
Summary of workshop outcome

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The workshop brought together 37 animal breeding experts from around the world to try to agree on how to create genetic development in the livestock resources used for medium and low-input production systems. The emphasis was on how to make it happen – both to initiate and sustain desirable genetic change. The papers in these Proceedings had all been circulated in advance so that the entire four days could be devoted to group or plenary discussions. Three separate working groups tackled each of seven subjects¹ and we therefore had the benefit of their often different approaches.

The initial focus was on the five seminal documents. These had been carefully commissioned in order to provide syntheses of available knowledge and experience on successive stages in the improvement process:

- Breeding goal definition
- Structures and procedures for straight-breeding
- Structures and procedures for cross-breeding
- Economic evaluation of breeding programmes.

It was inevitable that these documents would deal more with technical aspects than with organisational detail or the policy framework necessary to make improvement happen. This is because authors capable of writing up-to-date technical summaries are unlikely to have been heavily involved in implementation.

Hence it was hoped that the 27 case studies from lower input production environments would permit the discussions to identify the key operational and policy issues which have impacted on past attempts to improve livestock for such production systems. Again, inevitably, there are too few available accounts of such attempts where we have sufficient detail or

¹FAO is using *inter alia* the output from the Workshop to produce guidelines or decision aids for use at different levels – both policymaker and technician – and eventual incorporation into FAO guidelines for total management of farm animal genetic resources

an adequate number of generations to permit judgements about success or failure. With hindsight, we might usefully have assembled additional case studies from high input systems in developing countries in order to tease out factors controlling their success rates. Nevertheless, the accounts reproduced in these Proceedings, some of them admirably clear and precisely following their terms of reference, served as a valuable back-drop for the discussions – in which many of the authors participated.

No attempt will be made here to summarise the recommended procedures for creating genetic improvement in any detail². In this synthesis the attempt is only to record the results of the workshop discussions where they pointed out gaps in the seminal papers and, more importantly, where they suggested operational issues and approaches relevant to successive parts of the improvement process. However, consulting the seminal papers will be most useful in showing what and how steps must be made. Finally, this Summary Outcome brings together a number of areas of enabling policy that the participants identified as necessary if there is to be a suitably encouraging environment for improvement schemes both to start and to be maintained.

These additional points should therefore be seen as complementary to the material in the seminal documents and based upon the experience drawn both from the case studies and from the experts interacting vigorously in group and plenary discussions.

**Technical
issues**

In general, the seminal papers covered the technical aspects of genetic improvement fairly thoroughly. There was some overlap that resulted from asking five different authors to write about components of the whole. There were also omissions arising in part from their specific briefs, which for example concentrated on straight- and cross-breeding for extensive grazing systems, and in part from their own greater familiarity with ruminant species which have received more attention in developing countries animal breeding initiatives than have the important monogastrics. As a result, the technical issues specific to poultry and pig improvement were under-emphasised.

Specific areas that emerged from the discussions included the following:

- 1 When proposing improvement goals and goal values in medium and low input systems, it is important to incorporate such

²Development Objectives and Breeding Goals; Accessing the Breeds; Straight Breeding; Crossbreeding; Economic Evaluation; Enabling Policy for Genetic Improvement; and Genetic Evaluation

non-monetary values as risk management, social capital, draught usage and aesthetic value. Improvement of product quality may also be as highly valued as increased production efficiency. These goals and their values should be established within a context of a characterised production system

- 2 It was not thought useful to make a distinction between crossbreeding systems which utilise only local resources and those that rely on breeds brought in from other environments or countries. There are no differences theoretically, but operationally there could be differences in lower input production systems due to higher degree of fitness of the local genetic resources.
- 3 While it is now possible to assess the effects of some technologies like artificial insemination, embryo transfer and BLUP, there are others like marker-assisted selection and transgenics for which no firm predictions can yet be made.
- 4 Genetic improvement utilising straight breeding structures is simultaneously a most appropriate method for the conservation of the genetic resources where farmers are still using the breeds.
- 5 Aspects of economic evaluation were addressed in several of the seminal papers but none of them illustrated a logical and comprehensive approach (such as Z-Plan). This has resulted in an inadequate presentation on expected investment performance, particularly in terms of times required in the larger species and the distribution of benefits throughout the breeding pyramid. Analysis of the sensitivity of returns, both to parameter errors and price uncertainty, is another area that needs inclusion, as does the subject of competition between programmes and between sectors.

