

---

---

# Structures for improving smallholder chicken production in Bangladesh breeding strategy

*H.A. Jensen*

*D-2500 Valby, Denmark*

---

The framework for rural poultry development in Bangladesh has been developed through an historically long learning-by-doing process. The two main actors in this process are: 1) a national NGO, the Bangladesh Rural Advancement Committee (BRAC); and 2) the Government through the Department of Livestock Services (DLS).

---

---

## Introduction

---

---

In the late 1970s BRAC identified poultry rearing as a source of income for landless, particularly destitute women. In the early 1980s BRAC and DLS initiated a participatory action research programme aimed at increasing the productivity of small flocks of hens in village conditions and to develop a replicable smallholder model.

In 1987 the experiences of poultry development and the Government food for aid for destitute women were integrated into an independent programme 'Income Generation for a Vulnerable Group Development Programme'. The results were very promising and other development programmes built on the same concept followed, but were further refined based on previous experiences.

Currently ten national NGOs are involved in the smallholder concept and Governmental institutions; extension, education and research are in the process of being integrated in the smallholder concept. However, BRAC is by far the leading NGO in the development of a smallholder poultry sector. The possibilities for women's participation in poultry development are according to Dr Saleque and Shams Mustafa (1996) (BRAC), as follows:

1. About 70 percent of rural landless women are directly or indirectly involved in poultry rearing activities. Traditionally these women have some experience in poultry rearing, which therefore represents skills known to them.
2. BRAC has proved that homestead poultry rearing is economically viable. If the landless women are properly trained, supported with

*Table 1. Summary of poultry activities and projects.*

| Project  | SLDP I   | PLDP     | PNP      | SLDP II | IGVGDP   | RDP /BRAC   |
|----------|----------|----------|----------|---------|----------|-------------|
| Project  | 1992-98  | 1998-02  | 1997-01  | 1999-03 | 1987-    | 1986-       |
| Period   | IFAD /   | ADB /    | World    | Danida  | WFP      | Continue as |
| and      | Danida   | Danida   | Bank     |         |          | a BRAC      |
| Donors   |          |          |          |         |          | activity    |
| Thanas   | 80       | 89       | 40       | 26      | Country- | Country-    |
| covered  |          |          |          |         | wide     | wide        |
| Benefi-  | Landless | Landless | Poorest  | Primary | Very     | Rural poor  |
| ciaries: | poor     | and poor | HHs      | poor    | poor     | 1.2 million |
| number   | women    | women    | with a   | women   | women    | HHs         |
| and type | 400 000  | 363 000  | child    | 109 000 | 400 000  |             |
|          | HHs      | HHs      | below 2  | HHs     | HHs      |             |
|          |          |          | years or |         |          |             |
|          |          |          | pregnant |         |          |             |
|          |          |          | women    |         |          |             |
|          |          |          | 69 000   |         |          |             |
|          |          |          | HHs      |         |          |             |

Kazi Abdul Fattah (1999). Director General of DLS

HHs: House Holds

Thana: Administrative unit. Bangladesh is divided into some 460 Thanas.

credit and other necessary inputs and made to operate under the supervision of extension workers of both Government and BRAC, the Government machinery is activated to provide for the delivery of services, the poultry sector could be one of the most productive sectors.

3. Poultry rearing is suitable for widespread implementation as it is of low cost, requires little skill, is highly productive and can be incorporated into household work.
4. There are few or no job opportunities for the landless, disadvantaged women. Poultry is the only activity in which a large number of landless women can participate.
5. In the small-scale poultry units which support the landless, production per bird may be low, but distribution of benefits will be more equal and have great human development impact.
6. Poultry rearing is culturally acceptable, technically and economically viable. Moreover, the ownership of poultry is entirely in the hands of women. This is an asset over which the poor women actually have control. This activity can therefore play an important role in poverty alleviation which is the main goal of BRAC.

BRAC has taken the advantages of using poultry as an instrument in its poverty alleviation programme. BRAC had, in 1997, 2.2 million members of which more than 1.2 million were involved in poultry activities. Table 2 shows the development of BRAC's poultry activities.

