Village poultry production systems: challenges and opportunities in achieving food security

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Structure of the presentation

• The general context
• Opportunities and challenges
• Appropriate livestock genetics for developing countries – options
  • Identification
  • Delivery
• Concluding remarks
General Context

• Population increase
  • 2012 - 7 Billion
  • 2030 - 9 Billion

• One billion people involved in animal farming

• 70% rural poor depend on livestock for their livelihoods

• Domestic animals supply 30% of total human requirements for food and agriculture
General Context (cont...)

- Urbanization
- Consumption and demand
- Production

% production increases of meat and milk in the last 20 years

<table>
<thead>
<tr>
<th>Country groups</th>
<th>% Meat</th>
<th>% Milk</th>
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<tbody>
<tr>
<td>Developed countries</td>
<td>24</td>
<td>2</td>
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<tr>
<td>Developing Countries</td>
<td>265</td>
<td>172</td>
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How can the challenge be met?

- Increase in number of animals
  - In developing countries- the trend is increase in number
  - But this has negative effect on the already fragile ecosystem
- Improve productivity
Opportunities

- Diverse and large number of genetic resources available – remains largely unexploited

- Available results – untapped potentials
  - Productivity could be doubled

- Creative use of existing & emerging technology
Challenges - general

• Arrangements to correct past failures in livestock breeding initiatives
  – technology-driven productivity growth has largely failed
• Human, research and institutional capacity in developing countries (E.g. States of the Worlds AnGR)
• Appropriate use of genotypes (local & exotic)
• Focus on “improvement”, not just breeding! “Empowering” not “Restricting” the farmer
• Response to market demand (Example from Ethio.)
• Climate change –direct and indirect effect on AnGR -demand for adapted genetics? (E.g. CBBP)
What are the drivers of change?

Irreversible events in LDCs

- Multiple drivers/irreversible events in LDCs:
  - Population
  - Urbanization
  - GDP growth
  - Demand from domestic, regional, international markets
  - Climate change???????
Key concerns for the future

– How to achieve food security?
– How to maintain livelihoods?
– Protection and maintenance of ecosystems services?
– Economic growth??
– Reducing the environmental impacts for/by the livestock sector????
Chicken!!

- Large in number and wider in distribution
- Fulfilling different purposes in different times
- Transformed to big industry
- Forms of production systems in LDC’s
Production systems in the tropics

• Village production system
• Commercial production system
• Small scale production system

⇒ Based on:

• Objectives of the producer
• Type and number of animals
• Management system followed
Village production system

⇒ Predominant production system
   • 60 to 90% of chicken population
   • 40 to 90% of meat and egg
   • Source of protein and small cash
   • Continuous predominance of markets

⇒ Little attention to the system and animals

Even though local chicken are:
   - good in a number of fitness treats
   - Good mothers
   - Requires low input etc
Hen performance history

- Constraints
  - Disease
  - Predation
  - Feed
  - Information

Non-stimulated
46 eggs/year

50% of chicks died
Hen performance history and measures to improve laying

- Stimulated: 76 eggs/year
- Non-stimulated: 46 eggs/year

50% of chicks died
Scavenging Feed Resource Base (SFRB)!

Immediate environment

Season/weather

Number of households

Household refuse

Grain supplement

SFRB

Scavenging feed resource base sub-model

Village flock

Use and benefits

Foundation/replacement

Growth

Gifts

Family nutrition

Sacrifice

Mortality

Consumption

Market

Reproduction & replacement

Flock dynamics sub-model
Input-output relationships

Input
- Foundation stock
- Replacement stock
- Grain supplements
- Non-market value
  - SFRB

Output
- Market value
- Reproduction
- Sale
- Consumption
- Manure

Non-market value
- Cleaning the environment
- Socio-religious function
- Tick control
What is unique in chicken (opportunities)?

• Indigenous and integral part of the farming system
• **Offers poor people pathway out of poverty (by and for the poor!!!!!! –real opportunity)**
• Short generation interval
• Small investment and land requirement
Transforming village poultry systems into small agro-business ventures

100 layer chicken package

Case number 1
Background!

• Chicken research and development approach in the tropics
  – exotic breeds of cockerels of 15-20 weeks of age in exchange for local cockerels of rural subsistence
  – The other approach which is still being implemented is based on distribution of exotic breeds of chicken to individual farmers, a maximum of 6 chickens (5 pullets and 1 cockerel) per household.
  – Although introduction of exotic breeds in the form of fertile eggs (Alemu and Tadelle 1997).
• These schemes have been in effect since the beginning of poultry research and development in Ethiopia in the mid 1950s, and millions of improved breeds of chicken have since been distributed in the different forms (Aleme and Tadelle 1997).

