housing of the birds during the night, however, often takes place. Supplementary feed consists mainly of household wastes, insects, larvae and seeds (Minga *et al.*, 1989; Kabatange *et al.*, 1990; Aini, 1990; Pandey, 1992).

Mortalities observed are in the range of 80 - 90% within the first year after hatching (Matthewman, 1977; Wilson *et al.* 1987). For the same reasons the owners never include chicks when they refer to the flock size. The mortality is believed to be caused by mismanagement, lack of supplementary feeding, predators and diseases (Aini, 1990; Pandey, 1992). Little research has been published on rural poultry health, despite the fact that up to 80% of the poultry population in Africa and Asia is kept by the households as free-range chickens (Minga *et al.* 1989; Aini, 1990).

Although solid data have not been published, Newcastle Disease (ND) is regarded as the principle factor limiting rural family poultry production in all African and Asian countries. ND may kill up to 80% of household poultry in Africa (Minga *et al.* 1989; Aini, 1990; Bell, 1992), but is not expected to account for the high early mortality rate according to the authors. In addition, detailed epidemiology of the disease in the village situation is largely unknown (Yongolo, 1997). Furthermore, recent studies have shown that other diseases are present in scavenging poultry communities (Bell *et al.* 1990; Cumming, 1991; Bell, 1992; Chrysostome *et al.*, 1995; Permin *et al.*, 1999). Since most of our knowledge relies on seroprevalence studies, solid longitudinal studies on causes of mortality are strongly needed to improve our knowledge on the prevalence and significance of the single diseases under village conditions. The following data therefore mainly reflect experience obtained under backyard conditions in developed countries.

DISEASES

According to Jordan and Pattison (1996) and Calnek *et al.* (1997) poultry diseases can be divided into five groups, namely bacterial (Table 1), viral (Table 2), fungal (Table 3) and parasitic (Table 4). Besides there are various non-infectious diseases affecting chicks and growers. These are mostly associated with nutritional deficiencies (i.e. vitamins A, D, E, etc. as well as minerals and amino acids). Only the diseases of expected importance under village conditions, e.g. those causing high mortality rates in chickens are mentioned in these Tables.

TABLE 1: IMPORTANT BACTERIAL DISEASES IN FREE-RANGE POULTRY AND THE AGE GROUP WHERE THE DISEASE IS MOST OFTEN OBSERVED

disease	**age group**
escherichia coli	all ages, but mainly chicks
salmonella spp.	all ages, but mainly chicks
salmonella pullorum	chicks < 3 weeks
salmonella gallinarum	growers, adults
pasteurella multocida	growers, adults
haemophilus paragallinarum (coryza)	growers, adults
clostridium perfringens	all ages, but mainly growers
mycobacterium avium	adults
mycoplasma gallisepticum	all ages
mycoplasma synoviae	all ages

TABLE 2: IMPORTANT VIRUS DISEASES IN FREE-RANGE POULTRY AND THE AGE GROUP WHERE THE DISEASE IS MOST OFTEN OBSERVED

disease	**age group**
*marek's disease	> 6 weeks
*leucoses	adults
newcastle disease	mainly growers and adults
fowl pox	all ages
infectious laryngotracheitis	growers, adults
*infectious bursal disease "gumboro"	< 8 weeks

*immunosuppressive disease

TABLE 3: IMPORTANT FUNGAL DISEASES IN FREE-RANGE POULTRY AND THE AGE GROUP WHERE THE DISEASE IS MOST OFTEN OBSERVED

disease	age group
aspergilloses	chicks
mycotoxicoses	all ages

TABLE 4: IMPORTANT PARASITIC DISEASES IN FREE-RANGE POULTRY AND THE AGE GROUP WHERE THE DISEASE IS MOST OFTEN OBSERVED

disease	age group
coccidiosis	chicks, growers, (adults)
histomoniasis	1 - 3 months
nematodes	all ages
haemoparasites	chicks, growers
ectoparasites	chicks, growers

DISCUSSION

Approximately 80% of the world poultry population is kept as free-range poultry (Minga, 1989; FAO, 1998). The free-range poultry production system has also been designated as the 'low input - low out' system (Pandey, 1992). Mortality in this system is in the range of 80 - 90% within the first year after hatching (Matthewman, 1977; Wilson *et al.*, 1987) and is believed to be caused by mismanagement, lack of fresh water and supplementary feed, predators and diseases (Aini, 1990; Pandey, 1992). Of these, diseases are believed to be the main limiting factor to the production of indigenous chickens (Aini, 1990). Among causes of early mortality nutritional diseases might be expected to dominate due to shortage of supplementary feed before and after hatch. In addition, the quality of hatching eggs might be questioned under the climatic conditions present in these countries. Avitaminoses and lack of protein weaken the chicks and make them vulnerable to other diseases and predators. Diseases are also easily contracted under free-range conditions due to the scavenging habits of these birds (Soulsby, 1982; Pandey, 1992). With an unconfined type of management, disease control is very difficult to carry out and is therefore rarely practised by the owners.

As mentioned earlier, Newcastle Disease is believed to be the most important disease in free-range systems (Minga, 1989; Aini, 1990; Bell, 1992). During outbreaks of the disease up to 80% of the population may die. This, however, is dependant on different factors including the virulence of the strain causing the outbreak (Alexander, 1997). A recent study in Nicaragua (Kyvsgaard, 1999) has, however, shown that in ND-immunised birds mortality is still high. The majority of the mortality is found in chicks and growers up to 3-4 month of age. In these groups up to 52.5% of the animals died due to causes other than ND. Similar studies in Mali by Wilson *et al.* (1987) have shown that chick mortality is in the range of 60% within the first 3 months after hatching.

A study in Morocco (Bouzoubaa *et al.*, 1992) has revealed that up to 58% of the village chickens had antibodies against Salmonella gallinarum and S. pullorum. Similar findings were reported in Nigeria by (Adesiyun *et al.* 1984). Chryosostome *et al.* (1995) also reported that 10% of the village chickens had antibodies against S. pullorum and that 62%

had antibodies against Mycoplasma gallisepticum. Furthermore, 65% of the animals had antibodies against ND. In Mauritania, Bell *et al.* (1990) found that 17.5% of the birds had antibodies against S. pullorum and that up to 46.2% of the birds had antibodies against Gumboro disease. In the same animals 7.5% had antibodies against ND.

In Tanzania, Permin *et al.* (1999) examined 600 live chickens and found the presence of a range of diseases. All animals were parasitised with one or more (up to 14 species) species of endoparasites. In total 29 different species were detected in the study. Furthermore, 65.7% of the animals were parasitised with Cnemidocopt-es mutans, Dermanyss-us gallinae and/or Echidnopha-ga gallinacea.

The animals were also infected with a range of haemoparasites, the most common being Plasmodium juxtanucleare and Aegyptinella spp. Antibodies against Newcastle disease was seen in 7.3%, against Salmonella enteriditis in 2.0%, against Salmonella gallinarum/pull-orum in 52.7%, against Infectious Laryngotracheitis in 58.3% and against Gumboro disease in 42.3%. Similar studies have, to the knowledge of the authors, not been carried out in Asian countries. The significance of all these diseases, however, remains to be investigated. In addition, it should be noted here that a general trend for these studies is that they have only looked for antibodies against selected diseases.

CONCLUSION

Long-term cohort studies, examining the causes of death, have to date not been carried out in the free-range production systems. Important knowledge on the proportion of the individual disease of the overall mortality is thus not known. It is consequently postulated that diseases other than ND are present in free-range poultry production systems and that a successful development of this production system is only achieved when the exact causes of death is known. Since publications on disease prevalence based upon post mortem examinations are not expected to be accepted by existing international peer-reviewed journals the WPSA (World's Poultry Science Association) should be addressed to establish an international journal dealing specifically with problems relating to scavenging/family poultry. Establishing such a journal would ensure a rapid implementation of research results obtained.

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Family poultry production and utilization pattern in Bangladesh

Q. M. E. Huque

ABSTRACT
A survey was carried out to investigate the production and utilization pattern of family poultry. A total of 500 households from five regions were interviewed. The result revealed that the highest number of poultry per farm was found with large farmers (22.7) while the lowest was found with landless farmers (7.3).

The highest number of birds was available at the farm household during April-June and that was the lowest during July-September. Highest number (41.7) of eggs per bird was found during January-March while the lowest (25.8) was during July-September.

Large farmers consumed more poultry than the other farm categories but they sold lowest number. The landless farmers consumed lowest (17.1) chicken meat but they sold highest number (82.9 percent). The large farmers consumed more chicken (43.9 percent) and duck (31.1 percent) eggs than other categories of farmers, which was opposite to the landless farmers (18.6 percent for chicken egg and 12.4 percent for duck egg). The income of small farmers (Tk. 1513) and landless (Tk. 1440) farmers were higher than that of medium (Tk. 944) and large (Tk. 736) farmers. Small farmers were the most effective beneficiaries of family poultry rearing in Bangladesh.

