Supplementary materials: Research area species information overview

The study sample is located in the transition zone from meadow steppe to typical steppe, in which *Stipa grandis* was the establishment species and dominant species, and *Leymus chinensis* was the subdominant species. The soil type is chestnut soil and the climate is dry. When the rainfall is high, the preponderance of *Stipa baicalensis* will increase, but it is not a group species, and the population of *Leymus chinensis* will increase to a certain extent after the grassland improvement.

Table S1: Plant community species composition under different grassland restoration measures in the study area

Vegetation classification	Name	Description	Emergence of species			
			CK	RP	F	E
Poaceae (Gramineae)	*Stipa grandis*	Dominant species/group species	√	√	√	√
	Leymus chinensis	Subdominant species	√	√	√	√
	Stipa baicalensis		√	√	√	√
	Agropyron cristatum		√	√	√	√
	Cleistogenes squarrosa		√	√	√	√
	Poa pratensis		√	√	√	√
	Koeleria macrantha		√		√	
Fabaceae	*Melilotus dentatus*			√	√	
	Caragana microphylla				√	
Asteraceae（Compositae）	*Klasea centauroides*		√		√	√
	Artemisia oxycephala				√	
	Carpesium abrotanoides			√		√
	Artemisia scoparia		√	√	√	√
	Ixeris polycephala			√		√
	Artemisia frigida		√	√		√
Forb	*Allium anisopodium*			√		
	Plantago depressa			√		
	Chenopodium aristatum					√
	Carex duriuscula		√			√
	Cymbaria dahurica		√	√		
	Potentilla bifurca		√	√	√	
	Dontostemon dentatus			√		
	Carex korshinskyi		√	√	√	√
	Chenopodium glaucum					√
	Chenopodium acuminatum					√
	Potentilla tanacetifolia		√	√	√	√
	Phlomis tuberosa		√			
	Linaria vulgaris				√	
	Galium verum			√		

Allium tenuissimum		√
Salsola collina	√	√

CK, RP, F and E in the table represent control group, root cutting treatment, organic fertilizer treatment and enclosure treatment respectively.