*Table 2. Component wise poultry programme participants – cumulative numbers 1990-97.*

| Component                      | 1990   | 1991  | 1992  | 1993   | 1994   | 1995   | 1996   | 1997   |
|--------------------------------|--------|-------|-------|--------|--------|--------|--------|--------|
| 1. Poultry worker <sup>1</sup> | 3 841  | 5 000 | 7 504 | 22 788 | 25 033 | 31 135 | 33 572 | 41 228 |
| 2. Chick rearer                | 650    | 1 106 | 1 952 | 5 836  | 8 244  | 8 453  | 10 986 | 14 723 |
| 3. Smallholder <sup>2</sup>    | 56     | 105   | 191   | 455    | 638    | 802    | 840    | 1 190  |
|                                | 664    | 051   | 457   | 441    | 104    | 906    | 488    | 490    |
| 4. Pullet rearer               |        |       |       |        |        |        | 1 308  | 2 260  |
| 5. Model rearer(PS)            |        |       |       |        |        |        | 7 761  | 11 195 |
| 6. Egg collectors              |        |       |       | 2 255  | 2 284  | 2 384  | 2 629  | 2 798  |
| 7. Hatchery owners             |        |       |       | 327    | 454    | 955    | 1 115  | 1 349  |
| 8. Feed seller                 | 24     | 52    | 104   | 807    | 1 515  | 2 800  | 2 347  | 2 450  |
| 9. Cage rearers                |        |       |       |        |        |        | 50     | 5 000  |
| 10. Broiler rearers            |        |       |       |        |        |        | 25     | 1 000  |
| Total                          | 61 179 | 111   | 201   | 487    | 675    | 847    | 900    | 1 272  |
|                                |        | 209   | 017   | 454    | 634    | 633    | 281    | 493    |

Saleque (1999)

<sup>1</sup>Para vet.

<sup>2</sup>Key Rearer with 10 hens

BRAC has established a commercial wing for supplying inputs to its members.

The smallholder described below is intended to provide the background for understanding the formulated breeding strategy. For a more functional description of the model, reference is made to Jensen (1996) and Saleque (1996 and 1999).

### The smallholder model

The smallholder sector is built up by the implementation of a number of development projects. The development objectives of the Government are improving living standards and welfare of the poorer strata of the rural population. The development objectives of the projects are a sustainable increase in the smallholder poultry sector and therefore, gives support to women especially those from the poorest and landless households. The immediate objectives are improved husbandry practice and increased institutional capacity of Government institutions and the participating NGOs leading to increased productivity.

### Objectives and target groups

The target groups are women belonging to the poorest segment of the rural population. The potential beneficiaries are all selected on poverty criteria.

## **Development Strategy**

The common features of a smallholder development project are: 1) a component directly targeting the beneficiaries, the NGO component; and 2) a component targeting institutional development, the DLS component.

The smallholder model is based on creating an enabling environment, *inter alia*, an environment in which all inputs and services needed are available in the village to minimise the risks for investment in a smallholder activity. Furthermore, no subsidies are involved at the user level, all the activities operate in free market conditions.

