[Supplementary material]

Foraging and farming: archaeobotanical and zooarchaeological evidence for Neolithic exchange on the Tibetan Plateau

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Methods

Flotation and identification of charred plant seeds

A total of ninety-two soil samples and 1778 liters, were collected from two ash pits (H1 and H2) and three cultural layers (L2, L3, L4) during the excavation of one 4 × 4m trench. These samples were then floated to extract plant remains. Carbonized plant remains were collected in a 0.2mm mesh using flotation, then dried in the shade and sorted through 0.35, 0.7, 1, 2 and 4mm mesh sieves. Seeds were identified under a 40× stereoscopic microscope. All charred plant seeds were preliminarily identified by Haiming Li of Lanzhou University and identifications were subsequently confirmed by Jingang Yang of the Paleoethnobotany Laboratory at the Institute of Archaeology, Chinese Academy of Social Sciences.

Collection and identification of animal remains

Animal bones unearthed from ash pits and cultural layers and fragments of animal bones floated from soil samples were collected in Zip lock bags, washed in water to remove all dirt, and then laid them out in the shade for one to two days to dry. Sorting and taxon identification were carried out in the MOE Key Laboratory of Western China's Environmental Systems (Ministry of Education) in Lanzhou University based on the morphological characteristics of the bones. We compared animal bones from the Zongri site to modern and ancient zoological specimens held in the Zooarchaeology Laboratory, Institute of Archaeology, Chinese Academy of Social Sciences and to atlases of animal skeletons (Schmid 1972; Hillson 2005; France 2009).

Selecting samples and radiocarbon dating

A total of ten millet seeds were selected for accelerator mass spectrometry (AMS) radiocarbon dating. Three charred foxtail millet seed samples were pretreated using standard procedures (acid-alkali-acid) at the chronology laboratory of the MOE Key Laboratory of Western China's Environmental Systems (Ministry of Education), Lanzhou University. Their dates were measured at Peking University, Beijing. Seven broomcorn millet seed samples were dated at Beta Analytic, Miami, USA. The IntCal13 curve (Reimer *et al.* 2013) and the Libby half-life of 5568 years were used in the calculation of all dates. The calibration was performed using OxCal 4.3 (Bronk Ramsey & Lee 2013). All ages are reported as cal BC (Table 1).

Table S1. Proportions of identified plant remains from the excavation of the Zongri site in 2015.

Cultural units	Lab. no	Soil (L)	Charcoal		Agricultural crops		Weeds										T
			Weight(g)	g/L	*Setaria italica*	*Panicum miliaceum*	*Chenopodium album*	*Atriplex* spp.	*Medicago* spp.	*Setaria viridis*	*Kochia scoparia*	*Hippophae rhamnoides*	*Carex* spp.	*Lotus* spp.	*Panicum miliaceum* var. *ruderale*	Unknown	
L2	N02E02	19	21.1	11.1		1											1
L2	N02E04	28	9.1	3.3		1											1
L2	N03E03	35	31.6	9.0		2											2
L2	N04E02	14	7.1	5.1		1											1
L2	N03E02	14	16.4	11.7		3											3
L2	N04E01	13	11.6	8.9	1												1
L2	N02E02	14	27.6	19.7	1												1
L2	N02E04	13	15.1	11.6		1											1
L2	N03E01	14	24.7	17.6		2											2
L2	N03E03	17	12.5	7.4		3											3
L2	N03E04	20	12.2	6.1		2											6
L2	N04E04	20	15.6	7.8	1	4	1										6
L2	N03E02	36	39.9	11.1	1	4		1									3
L2	N03E03	17	68.6	40.4		1		2									1
L2	N04E01	17	35.4	20.8		2											2
L2	N04E02	19	23.4	12.3		2											2
L2	N04E03	21	28.0	13.3		6											6
L2	N04E04	17	27.4	16.1		2											2
L2	N03E03	11	38.2	34.7		2											2
L2	N03E04	10	31.5	31.5	2	4					1						7
L2	N04E01	19	33.2	17.5	2	3											5
L2	N04E03	12	70.2	58.5		5	1				1						7
L2	N04E04	17	58.7	34.5		1											1

