Constraints to adoption and sustainability of improved practices in scavenging poultry systems

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Introduction

There are two types of landscapes on which poultry scavenge: one that contains households (the farmstead or village) and the other without households (e.g., pasture or range). Hence, there are three well recognized scavenging production systems (SPS) as identified by Sonaiya and Swan (2004):

(a) Free-range extensive system where poultry are not confined, but roost in trees and nest in bushes and no supplements are deliberately given.

(b) Backyard extensive system where poultry are housed at night and scavenge during the day in the backyard; complete feed, grains, grain byproducts or kitchen wastes are provided in the morning and evening to supplement scavenging.

(c) Semi-scavenging system where poultry are allowed outside the backyard for six to eight hours for scavenging and complete or supplementary feeding is provided.

These SPS are “low input-low output” systems but are thought to be a reliable approach to food security, income generation, and therefore an excellent step in poverty alleviation due to their quick turnover and low investment requirement (Rangenekar and Rangenekar, 1996; Sonaiya, 1996; Branckaert, and Gueye, 2000; Permin et al., 2001). Scavenging poultry systems are economic and ecologically sustainable. In Vietnam, the feed cost per kg body weight was reported to be 29% lower for scavenging systems compared with confined systems and feed cost per kg eggs was 31-41% lower for scavenging systems (Do Viet Minh, 1999). The scavenging chickens convert leftover grains, human food leftovers and insects into IDI that are compatible and adapted to the social, economic and cultural needs of small holders, as well as partnership activities that emphasize institutional capacity development and sharing of technologies, protocols and materials.
poultry meat and eggs. Their manure encourages the development of earthworms in the soil, which, together with termites and other insects, form an additional source of feed. Poultry eat young grass, green leaves and other vegetation and hence are useful in insect and weed control.

Challenges to SPS development

The first challenge is that of chick production and mortality. The level of chick production by unimproved birds is very low compared to that of commercial hybrids in high-input systems (FAO Sectors 1 and 2). For example, a scavenging chicken hen lays only 30 - 80 eggs per year, while an industrial chicken hen lays 320 eggs annually. The low output in chick production relate to genetic resources, brooding management, lack of supplementary feeding, predators and diseases. Disease prophylactic measures developed specifically for SPS are scarce and high chick mortality rates are frequently reported in Africa (Wilson, et al., 1987; Bessin et al., 1998; Dakpogan et al., 2011).

The second challenge is that of feed availability and use. The use of the range for scavenging by poultry can generate unforeseen problems. For example, in Australia, emus (which are flightless birds) forage in paddocks and consume fodder intended for sheep and cattle. The birds are hungry and aggressive enough to chase sheep away from grain put out by farmers. However, this reported behaviour is related to the movement of thousands of emus into the State of Victoria’s north-west from drought-stricken areas of western New South Wales and Queensland in search of food and water (World Poultry, 2002a).

The third challenge to SPS development is a lack of knowledge among poultry owners, marketers, extension personnel, researchers, government policy makers and project development officers on one hand, and a non-supportive educational system, on the other hand (Sonaiya , 2009). A case in point is the Catholic Relief Service (CRS) provision through a local NGO of assistance for poultry keeping to three pilot communities in the Koya chiefdom in northern Sierra Leone. Ten improved cocks were supplied to each pilot community for cross breeding with the local hens and the crossbreds were to be distributed to other communities in the Chiefdom. On average, 20 hens were to be served by one cock with all the 21 birds confined in a small room. Saw dust was used as the bedding material with only one water trough and one feed trough provided in each room. The feed was locally made out of rice husk, bulgur wheat and a small quantity of smoked fish skin. Water and tetracycline were administered to sick birds. Most of the cocks died because the feed was inadequate, the water was contaminated with sawdust, there was no vaccination and the rooms were too small to accommodate the number of birds. There was a glaring lack of knowledge of poultry management by all concerned.