• Despite such a large number of improved breeds introduced into the village system improvement was limited mainly due to the high mortality rate of modern breeds as a result of their poor adaptation to the rural environment.

• Distribution of 6 exotic chickens per household may still be considered useful in rural areas where opportunities for intervention at higher scales would be limited due to limited access to infrastructure and market.
objectives

• To transform village poultry production into viable commercial venture in potential areas, and

• To generate sustained income for poor households,
The implementation process

- Construction of poultry houses, hay box brooders and equipment
- Supervision, data recording, monitoring and evaluation
Selected package of technologies

• Animal used: 100 sexed day-old chicks of Bovan hybrid layer strain
• Feed: Formulated rations
• Vaccination: Newcastle and Marek's disease
• Drugs and chemicals: Antibiotics, vitamins and disinfectants
• Equipment: Waterers and feeders
• Poultry house: Constructed of locally available materials
• Hay box brooder: Constructed of lumber and hay
• Recommended management and health care practices
Results
Social assessment

• *Attitudinal and institutional changes*
  – the awareness creation workshop and as time passes by and benefits realized, all parties got a conviction to consider the technology as a viable agricultural venture.
Biological Assessment

• *Egg production*
  – Birds attained egg laying at the age (5%) of 20 weeks
  – Mean hen day egg production reached 41% after 20 weeks of laying.
Fig. 1. Mean, minimum and maximum egg production (hen day percent) of a hybrid layer strain (Bovan) distributed at a day-old to 15 households in the peri-urban villages of Lume, Ada and Akaki Weredas.
Mortality

• Survival of chicks during the first 8 weeks of brooding using this modified hay-box was almost 100% (99.5%).

• Only 3 chicks died in one household in Ada Wereda
Mortality in the growing and laying stages

- On average about 96% of the chicken survived to the laying age while mortality to from 19 to 40 weeks of age was less than 5%.

- The overall mortality of the flocks in the peri-urban village households was surprisingly less than 8%,
  - a level even lower than the commercial standards ranging from 10-20.
Fig. 4. Mortality of chickens (average of households) at different age classes in the 3 weredas (out of 100 chicks housed)

Number of Birds Dead/Household

- From Day-Old to 8 weeks
- From 9 to 18 weeks
- From 19 to 40 weeks

Lume  Ada  Akaki
Socio-economic assessments

• The results from the economic trends implied by 20 weeks of egg production (about 40 weeks of bird's age) indicated that the operation is quite viable and has a very positive prospect of profiting.

• Cost benefit analysis at farm household level
  – net returns ranging from Birr 1939.00 to Birr 2806.00 were obtained with the total cost of production ranging from Birr 5788.00 to Birr 6311.00 in the periods considered.
The prospect from the rising trend of egg production coupled with the net benefit obtained so far (for the 20 weeks of egg production), clearly indicated the comparative position of poultry production to crop production.

- For instance, comparing the average returns of Birr 2470.00 obtained from poultry production from only 18 m² size of land to the profitability of crop production from 1 ha of land:
  - it was found that production of chickpea which was the most profitable crop in Ada-Liben gave returns to land, labor and management of 4505.00 Birr/ha followed by bread wheat (3999.00 Birr/ha) and tef (3827.00 Birr/ha)
• Considering the fact that poultry manure under such production system contains about 4 to 7 percent of nitrogen (Mitchell and Donald 1995),
  – on average the economic value of the plant nutrients in poultry manure, produced from 100 birds, can be approximated as Birr 810.00 for the first 40 weeks of bird's age
Challenges!