L2	N04E01	14	31.2	22.3		6					1					7
L2	N04E02	25	103.8	41.5	1	8										9
L2	N04E03	16	66.5	41.6		4										4
L2	N01E04	22	68.0	30.9		2										2
L2	N03E01	49	297.1	60.6	2	20										2
L2	N03E02	42	88.4	21.0	1	8										9
L3	N03E04	16	111.5	69.7		20										2
L3	N02E03	27	74.5	27.6	1	11										1
L3	N03E03	38	206.4	54.3		7	1									8
L3	N02E04	16	56.9	35.6	2	4										6
L3	N03E03	18	152.5	84.7		18										1
L3	N04E01	34	151.5	44.6		8		1								9
L3	N04E02	19	55.8	29.4	2	14		1								1
L3	N04E04	19	252.0	132.6	23	180										2
L3	N03E02	17	40.9	24.1		6		1								7
L3	N04E01	16	47.4	29.6	3	3										6
L3	N03E04	16	126.9	79.3		8	2									1
L3	N03E03	17	101.3	59.6	2	18										2
L3	N3E02	16	131.3	82.1	1	9										1
L3	N03E03	17	167.8	98.7	10	105										1
L3	N03E04	24	111.8	46.6	1	6										7
L3	N04E01	18	51.6	28.7	1	6										7
L3	N04E02	26	125.9	48.4		8		1								9
L3	N04E03	19	126.6	66.6	1	16										1
L3	N03E02	18	57.9	32.2	2	3										5
L3	N03E04	19	44.6	23.5	2	17										1
L3	N04E01	14	76.2	54.4		9										9
L3	N04E02	19	97.0	51.1		15										1

L3	N04E01	19	84.1	44.3	2	29	1	8			5		1				4
L3	N04E02	19	103.3	54.4	17	84	2	11			1						1
L3	N04E03	26	229.1	88.1	25	272	4	9	1								3
L3	N04E04	19	152.5	80.3	11	70	1										8
L3	N04E03	19	71.6	37.7	6	48				1							5
L3	N03E02	20	68.2	34.1		9	1										1
L3	N03E03	21	79.2	37.7		11	2	1									1
L3	N03E04	23	145.3	63.2	4	29											3
L3	N04E01	20	33.9	17.0	9	30	2	1									4
L3	N02E04	20	83.1	41.6	2	22											2
L3	N03E04	21	203.8	97.0	4	16											2
L3	N02E04	14	134.0	95.7	4	26											3
L3	N03E02	16	62.4	39.0		4											4
L3	N03E03	14	90.5	64.6		18											1
L3	N03E03	16	90.0	56.3	7	22		2		1							3
L3	N03E04	14	136.6	97.6	4	22											2
L3	N02E03	16	62.7	39.2		4											4
L4	N02E04	19	69.6	36.6	1	5											6
L4	N04E01	17	34.9	20.5	4	27											3
L4	N04E03	22	200.0	90.9	21	159	1	1									1
L4	N04E04	28	186.7	66.7	200	841	15	4		4	6	3			1		1
L4	N04E02	14	24.7	17.6	5	17											2
L4	N02E04	14	46.5	33.2	2	15											1
L4	N04E02	18	139.0	77.2	27	207	3							3			2
L4	N04E04	20	169.4	84.7	18	142								1			1
L4	N03E03	17	163.0	95.9	8	14	2										2
L4	N04E02	15	109.4	72.9	4	21		1									2
L4	N04E02	19	152.1	80.1	5	25											3

L4	N04E03	14	121.6	86.9	2	11		1									1
L4	N04E03	17	189.3	111.4	21	45	8										7
L4	N03E04	19	218.6	115.1	17	30											4
L4	N03E03	24	325.4	135.6	5	15											2
L4	N04E02	19	195.7	103.0	14	30	2	1									4
L4	N04E03	14	62.6	44.7	4	3											7
L2	②a date	12	24.8	20.7	1	2											3
L3	③ date	14	129.4	92.4	5	72	3	3									8
L4	④ date	13	155.7	119.8		6											6
L2	H1	14	44.4	31.7		2											2
L2	H1	47	255.1	54.3	113	354	3	1		4							4
L3	H2	19	37.1	19.5		9											9

Table S2. The stone artefacts unearthed from the Zongri site based on previous publication by Qinghaisheng Wenwu Guanlichu and Hainanzhou Minzu Bowuguan (1998).

Microliths					
Microblade cores and microblades					
62					
Chipped stone tools					
Choppers and Disc-shaped stone					
80					
Ground stone tools					
Stone chisels	Stone balls	Stone axes	Stone knives	Stone adzes	Spinning wheel
9	2	9	43	6	1

Table S3. The stone artefacts unearthed from the Zongri site in this study.