These three levels of challenge to the development of SPS have been faced and innovations, developments and interventions (IDI) have been produced to meet the challenges.

Examples of IDI in SPS

The Kuroiler breed development in India

The development of “Kuroilers” by Keggfarms Pvt. Ltd., New Delhi was to meet the challenge of availability of suitable germplasm with reasonable productivity under the SPS. Kuroilers are dual purpose, multi-colored & hardy birds that produce 200 eggs (4-5 times more than non-descript hens) and grow faster; a Kuroiler cock reaches 1 kg weight in 6-7 weeks compared to 18-20 weeks by non-descript cocks (Sharma, 2004). Every year Keggfarms distributes about 10 million Kuroiler chicks to 800,000 poor families across Uttarakhand, Uttar Pradesh, West Bengal, Assam, Orissa, Jharkhand, Chhattisgarh, Bihar and the North-eastern states through 1500 “mother units”. These mother units buy 400-2,000 birds at a time, rear them till 3-4 weeks and then supply them to the nearby villages through mobile vendors on cycles. Typically, a mother unit entrepreneur and a mobile vendor each make a profit of Rs 3 per bird (Sharma, 2007). An FAO survey showed that Kuroilers have made substantial contribution to poor peoples’ livelihoods in terms of increased income, women’s empowerment and enhanced nutritional status of households. Galukande et al., (2011) reported that the Ugandan National Animal Genetic Resource Centre and Data Bank (NAGRC & DB) in collaboration with United States’ Arizona State University had imported Kuroiler hatching eggs in 2010 and compared their hatchlings with those of Ugandan native chickens. The result of the study demonstrated that Kuroilers represent a 133 percent increase in meat production and a 462 percent increase in egg production. These figures also point to a 341 percent increase in income for...
Hay box chick brooder in Ethiopia

The general indication is that broody hens in the SPS cease egg laying for 81 days for the purpose of rearing 2.8 chicks to 84 days of age during which predators cause premature death of chicks (Solomon Demeke, 2007). If artificial brooding is adopted, chick mortality of 60% is reduced, the hen is relieved from the long broody periods and can come into lay again within a short period and hence productivity of SPS is increased.

The Ethiopian national poultry development programme was initiated in the early 1950s and concentrated on the distribution of 84-days old exotic pullets and cockerels. The aim was to promote small scale production of exotic poultry breeds within the rural farming population and to up-grade the indigenous chickens by crossing their hens with exotic males. However, the supply of improved pullets and cockerels from the government poultry multiplication and breeding centers has never been commensurate with the demand due to the lack of the huge requirement of brooding facilities, even though there was adequate hatching capacity.

The hay-box chick brooder in which no artificial heat is used was developed by Prof. Solomon Demeke at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) with financial support from the Ethiopian Science and Technology Commission (ESTC). The hay box brooder is a low-input technology that releases the mother hen to go back to laying, increases small scale poultry production in general and egg productivity in particular. It is easy to construct, use and modify with the use of locally available skills and materials (www.n sac.ca/international). To promote adoption and sustainability of the hay-box brooder, operational manuals were prepared with the financial support of the Food and Agricultural Organization of the United Nations Sub-regional Office for Eastern Africa (FAO-SREA). The manuals are available in English and all local Ethiopian languages (www.ethiopian-gateway.com/eaportal/.../poultry-capacity-building).

Within the “Agricultural Sustainability” project funded by the Canadian International Development Agency (CIDA), the hay-box brooder was extended to hundreds of farmers in the Jimma Zone. The project funds were provided from 2005 to 2009 to distribute brooder boxes, day old chicks of improved breeds and starters feed and to deliver short, companion training to beneficiaries. In addition, JUCAVM students got to practice community development skills by assisting farmers in hay box brooder construction. The technology was extended to Gambella and Asossa states with the support of ESTC and the United Nations High Commission for Refugees (UNHCR). With further sponsorship by FAO-SREA, the hay box brooder is now available in Kenya and Tanzania and is helping SPS farmers solve the problem of high chick mortality rates within the first 56 days of life. In Kenya, the brooder costs just Ksh100 (€ 1) to make (http://spore.cta.int/images/stories/pdf/5E145-web). To enable adoption in other countries, details of the hay box brooder were published in a news article in the International Ag-sieve Newsletter of the Rodale Institute, USA (http://fao.org/docrep/fao/011/ai320e/ai320e00.pdf) and also in Spore Bulletin of the European Union Technical Committee on Agriculture (CTA).