INTRODUCTION
Family poultry production in Bangladesh is spread all over the country without much input. It is a low input-low output profitable system with little care and with almost no extra supplementary feeding. About 98 percent of the poultry meat and eggs come from scavenging poultry (UNDP/FAO, 1983). More than 80 percent of the rural households raise poultry (Huque, 1987; Ahmed, 1988; Anonymous, 1985). Even in some areas about 96-98 percent of the households keep only chickens (Islam, 1987; Maijer, 1987). Maijer (1987) also found that 60 percent of the households kept ducks in Noakhali region.

There are about 138.2 million chicken and 13 million ducks in Bangladesh (Anonymous, 1998), and traditionally women and children are the raisers of these birds. Production performance of the family poultry is very low as compared to the intensive poultry industry. The scavenging indigenous chickens lay about 35-45 eggs per year (Bulbul, 1983; Ahmed and Islam, 1985; Sazzad, 1986; Huque *et al.*, 1990) and ducks lay about 60-90 eggs per year (Salam and Bulbul, 1983; Latif, 1991; Salam and Aftab, 1987; Huque and Hossain, 1991; Huque, 1991).

Information on the family poultry is scarce. Improvement programmes cannot be chalked out due to lack of accurate data on production of family poultry. The UNDP/FAO project progress report (1986) on Bangladesh concluded that there was a great variation between villages in regard to the types of performance of each village chicken flock. However the cause of this variation was not known and too little quantitative data were available on the performance of family chickens. This study was undertaken to provide data which will help to overcome the lack of knowledge regarding production and utilization patterns of family poultry and the income generated in rural households through poultry rearing.

METHODOLOGY

Five areas were selected for survey on the basis of topography and ecology of the country. The areas were Savar, Sadar, Botyaghata, Birganj and Hathazari Thanas of Dhaka, Sylhet, Khulna, Dinajpur and Chittagong district, respectively. The first baseline survey was undertaken by a pre-tested questionnaire during January-February 1989. Two villages were selected in each Thana on the basis of secondary information collected from local Thana and District Livestock Officer.

Individual households (families) were interviewed directly by a Field Assistant and Scientific Officer. On the basis of baseline survey, the households were divided into four categories depending on their own land holdings as landless (0-0.5 acre), small (0.51-2.00 acres), medium (2.01-5.00 acres) and large (5.01-above acres) by using proportionate stratified sampling technique from all 10 villages.

One hundred poultry-raising households from each area were selected through stratified random sampling technique and a total of 500 households constituted the total sample size for the study. The interview schedule was maintained for four period covering one complete year, i.e. January-March, April-June, July-September and October-December. To collect accurate and reliable data, one enumerator was placed in each area for the whole year that visited each selected household several times during survey period. The Scientific Officer supervised the data collected by Field Assistant in each period.

RESULTS AND DISCUSSION

Distribution of family poultry

The numbers of chickens, ducks and pigeons per farm in the four categories of households are presented in Table 1. The data showed that the highest number of chickens (11.9), ducks (10.0) and pigeons (0.8) were owned by large farms and these were lowest in landless farms. The data showed that the number of chickens per farm was positively correlated with the farm size (r=0.83). The mean distribution of chickens, ducks and pigeons per farm were 7.2, 2.6 and 0.2, respectively. The average number of family poultry per farm was 10.0 (Table 1).

TABLE 1: MEAN DISTRIBUTION OF POULTRY PER HOUSEHOLD BY FARM SIZE

Farm size	Chicken						
	Adult chicken		Grower	Chick (0-7 weeks)	Total		
	Cock	Hen					
Landless (n=512)	0.2	1.8	1.4	2.2	5.6		
Small (n=249)	0.2	2.0	2.7	2.7	7.7		
Medium (n=92)	0.5	2.9	2.4	2.8	8.6		
Large (n=92)	0.3	4.2	2.8	4.1	11.9		
All farm (n=1000)	0.4	2.2	2.1	2.6	7.2		
Farm size	Duck					Pigeon	
	Adult		Grower	Duckling (0-weeks)	Total		Grand total
	Drake	Duck					
Landless (n=512)	0.2	1.0	0.2	0.4	1.7	0.1	7.3
Small (n=249)	0.2	0.8	0.6	0.1	1.7	0.1	9.5
Medium (n=92)	0.3	1.8	0.4	0.3	2.7	0.7	12.1
Large (n=92)	0.8	5.9	2.6	0.6	10.0	0.8	22.7
All farm (n=1000)	0.3	1.5	0.6	0.3	2.6	0.2	10.0

n = number of households

The structural features of the population of family poultry by season are given in Table 2. There was variation in the number of birds between the season in different age group. The percentage of cocks in the population was higher in October-December (4.8 percent) and April-July (4.5). The feature indicated that October-December period was the breeding season when the farmers keep more males for hatching eggs in future. The chicks hatched in October-December period come into maturity during April-June period, which causes the increased number of cock (4.5 percent) in this period. Adult males were removed from the flocks.

This results in lower numbers of cocks (1.9 percent) during July-September. These structures show that the farmers used to keep higher number of hens (19.9 percent) for reproduction during October-December. The chicks hatched during October-December started laying eggs during April-June, which might be the reason of highest number of hens observed during April-June. Maximum number of chicks (71.7 percent) was found in January-March where the lowest number (14.1 percent) was found in July-September. The demographic structure of chicken population was directly influenced by season of the year.

The mature ducks were highest (74.2 percent) in October-December and lowest (45.2 percent) in April-June. The highest number of ducklings (27.6 percent) was found in April-June, which indicates that the farmers hatched eggs for ducklings before the start of rainy season. No duckling was available in the months from October to December. The farmers do not hatch duck eggs during the winter season of the year (Table 2).

TABLE 2: STRUCTURE OF FAMILY POULTRY BY SEASONS (PERCENT)

Species	July-September n=500	October-December n=500	January-March n=500	April-June n=500
Total Chickens	(3076)	(3787)	(4462)	(4987)
Cocks	1.9	4.8	1.5	4.5
Hens	12.3	19.9	19.1	25.2
Growers	71.7	51.6	7.8	31.1
Chicks	14.1	23.8	71.7	39.3
Total Ducks	(931)	(709)	(879)	(1106)
Drakes	18.4	15.2	9.1	14.3
Ducks	47.8	74.2	64.3	45.2
Growers	15.2	10.6	4.1	12.9
Ducklings	18.7	-	22.5	27.6
All species	(4007)	(4469)	(5341)	(6093)

Figures within parenthesis indicate number of birds, n = number of farmers

The average chicken egg production per family was found to be the highest during January-March (20.6) and the lowest (16.4) during July-September in the year. In case of ducks, it was highest (21.1) and lowest (9.4) in the same season. The annual egg production per bird was 37.7 in chickens and 49.7 in ducks. This was highest in both species during January-March (17.7 in ducks and 10.2 in chickens). It was observed that the total egg production per bird was higher in ducks than in chickens, indicating that the production potentiality of indigenous ducks was better than that of indigenous chickens. This result was in agreement with that reported by Sazzad (1986) and Huque *et al.* (1990).

Utilization pattern of poultry and eggs

The consumption and sale pattern of chickens by the farmers owning different family farm categories and from locations are presented in Table 3. Cockerels and cocks were more consumed more by all types of farmers, except for small farmers who consumed less cockerels. The highest percentage of chickens was consumed in Hathazari region (26.7 percent) in comparison with the other four regions, and the lowest consumption rate (8.0 percent) was observed in Birganj region. The landless farmers sold the highest proportions of chicken, except for cocks, and large farmers disposed of the lowest proportions of their birds. The highest (34.0) percentage of chickens was sold in Sylhet region and the lowest (1.0) in Savar region (Table 3). It was found that the large and medium farmers consumed more than two-thirds of their chicken production while the landless and small farmers sold two-thirds of their chicken production. This consumption and sale patterns indicated that landless and small farmers earn more cash money from poultry rearing.