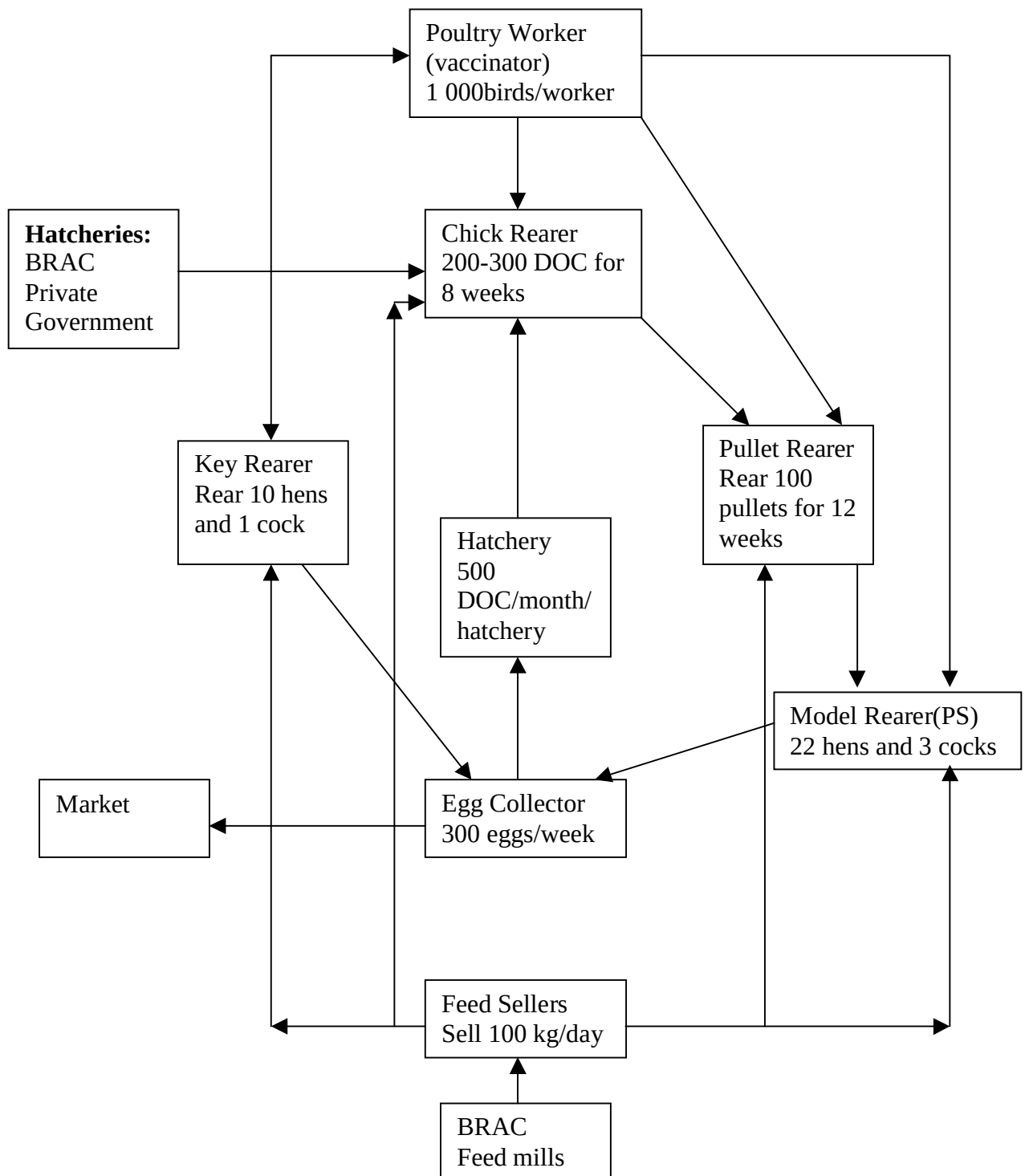
Poultry activity is compulsory for the first loan, but after repayment of the first loan the beneficiary is entitled to a new loan and is this time free to select an activity of her own choice.

The NGO component comprises: 1) establishing of area offices, one for each 3 000 to 6 000 members; 2) selecting potential beneficiaries; 3) organizing village groups; 4) commencing a savings programme; 5) training of beneficiaries; 6) creating and enabling an environment by establishing income generation activities such as input suppliers, veterinary service activities and marketing; 7) providing loans and assisting each of the beneficiaries in establishing an income generation activity; and 8) technically supporting the operation of different activities.

The establishing cost and first three years operational costs of an area office are usually covered by the project (Donor). After that, the profit margin from loans, sales of inputs and service fees from the 3 000 to 6 000 members is enough to cover the NGO's cost of maintaining and operating the office.

The DLS's role, as the implementing agency, is to coordinate, monitor, control and to provide technical support. An important activity in this respect is to accumulate experiences from previous and on-going projects and ensure that these experiences are reflected in formulation of new projects.

In on-going and planned projects there are DLS components such as: 1) activities and facilities for implementation of a breeding programme; 2) activities and facilities for establishing a Management Information System; 3) activities and facilities for establishing an international training institution; and 4) budgets for applied research activities and a comprehensive human resource development programme.



BRAC Poultry Programme. Modified after Saleque 1999.

