We extend the curvaton scenario presented by Erickcek et al. (2008, 2009), to explain how the even-odd multipole asymmetry of the Cosmic Microwave Background (CMB) (also called parity asymmetry, (Kim & Naselsky 2010)) and power anisotropies can be generated by the curvaton field, which acts as an extra component to the spectrum of adiabatic perturbations in the inflationary epoch. Our work provides a possible cosmic explanation to the CMB large-scale asymmetry problems besides systematics and unknown residuals.