TABLE 3: UTILIZATION PATTERN OF CHICKENS IN DIFFERENT FAMILY FARM CATEGORIES AND LOCATIONS

Farm category/Location	Percentage of chickens consumed per farm				
	Cock	Hen	Cockerel	Pullet	Total
Large	28.0	12.3	35.4	15.2	90.8
Medium	21.9	5.7	32.2	15.1	74.9
Small	9.7	5.1	4.4	5.1	24.2
Landless	5.6	3.2	5.8	2.5	17.1
Mean	16.3	6.6	19.5	9.4	51.7
Savar	1.6	4.0	5.6	10.8	22.2
Birgonj	0.7	3.1	1.1	3.1	8.0
Botyaghata	1.2	10.5	0.7	4.2	16.6
Sylhet	1.5	1.7	6.2	2.6	12.1
Hathazari	5.6	5.2	7.9	8.0	26.7
Farm category/Location	**Percentage of chickens sold per farm**				
	Cock	**Hen**	**Cockerel**	**Pullet**	**Total**
Large	5.4	2.5	0.6	0.7	9.2
Medium	11.5	9.9	2.6	1.1	25.2
Small	19.3	10.1	23.9	22.5	75.8
Landless	9.9	14.0	29.9	29.0	82.9
Mean	11.5	9.1	14.3	13.4	48.3
Savar	0.5	0.2	0.2	0.2	1.0
Birgonj	0.4	1.6	2.3	2.8	7.0
Botyaghata	1.2	1.4	0.4	1.7	4.7
Sylhet	0.4	6.1	0.5	17.1	34.0
Hathazari	0.4	1.4	1.8	2.1	5.6

The Table 4 gives the consumption and sale pattern of ducks by the farmers owning different family farm categories and from locations. The percent of ducks consumed per farm was highest (13.9) in Botyaghata region and lowest (1.2) in Birganj region. The percent of ducks sold per farm was highest (37.8) in Sylhet region and lowest (0.58) in Hathazari region (Table 4). The consumption and sale pattern of ducks were similar to those of chickens but the large and medium farmers consumed less ducks than chickens.

TABLE 4: UTILIZATION PATTERN OF DUCKS IN DIFFERENT FAMILY FARM CATEGORIES AND LOCATIONS

Farm category/Location	Percentage of ducks consumed per farm				
	Drake	Duck	Male grower	Female grower	Total
Large	9.7	23.2	6.6	2.9	52.4
Medium	12.2	17.9	7.8	7.1	45.0
Small	7.7	15.8	1.4	0.7	25.5
Landless	8.2	14.6	0.9	0.6	24.2
Mean	11.9	17.2	4.2	2.8	36.8
Savar	1.7	1.8	0.6	-	4.1
Birgonj	0.6	0.6	-	-	1.2
Botyaghata	6.6	6.4	1.2	-	13.9
Sylhet	4.7	0.6	0.6	0.6	6.4
Hathazari	1.2	1.2	-	-	2.3
Farm category/Location	**Percentage of ducks sold per farm**				
	Drake	**Duck**	**Male grower**	**Female grower**	**Total**
Large	25.0	12.2	6.2	4.3	47.7
Medium	22.2	13.8	10.2	9.3	55.0
Small	24.0	20.3	4.0	16.2	74.5
Landless	15.4	28.9	15.3	16.2	74.8
Mean	21.6	18.8	11.4	11.5	63.2
Savar	7.0	2.9	1.2	1.2	12.2
Birgonj	0.6	7.0	-	-	7.6
Botyaghata	2.3	2.4	3.5	2.3	10.5
Sylhet	2.3	29.7	2.9	2.9	37.8
Hathazari	0.6	-	-	-	0.6

The highest number of chicken and duck eggs (43.9 percent and 31.1 percent) were consumed by the large farmers, while the lowest number of chicken and duck eggs (18.6 percent and 12.4 percent) were consumed by the landless farmers (Table 5). The data clearly indicated that the consumption of duck eggs was lower than that of chicken eggs.

The landless farmers hatched highest percentage of chicken (44.1) and duck eggs (25.2) than other farm categories. These results demonstrated that the landless group used maximum eggs for production. The highest percentage of chicken eggs was lost (17.7 percent) by the large farmers, and the lowest loss (2.7 percent) was recorded by the small farmers (Table 5).

TABLE 5: UTILIZATION OF FAMILY POULTRY EGGS ACCORDING TO THE FARM SIZE (PERCENT)

Poultry species	Farm size				
	Large (64)*	Medium (74)	Small (124)	Landless (256)	All farm
Chicken					
Total Production	(7549)**	(8577)	(91500)	(14345)	(121971)
Consumption	43.9	38.9	29.8	18.6	32.8
Hatched	23.5	24.1	33.4	44.1	31.3
Sale	14.9	30.9	34.1	31.4	27.8
Losses (broken and damaged)	17.7	6.0	2.7	6.0	8.2
Duck					
Total Production	(6474)	(7532)	(15008)	(11936)	(40950)
Consumption	31.1	30.9	18.2	12.4	23.2
Hatched	19.1	20.5	14.1	25.2	22.3
Sale	42.4	39.7	49.8	56.5	47.1
Losses (broken and damaged)	7.2	8.9	7.9	5.8	7.5

* Figures within parenthesis indicate number of farms
**Figures within parenthesis indicate total number of eggs

The yearly total income generated from the sale poultry and eggs are given in Table 6. The sale of live birds and eggs generated the highest (Tk. 1513) income in small farmers and the lowest (Tk.736) in large farmers (1 US $ = Tk.48.5). This clearly indicated that the small farmers were the most effective beneficiaries of poultry rearing in Bangladesh. The yearly income calculated for the consumed poultry meat and eggs per farm was highest (Tk. 1791) in large farms and lowest (Tk. 655) in landless farms, which demonstrated that landless families consumed the lowest number of birds from their production. The total yearly income generated by family poultry rearing was Tk. 2397 per farm under scavenging system of production. As more than 80 percent of the farmers raise poultry, family poultry have a great impact on national economy. It can be concluded that any intervention in family poultry production system, small and landless category farmers will be major beneficiaries which will have direct impact on poverty alleviation in developing countries.

TABLE 6: INCOME GENERATED FROM POULTRY AND EGG IN DIFFERENT FAMILY FARM CATEGORIES PER YEAR (IN TAKA)

Species	Large			Medium			
	Sold	Consumed	Total	Sold	Consumed	Total	
Chicken							
Live bird	107	1052	1159	250	744	994	
Egg	49	144	193	72	90	162	
Duck							
Live bird	455	503	958	541	771	1312	
Egg	125	92	217	81	63	144	
Grand total	736	1791	2527	944	1668	2612	
Species	**Small**			**Landless**			**Mean**
	Sold	**Consumed**	**Total**	**Sold**	**Consumed**	**Total**	
Chicken							
Live bird	784	255	1039	836	173	1009	1050
Egg	50	44	94	18	10	28	119
Duck							
Live bird	611	519	1130	533	560	933	1098
Egg	68	25	93	53	12	65	130
Grand total	1513	843	2356	1440	655	2095	2397

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COMMENTS ON FAMILY POULTRY PRODUCTION AND UTILIZATION PATTERN IN BANGLADESH

Dr. Asifo O. Ajuyah

Hello Huque,

Thanks for your paper on poultry production and utilization pattern in Bangladesh. It contained pertinent production indices that could mirror the situation prevailing in other developing countries. However, data on per capita rural consumption of poultry meat instead of percent consumption would be a better indices of nutritional objectives of the village chicken within groups (landless, small, medium and large). In addition, production objectives (income, food, etc) seem to be quite different between the four group of farmers, what about their production systems?

Regarding your comparisons between the village ducks and chickens, you did not provide explanations why the potential of the indigenous ducks for egg production is greater than that of the indigenous chickens. Are there specialized duck farmers in Bangladesh? Or chicken farmers also raised ducks?

I would presume that greater genetic improvements must have occurred within the duck population than within chickens. In addition, under rural situations, ducks are better scavengers than chickens.

Prof. Tushar K. Mukherjee

Dear Emdadul,

I read your interesting and well-written article on 'Family poultry production and utilization pattern in Bangladesh' presented in the E-Conference of INFPD/FAO. Could you please give me some additional information on poultry mortality and disease patterns of landless, small, medium and large farms. In Malaysia there is a renewal of interest in village chicken production because of lean and tasty meat production, and to enhance the income of rural farmers in two poorer states in the East Coast. Bangladesh's large farmers' model will fit here. Is it possible to inform also what was the supplementary feeding regime in the large farms, besides the feed the chickens obtain through scavenging. I am now a member of the Committee on Small Farm's Native Chicken Development of the local Veterinary Department. It would be appreciated if you could provide us with the above information.

Dr Jestina F. Kusina

The results of your survey are very interesting. You seem to have covered quite a large area and for quite a long period. However, I would like to know whether the breeds of the chickens monitored in the survey, especially the layers, were the same across the areas.

The data on utilization pattern shows that the landless people (I assume they are also the poorest) benefited from keeping poultry. I would like to commend them for saving some of the eggs for home consumption.