BRAC broilers and layers in cages are not included in the above flowchart. The activities shown in the flowchart have to be compared with the numbers in Table 2. For instance there are more than 14 000 chick rearers, each rearing some 250 chickens four times a year, making an annual production of 14 million eight week old pullets.

## Breeding strategies

### Context

The end user, the smallholder, keeps a small flock of chickens, which is normally composed of four to six high yielding variety (HYV) hens, one HYV cock and three to four Desi hens. The Desi hens are used in the traditional way: incubating, rearing and laying (reference is made to Jensen, 1996). The HYV hens are used for production of table eggs and to some extent to production of hatching eggs. The hens are scavenging for the main part of their feed, but in particular, the HYV hens are also provided with supplemental feed.

The distribution flow is rather complicated, because it is divided into a number of small entrepreneurs: Suppliers of PS > Chicken Rearers > Pullet Rearers > Model Rearers > Mini Hatcheries > Chicken Rearers > Key Rearers.

The HYV chickens are sold by the Chicken Rearers to the smallholders at an age of eight weeks or produced by the smallholders (Key Rearers) themselves.

The DOCs (Day Old Chickens) are provided to the Chicken Rearers by either: 1) mini- hatcheries; 2) Government Poultry Farms; 3) NGO hatcheries; 4) private hatcheries; or 5) by the Smallholder herself by using the Desi as mother hens.

*Table 3. Sources of Parent Stock (PS).*

| Sources of PS                 | Breeds                        | Replacement of PS                                            | Customers                               |
|-------------------------------|-------------------------------|--------------------------------------------------------------|-----------------------------------------|
| Government Poultry Farms, GPF | White Leghorn, RIR, Fayoumi   | Reproduction of purelines                                    | Model rearers                           |
| NGO-Hatcheries                | Hybrids (Commercial PS)       | Imported                                                     | Chicken rearers                         |
| Private Hatcheries            | Hybrids (Commercial PS)       | Imported                                                     | Chicken rearers through NGOs            |
| Model Rearers                 | RIR males and Fayoumi females | Purchased from GPF                                           | Chicken rearers through mini hatcheries |
| Key Rearers                   | Exotics and crosses with Desi | Purchased from chicken rearers or reproduction of own stocks | Other villagers                         |

The development of the different sources of parent stocks has been driven by the demand of day old chickens. A breeding strategy was formulated in the mid 1990s based on a Central Government breeding farm planned to produce parent stock to Sonali chickens, a cross between RIR males and Fayoumi females and parent stock to produce a cross between Fayoumi males and commercial hybrids as the female line. The implementation of the breeding strategy has fallen behind the development and the NGOs had found other ways to satisfy the demand of day old chickens and this may not be the optimal solution for the end user.

A suitable breeding strategy for the smallholder concept is rather complicated. In the reproduction and multiplication links the hens are kept in confinement and fed with balanced feed. Consequently, egg production traits are the most important for a viable operation. However, the end user, the smallholder with ten hens, keeps the hens in semi-scavenging conditions and consequently such traits as scavenging traits and survival traits are the most important. A way to solve that, is the use of specialised breeds or lines, as shown by Moav (1966) in which the reproduction traits are conveyed through the female line while the traits important for the end product are conveyed through the male lines.

An experiment commenced in 1993 where different exotic hens were tested in semi-scavenging conditions. One of the breed combinations was a cross between commercial hybrid as the female line and an improved breed (Fayoumi, RIR or WL) as the male line. The hypothesis was, that use of commercial hybrids as parent hens would satisfy the multiplication links with respect to high egg yield while use of another breed such as males would satisfy the end user with respect to good scavenger and survival traits. Another breed combination was a cross between RIR-male and Fayoumi-female (SONALI), a combination known to have high performance values in the semi-scavenging system (Amber, 1986). A summary of the results is shown in Table 4.

The outcome of the experiment (Rahman et al., 1996) shows that the SONALI hens had the highest egg production and the lowest mortality rate. Although these performances were not significantly different from some of the combinations with hybrids as those of the female combination, it was decided to base the breeding strategy on production of SONALI hens. One of the reasons was that SONALI in several experiments had proven to be a superior combination.