The workshop discussions frequently concluded that the total amount of information needed to follow optimum procedures is unlikely to be available at the outset in most medium and low input systems. This need not be too serious at the start of a development project. It is important to understand the development objectives and from these to specify the correct breeding goals. When profit functions cannot be formulated from the outset, then other, cruder methods may be utilised to derive goal values, and fitness traits can be handled by independent culling levels. Further sophistication can be based upon information derived from the early stages of the programme – perhaps through a new or enhanced recording scheme. Similarly, the initial number of participating herds or flocks, or the size of an original nucleus may be very modest, but growth can follow later. Decisions on new resource populations will usually have to be made on the basis of data that are **not** sufficiently comprehensive, relevant or reliable. The procedures may therefore need to be employed at more than

Operational aspects

one level; an initial rough screening followed by a more thorough evaluation among the most likely breeds. Genetic evaluation of individual candidates can also start with ultra-simple methods (visual appraisal), which is how most successful improvement programmes began in developed countries (and some have continued that way). It is thus vital that the operational staff can understand, or can be advised, how to modify optimum procedures in order to make something useful happen.

- 1 It is essential to consult with the farmers/livestock producers since they will at least be the customers for the improved animals, and often full partners in the improvement process itself. Such consultation is unlikely to be simple, and may well involve explanations of how scientific improvement is created and disseminated. But it should not stop at the producers, since all the downstream buyers may also have valuable inputs (dairy, slaughterhouse, wool buyer, and retailer) as well as other service industries (feed, healthcare).
- 2 Cost and benefit sharing must be given serious consideration at the outset. Different components of the genetic improvement programme could have different players and stakeholders at different stages. For instance the state may benefit directly from a recording scheme in aspects not necessarily directly related to the programme, so it should pay due share in the recording process. Costing and benefit sharing will develop with the development of the breeding initiative.
- 3 There is a need to supplement the actual improvement procedures with 'marketing efforts' by the private or public sectors – shows, demonstrations, talks, competitions, training schools. Exploit the 'pyramid of influence' – identify the key influencers in the community, convince them of the benefits and get them to spread the message.
- 4 Recording was the subject of the previous FAO/ICAR workshop but it was heavily biased towards milk production. There is a need for more advice on recording all animal species in low input systems, particularly where they are difficult to reach (small scattered or migrant herds or flocks) and on methods of assessing and recording fitness or adaptations.
- 5 Care is needed in obtaining an appropriate sample of any new population, depending upon its intended use. It may need to be large, random and unrelated, or alternatively a highly selected group from the top tested stratum. Realistically one is often restricted to sampling countries and herds which can comply with the health regulations of one's own veterinary advisers, and of the importing country's government officers. It is important that those

- regulations are not set so high that valuable improvements are always excluded.
- 6 The method of dissemination of genetic improvement throughout a livestock industry must also, in practice, be greatly influenced by health considerations.
- 7 Discontinuous crossbreeding has been widely adopted in high input poultry and pig production systems. It has enabled all routine selection decisions to be concentrated in the hands of specialists. This has led to increased rates of genetic gain and has simplified management at commercial level. Producers then influence the genetic merit of their animal resources through periodic choice between competing sources and, marginally, by their culling decisions. Similar programmes might be possible in lower input systems unless some of the following constraints apply.
- 7.1 There may not be the necessary specialists who are trusted to make the genetic decisions
- 7.2 It may be too difficult to organise an efficient dissemination system
- 7.3 Market signals may not be clear enough to convey the producers' real needs back to the specialists
- 7.4 There may not be competing sources of stock because the overall business environment is under-developed
- 7.5 The risk of spreading disease through routine and rapid genetic dissemination may be too great.
- 8 While rotational crossing appears to be a highly efficient system and was once widely used in the US pig industry, it is very difficult to achieve its theoretical potential except in large, well-recorded and managed units.
- 9 New methods of genetic improvement should be applied in low input systems in stages, with thorough assessments along the way, and with opportunities to return to the original genotypes if the initial assumptions prove incorrect.
- 10 Genetic evaluation systems were not a primary subject in this workshop. Nevertheless, it was recognised that they will usually rest upon a data management system which must be customised and kept up to date and will require adequate resources.

- 11 Routine assessments of progress against plan should be made for those components of the genetic development system which are under the control of the technical staff. In selection programmes these are mainly the realised selection differential (for individual traits or an index), the realised generation interval and their ratio. Other measures can be devised to monitor the efficiency of immigration or crossbreeding or dissemination.
- 12 Because of initial uncertainty about the importance of genetic-by-environment (G x E) interactions in a specific programme, it must be advisable to estimate breeding values from performance measured in a relevant environment.
- 13 No genetic improvement programme should be established in isolation from a broader attempt to ameliorate other aspects of the production and marketing system. Such changes may allow the direct responses to be expressed and could help to compensate for any negative correlated responses.