Range and pasture usage in Sri Lanka and Nigeria

Whether and how chickens will make proper use of the range or pastures is a problem experienced by all SPS producers: traditional free-range, intensive free-range and organic chickens systems. For all the three types of producers, an estimation of the quantity and quality of scavengable feed available on the range will help them to optimize range or pasture use and reduce the cost of feed supplementation if supplements are used or allowed. Roberts and Gunaratne (1992) and Sonaiya (2004) have reported on the scavengable feed resources for poultry production in Southeast Asia and West Africa, respectively.

De Vries (2000) studied the behaviour of local chickens in the backyards in a Nicaraguan village by recording their activities at 15 minutes intervals for a period of 12 hours once a week for five weeks. At the end of this monitoring period, chickens were caught and slaughtered between 10 and 12 noon after having scavenged all morning. The hens were recorded to have spent 46% of the 12 hours scavenging for feed. Of the time spent eating, 37% and 25% were spent consuming insects and weeds, respectively. Crop contents of the hens had 11.5% CP, similar to the value of 11.2% CP reported by Roberts and Gunaratne (1992) in Sri Lanka, but higher than 9.2% CP reported by Sonaiya (2004) in Nigeria.

Range usage has been studied in Europe in the context of commercial free-range systems. A 4-year...
study (Hegelund et al., 2005) was conducted in Denmark on 29 flocks of layers in 5 commercial organic egg production system with 500 to 6000 ISA Brown hens. Number of hens outdoors was estimated 8-40 times throughout the production period along with information on climatic conditions. The average number of hens outside varied from 2 to 24% between flocks. In general, the percent of hens outside decreased, when the flock size increased. There was a significant effect of farm, age, time of day, season, wind, rain and temperature while the presence of tents did not significantly affect the number of hens going outside. The majority of hens were recorded outside before noon and the number steadily decreased until evening.

Harlander-Matauschek (2002) in Germany carried out 2 experiments. Experiment 1 studied three groups of ISA-Brown laying hens, containing 250, 500 and 1000 birds each which were kept on deep litter with a stocking of 5 birds/m². Each group had access to a 20m X 225m free-range area. The areas were separated by wire mesh, which allowed visual contact between the groups. Marks were placed at 25m intervals to create nine different zones on the range, after 2 weeks of adaptation the number of hens in each zone was counted hourly from 7 am to 7 pm 3 days a week. The trial lasted 3 weeks and was repeated after regrouping of hens. In experiment 2, 8 groups of ISA-Brown laying hens, of 256 birds each, were kept in deep litter compartments with a stocking density of 5 birds/m². Each compartment had 2 pop-holes leading onto the range. Range surface available was 10 m²/bird. Five different pop-hole dimensions were tested (20cm X 30, 60, 90, 120,150cm). The number of hens on each range was counted hourly from 7 am to 7 pm on 35 days over a period of 3 months. The percent of birds using the range decreased from 38% in the group of 250 to 35% in the group of 500 to 22% in the group of 1000 laying hens. 60% of the hens on range remained within a distance of 50m of the building. More hens of the group of 1000 moved further away from the house as compared to the smaller groups (P<0.001). Pop-hole dimensions had no significant (P>0.05) effect on number of birds on the range. It was concluded that increasing group size seems to decrease the percentage of hens using the range while pop-hole dimensions did not influence the number of hens on range.