Microliths						
	Microblade cores					
L4	1	—	—	—	—	—
Chipped stone artifacts						
	Disc-shaped stone	Choppers	Scrapers	Stone axes	Cores	Flakes
L2	2	4	6	2	2	3
L3	—	—	—	1	—	—
L4	—	—	—	—	—	2

Ground stone tools						
	Quern-stone	Elongated handstone	Stone axes	Stone knives	Stone adzes	Ornaments
L2	—	—	1	1	1	1
L3	3	1	—	—	—	—
L4	—	—	2			

Table S4. Coordinates and calibrated radiocarbon dates of known sites associated with foraging and agricultural subsistence practices in the NETP during the period of 13 050–2050 BC.

Site	Longitude(°)	Latitude (°)	Radiocarbon date (BP)	Calibrated age (cal BC)		Reference
				1σ (68.2%)	2σ (95.4%)	
Palaeolithic sites						
Jiangxigou 1	103.38	25.07	12470±60	12688±227	12690±386	Brantingham *et al.* (2007)
Jiangxigou 2	100.28	36.62	8170±50	7179±106	7190±129	Brantingham *et al.* (2007)
Heimahe 1	99.78	36.73	10850±60	10785±36	10806±82	Madsen (2009)
Heimahe 3	99.78	36.73	7630±50	6495±63	6506±85	Brantingham *et al.* (2007)
Xidatan 2	94.26	35.71	5760±40	4615±64	4607±102	Brantingham & Gao (2006)
Yeniugou	94.25	35.88	7675±40	6516±50	6523±71	Tang *et al.* (2013)

Yantaidong	100.88	36.87	12248±265	12317±456	12428±804	Yi *et al.* (2011)
Yangquxi	100.27	35.69	4590±30	3417±74	3312±186	Yi *et al.* (2011)
Shalongka	102.02	36	7535±58	6368±93	6362±111	Dong *et al.* (2013)
Layihai	100.71	35.95	6745±85	5646±79	5647±153	IA, CASS (1991)
HZYC1	100.88	36.64	11020±60	10941±86	10937±148	Chen *et al.* (2015)
151 site	100.48	36.56	6990±60	5892±85	5867±122	Rhode *et al.* (2014)
10HTHS1	100.78	36.87	10230±60	9992±119	10061±358	Rhode *et al.* (2014)
BWC3	100.76	36.88	9510±50	8932±186	8894±242	Rhode *et al.* (2014)
Gahai	100.57	37.05	9750±40	9249±25	9233±59	Rhode *et al.* (2014)
Xiadawu	99.18	35.02	9885±35	9323±34	9354±83	Hou *et al.* (2016)
Canxionggacuo	96.24	33.67	6745±85	5646±79	5647±153	Hou *et al.* (2016)
Palaeolithic sites with OSL dates						
site	Longitude	Latitude	De (Gy)	Dose rate (Gy/ka)	OSL age (ka)	Reference
Xiaochaidan1	95.52	37.46	33.3±2.3	3.46±0.24	9.6±0.9	Sun *et al.* (2010)
Xiaochaidan3	95.52	37.46	30.4±2.6	2.82±0.21	10.8±1.2	Sun *et al.* (2010)

Neolithic sites with millet remains						
Site	Longitude(°)	Latitude (°)	Radiocarbon date (yr BP)	Calibrated age (cal BC)		Reference
				1σ	2σ	
Hurere	102.78	35.89	4530±60	3232±126	3259±234	Chen *et al.* (2015)
Luwalinchang	101.94	35.95	4470±25	3209±117	3182±154	Chen *et al.* (2015)
Gayixiangjing	101.27	36.08	4410±40	3012±82	3119±206	Chen *et al.* (2015)
Hongtuzhaizi	102.55	35.72	4395±30	3007±77	3006±90	Chen *et al.* (2015)
Adaqiha	102.01	36.02	4340±40	2958±53	2988±98	Chen *et al.* (2015)
Zhangga	102.56	35.73	4340±40	2958±53	2988±98	Chen *et al.* (2015)
Heibiya	102.01	36.64	4245±30	2889±17	2811±103	Chen *et al.* (2015)
Hongyazhangjia	102.82	35.91	4185±35	2790±92	2764±127	Chen *et al.* (2015)
benbakou	101.55	36.68	4185±25	2791±86	2781±104	Chen *et al.* (2015)
Shangduoba	101.92	36.07	4035±30	2535±46	2651±178	Chen *et al.* (2015)
Pinganxincun	102.01	36.47	3980±25	2516±45	2517±53	Chen *et al.* (2015)
Yaluhu	102.32	35.89	3940±25	2418±68	2453±108	Chen *et al.* (2015)
Mijiawan	102.33	36.54	3900±30	2404±58	2383±86	Chen *et al.*