Policy issues

The successive steps in developing enabling policies were seen as:

- Description of the current situation
- Definition of the development objectives
- Strategy to manage animal genetic resources
- Implementation, monitoring and evaluation.

It was recognised that the different areas of international, national or local policy may help or hinder the development of successful genetic improvement programmes. The following areas are provided as a checklist.

- 1 **Education.** There is a need for both highly trained specialists and skilled technicians, but also for livestock producers to be aware of what genetic change can achieve and how this can occur. If the best specialists with good local knowledge are to be retained in developing countries, it may be essential to establish meaningful collaboration with overseas organisations, perhaps where they were trained. Education is of course necessary in all aspects of animal production and veterinary sciences and not just in genetic improvement.
- 2 **Zootechnical.** In developed countries there has been a long evolution of policy instruments controlling herd-books, licensing of breeding males, importation of breeds and artificial breeding centres. Most of this was imposed by government, but livestock breeders themselves evolved systems to guard the purity of their breeds (although these have sometimes hampered genetic development). It may not be necessary to copy all these rules or

institutions. The requirement is for organisations which ensure farmers' participation and which can provide the necessary services to support genetic progress.

While it is mainly the countries responsibility FAO or some other agency may assist to consolidate the available information on the performance of indigenous and other livestock in specified environments and make it widely available.

- 3 **Veterinary.** Policies regulating livestock importations, movement within countries, diagnostic laboratories, drug usage, notifiable diseases, and inspection down the food chain are all necessary components for modern livestock industries.
- 4 **Research.** There will always be a need for problem-solving within production systems, including reproduction, biotechnology, and veterinary research. In the early stages it may also be necessary to have demonstration projects showing producers what can be achieved – even if the answers are already well known in other areas or countries.
- 5 **Finance.** Local banks or credit institutions may need to provide finance in the early stages of livestock improvement programmes – since costs normally precede returns, often by several years. Inducements may also be needed to help persuade producers to avail themselves of improved genotypes.
- 6 **Market.** Schemes to promote the grading, classification and labelling of produce can help to generate increased prices for higher quality, so that the market itself begins to finance the costs of the programme. Unprotected markets can suffer from dumping of imported products that may stifle any initiatives to improve the local output.
- 7 **Environmental.** Policies must be in place to prevent pollution and ensure sustainability of improved production systems.
- 8 **Welfare.** The welfare of both livestock and workers needs protection on the farms, during transport, at markets and abattoirs.
9. The Workshop naturally left many questions unresolved. One of these concerns the likely roles in developing countries of international agencies, government, co-operatives and the private sector – either local or foreign. Today, though many successful improvement programmes in developed countries are firmly in the private sector, they have evolved from earlier arrangements that relied heavily on public investment that continues at least in education and research. It may not be necessary to repeat such a

long evolutionary process in other countries. FAO should be working closely with co-operative and private breeding organisations to see where their businesses, or at least their methods, could hasten the development of new programmes: to make it happen!

There is also the issue of what will be the structure of livestock industries in ten, twenty or thirty years' time; not long in terms of animal generations. And will they still be working within the same environmental constraints? There is today a reaction against many past attempts to introduce high input high output breeds into unsuitable environments and a commendable interest in seeing whether indigenous breeds can be improved without losing their valuable adaptation.

Nevertheless, it seems likely that the number of livestock-owning households and small-scale farmers will decrease as humankind continues to shift towards urban life. Similarly, serious pests, diseases and deficiencies will gradually be conquered as they already have been in developed regions. The result, as in the more developed world, will be increased scale and more specialised livestock enterprises that may in turn demand different breeds and crosses. Genetic improvement efforts must constantly bear these possibilities in mind and not concentrate solely on breeding objectives constrained by today's problems. It is important that the many breeding programmes operating around the world produce genotypes adapted to the variety of economic, disease and climatic environments that will exist in the future. Otherwise the inevitable time-scale of improvement may mean that the solutions (new and improved strains) are already out of date for the new conditions.

10. The third output from the Workshop was surely an improved understanding among the privileged participants. It is inevitable that this will be expressed in their future work whether this is teaching, extension, writing or planning and supervising projects. While the direct experience of interacting with many of the authors had to be limited to a fairly small group, it is hoped that countless others will benefit from reading the Proceedings.

This volume contains a unique collection of papers combining up-to-date summaries of animal breeding theory with concise accounts of attempts to improve livestock in difficult situations. While the reviews require some specialist training to utilise them fully, the case studies should be required reading for anyone contemplating new projects.

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