A breeding strategy for the semi-scavenging concept was outlined by Jensen (1996a). 'In general, breeding strategies in developing countries have focused far too much on the genetic potential of the breeds. It is stressed, however, that improved breed can never be a substitute for bad management.

Table 4. Performance of experimental hens reared in semi scavenging condition according to breed combinations.

| Parameters                                                               | Breed combinations<br>(Least square mean values) |                           |                      |                     |                     |                     |                            | WLH x AB             |
|--------------------------------------------------------------------------|--------------------------------------------------|---------------------------|----------------------|---------------------|---------------------|---------------------|----------------------------|----------------------|
|                                                                          | AB<br>(Lohmann<br>brown)                         | (A x RIR)<br>x<br>Fayoumi | Fayoumi<br>x AB      | RIR x<br>AB         | RIR x<br>Fayoumi    | RIR x<br>WLH        | (RIR x<br>Fayoumi) x<br>AB |                      |
| 1. Age of first egg (week)                                               | 34.5                                             | 32                        | 32                   | 34                  | 33                  | 32                  | 32.5                       | 34                   |
| 2 Eggs/hen/year *<br>(hen day)                                           | 140 <sup>ab</sup>                                | 137 <sup>b</sup>          | 125 <sup>b</sup>     | 139 <sup>ab</sup>   | 156 <sup>a</sup>    | 128 <sup>b</sup>    | 141 <sup>ab</sup>          | 139 <sup>ab</sup>    |
| Actual no. of eggs<br>per hen (hen day)                                  | 86 <sup>b</sup>                                  | 104 <sup>ab</sup>         | 86 <sup>b</sup>      | 105 <sup>ab</sup>   | 119 <sup>a</sup>    | 97 <sup>b</sup>     | 86 <sup>b</sup>            | 99 <sup>ab</sup>     |
| 3. Mortality % (excluding<br>predator loss)                              | 22.14 <sup>ab</sup>                              | 35.04 <sup>b</sup>        | 27.59 <sup>ab</sup>  | 32.64 <sup>b</sup>  | 15.98 <sup>a</sup>  | 25.21 <sup>ab</sup> | 21.20 <sup>ab</sup>        | 22.88 <sup>ab</sup>  |
| 4. Mortality % due to<br>predator                                        | 1.38                                             | 0.87                      | 1.40                 | 2.71                | 2.09                | 0                   | 5.31                       | 2.61                 |
| 5. Supplementary energy<br>Kcal/bird/day                                 | 146 <sup>b</sup>                                 | 122 <sup>a</sup>          | 136 <sup>ab</sup>    | 144 <sup>b</sup>    | 130 <sup>a</sup>    | 134 <sup>ab</sup>   | 146 <sup>b</sup>           | 135 <sup>ab</sup>    |
| 6. Supplementary protein<br>(g)/bird/day                                 | 7.3 <sup>b</sup>                                 | 6.0 <sup>a</sup>          | 6.9 <sup>b</sup>     | 7.2 <sup>b</sup>    | 6.4 <sup>a</sup>    | 6.6 <sup>ab</sup>   | 7.1 <sup>b</sup>           | 6.6 <sup>ab</sup>    |
| 7. Supplementary feed cost<br>(Taka)/bird/laying year                    | 202.51 <sup>b</sup>                              | 177.44 <sup>a</sup>       | 193.72 <sup>ab</sup> | 203.18 <sup>b</sup> | 184.20 <sup>a</sup> | 190.62 <sup>a</sup> | 205.32 <sup>b</sup>        | 192.10 <sup>ab</sup> |
| 8. Gross margin<br>(Taka)/hen up to one<br>laying year (Income–<br>Cost) | 134.66 <sup>b</sup>                              | 169.83 <sup>ab</sup>      | 113.08 <sup>c</sup>  | 133.13 <sup>b</sup> | 205.17 <sup>a</sup> | 145.53 <sup>b</sup> | 132.09 <sup>b</sup>        | 154.65 <sup>b</sup>  |
| 9. Egg production period<br>(Months)                                     | 8.54                                             | 9.84                      | 9.17                 | 9.37                | 9.84                | 9.13                | 8.74                       | 8.97                 |