Here in Zimbabwe, I am in the process of formulating projects involving village poultry to run for quite a number of years. I would like to start with a baseline survey to generate information needed to identify and formulate projects with the beneficiaries' input and participation. I realize that the objectives of your survey and the one that I would like to carry out may be different, but I will also need to do a monitoring study and evaluation of the projects at some stage. Therefore, I would like to ask you what sort of problems you encountered and how you handled them during the study, bearing in mind the large number of households and vast differences in the area. Did you do any gender analysis together with this study, or was it not important in your study?

Is it also assumed that the flock dynamics (demographics) of the chickens were directly influenced by season of the year through planned cullings of cocks and specific hatchings during parts of the year as you mention in your paper. Could other seasonal effects have played a part in this, e.g. seasonal effects of nutrition, diseases and mortality due to other environmental factors like rain, cold and predators?

Observations on family poultry units in parts of Central America and sustainable development opportunities

J. G. Mallia

ABSTRACT

Underdeveloped regions of the outlying coastal Belize, Guatemala and the Mosquitia (Honduras) rely on smallholder'family'poultry production as their primary source of domestic animal protein, with the domestic fowl being the most widely kept poultry species. The extensive system of management is the most frequent. This system requires minimal costs, but mortalities due to disease and predation are very high, and poultry production is low and irregular. Coastal populations therefore rely heavily on fishing and hunting for animal protein, and few viable forms of poultry product marketing have been developed.

Inland indigenous Indians in Guatemala raise large numbers of chickens ('pollo criollo') and turkeys ('pavo criollo'), under extensive or partially confined systems. Widespread and successful marketing of these species is present. Partially confined 'backyard' rearing of chicks until at least six weeks of age, with the associated development of feeding systems based on local products should reduce the markedly high mortalities due to predation. The segregation of turkeys from fowl may also have major impact on reducing turkey and chicken mortalities. Other sustainable interventions, such as disease prevention programmes for several of the outlying communities (Creole, Garifuna) are necessary, albeit challenging. Rural populations in Central America are very receptive to poultry veterinary outreach. A holistic approach using epidemiological studies and multivariate modelling are broad interventions that may have a widespread impact on the sustainable improvement of poultry production.

Key words: Central America, multivariate modelling, poultry epidemiology, sustainable development, village poultry

INTRODUCTION

The raising of family poultry in Belize, Guatemala and the coast of Honduras is as diverse as it is intense, despite the relative smallness of this area. The diversity is at least partly explained by the wide ethnic mix and cultures, coupled with marked differences in the terrain and climate patterns of the region. Substantial differences in the development and infrastructure and also the presence of tourism further complicate the picture.

Belize has a population of 200,000 (50% Creole, 30% Mestizo, 10% Maya and 10% Garifuna). About half of the country is covered by dense jungle and the rest is farmland, scrub and swamp. Belize is hot and humid year round. Rainfall is around 4m (13ft) a year, mainly between June and November. The Republic of Guatemala has a population of 11 million (56% of Mestizo and 44% Mayan). Guatemala's western highlands (up to 3800m) have night temperatures around freezing point at night. Days are chilly, overcast and humid during the rainy season, but warm in the dry season (October to May). The jungle lowland of El Petén and the Caribbean coastline are mainly jungle-clad, punctuated by agricultural activity and expanding road systems. This area's climate varies from hot and humid to hot and dry. The Republic of Honduras has a population of 5.8 million (90% Mestizo, 7% Indian, 3% other ethnicities). The wettest months on the Honduran Caribbean coast and the Mosquitia are from September to February, although it rains practically all the time and floods frequently. Country information was derived from "Lonely Planet On-Line".

The considerable diversity in climate, terrain, ethnic groups and socio-economic development is at the basis of the significant difference in the importance of family poultry across the region. This report therefore focuses on specific areas and groups where smallholder poultry were putatively important. Emphasis was placed on regions where sustainable options for family poultry development were envisaged.

POULTRY TYPES, BREEDS AND MANAGEMENT SYSTEMS

Family poultry, especially chickens and turkeys, are widespread across the region. However, the numbers and proportions vary considerably. Family poultry appeared to be the most important class of livestock in most of the outlying communities on the Caribbean coast. Although fishing was still the major source of animal protein, environmental restraints may oblige local inhabitants to seek alternative sources in the future. Chickens are kept for meat and eggs, and other poultry species are raised for meat. Some areas have an active market trade, where poultry are bartered or sold. Poultry types, breeds and management systems appeared to vary according to the area of the country, the size of the town or the village, the proximity to nearby cities and touristic centres and, particularly, the ethnic group under consideration.

CREOLE FAMILY POULTRY

The Creoles are the most evident ethnic group in most of Belize, the urban parts of Roatan (Bay Islands) and the Mosquitia. Their culture is more closely linked to the Caribbean Islands such as Jamaica than to that of other people in Central America. The main poultry species raised were the domestic fowl. Turkeys, muscovies, geese and guinea fowls were occasionally raised. Formerly, turkeys and muscovies were raised in larger numbers.

Creoles living in large urban centres such as Belmopan and Belize City (Belize) did not rely heavily on family poultry, as industrially raised poultry and other sources of animal protein were easily available. However, family poultry even had a place within the city, raised under semi-intensive or backyard systems. They were even allowed to range freely at the periphery of the city. Smaller towns and villages had large numbers of poultry, and the backyard or extensive (free-range) systems were used. The backyard system appeared to be the more popular, although it required more capital input and organization than free-ranging system. Ownership and management were often, but not exclusively, the domain of village women who regard poultry as a useful source of eggs, meat and income.

Turkeys were narrow-breasted. Their feathers were usually black or bronze, and birds were rarely raised for. It was not unusual for farmers to lose all their poults from diseases. Muscovies (pied pattern) and geese (grey) were infrequently raised, or only in small numbers, as they were considered to be too unhygienic for raising in close proximity to the house, particularly if the compound was small and enclosed. Guinea fowls (helmeted, 'wild type' grey) were rare and raised as a curiosity and as 'alarm dogs' around compounds.

Chickens were widely kept, and usually were large and compact with a 'heavy breed' or 'Asiatic' conformation (e.g. Rhode Island Red or Sussex) but with proportionately longer legs (Mallia, 1999c). Some poultry however had some 'Mediterranean' features (large single comb, long neck and slender, upright posture and a large, well-developed tail carried with prominent sickles at almost 90o to the line of the back in the males).

However, white cheeks, white eggs and the non-sitting characteristic (also typical of Mediterranean-type fowl) were not present. There was clearly a strong negative selection pressure for non-sitting hens, as artificial incubation is not practised in these communities. Results obtained from 59 males and 126 females revealed that, on average, males weighed 3.89kg (standard error, 0.10kg) and females weighed 2.90kg (standard error, 0.05kg). The naked-neck trait was also present, known locally as the 'Peel-neck chicken'. All chickens were soft-feathered, but highly variable in colour: white, black, brown, red, partridge, speckled, silver cuckoo and wheaten colour phases were present.

The hens laid tinted or light brown eggs. Most eggs from free-range hens were successively recovered as they were supplied with 'nest-sites' ranging from boxes to old planks of wood propped against a wall, usually near the owner's house. Free-range poultry were regularly fed on household scraps, discarded farm-produce and grains. This served as an incentive for them to come close to the household. As a result the poultry had a better diet, hens were trained to lay in a convenient location (facilitating the collection of eggs) and they roosted closer to the house.

A reduction in predation, theft and losses from inclement weather was also achieved. Theft of mature poultry was a potential problem in the larger Creole centres, hence they were not extensively ranged in certain communities. Hens were cautious and defensive when with young, caring for them until weaning. However, this limited the number of eggs and chicks produced. Despite the substantial phenotypic variation among the fowl, no single 'type' was singled out as being more productive or prolific. Hens commenced laying eggs between seven and eight months, and laid less than 80 eggs per year. Growth and number of eggs laid, especially those kept in confined quarters, was probably linked to ration quality and quantity and particularly the presence of disease.

Poultry of different types and ages were allowed to range together, or were often housed together. Because of this husbandry system, it was unfortunately impossible to assess the types of disease present and the actual risk of disease.

Rudimentary breeding programmes were present for birds raised in pens and compounds. The larger roosters were kept for breeding and changed with a certain frequency. Hens which had ceased to lay were consumed. It was clearly more challenging to control breeding in free-range poultry. For example, the identification of poor layers was often unsuccessful. The female to male ratios under this system usually ranged from 5:1 to 10:1, depending on how many roosters were harvested for consumption, or the size of the pen or compound for backyard poultry, but also on market demands. A discreet exchange of poultry occurred among communities, so inbreeding was a possible concern only in the more outlying communities such as the extreme south of Belize and parts of the Honduran Mosquitia.