• Major challenges faced, potential threats to adoption of the model and issues for further consideration
  – At the set out of this project there were persistent doubts and fear of risks both by the participant farmers and a few of the anticipated collaborators regarding the success of such a 'bold' initiative.
  – As a result of such lingering doubts 3 farmers dropped out of the 18 farmers selected and trained to participate in the activity.
Case number two

Improving village chicken production to elevate livelihoods of poor people
- Egg production
  - Growth (wt at 16 wks)
  - Age at first egg

- 2nd generation
  - Promising results

- Set up breed improvement program

- High mortality
- Man power
- Diagnostics
- Facility

- Egg production
  - 34-75 at 45 wks of age

- Age at first egg
  - 223-148 days

- Growth
  - 550-788 g

- Livability
  - 50%-97%

- 10th generation
- Color fixation
- Divergent selection for Disease resistance
- Crossbreeding and supply
- Composite breed development and test
- Develop and test different scenarios of dissemination
Poultry production in Ethiopia

- Village system responsible for majority of poultry production (more than 90% meat and egg)

Poultry offers poor people pathway out of poverty (by and for the poor!!!!!!! –real opportunity)
Vicious cycle of high poultry mortality and low productivity requires systemic change

High mortality drives a vicious cycle

- High mortality and low productivity reduces the incentive for farmers to invest significant effort in caring for birds
- Without basic care and vaccination, mortality remains high, impacting productivity.
- Basic practices such as housing, watering, egg removal are not applied, further impacting productivity

Justification for change

- Low feasibility of vaccination in backyard systems (low demand, plus access challenges) means a health or genetic intervention alone would be unlikely to deliver sustainable benefit

- Establishing a breeding program creates the infrastructure and scale (especially for vaccinating chicks) as well as the financial incentive for farmers to take better care of their poultry

- Opportunity to break the vicious cycle, improving both productivity and survivability through a mix of moderate breed improvement, and vaccination

- Requires establishment of a delivery system that should become self-sustaining in the long-term
What can we offer?

Genetically improved indigenous birds (horro) in their 6th generation (products of within breed selection programs)
Overall objective

• To improve production of village chickens through selective breeding using participatory approach

Trait preference:

• PRA (participatory rural appraisal) conducted and farmers identify traits of preference
  • Egg production
  • Age at first egg
  • Growth
Breeding program to improve local chicken breed (Horro)

Mass selection based on own performance:

– Growth: based on live weight at 16 wks in both sexes
– Age at first egg in females; and
– Cumulative Egg number at 45 weeks in females
Genetic improvement in Cumulative egg number at 45 weeks of age through 5 generations of selection

% increase from base population

Selection effect from:

- Generation 5: 123.5
- Generation 4: 114.7
- Generation 3: 73.5
- Generation 2: 79.4
- Generation 1: 41.1

Base population (34)
Genetic improvement in Age at First egg (AFE) through 5 generations of selection

Age at First egg

Generation effect from:
- Generation 5
- Generation 4
- Generation 3
- Generation 2
- Generation 1
- Base population

Generation
Poultry’s high rate of reproduction enables rapid scale

This model can be implemented simultaneously in multiple geographies.
Scale can be achieved quickly through multiplier flocks in village-based mini-hatcheries

**Phase 1**
- **Selection / development**
  - Research project identifying and testing different sources of indigenous chickens.
  - Could involve within-breed selection or cross-breeding
  - Might take 2 to 3 years (we have it).

**Phase 2**
- **Dissemination / multiplication**
  - Establishment of multiplier flock.
  - Starts with initial flock of female birds (and suitable number of cocks) selected or developed in Phase 1
  - Rapid multiplication over period of 24-30 months to achieve scale

**Phase 3**
- **Supply to smallholders**
  - Ongoing supply of chicks from the multiplier flock
  - Some chicks retained as replacements to sustain multiplier flock
  - Male and female chicks vaccinated and sold to farmers

**Key activities**
- Create initial flock:
  - 100 hens
  - Appropriate # of cocks

**Outcomes**
- Grow multiplier flock (hens)
  - Start: 100
  - 12 months: 1,970
  - 18 months: 38,800
  - 24 months: 765,000
  - 30 months: 15 million

- Supply vaccinated chicks to farmers, while sustaining flock
  - 10 male, 10 female per year
  - Benefit: $???? per smallholder
  - millions smallholders
  - More million smallholders
Additional Recommendations

• Continue animal health investment to determine if lifelong disease resistance can be conferred by either a single vaccination to the chick, or through breeding (Newcastle, Marek’s disease)

• Opportunity to breed for disease resistance, or for synergy between breed and vaccine
Genetic improvement of livestock is complex, but can deliver substantial and long-lasting benefits

As seen in the developed world, huge gains can be unlocked through genetics

however...

To fully benefit from breed improvement requires a system approach (community/farmer) participation, health, nutrition etc

but...

This can also be a catalyst for improving the wider system – triggering input supply, better marketing etc

and...

Unlike many other types of intervention, benefits can span generations