In a study in the UK (Gordon and Forbes, 2002), pasture usage was measured using a system of transponders and receivers located at key points below ground in the paddocks. This was done for female Ross 308 birds grown to day 56 in winter, and ISA 657 birds grown to day 81 in summer. Treatments were either standard or enriched brooding, with pasture only or enriched pasture. Standard brooding was in a controlled environment house until day 42. Enriched brooding was in naturally ventilated houses in which birds had sight of pasture from an early age and access from day 21. Enriched pasture included artificial shelter, with straw bales and a conifer “wigwam” used to provide natural shelter. Stocking density on the range was 2m² per bird. Pasture usage was affected by weather conditions with fewer birds being detected outdoors in windy and wet weather. Multiple regression analysis produced the following equation, relating the number of transponders detections on range to weather conditions:

\[ N = 67.9 - 10.8T_{\text{min}} + 4.63T_{\text{max}} - 0.061W + 2.37R \]

where:
- \( N \) = number of detections per day;
- \( T_{\text{min}} \) = minimum ambient temperature (°C);
- \( T_{\text{max}} \) = maximum ambient temperature (°C);
- \( W \) = wind run, km;
- \( R \) = rainfall, mm;
- \( r^2 = 0.39, p<0.05 \).

Constraints to adoption and sustainability of IDI in SPS

These range use methods are an example of IDIs that are not adopted by small scale SPS. The question that arises is why are some IDIs not widely adopted and if adopted, are they sustainable?

With regards to the Scavenging Feed Resource on the range, since it is made up of materials from the surrounding environment, by-products from harvesting and processing of grains and cultivated and wild vegetation (Sonaiya, 2004), the first constraint to adoption is that there are serious problems of quality control, assessment and maintenance of the range. Improvement in productivity of SPS requires improvement in the nutritional balance of the diet. Range use methods alone do not provide information on what feeds and nutrients are scavenged from the free range. Secondly, there are health and food safety implications of scavenging that are equally of importance. One of the health problems is worm infestation of the birds leading to inefficient feed conversion and lowered production. A survey by the Scottish Agricultural College showed that 96% of free-range layer flocks in the UK were infested by worms (World Poultry, 2002b). In the Netherlands, the Dutch Platform Biologica reported that organically produced chickens contained higher...
levels of campylobacter and dioxins than birds kept in confined conditions (World Poultry, 2002c).

Generally, for all IDI, the first constraint to adoption and sustainability is the small flock size of SPS which relates directly to the cost and scale of operation that the IDI entails. SPS have small flock sizes with non-homogenous flock structure. For example, Ochieng et al., (2010) reported that in the Western Kenya region, flock size is an average of 23 chickens per household. The flock structure is dominated (80%) by chicks, hens and pullets. In addition, very few farmers accessed institutional support services such as extension services, training, credit and veterinary services. Utilization of hired labour is associated with intensification from free range to semi-free range production system. Although, farmers had knowledge of the benefits of housing, adoption of housing remained very low with majority of them (72%) having no housing for chicken. In terms of seed supplementation, homemade rations were popular among farmers. About 86% reported challenges with Newcastle Disease with very few farmers vaccinating their flock. It was concluded that there is low adoption of IDI among smallholder farmers due to a lack of resources.

From research conducted in Udaipur district of Rajasthan, and in Trichy District of Tamil Nadu states of India, Conroy et al., (2005) concluded that there are abundant opportunities for improving the traditional SPS with very simple and low-cost technologies but that it will be very difficult to replace traditional SPS with a semi-confined or confined system. This means that an “improved SPS” is easier and cheaper to realize than a large scale shift to a semi-SPS or confined poultry system.

In many developing country situations, creating the necessary conditions for a semi-intensive, semi-confined model will incur high costs, so if anything goes wrong the consequences could be more serious than they would be in scavenging systems. For example, high mortality rates have been a problem in some projects promoting semi-intensive systems, and have resulted in delinquency in credit repayments. IFAD has recommended, therefore, that SPS improvement models “should not require a large initial investment” (Hajime Nabata, 1997).