Rahman et al (1996)

Figures with same or no superscript in a row are not significantly different (P<0.05)

\* Corrected for 12 months egg production period

### Potential Breeding Strategy Commercial Hybrids as Parent Hens

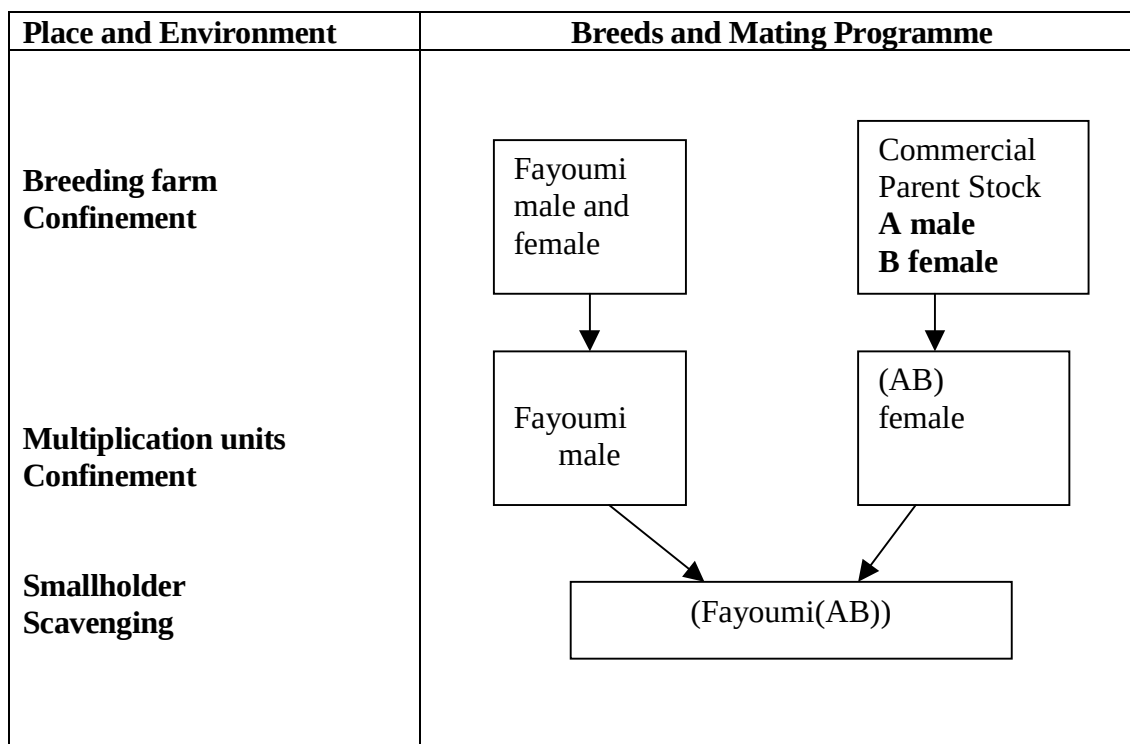




Table 5. Rate of lay, percent for pure-breed and crosses and the hybrid vigour.

| Feeding system              | RIR | Fayoumi | SONALI | Hybrid vigour |
|-----------------------------|-----|---------|--------|---------------|
| Free access, in confinement | 46  | 49      | 50     | +5%           |
| Scavenging + 75 g supp.feed | 19  | 20      | 33     | +69%          |
| Scavenging + 25 g supp.feed | 12  | 10      | 18     | +64%          |

Rahman (1996).

The objectives of a breeding strategy for the semi-scavenging poultry holdings are to:

1. Maintain breeding stocks with a genetic potential which matches the best smallholder management skills for producing eggs on the basis of a behaviour conducive to semi-scavenging conditions. Consequently, the management skills and not the genetic potential will be the limiting factor in improving the productivity.
2. Maintain the breeding stock under circumstances which give the best health security and produce parent stocks with a uniform antibody status in order to obtain the best immunity from the vaccination programme.
3. Have a multiplication and distribution system which optimises the financial results for the end users, in this case the smallholders take the productivity in the multiplication units into due consideration.