The consumption of poultry, in particular chicken, among Creoles is very popular. Industrially raised poultry meet this need only in larger centres. However, even large but relatively remote settlements such as Mango Creek (Belize) rely on family poultry, as many people cannot afford to raise poultry intensively or to buy, for their consumption, poultry produced intensively and brought over from other parts of the country (transport costs make them expensive). Although the demand is present, backyard or free-range (family poultry) did not sufficiently meet the need.

GARIFUNA FAMILY POULTRY

The Garifuna are of African descent, and were brought over to St. Vincent, and subsequently Punta Gorda (Bay Islands), from where they spread to the central-southern coast of Belize, in Dangriga, Seine Beight, Georgetown and Barranco. In Guatemala, they are present in Puerto Barrios and Livingston, on the Caribbean coast. In Honduras, they were widely present in La Ceiba, Tela, Trujillo, Barrio Cristales, Triunfo de la Cruz, Limon, Palacios, Brus Laguna, Puerto Lempira and the Bay Islands. However their culture and lifestyle is still relatively similar across all these areas.

The Garifuna relied heavily on fishing and agriculture for their livelihood, and raised mainly domestic fowl and a few muscovies. Approximately 100% of the total chicken population in the Mosquitia and several smaller Garifuna communities in Belize, Guatemala and Honduras were raised under extensive or backyard systems of management, with very little capital input. Individual women or groups of women owned poultry. The numbers of poultry owned and even ownership often changed. Garifuna living in larger centres, such as Dangriga (Belize) and La Ceiba (Honduras) have a considerably lower reliance on family poultry enterprises.

Turkeys and other poultry were not observed. Chickens had a body size and weight was almost always very modest. An adult male weighed around 2kg and a female 1.5 kg at 12 months. However, they were very alert, hardy, long-legged and active fliers and foragers, excellent traits for free-ranging birds in the tropics. The plumage varied substantially, but partridge-type plumage and other dark coloured feathering such as grey and black were predominant.

There was little evidence of genetic mixing with contemporary commercial hybrids such as Leghorns, Rhode Island Reds, or the presence of particular genes such as those for naked neck (Na) and frizzle (F). Poultry scavenged for plants, seeds, insects and worms, but this diet was also supplemented with farm-produce excess and rejects and also household scraps. Poultry spent most of the day actively searching for food. They often showed 'opportunistic feeding'; for example feeding on coconut meal, spilled grains, and insects and larvae that had a seasonal occurrence. This behaviour was considered to be especially important, as deliberate feeding of poultry was, at best erratic. The 'cafeteria system' is said to be as balanced as complete feeds, the challenge being to determine the nutrient content of the available feed resources, and to provide such nutrient sources to birds in the appropriate moments (Branckaert, 1990).

Poultry were vulnerable to weather extremes such as heavy rains and flooding, frequent in some areas such as the Mosquitia. This situation was aggravated by the lack of housing for poultry. Therefore the relative lack of involvement and skills in managing family poultry resulted in high mortalities due to climate extremes, but also predation and disease. The precise impact was impossible to assess as no records were usually kept. Predation from domestic cats and dogs in the smaller settlements was of a modest entity relative to that from wild predators. Theft was also a relatively small concern, probably due to the smallness of many of these communities. As flocks were not confined, poultry of different ages were allowed to mix freely, possibly having a deleterious effect on the health status of the flock. However, this is based primarily on reports on industrially raised or partly confined non-industrially raised poultry. There is a marked paucity of epidemiological studies of poultry disease under extensive systems of management.

Breeding programmes were not present in most family poultry units: matings were not planned, and even the choice of breeding rooster was quite arbitrary. The chickens were very precocious, reaching sexual maturity before 8 months. The hens were excellent mothers, guiding chicks to potential food sources most of the day, heeding distress calls from stragglers, and intervening when the young birds were compromised by the presence of other chickens and muscovies. Not surprisingly, production traits appeared to be negatively correlated with these characteristics. Meat yield was less than 70% of the live weight, and egg production possibly reached 50-70 tinted or light brown eggs per annum, often much less.

However, natural selection was at least as important, and possibly more in the selection of surviving birds than that which was done by the part of the personnel involved. The female to male ratios under this system usually ranged from 5:1 to 15:1, depending on how many roosters were harvested for consumption, but also on predation: roosters tended to wander further afar from the village, and often leave after the hens when faced with a threat (predator).

The predation rate on roosters was therefore said to be higher than that for hens. In the case of muscovies, the female to male ratios were around 3:1 to 5:1. They were raised in a similar manner to fowl, and fended almost entirely for themselves. They often scavenged in parts of the coastline where the fish catch was gutted on the beach. Although they coexisted fairly readily with domestic fowl, the ducks were quite aggressive towards fowl and their chicks when they were with their ducklings. Most muscovies were variegated black and white, and size differences between males and females were less marked than those in Europe and North America.

Inbreeding among fowl was possibly a concern, and fertility may have been quite low in some of the smaller, outlying coastal communities. Community isolation and infrequent introduction of new specimens into the village flock were the prime reasons. Low stocking density and few new additions of birds resulted in little fighting among males. Fighting was almost unknown among females once a peck-order (or despot system) was established. The nest-site was usually unknown, hence estimating the average clutch size, hatchability, chick survivability and other important information could not even be guesstimated. Chicks remained with the hen until weaning, few clutches were therefore laid, and poultry production was low and irregular. As a result coastal populations were obligated to rely heavily on fishing and hunting for animal protein. A further consequence was that few or no forms of poultry marketing were developed among the Garifuna.

There were no social or religious restraints on the consumption of poultry for the Garifuna. Even if industrially raised poultry were to arrive at some of the more remote areas, it would not be affordable to many. Unfortunately, despite the demand, the present situation of family poultry was not sufficient, or consistent enough to provide a reliable source of animal protein among these people.

'INDIAN' AND 'MESTIZO' FAMILY POULTRY

The Mestizos have a Latin-Hispanic culture, similar to that found in many other parts of Central America. They predominate in Honduras and larger towns and cities in Guatemala. However, Indians still predominate in non-urban settings, especially in the highlands of Guatemala, and the raising of turkeys is part of their highly traditional culture. Indians and Mestizos are also very visible in the northern half of Belize. Family flocks are usually associated with crops (e.g. maize) and other livestock species, as observed in other parts of the world (Sonaiya, 1990a).

The main poultry species raised were the domestic fowl and turkeys. However, muscovies and geese were widely raised in parts of the region. 'Criollo' or indigenous poultry was raised within the city and under semi-intensive or backyard systems (e.g. in Antigua and Guatemala). Birds were even allowed to range freely at the periphery of some of the larger cities (e.g. La Ceiba, Honduras). However urban dwellers, usually Mestizos, relied mainly on industrially raised poultry.

Most towns and villages had large numbers of poultry. Extensive husbandry systems (backyard or free-range) were used (e.g. in Solola, Guatemala), although poultry raised under the free-range system was housed at night and supplemented with feed. Birds were managed and owned almost exclusively by women of the household, although men and children were also involved. For example, men and children were responsible for bringing harvest waste from the fields to the compound.

Turkeys were all of the traditional narrow-breasted phenotype, with prominent, long legs. A survey of 47 males and 79 females revealed that toms weighed between 11-13 kg and hens 5.9–7.2 kg. The commoner colour phases were black and bronze, but other varieties such as red, buff, grey and variegated birds were also present. They were raised together with chickens and other poultry in most regions, and were not considered a challenge to raise. It was not unusual for a turkey-hen to loose all its poults from diseases.

The historic importance of the turkey in Central America and the high esteem it is regarded with by indigenous Indians has been documented (Mallia, 1998a). However, the present range of indigenous turkeys in Central America was very discontinuous. Climate and ethnic group of a region were important features that determined the number of turkeys present and the husbandry system(s) adopted. Turkeys tended to be raised mainly by Indians, less so by the Mestizo and Creoles, and not at all by the Garifuna. Although present in all agroecosystems in Central America, the success of raising turkeys was very variable. Most areas where mixed flocks (chicken and turkey) have long been present have a turkey population that has been largely decimated.

A report on indigenous turkeys in Oaxaca, Mexico, suggested that blackhead, caused by Histomonas meleagridis, may be responsible for the markedly high turkey chick mortality in mixed flocks (Mallia, 1998a). There is a possibility that drier areas can support mixed flocks slightly better because earthworms are fewer in number and tend to surface to the ground less than under humid conditions. Earthworms are vectors for the cecal worm (Heterakis gallinae), and H. meleagridis can remain viable for long periods of time within the worm. For example, in the region of Zacapa, Guatemala, the climate is subdesert, and very hot and dry. Turkeys and chickens were kept in free-range system or together in large outdoor pens.