Conroy et al., (2005) recommend the following pathway for improving SPS. Since most unimproved SPS are characterised by high chick mortality and relatively poor hatchability, it would be sensible to begin any poultry development programme by addressing these two problems, with measures requiring little, if any, cash (Step 1). Subsequently, ways of improving the marketing of birds could be identified (Step 2); and, once effective market channels had been identified or established, interventions requiring higher expenditure or levels of organisation (e.g. supplementation using commercial feeds, ND vaccination) could be considered (Step 3). These 3 steps are very similar to the 5 step pathway recommended by the FAO for rural poultry development (Bessei, 1987; 1990; 1993).

Probably the best known attempt at a wholesale shift from traditional SPS to semi-confined SPS is the Bangladeshi Semi-Scavenging Model - BSSM (Jensen, 1996), which was jointly developed by the Bangladesh Department of Livestock Services (DLS) and an NGO, the Bangladesh Rural Advancement Committee (BRAC) with sponsorship from the World Food Programme and has been promoted by Asian Development Bank, FAO, IFAD and the Danish Development Agency, DANIDA, among many supporters, local and international. The BSSM does produce substantially higher returns than any Improved SPS model, but it requires several times more resources and more support components to be in place; and hence can only be adopted effectively where these conditions are satisfied or where strong political support is available to create the conditions (Sonaiya, et al., 2002). The requisite components include: formation of village groups, the existence of a credit and savings facility/system, input supply services (vaccine/medicine, feed, parent stock), breeders and hatcheries. In the BSSM, the major risks to sustainability have been identified as: the economic sustainability of the “model rearer” cadre, a weak link in the value chain; and insufficient capacity utilisation of the output of the mini hatcheries cadre, another weak link in the value chain (Alam, 1997).

The most important assumptions for the adoption of semi-confined SPS models are related to the inputs and materials required to be sourced from outside the village. These are: supply of appropriate breed and parent stock free of specific diseases, availability of ingredients for quality feed, and availability of vaccines and medicines. For appropriate parent stock, there is complete dependence on government breeding farms whether the breed is locally developed (e.g. Fayoumi in Egypt, Sonali in Bangladesh and the Shika Brown in Nigeria) or commercially imported (e.g. Kuroiler in Uganda). It must be emphasised that availability of appropriate parent stock is the bedrock of SPS development.
Lessons learned and conclusions

IDI adoption and sustainability are handicapped by the cost of the IDI. Farmers in developing countries, particularly if they are traditional in production practices, are hesitant to pay for an outcome that depends on many other factors such as weather.

Another constraint is the lack of information about the IDI. Full and adequate information is an important factor for potential new adopters to make decisions (Chaudhry, 2011).

All IDI involve something new and novel for the stakeholders other than the developers. IDI adoption and sustainability requires that people are made familiar with the various technological solutions that are available, as well as their potential and their limitations. For this the role of the so called ‘innovation brokers’ can be extremely helpful, the tasks of such innovation brokers include:

1) Demand articulation;
2) Network composition; and
3) Innovation process management which must also provide guidance in complying with regulatory requirements (Klerkx et al., 2009).

These innovation brokers help reduce the transaction costs for engaging in partnerships, and make sure that actors at different levels (countries, labs, individuals, private sector, etc.) interact. Innovation brokers help to maintain flexibility to be able to have a well-composed partnership. They also may help signal problems related to inadequate incentives (e.g. researchers are rewarded for academic publications rather than working with stakeholders) and make connections to policy makers and decision makers to help resolve all structural problems hindering innovation.

Many organizations may take such an innovation broker role. Klerkx (2011) gave two examples of institutional brokers in agricultural technology:

- The International Service for the Acquisition of Agri-Biotech Applications (ISAAA), a non-profit organisation established to broker access for developing country research institutes to technologies, genes and protocols owned by the private sector or held in public laboratories in developed countries; and
- The African Agricultural Technology Foundation, a non-profit organisation that negotiated a royalty-free licence with Monsanto to develop a transgenic cowpea variety resistign the pod-boring insect, Maruca vitrata, a serious field pest of cowpea.

