Economic Aspects of Dairy Cattle Breeding

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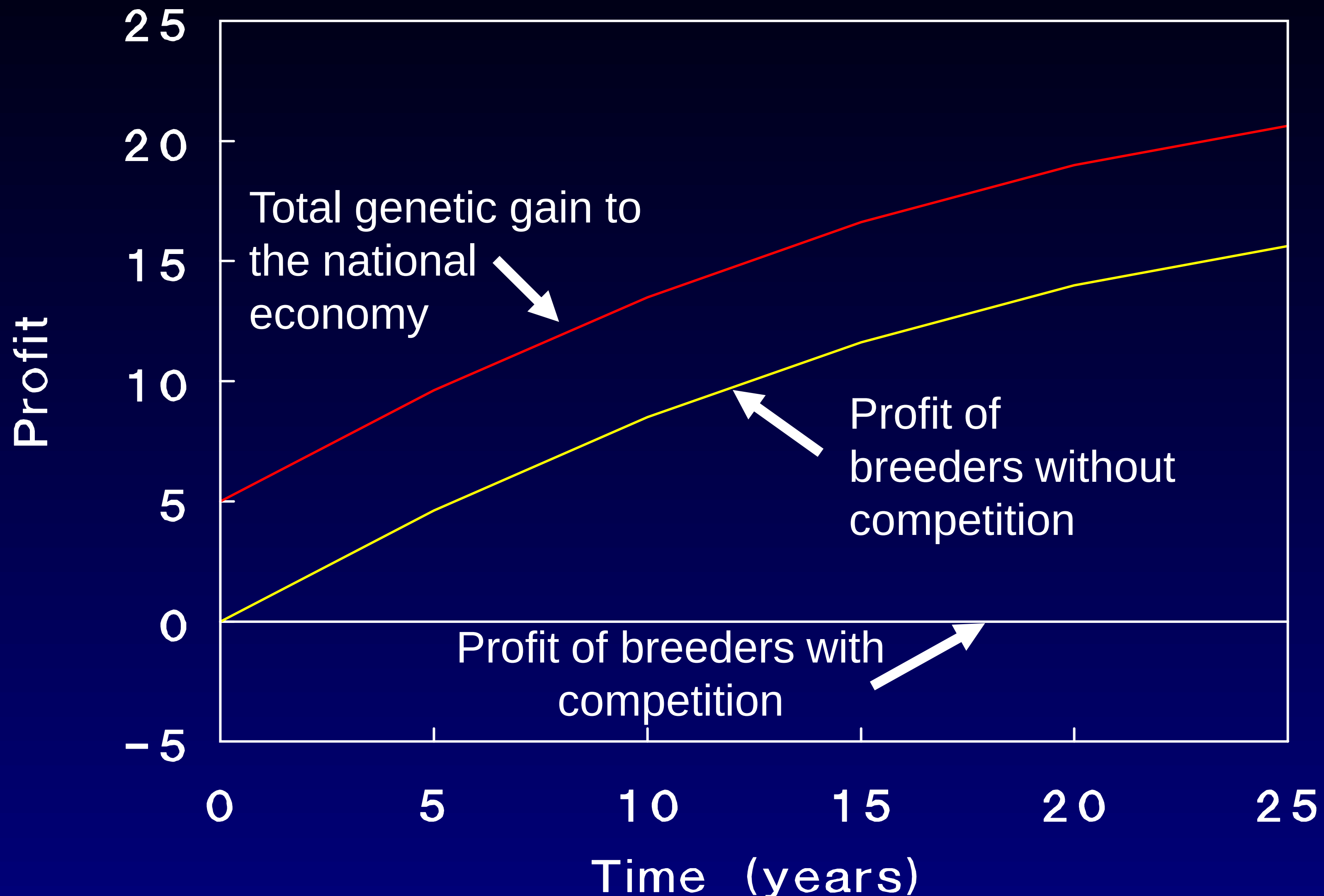
Economics:

the dismal science?

Entities involved in genetic breeding

- Farmers
- Breeders (commercial or cooperative)
- Food processors
- Consumers
- Government

Who gains from genetic improvement?



Costs in breeding programs

After initial start-up costs, annual costs will tend to be constant. The main cost elements in breeding programs:

- Data recording (useful to farmers for herd management)
- Keeping nonproductive animals (males) for future breeding
- Progeny testing of candidate males. Must pay farmers to inseminate with unproven bulls.
- Data analysis, usually government or university service.
- **Genotyping costs, can be big.**

Costs in breeding programs, conclusions

- Generally, in traditional breeding programs, total direct costs are small relative to the value of genetic gain.
- This is not true for genotyping costs, for example, genotyping 10,000 animals at $100 per animal = $1,000,000.

But, genetic gains are unlike other investments!

- On the national level, gains due to genetic improvement are cumulative and eternal, while costs are not.
- Thus, a little bit of genetic improvement goes a long way!

Minimal acceptable rate of return

If returns are discounted, the minimal acceptable annual return, V, from the gain of a single cycle of genetic improvement extended to infinity is computed as follows:

$$Nd = V$$

Where:

- N = initial investment, and d = discount rate.
- That is with a discount rate of 5%, the initial investment up to 20 times the annual return is economically justified!

Economic value of genetic gain

In an ongoing breeding program with a constant rate of genetic gain per year, the nominal values of annual rate of genetic gain = *V*.

The cumulative discounted returns to year *T*, R_v; will be a function *V*, the discount rate, *d*; the profit horizon, *T*; and the number of years from the beginning of the program until first returns are realized, *t*.

R_v is computed as follows (Hill 1971)

$$R_v = V\,\frac{r_d^{t} - r_d^{T+1}}{(1 - r_d)^2} - \frac{(T - t + 1)\,r_d^{T+1}}{1 - r_d}$$

where $r_d = 1/(1+d)$.

For example, with $d = 0.08$, $T = 20$ years, and $t = 5$ years, $R_v = 32.58V$.

That is, the cumulative returns are equal to nearly 33 times the nominal annual returns.

Example: a 10% increase in genetic gain from genomic evaluation in Israel

- The nominal value of a 10% gain in milk production, about 10kg/yr, is worth $1/cow, or $100,000 for 100,000 cows.
- With a discount rate of 8%, and first income after five years, the *cumulative* value of the genetic gain is 33 times the *nominal* value, or $3,300,000!

Economic evaluation of costs in a breeding program

Costs, unlike genetic gain, only have an effect in the year they occur.

We will assume that annual costs are equal during the length of the breeding program, and that first costs occur in the year after the base year.

C_T, the net present value of the total costs of the breeding program, is computed as:

$$C_T = \frac{C_c r_d (1 - r_d^T)}{1 - r_d}$$

where C_c = annual costs of the breeding program. Using the same values for T, and d, $C_T = 9.82C_c$.

Nominal costs vs. nominal gain

Thus, with a profit horizon of 20 years, cumulative profit is positive if $V > 0.31C_c$.

Thus if nominal annual gain due to application of new technology = $100,000/yr, an annual investment up to $300,000/yr is economically justifiable.