The semi-scavenging model is in fact an integrated production chain and all links involved shall be considered in the formulation of a breeding strategy. Breeders and chicken rearers, where the birds are kept in confinement and fed with balanced feed, must *inter alia* also be viable units. In reproduction links, the egg yield and feed efficiency are the most important traits, while at smallholder level, traits such as survival rate and scavenging behaviour are more important.

Indigenous breeds are developed and adapted to the local environment and do not produce eggs in confinement with free access to balanced feed. Consequently, they have lower productivity than the improved breed when kept in confinement when they are kept in multiplication units. However, a programme where indigenous breeds are used as parent males will not effect the viability of the multiplication units.

In Table 6 the production cost for producing day old chickens calculated for the breed combinations is shown: commercial parent stock, commercial parent hens used as grand parent stock (Hybrids), and Fayoumi.

Table 6. Cost calculation of Day Old Chicken (DOC) with different parent hens.

| Assumptions                      | Fayoumi  | Hybrid   | Comm. PS |
|----------------------------------|----------|----------|----------|
| Price, day old PS, taka          | 30       | 40       | 200      |
| Rearing, feed, kg                | 9        | 9        | 9        |
| Laying feed, kg                  | 46       | 46       | 46       |
| Other cost, % of feed cost       | 0.4      | 0,4      | 0,4      |
| Feed price, taka / kg            | 12       | 12       | 12       |
| Survival rate, rearing, %        | 0.9      | 0,9      | 0,9      |
| Survival rate, laying, %         | 0.9      | 0,9      | 0,9      |
| Egg yield, number per hh         | 200      | 260      | 240      |
| Ratio of hatching eggs           | 0.75     | 0,9      | 0,9      |
| Utilisation of hatching eggs     | 0.95     | 0,95     | 0,75     |
| Hatchability of egg set          | 0.75     | 0,75     | 0,75     |
| Price for DOC, unsexed, taka     | 12       | 12       | 15       |
| Price for table eggs, taka / egg | 3        | 3        | 3        |
| <i>Cost calculation, per hen</i> |          |          |          |
| Day old PS                       | 33.33    | 44.44    | 222.22   |
| Feed                             | 660.00   | 660.00   | 660.00   |
| Other cost                       | 264.00   | 264.00   | 264.00   |
| Total cost                       | 957.33   | 968.44   | 1 146.22 |
| <i>Production</i>                |          |          |          |
| Number of eggs                   | 200.00   | 260.00   | 240.00   |
| Number of hatching eggs          | 150.00   | 234.00   | 216.00   |
| Unutilised hatching eggs         | 7.50     | 11.70    | 54.00    |
| Number of table eggs             | 57.50    | 37.70    | 78.00    |
| Number of DOC                    | 106.88   | 166.73   | 121.50   |
| <i>Income, taka</i>              |          |          |          |
| Sales of DOC                     | 1 282.50 | 2 000.70 | 1 822.50 |
| Sales of table eggs              | 172.50   | 113.10   | 234.00   |
| Total sales                      | 1 455.00 | 2 113.80 | 2 056.50 |
| <i>Profit, taka per hen</i>      | 497.67   | 1 145.36 | 910.28   |
| <i>Production cost per DOC</i>   | 8.96     | 5.81     | 9.43     |

Note: The actual production costs may differ from this calculation, but the differences will be very close to the figures shown above.

By using hybrids as parent hens instead of commercial parent stocks, the overall cost will be reduced with three to four taka per DOC. Fayoumi and commercial parent stock have almost the same production cost.

Jensen(1996). Not published

The preliminary conclusions to be drawn are:

1. The semi-scavenging model developed in Bangladesh can provide an environment and management skills to utilise the genetic potential of breeds with a higher value than the capacity of randomly selected HYV breeds.
2. There is no rational behind use of commercial layers in semi-scavenging conditions at smallholder level. However, use of commercial hybrids as parent hens will enhance the viability of the rural parent farms and a combination of hybrid parent hens and a HYV male may be a viable solution for smallholders.
3. The SONALI (RIR x Fayoumi) breed has a remarkable high performance in semi-scavenging conditions compared with other breeds.