A third example of an institutional broker is:
- The Dissemination of New Agricultural Technologies in Africa (DONATA) project, which promotes the use of Innovation Platforms for Technology Adoption (IPTAs) in several countries in West, East and Central Africa (Mayanja, 2011).

The innovation broker may not necessarily be an institution. It may be a well trained and experienced technology transfer professional representing the public research institutions who is able to “grease the wheels” of the adoption process. The technology transfer professional can ensure roles were understood, manage the feedback loops, negotiate understandings of path to market and appropriate rewards and then put in place appropriate documentation (Jones, 2011).

For an agricultural innovation to be successfully adopted and sustained at the smallholder level requires partnerships between stakeholders such as: locally functioning non-political association of farmers; non-political regional association of informed farmers’ representatives; agricultural university / research institute (to evaluate the trials and assess the performance of crops or animals), agricultural extension system / non-governmental organization (NGO) involved in this sector (to mediate training from various quarters and provide advice on a day-to-day basis to farmers); financial institution (to provide credit finance to the smallholders); government department (to fix fair prices, monitor progress, offer guarantee to farmers, collect data and pass on the information to government); village level administrative body (for effective assistance in local administration related problems); along with a functional marketing system (Seshadri, 2011).

To create trustworthy partnerships, early discussions will be mandatory to agree on elements like funding mechanisms, roles and responsibilities, intellectual property rights or commercialization schemes. It also necessitates that policies and the legal environment facilitate the development of technology through effective administrative framework, predictable and science based regulation and a pragmatic liability regime (Mondy, 2011).

The Bolivian Alliance for Sustainable Development (Alianza Boliviana sobre el Desarrollo...
Sostenible - ABDES, www.abdes.org) is a network of NGO networks that works in Bolivia on the Millenium Development Goals (MDGs), particularly MDG 1: Eradicate Extreme Poverty and Hunger to MDG 7: Ensure Environmental Sustainability and MDG 8: Global Partnership. Between 2008 and 2010, ABDES carried out a very large study reported by José Campero Marañón (2011) comparing the production of small farmers with commercial businesses. The survey sample was 7,962 families (10.2 % of the population) distributed over 961 communities and 29 rural municipalities. The study showed that though small holder farmers have adopted applied technologies for livestock production, brand new technologies have not yet been massively and sustainably adopted for normal production, despite the efforts of international cooperation and triangular cooperation.

So, even in partnerships that worked, the main problems are a low participation rate of small holders in the research process and the fact that in most cases researchers focused their research on topics related to their academic background (deepening of research related to their Master’s thesis or PhD, topics that do not tackle the complex problems around smallholder farming). This shows the need for technologies that are compatible and adapted to the social, economic and cultural needs of small holders. The partnership activities likely to be most beneficial for smallholders are institutional capacity development and sharing of technologies, protocols and materials.

“What are the hurdles that can prevent effective international collaboration and how can they best be overcome?”

Often, collaboration for innovation through partnerships (also often called innovation platforms, innovation networks) is hindered by gaps or divides, of a cultural or institutional nature. Such divides may be caused, for example, by different incentive systems for public and private actors, differences between local indigenous knowledge systems and formal scientific knowledge systems, social differences that cause exclusion of certain actors and ideological differences amongst different non-governmental organisations (NGO). Also, people may be unaware of interesting cooperation partners, so a partnership may not form in the first place.

A combination of researchers, farmers, processors, traders and other private sector players who provide services to the value chain actors (as platform members) has proven very useful in many instances. Translating research findings for the consumption and commercialization of smallholder farmers is a daunting task without partnerships. But what is also crucial is to clearly spell out the terms of the partnership and realize that membership of such partnership is fluid, with partners moving in and out.

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