

Use of biological resources

Crop plants

Glasshouses

Warmth Extra light Extra CO₂ Pest protection

Limiting factors

CO₂ Temperature Enzymes denature

Fertilisers

Nitrates Faster growth Higher yield

Pesticides

Kill pests fast Non-target harm Resistance

Biological control

No chemicals Slower May become pest

Selective breeding and GM

Selective breeding

Choose best parents Repeat many generations Plants and animals

Impact of selective breeding

Higher yield Less genetic variation Inbreeding

Restriction enzyme cuts DNA

Specific site Sticky ends

Ligase joins DNA

Recombinant DNA

Vectors

Plasmids Viruses

Transgenic

Gene between species

Insulin from bacteria

Recombinant plasmid Fermenter Extract and purify

GM plants

Bt toxin Higher yield Concerns

Micro-organisms and fish

Yeast and bread

Anaerobic respiration CO₂ makes dough rise Ethanol evaporates

Yeast practical

Oil layer Water bath Count bubbles

Yoghurt

Lactobacillus Lactose to lactic acid Milk thickens

Industrial fermenter

Aseptic Nutrients Temperature and pH Oxygen and stirring

Fish farming **Biology only**

Water quality Predation Disease and waste Feeding Selective breeding

Cloning **Biology only**

Micropropagation **Biology only**

Explants In vitro Nutrient agar

Identical plants **Biology only**

Commercial quantities Desirable characteristics

Dolly the sheep **Biology only**

Diploid nucleus Enucleated egg Surrogate mother

Cloned transgenic animals **Biology only**

Human gene Protein in milk