An appropriate breeding strategy may be the use of commercial brown hybrids as parent hens and a coloured improved breed as parent males. Even though the strategy may not be the optimal solution, it is manageable and can be applied until a better strategy has been developed. Furthermore, the proposed strategy provides optimum opportunities for parent farms to be viable operations, because the parent hens will have high genetic potential for producing hatching eggs with low feed costs when kept in confinement and provided with balanced feed. (This strategy is not applied in Bangladesh).

The main constraint in implementing the breeding strategy is the low level of biosecurity (conditions which minimise the health risk) on Government Poultry Farms intended to be used as multiplication units and with a central breeding farm as supplier of the parent stocks. The farms are not designed to use an all-in -all-out system and the hatchery is located close to the chicken houses. This problem has not been solved yet and in the meantime the NGOs develop their own ways of distribution chickens.

DLS is in the process of establishing a separate breeding farm operating as a grandparent farm for producing parents to SONALI chickens at six of the Government's hatchery farms.

---

### **Present breeding plans**

---

There will be 2 500 Fayoumi hens and 500 RIR hens as grandparents. The grandparent population will be reproduced from the pure-breeds with some selection pressure on egg size and age at maturity.

Even though the breeding goals are defined, good scavenging and survival traits, a method to record such traits and use them in a selection index have to be developed.

## **Lessons learned**

1. The research base for breeding activities related to semi-scavenging or scavenging conditions is very limited.
2. Government poultry farms are usually designed to carry out a number of activities and biosecurity in this respect has low priority.
3. A dissemination structure in which biosecurity has high priority is a must due to the direct link from breeding to all the end users. It is very difficult to integrate existing Government farms into such a system.
4. Politically it is difficult to implement a system in which due consideration is given both to the reproduction and multiplication links and to end users.
5. The reproduction links and the hatcheries are more powerful than the end users in setting the breeding goals.
6. Research institutions in the developing countries are not involved enough in developing breeding activities to be used in their own country.
7. To formulate and implement a breeding strategy is a long process and takes at least five years. Consequently, a dissemination system with high biosecurity has to be developed and implemented as the first step and simultaneously the breeding programme can be developed.

## **Reference**

**Fattah, Kazi Abdul** (1999). Poultry as a Tool in Poverty Eradication and Promotion of Gender Equality. Proceedings of a Workshop: Editors, Frands Dolberg and Poul Henning Petersen. <http://www.husdyr.kvl.dk/htm/php/tune.htm>

**Jensen, Hans Askov** (1996). Semi-Scavenging Poultry Flock. Proceedings of a Workshop: Editors, Frands Dolberg and Poul Henning Petersen. <http://www.husdyr.kvl.dk/htm/php/tune.htm>

**Jensen, Hans Askov** (1996a). Semi-Scavenging Model for Rural Poultry Holding. Proceedings of XX World Poultry Congress, New Delhi, India. Volume 1.

**Moav, R and W.G. Hill** (1966). Specialised sire and dam lines. Selection within lines. Anim. Prod. 8, 375-90.

**Rahman, Mahfuzar, Poul Sorensen, Hans Askov Jensen and Frands Dolberg** (1996). Exotic Hens Under Semi Scavenging Conditions in Bangladesh. <http://www.cipav.org.co/lrrd/lrrd9/3/bang931.htm>

**Rahman, Mahfuzar, N. Islam, N.R. Sarker and M.M. Islam** (1996). Effect of Supplementary Feeding on Production Performance of RIR, Fayoumi and their Cross-bred Chicken in Rural Bangladesh. Bangladesh Journal of Livestock Research, Volume 5 – 1998.

**Saleque, Md, A. and Mustafa Shams** (1996). Landless Women and Poultry: The BRAC Model in Bangladesh. Proceedings of a Workshop: Editors, Frands Dolberg and Poul Henning Petersen. <http://www.husdyr.kvl.dk/htm/php/tune.htm>

**Saleque, Md.A.** (1999). Scaling-up: Critical Factors in Leadership, Management, Human Resource Development and Institution Building in going from pilot project to large-scale implementation. Proceedings of a Workshop: Editors, Frands Dolberg and Poul Henning Petersen. <http://www.husdyr.kvl.dk/htm/php/tune.htm>