Polycrystalline compounds of Ca_{0.9}Y_{0.1}Mn_{1-x}Fe_{x}O_3 for 0 ≤ x ≤ 0.25 were prepared by solid-state reaction, followed by spark plasma sintering process, and their thermoelectric properties from 300 to 1200 K were systematically investigated in terms of Y and Fe co-doping at the Ca- and Mn-sites, respectively. Crystal structure refinement revealed that all the investigated samples have the O′-type orthorhombic structure, and the lattice parameters slightly increased with increasing Fe concentration, causing a crystal distortion. It was found that with increasing the content of Fe doping, the Seebeck coefficient of Ca_{0.9}Y_{0.1}Mn_{12x}Fe_{x}O_3 tended to increase, while the tendency toward the electrical conductivity was more complicated. The highest power factor was found to be 2.19 × 10^{-4} W/mK² at 1150 K for the sample with x = 0.05 after annealing at 1523 K for 24 h in air. Thermal conductivity of the Fe-doped samples showed a lower value than that of the x = 0 sample, and the highest dimensionless figure of merit, ZT was found to be improved about 20% for the sample with x = 0.05 as compared to that of the x = 0 sample at 1150 K.