Run 6-14 (Figure 6-41) showed that the process of technological development might not succeed fully in avoiding the pollution crisis mode of behavior. In Run 6-18 (Figure 6-46) the adaptive pollution generation control technologies of Run 6-14 are combined with the social policies of Run 6-17 so that the generation of pollutants PPGR ceases to grow in the year 2020. This combination of social and technological policies is considerably more successful in avoiding high levels of damage than either policy implemented separately. In both Run 6-14 and Run 6-17, high pollution levels cause considerable damage to life expectancies and land fertility in spite of active technological policies. In Run 6-18, however, the social policies that stabilize pollution generation PPGR reduce the rate of growth of persistent pollution PPOL after the year 2020. As life expectancies begin to fall, new technological policies of pollution control are developed to further reduce the growth in persistent pollution. Because pollution generation has already leveled off before new technologies are implemented, the technological policies are much more effective.* These technological policies are more successful when combined with growth-reducing policies because the long delays before the full effects of these new technologies are felt are much less critical to the behavior of the sector when pollution generation is no longer growing.

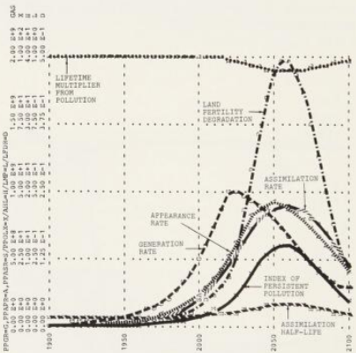

Figure 6-46 Run 6-18: behavior of the pollution sector when adaptive persistent pollution generation control technologies are combined with material equilibrium in the year 2020

*The land fertility degradation rate LFDR grows to high levels in Run 6-18 because new pollution control technologies are developed only in response to a decrease in life expectancies, measured by the lifetime multiplier from pollution LMP. A more realistic control policy might develop new pollution control technologies as a function of the damage to both life expectancies and land fertility.

Summary

The preceding eighteen pollution sector runs illustrate several important behavioral characteristics of global persistent pollution as modeled in World3. One important characteristic is the effect of delays on the behavior of the sector. Because of the transmission delay, the level of pollution may increase for a decade or more after the rate of generation has become constant or even begun to decline. The delay implicit in the assimilation half-life AHL influences the amount of pollution present under steady-state conditions (when generation, appearance, and assimilation are all equal and the level of pollution is constant). When the rate of generation is low and constant, AHL is comparatively short (1.5 years), and the assimilation rate equals the appearance rate at rather low levels of pollution. Ambient pollution will be only about twice the amount of pollution assimilated annually. When the generation rate is high, pollution mounts, and the delay inherent in assimilation increases. Then the ambient pollution must grow to much more than twice the amount assimilated annually before the assimilation rate equals the rate of generation and the pollution level stabilizes.

The delay implicit in the assimilation half-life AHL also causes the assimilation rate to lag behind both the appearance rate and the generation rate. As a result, ambient pollution levels tend to rise whenever the generation rate is increasing. The strength of the relationship between the level of pollution and AHL is also an important determinant of the model's behavior. If AHL is not raised by increasing pollution levels, then the pollution crisis mode becomes much less likely. Because the actual magnitude and the long-term determinants of AHL are not well understood for the total class of global persistent pollutants, obtaining information on AHL would be an important empirical research objective.

The magnitude of the pollution transmission delay PPTD has little effect on the general behavior mode of the sector if growth continues. However, when adaptive pollution control policies are instituted in response to observed pollution damage (the most likely case in the real world), the length of the transmission delay becomes very important. The greater the delays in the response of society to pollution damage, the longer will society be exposed to unacceptably high levels of pollution before abatement becomes effective. Thus longer transmission delays make effective pollution control much more difficult.

Finally, as long as there is exponential growth in the generation of pollution, ameliorative measures ultimately do little to prevent the model from exhibiting unacceptable levels of pollution damage. Growth in the generation of pollution must eventually stop if unacceptable consequences are to be avoided. An ostensibly short delay in acting to curtail growth in the generation of pollution may add disproportion-