The Coban area is also close to Zacapa and traditional Indians predominate, but the climate is cool and wet. Although mixed groups of poultry were present, turkeys were relatively rare, while chickens, muscovies and geese predominated. In Livingston, Guatemala, with a hot and humid climate, mixed groups of poultry were also present, and here too, turkeys were relatively few. Chickens were the commonest category of poultry, although many muscovies were also kept. In the part of Livingston peopled by Garifuna, turkeys were absent, emphasizing the importance of cultural differences based on ethnicity present even within the same town. The Chiquimula area, contiguous with Zacapa is also hot and dry, but the population is predominantly Mestizo. There were relatively few mixed flocks of turkeys and chickens raised in the traditional manner, once again due to cultural differences.

Waterfowl were very numerous in the region between Zacapa and Puerto Barrios and also around Lake Izabal in Guatemala, but fowl still predominated. Turkeys were relatively uncommon in the hot, humid coastal areas. The province of El Peten was in a rapid state of development, especially along the recently widened jungle highway. Poultry are the commonest group of domestic animals present, especially chickens. In frontier homesteads in newly logged jungle areas, free-range turkeys were very successful in raising and weaning sizeable clutches of poults. This may be due to the lower rate of ground contamination by H. meleagridis and H. gallinae. Interestingly, even in El Peten, villages that had been established for a few years appeared to have the usual very high proportion of chickens when compared to turkeys.

Northwestern Belize is contiguous and well linked with Guatemala and free-range turkeys were here widely present, unlike the rest of Belize. Indian villages in the western highlands of Guatemala in the Chichcastenango and Quetzaltenango areas supply many of the larger urban centres with turkeys. For example, many of the turkeys in Solola and Panajachel are purchased as poults or young adults at the weekly Chicastenango market. Many of these smaller villages were unfortunately relatively inaccessible, so the management strategies for the relative success in breeding turkeys were not identified. However, villages such as San Antonio Palopo, near Panajachel, did not allow their turkeys to range freely with chickens. Turkeys were kept enclosed. Furthermore, the pens were made of elevated, compacted earth. This facilitated drainage and discouraged growth of vegetation. It also minimized the mixing of chickens with turkeys, and presumably did not create a favourable environment for earthworms.

Chickens were widely kept, and were generally similar to those described under 'Creole' family poultry, but with greater phenotypic variability. They were mainly of the 'Asiatic' type, but poultry with a light frame and 'Mediterranean' features were also frequently present. The naked-neck trait was widely present throughout Belize and Guatemala, and rarer in coastal Honduras. Chickens with the rumpless trait were present in Livingston, Guatemala. In the crater villages around Panajachel, Guatemala, poultry with a 'muffled face' phenotype were present, similar to that observed in the Auracana (Latin American breed) and Faverolle (French breed). There was no predominant colour phase for fowl, and all were soft-feathered and laid tinted or light brown eggs.

Management practices for chickens are similar to those described for 'Creole' family poultry, however feed supplementation was more significant, and flock size tended to be larger. For example, flocks of 50 chickens were not uncommon. Furthermore an organised marketing system was in place. A healthy exchange of poultry stock took place through local and distant markets. This reduced the possibility of inbreeding and also encouraged families to raise larger numbers of poultry, as selling then beyond the village level was easily possible. Poultry, particularly the sale of chickens and turkey therefore represent a guaranteed source of income for some Indian families, particularly the women who look after the poultry, as occurs in other parts of the world (Sonaiya *et al.*, 1999).

POSSIBLE OPPORTUNITIES FOR IMPROVING POULTRY PRODUCTION AND PRODUCTIVITY

The general conditions necessary for a successful implementation of poultry development programs were summarized by Traoré (1999). The following are specific conditions and opportunities that focus on family poultry in parts of the Central American region.

Cultural attitudes

Creoles, Garifunas, Indians and Mestizos have no religious or cultural attitudes that may negatively influence the consumption of poultry, especially chickens. Indians have a particularly strong tradition for raising turkeys under backyard or free-range systems around village homes and gardens. Other ethnic groups, particularly Creoles and Mestizos, would probably be interested in raising turkeys, particularly if an extension service to discuss management and disease problems was available. Fast growing broad-breasted turkeys may find limited acceptance in regions of Central America with a high proportion of traditional indigenous Indians (Mallia, 1998a). Creoles were reluctant to raise waterfowl close to houses and gardens unless large bodies of water were in the vicinity. Garifunas mainly fish and grow crops. Raising livestock is not one of the major occupations of these people. However poultry products are popular and widely accepted, and this may serve as a greater incentive for raising them more efficiently and possibly in larger numbers.

Size of production unit and marketing systems

The size of production units may be increased, but only if there is a consistent local supply of feed to permit this, as feed can account for 60% or more of production costs (Gunaratne, 1999). Poultry production should be structured to guarantee a consistent quantity of produce for the market. It is clear that isolated communities, e.g. in the Mosquitia, will be restricted to production for a very local market, whereas regions with numerous adjacent towns may cater for a wider market, e.g. most villages in Guatemala. The rapid development of (non-package tour) tourism, for example the southern Belize and Honduran coastlines will also create a window of opportunity for locals. Aside from a reliable source of poultry for themselves, they can earn income through the production and sale of poultry and products to local restaurants. This already occurs in parts of the region, for example in Monkey River Town, Belize.

Large-scale poultry units where an intensive husbandry system is practised are ideal for urban centres or areas with an established tourist infrastructure (e.g. parts of the Caribbean coast and Guatemalan highlands). These areas have a market that requires a steady reliable source of poultry products, and intensive systems are generally already in place in these areas. However, it is unlikely that there will be any overall direct benefit to certain social groups if poultry products are too expensive. Furthermore, smallholders probably cannot compete with, or even participate with the raising of large, commercially grown flocks. Therefore the presence of industrial poultry farms does not replace the requirement for a parallel family poultry system in urban, peri-urban and rural areas (Sonaiya *et al.*, 1999).

Semi-intensive and backyard systems may be further encouraged around large towns, and possibly small cities to cover the niche market for urbanites who cannot afford intensively-raised poultry. Intensive systems of raising poultry may also not be financially viable, long term, due to its strong dependence on external inputs (Traoré, 1999). Another market is for people preferring a more 'natural' product, e.g. slower-growing, tasty 'pollo criollo' (local chicken) or 'pavo criollo' (narrow-breasted local turkeys). The marketing system is in place in many parts of Central America, so the concept of buy-sell or barter of poultry at the market is well established within local tradition.

Disease, breeding and management systems

Although breed productivity, in terms of eggs, meat and offspring was rather modest, the current ecotypes may actually be ideal for the conditions under which they are raised. It is probably futile altering and 'improving' local varieties unless this exercise is coupled with the introduction of appropriate management systems. In other parts of the world, indigenous birds have been found to be highly productive (Mathur *et al.*, 1989; Nwosu, 1979). It is perhaps better to initially fully assess the productivity potential of the current poultry genetic pool, and identify management and disease prevention strategies that can improve production.

Extensively ranged poultry should be routinely supplemented and encouraged to frequent the vicinity of the household. This practice will better the diet, encourage hens to lay eggs close to the house, convenient for the collection of eggs or segregating an incubating hen. If poultry are encouraged to roost close to the house theft, predation and losses from inclement weather are lessened. Improving poultry housing may also be significant for some communities, particularly in Garifuna communities. As reported elsewhere, this would probably result in lower chick mortality (Kitalyi, 1998), reduction of disease (Tadelle, 1996; Kaiser, 1990), predation and theft (Kitalyi, 1999).

Brooding hens incubating eggs in enclosed area, with early segregation of chicks to induce hen to lay again may be a useful strategy for backyard systems of management. These systems also have the advantage of having control over the diet of newly hatched chicks, minimizing chick predation and decreasing the incidence of disease as no mixing of chicks of different ages would occur.

The introduction of artificial incubation to backyard or semi-intensive systems of management would maximize the laying potential of sitting-type (broody) hens as it would eliminate the cessation of lay during incubation. Incubators or surrogate sitting-type hens are, of course, essential for breeding non-sitting types. The use of rustic, non-sitting chicken breeds is recommended if this set-up is feasible, as these chickens are often highly productive even under hot environmental conditions (Mallia, 1999a). However, pens have to be constructed (one-time input), and a consistent supply of feed must be guaranteed to the enclosed hens and chicks.

Programmes relating to new types and patterns of poultry disease, and the use of local feed products would have to be implemented simultaneously and maintained for some time for sustainable results. This investment may rapidly give dividends. For example, women volunteers for raising rustic, local chickens were successfully recruited and quickly trained to run a self-sufficient poultry unit. They used small incubators kept within the household, and constructed economical backyard pens. Production of eggs and chicks far exceeded the project prognosis (Mallia, 1999b). Co-operation with non-governmental organizations to develop rural poultry production in other parts of the world such as West Africa (Traoré, 1999) and India (Rangnekar and Rangnekar, 1999) have also given successful results. However, the lack of a continuous supply of supplementary feed is a major obstacle in much of the Mosquitia and parts of Southern coastal Belize, and is destined to be a major limiting factor in poultry production.

