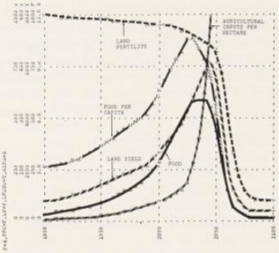
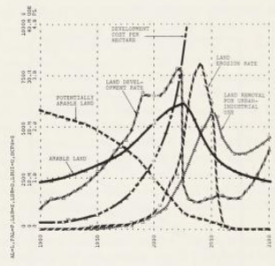


A. The behavior of land yields and food production



B. The behavior of arable land

Figure 4-72 Run 4-3: sensitivity test of the land yield multiplier from capital table, using the optimistic LYMCT

capital LYMC relationship, one that raises the upper limit by 50 percent and one that decreases it by 25 percent. These two curves will be used to investigate the sensitivity of the model's behavior to alternative assumptions of the upper limit to land yields.

Run 4-3 (Figure 4-72) shows the results of a simulation using the "optimistic" curve from Figure 4-71. In this simulation, all other factors are the same as in the standard run, but agricultural inputs are now assumed to be capable of enhancing land yield LY by a maximum factor of 15. As might be expected, land yields LY peak higher, causing food production F to peak higher. The overshoot and decline mode of behavior remains, however, and the decline occurs only a few years later than in the standard run. The decline is caused by the same sequence of events that brought about the decline in the standard run—reduced land fertility from pollution, diminishing returns to both capital and land, and exponentially growing food demand from a growing population. Note that the decline is more severe here than it was in the standard run, since the higher land yield LY leads to an increased rate of erosion LER.

Run 4-4 (Figure 4-73) shows the results of a simulation using the "pessimistic" curve for the land yield multiplier from capital LYMC in Figure 4-71, which assumes a maximum enhancement of land yield LY of 7.5 times the inherent fertility ILF. Again, all other factors are the same as in the standard run. In this run, land yield LY and food production peak at values slightly lower than their maximums in the standard run. However, the decline still occurs at about the same time and for the same reasons. Arable land AL does not decline as rapidly as in the standard run, since lower yield leads to a lower erosion rate.

Run 4-5 (Figure 4-74) shows a simulation using a 35 percent increase in the estimate of the value of potentially arable land total PALT. Since more potentially arable land PAL exists, development costs remain low, and the rate of land development LDR is consistently higher than in the standard run. This increased rate of land development causes potentially arable land PAL to approach zero almost as quickly as it did in the standard run. Eventually, increasing development costs per hectare DCPH force an abandonment of land development around the year 2025—only five years later than in the standard run. Arable land AL peaks at a higher value than it reached in the standard run. Since the marginal return on land development is higher than in the standard run, a smaller fraction of investment is allocated to agricultural inputs throughout Run 4-5. Therefore, land yield LY does not reach the peak value obtained in the standard run, and there is less land erosion. Because of the lower cultivation intensity, the decline in arable land AL is less steep than in the standard run. Total food production reaches a higher value before it eventually declines.

Run 4-6 (Figure 4-75) shows a simulation using a decreased estimate of the value of potentially arable land total PALT. PALT is decreased from 3.2 to 2.4 billion hectares. In this simulation, arable land AL peaks about 10 years earlier than in the standard run. Since land development is marginally less productive than it was in the standard run, a larger fraction of investment is allocated to agricultural inputs. Land yield LY peaks at a higher value than in the standard run, bringing about more land erosion LER. The peak food production is about 20 percent less than the peak value of the standard run.

Notice that arable land AL no longer passes through its 1970 value of 1.4 billion hectares in the two sensitivity tests of PALT shown in Runs 4-5 and 4-6. A sensitivity test in PALT seeks to determine the possible consequences of incorrectly estimating PALT. But if the original estimate of PALT is poor, then some other compensat-