						(2015)
Liuwanshagou	102.56	36.44	3840±25	2276±67	2329±126	Chen *et al.* (2015)
Yangjiazhaipo	101.7	36.83	3715±25	2115±74	2115±83	Chen *et al.* (2015)
Xinjia	102.83	35.87	3690±30	2083±50	2086±109	Chen *et al.* (2015)
Xiasunjiazhai	101.75	36.74	3680±25	2080±53	2058±82	Chen *et al.* (2015)
Nanshansi	102.47	36.45	3680±25	2080±53	2058±82	Chen *et al.* (2015)
Zongri sites						
Site	Longitude(°)	Latitude (°)	Age (yr BC)			Reference
Langshetou	100.24	35.31	3650–2050			Chen *et al.* (1998)
Dongguotan	100.23	35.67	3650–2050			Chen *et al.* (1998)
Yangqu	100.26	35.69	3650–2050			Chen *et al.* (1998)
Xiangranggou	100.25	35.68	3650–2050			Chen *et al.* (1998)
Yangquxi	100.22	35.68	3650–2050			Chen *et al.* (1998)
Xialuquan	100.16	35.44	3650–2050			Chen *et al.* (1998)
Xiazhuang	100.15	35.45	3650–2050			Chen *et al.* (1998)
Moduotan	100.23	35.32	3650–2050			Chen *et al.*

				(1998)
Cainaigai	100.11	35.32	3650–2050	Chen *et al.* (1998)
Zengbenka	100.84	35.97	3650–2050	Chen *et al.* (1998)
Dongjikou	100.85	35.98	3650–2050	Chen *et al.* (1998)
Demang	100.85	35.98	3650–2050	Chen *et al.* (1998)
Ganguo	100.86	35.97	3650–2050	Chen *et al.* (1998)
Guorenduo	100.93	35.91	3650–2050	Chen *et al.* (1998)
Layiranqi	100.94	35.92	3650–2050	Chen *et al.* (1998)
Dazang	100.88	35.95	3650–2050	Chen *et al.* (1998)
Zhamaniha	100.93	35.91	3650–2050	Chen *et al.* (1998)
Tangshiguotai	100.62	36.27	3650–2050	Chen *et al.* (1998)
Xiamei	100.63	36.34	3650–2050	Chen *et al.* (1998)
Shangtangna	101.38	36.01	3650–2050	Chen *et al.* (1998)
Xiatangna	101.38	36.02	3650–2050	Chen *et al.* (1998)
Wulukou	101.38	36.01	3650–2050	Chen *et al.* (1998)

Sitaidi	101.38	36.01	3650–2050	Chen *et al.* (1998)
Xiapaixi	101.38	36.03	3650–2050	Chen *et al.* (1998)
Shangliutun	101.38	36.01	3650–2050	Chen *et al.* (1998)
Reshuigou	101.37	36.01	3650–2050	Chen *et al.* (1998)
Shangeda	101.38	36.01	3650–2050	Chen *et al.* (1998)
Xiapaiyuanyichang	101.38	36.03	3650–2050	Chen *et al.* (1998
Linkejianzi	101.38	36.02	3650–2050	Chen *et al.* (1998
Langshetou	101.44	36.05	3650–2050	Chen *et al.* (1998
Dongheyan	101.44	36.04	3650–2050	Chen *et al.* (1998
Sailikahean	101.2	36.11	3650–2050	Chen *et al.* (1998
Niduoganbg	101.19	36.13	3650–2050	Chen *et al.* (1998
Yabayan	100.34	35.93	3650–2050	Chen *et al.* (1998)
Ninabei	101.26	36.06	3650–2050	Chen *et al.* (1998)
Gayigengxiang	101.26	36.07	3650–2050	Chen *et al.* (1998)
Dancha	101.26	36.07	3650–2050	Chen *et al.*

				(1998)
Nongchangxi	101.25	36.07	3650–2050	Chen *et al.* (1998)
Dumuchari	101.2	36.11	3650–2050	Chen *et al.* (1998)
Huangheyan	101.43	36.05	3650–2050	Chen *et al.* (1998)
Jiabucha	101.51	35.88	3650–2050	Chen *et al.* (1998)
Xialanjiao	101.44	35.94	3650–2050	Chen *et al.* (1998)
Xialanjiaobei	101.47	35.95	3650–2050	Chen *et al.* (1998)
Kala	101.51	35.88	3650–2050	Chen *et al.* (1998)
Ganhongya	101.49	35.79	3650–2050	Chen *et al.* (1998)
Niandoulou	101.51	35.88	3650–2050	Chen *et al.* (1998)
Zongri	100.24	35.34	3650–2050	Chen *et al.* (1998)
Geguotang	100.41	35.27	3650–2050	Chen *et al.* (1998)

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