The raising of ducks has large potentials, especially in the wetter regions of Central America. Cultural resentment against ducks within the compound area must be avoided. For example a village pond may be dredged so as to encourage feeding and nesting in specific sites to reduce predation of ducklings. Supplementing with kitchen / field produce and waste should occur in the pond area, away from homes. The fragmented range for turkeys and the reduction of numbers of turkeys in many of their traditional areas are major concerns and warrant particular scrutiny (Mallia, 1998a). Turkeys should be segregated from chickens when possible, and housed in pens. The run should be dry, possibly elevated and limed to discourage the occurrence of blackhead, one of the major limiting factors in family-type management systems of turkeys (Mallia, 1998a). Controlled burning of areas close to the village may be employed with caution for extensively ranged turkeys.

Epidemiological surveys and the keeping of records is important for collecting long-term information regarding disease and productivity (Traoré, 1999). While the presence of Newcastle disease, IBD, fowl cholera and fowl pox, among others, are known to affect family poultry production (Aini, 1999; Sonaiya *et al.*, 1999; Traoré, 1999), actual incident rates are often not available. For example, as many as 750 million poultry in Africa die each year as a result of various diseases (Sonaiya, 1990b), but here too the value is only estimated. Furthermore, environmental and management risk factors are rarely identified and ranked, nor is their interaction assessed. This partly explains why field trials and studies with Newcastle disease vaccines in Africa were disappointing (Traoré, 1999). On a brighter note, holistic epidemiological studies and multivariate modelling have already started to contribute favourably to poultry production (Mallia, 1998b).

Questionnaires can be used for collecting information in family poultry management systems. Questionnaires are inexpensive and data collected may be readily utilized by extension workers or scientists for short-term projects (Mallia, 1998a; Mallia, 1999a). However, although they are highly informative, they cannot replace long-term observational studies based on *in-situ* monitoring systems. Information-gathering systems such as questionnaires and monitoring systems could form an integral part of a global system of epidemiological studies for various diseases affecting family poultry.

CONCLUSIONS

Sustainable family poultry development in Central America and elsewhere depends on the interplay between the environment, local resources, community size and agricultural practices, poultry management systems, political, cultural and the general socio-economic milieu. The resulting complex agro-ecosystem can be assessed by the use of multivariate modelling that allows for a holistic approach to problem-solving. The paucity of holistic, epidemiological studies that simultaneously assess the role of various risk factors concerning disease and good management practices, with poultry production as the outcome must be corrected. In this manner, control of risk factors and management practices can be ranked according to the positive contribution towards poultry production, allowing for possible interactions between the variables under consideration.

Through the International Network on Family Poultry Development (INFPD), the Food and Agriculture Organization (FAO) has shown its interest and commitment to family poultry development (Sonaiya *et al.*, 1999). INFPD therefore represents the ideal organization that can serve as a forum for discussion, and co-ordinate holistic epidemiological studies on family poultry.

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Nutritional status of family poultry in Bangladesh

Q. M. E. Huque

ABSTRACT

An oesophagial crop study was carried out in family poultry to determine the nutritional status in their feed. The crude protein, crude fibre, ether extract, ash, nitrogen-free extracts, calcium and phosphorus contents were determined in the feed collected from crop and gizzard. The significantly highest crude protein and crude fibre contents were found in Botyaghata during summer. In all locations, highest crude protein contents ($P<0.05$) were observed in summer, in comparison with the two other seasons. The crude fibre content was found to be about double the standard requirement in all locations. The calcium (Ca) content of the feed of laying hens in different locations was found close to the standard requirement for laying hens. However, the phosphorus (P) was deficient. This results in an imbalanced Ca/P ratio in the feed. The most common feed items found in the crop and gizzard were whole rice grain, boiled rice and vegetable materials. The feed obtained through scavenging was deficient in crude protein, and the crude fibre was found to be double the standard requirement. The Ca/P ratio in the feed was not found balanced.

INTRODUCTION

The family poultry in Bangladesh is characterized by small-scale operation. Family poultry population has been estimated about 80 percent of the total poultry population (1997-98) in Bangladesh. Poultry rearing is one of the most income generating activities for rural women, landless poor and marginal farmers. It provides the population with cash income, generates employment opportunities and, at the same time, increases the production of valuable animal protein.

Bangladesh has large potential for increasing meat and egg production through family poultry. The success depends essentially on the improvements of indigenous practices in extensive family poultry production systems. The potential for increasing poultry production is closely linked to an appropriate use of the locally available feed resources. The nutritional status of scavenging laying hens (domestic fowl) is not known. Balanced ration, which meets the nutritional requirement, is a prerequisite for an efficient production. Any adaptation or improvement programme using exotic/improved chickens required higher nutrient supplies than those intended for the local chickens (Sazzad, 1986).

Thus, before taking any comprehensive programme for the improvement of family poultry production systems, it is essential to know the existing nutritional status of the feed obtained by the scavenging hens in a day. It is also relevant to know whether the scavenged feed contained sufficient nutrients or not to support the egg production of laying hens. The present study was undertaken to determine the major nutritional status in the feed found in crop and gizzard of laying hens under scavenging system of rearing.

MATERIALS AND METHODS

On the basis of the country's topography and ecology, five locations were selected from different ecological zones like plane, low, high, hilly and saline land area of the country. The areas were Savar Thana of Dhaka district, Sadar Thana of Sylhet district, Birgonj Thana of Dinajpur district, Hathazari Thana of Chittagong district and Botyaghata Thana of Khulna district. To determine the nutritional status of laying hens under scavenging conditions, oesophagial crop study was conducted in three seasons. The number of sacrificed laying hens was 107, 98, 100, 95 and 100 at Savar, Sadar, Birgonj, Hathazari and Botyaghata Thanas, respectively. Birds were collected directly from farm household during the scavenging time and the birds were weighed and sacrificed on the spot by bleeding at the cervical region. The birds were collected at 9:30, 11:30, 13:30 and 15:30 hours of the day.

The sacrificed birds were carried to the Thana (lowest administrative unit) veterinary hospital/laboratory, and were opened for internal organs and the feed in the crop and gizzard of the scavenging hens were collected for further analysis. The feed collected from the gizzard and crop were weighed and the feed items were identified through eye observation and kept in the deep freezer. After freezing, the feed samples were brought to the Bangladesh Livestock Research Institute's laboratory. The feed samples were ground and mixed properly for analysis.

The proximate components of the feed were determined according to A.O.A.C. (1960). The ground samples were weighed out and digested with di-acid mixture (H2 SO4 : HClO4 = 2:1) for total content of calcium and phosphorus. When digestion was complete the content was transferred to a 50 ml volumetric flask and made up to the mark using de-ionated water. The phosphorus in the digest was determined by developing the yellow colour by adding ammonium molybdate, ammonium vanadate (Burtons solution) and measuring the colour with the help of spectrophotometer at 440 mu (Chapman and Pratt, 1961). Total Ca content in the digest was determined directly by using atomic absorption spectrophotometer.

The feed samples were collected in one complete year by dividing the year into three periods based on climatic conditions of the country. The three periods were October–January, February-May and June-September that were considered as winter, summer and rainy season, respectively. The data were analyzed using General Linear Models Procedure of SAS Programme (SAS/STAT User's Guide, 1988). The test of significance was made according to Kramar (1956).

RESULTS AND DISCUSSION

The chemical composition of the feed samples collected from crop and gizzard of hens are presented in Table 1. The significantly highest value of crude protein (CP) content in the scavenged feed of laying hens was found in Botyaghata during the summer. In each location, it was observed that the CP content of the feeds was higher ($P<0.05$) during the summer. The higher CP content might be due to the availability of pulses and insects during the summer than in the other two seasons of the year. This result was in agreement with the findings of Savory *et al.* (1978) who found that the diet of scavenging chicks contained about 56 percent of invertebrate food at first week of age during summer period. The level of invertebrate feed declined later to a somewhat lower level. The significantly lowest value of CP content was observed in Hathazari during the rainy season. It was observed that CP content of feed sample during the rainy season was lower than in any other period of the year. The lower availability of CP in Hathanzari (7.31 percent) and Sadar (7.75 percent) might be due to location-specific. This can be explained by the fact that Sadar location is a 'haor' (water logged) area and Hathazari is a hilly area. In the rainy season, the birds cannot scavenge properly due to heavy rainfall, which might be the reason for lower CP in these locations.

TABLE 1: CHEMICAL COMPOSITION OF COLLECTED FEED SAMPLES OF HEN IN RESPECT TO SEASON AND LOCATION.

Location	**Season**	**Mean +SE**			
		percent DM	**CP**	**CF**	**EE**
Hathazari	Winter	86.5	7.96[fg] +0.04	8.38[g] +0.09	1.70[a] +0.06
	Summer	86.9	8.81[c] +0.07	8.72[fg] +0.14	1.70[a] + 0.08
	Rainy	87.7	7.31[j] +0.02	8.49[g] +0.11	1.72[a] +0.11
Sadar	Winter	87.6	7.89[fgh] +0.07	9.30[e] +0.02	1.15[a] + 0.02
	Summer	89.5	8.56[cd] +0.04	8.47[g] +0.20	1.35[cde] +0.05
	Rainy	88.9	7.75[i] +0.09	8.92[efg] +0.21	1.13[e] +0.04
Birgonj	Winter	87.0	7.92[fgh] +0.11	9.64[cd] +0.06	1.37[cde] +0.02
	Summer	46.7	8.43[e] +0.09	8.54[g] +0.14	1.29[e] + 0.04
	Rainy	86.1	8.03[f] +0.09	8.87[fg] +0.08	1.44[bcd] +0.24
Botyaghata	Winter	88.4	8.51[d] +0.07	10.18[ab] +0.14	1.53[abcd] +0.06
	Summer	88.1	9.16[a] +0.05	10.30[a] +0.10	1.60[abc] +0.06
	Rainy	88.3	8.56[cd] +0.12	10.13[bc] +0.14	1.55[abcd] +0.08
Savar	Winter	87.8	7.81[gh] +0.02	9.73[bcd] +0.07	1.56[abc] +0.07
	Summer	87.5	8.87[b] +0.03	9.61[d] +0.08	1.65[a] +0.10
	Rainy	88.0	7.88[fgh] +0.04	9.05[ef] +0.10	1.63[ab] +0.07

Location	Season	Mean +SE			
		ASH	NFE	Ca	P
Hathazari	Winter	8.35d +0.22	60.15^{ab} +0.66	3.42^{c} +0.09	0.46^{c} +0.02
	Summer	8.31d +0.22	59.39^{abc} +0.71	3.38^{c} +0.08	0.44^{cd} +0.02
	Rainy	8.28d +0.22	61.90^{a} +0.30	3.68^{abc} +0.09	0.42^{cd} +0.03
Sadar	Winter	12.02ab +0.61	57.12^{de} +0.76	3.91^{abc} +0.11	0.30^{f} +0.01
	Summer	11.74abc +0.64	59.35^{bc} +0.78	3.55^{abc} +0.12	0.33^{ef} +0.02
	Rainy	13.29 +0.55	58.12^{a} +0.79	4.03^{bcd} +0.40	0.32^{abcf} +0.02
Birgonj	Winter	12.60a +0.74	56.34^{de} +0.85	3.83^{abc} +0.45	0.40^{de} +0.01
	Summer	10.1ed +0.27	57.68^{bcd} +0.82	3.36^{c} +0.39	0.42^{cd} +0.01
	Rainy	11.48bcd +0.33	56.3^{e} +0.72	3.50^{bc} +0.13	0.42^{cd} +0.02
Botyaghata	Winter	13.44a +0.40	54.72^{e} +0.51	4.31^{abc} +0.11	0.40^{cd} +0.03
	Summer	12.31a +0.50	54.72^{e} +0.51	4.72^{ab} +0.10	0.30^{e} +0.02
	Rainy	13.46a +0.60	54.51^{e} +0.77	4.80^{a} +0.50	0.30^{dc} +0.03
Savar	Winter	10.04cd +0.31	58.65^{bcd} +0.24	3.19^{c} +0.38	0.55^{a} +0.01
	Summer	9.75d +0.32	57.60^{cd} +0.43	3.41^{c} +0.27	0.54^{b} +0.01
	Rainy	9.76d +0.25	59.67^{abc} +0.34	3.35^{c} +0.21	0.57^{a} <+0.01

Means with different superscripts in the same column differ significantly (P<.05)

The crude fibre (CF) content in Botyaghata (10.30 percent) during the summer was higher (P<0.05) than in all other locations and in all seasons. It was observed that the overall crude fibre content was higher in Botyaghata in all seasons of the year. Botyaghata is the extensive rice producing area among the five locations, and rice is the main crop of this area. It is assumed that the hens of this area get more whole rice, which might be the cause of higher CF content in their scavenged feed. In all seasons, the overall CF content of the scavenged feed of hens throughout the year was higher than that of the standard poultry ration.

There was no significant difference in the ether extract (EE) content of the feed of laying hens of Hathazari, Botyaghata and Savar locations in all seasons. The EE content in Birgonj was lower (P<0.05) during the summer than the rainy season. In all seasons, the EE content was significantly higher in Hathazari than in Sadar.

The ash content in the feed in Botyaghata was higher (P<0.05) than in Hathazari and Savar locations in all seasons, but it was not significant (P>0.05) between Botyaghata and

Sadar locations. The ash content of Hathazari location was significantly ($P<0.05$) lower than Sylhet location. It was observed that the overall ash content of the feed samples was higher than the standard requirement for laying hens.

The nitrogen-free extracts (NFE) were lower ($P<0.05$) in Botayaghata than in Savar and Hathazari locations. This was due to the higher crude fibre content in Botyaghata.

The calcium (Ca) content in Botyaghata location during the summer and the rainy season was higher ($P<0.05$) than in Savar and throughout the year. When a particular location was considered it was found that Ca content in different seasons of the year was not significantly different. It was also observed that there was not much difference in Ca content of the feed of scavenging laying hens among the locations, and it was very close to the standard requirement for laying hens. The phosphorus (P) content in Savar location was higher ($P<0.05$) than in all other locations and in all seasons. It was found that the P content in the feed of scavenging laying hens was lower than the standard requirement for laying hens. Thus, the Ca/P ratio was not found balanced in the scavenged feed

Available feed items found in the crop and the gizzard of sacrificed birds are shown in Table 2. Practically the common feed ingredients and wastes picked up by the hens were those available at the homestead of the farmers. The availability of feed ingredients and wastes depends on crop pattern and climatic condition. The most common items found in the crop and gizzard of the hens were rice polish, whole rice grain, broken rice, boiled rice. Whole wheat, pulses, insects, etc. were found in a particular season of the year depending on the crop pattern and rainfall.

TABLE 2: LIST OF FEED ITEMS FOUND IN THE CROP AND GIZZARD OF FAMILY POULTRY

No.	Items
1.	Whole paddy
2.	Rice bran
3.	Wheat bran
4.	Whole wheat
5.	Earthworm
6.	Rice polish
7.	Broken rice
8.	Insects
9.	Whole rice grain
10.	Boiled rice
11.	Pulses
12.	Un-identified feed particles

The results revealed that the feeds scavenged by laying hens are deficient in protein and phosphorus. Huque and Ukil (1992) reported that the feeds consumed by family poultry was also deficient in energy under scavenging conditions. This has negative effects on production. Huque and Ukil (1993) found that supplementation of laying family duck under scavenging conditions increased egg production about double. On the other hand, Huque and Ukil (1992) reported that supplementation of laying family hens increased egg production, but this was not economically cost-effective with the existing prices of feedstuffs. Chick separation and non-broodiness have also a positive impact on egg production cycle of family poultry (Huque *et al.*, 1990).

CONCLUSION

From the results, it may be concluded that nutrients obtained from scavenging around the homestead were not enough to express the production potential of family poultry when the local germ plasm (breed) available in the country is considered. The seasons affect directly crop production pattern and availability of feedstuffs, and thus egg production of family poultry in Bangladesh. The nutritional status of family poultry needs to be improved through the use of locally available feed resources for higher production. Hence, the income of poor farmers can substantially be enhanced.

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COMMENTS ON NUTRITIONAL STATUS OF FAMILY POULTRY IN BANGLADESH

Dr. Asifo O. Ajuyah

Hello Huque,

Thanks for your free communication on the 'Nutritional Status of Family Poultry in Bangladesh'. A biological relationship could be deciphered from your data on energy and protein utilization based on seasonal variations. For example, during the summer months protein intake as determined by crop content appears higher, which could be related to lower energy requirement as a result of higher environmental temperature. In contrast, during the winter months, crop contents of energy supplying nutrient (EE, NFE) were higher most probably as a result of higher energy requirement. This observation tends to be true for most locations during the winter period.

This observation along with the variation in the seasonal availability of feed resources will permit a proper diet intervention strategy to improve productivity of scavenging chickens. However, to further look at the biological aspect of your data, information on the age of the hens used in your study, stage of production, protein to energy ratio, day length, activity level and mean ambient temperature, etc. are important.