

# Homegarden Agroecosystems Managed by Salar People on Qinghai-Tibet Plateau

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## Research

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# Abstract

**Background:** Salar is a Turkic-speaking Islamic ethnic group in China, who live primarily in Xunhua Salar Autonomous County, Qinghai-Tibet Plateau. Salar people have engaged in agriculture especially skilled in horticulture and their homegardens (HG) management. They are regarded as the first people on Qinghai-Tibet plateau to practice horticulture, especially manage their HGs, which are traditional farming systems and also supplementary food production systems. Traditional knowledge of Salar people associated with their homegardens always contributes in livelihood, food security, ornamental value and biodiversity conservation. The cultivation of different plants in HGs for self-sufficiency has a long tradition in China's rural area especially in some mountainous areas. However, Salar people's traditional HGs have not been described. The present paper aims to report the features of Salar's HGs focusing on agrobiodiversity and its important role.

**Methods:** The methods used in this work included literature study, semi-structured interviews, participatory observation, and panel consultation. A total of 60 households in each 9 villages were surveyed. In each household there are 4-12 family members, aged from 20 to 86 years old. The homestead size is between 200 and 1200 m<sup>2</sup>. Plant species cultivated in homegardens were identified according to *Flora of China*. Based on comprehensive survey of Salar people's HGs and related background data, we identified and characterized the most important functions and ecosystem services provided by HGs of Salar people.

**Results:** According to primary production systems, there are 4 different types of HGs, including ornamental focus, product focus, dual-purpose and multi-purpose. In total 108 (excluding weeds and bonsai) plant species were found in HGs of study area, within 43 families. The most important and frequency plants are *Rosa chinensis*, *Armeniaca vulgaris*, and *Capsicum annum*. The average number of plants varied from 4 to 32 species in each homegarden in three investigated townships. HGs of Salar people contain 8 different functions and we identify and characterize 16 services: 2 regulating services, 2 support services, 4 production services and 8 culture services.

**Conclusion:** This paper reveals the floristic diversity of HGs of Salar communities. Meanwhile, it provides basic information for homegarden agroecosystem of Salar people. Ecosystem services and function research suggested that Salar people's homegarden agroecosystem provide ecosystem services mainly related to supply services and culture services. Salar people's HGs are important food supplement, aesthetics and cultural spaces where knowledge related to agricultural practices is transmitted and through which households may improve their leisure and livelihoods.

## Background

Salar people are a Turkic-speaking Islamic people who is one of the ethnic groups with less population in China, and live primarily in Xunhua Salar Autonomous County, Qinghai Province, Northwest China. According to a report of China National Institute of Statistics, approximately 140,000 Salar people live in

China [1]. Their origins are uncertain, but Salar people themselves consider that during the thirteenth century their ancestors left Samarkand in present-day Uzbekistan and eventually settled in their present location [2]. They still speak the language of their ancestors but without a writing system, according to knowledgeable informants, approximately ninety percent of all Xunhua Salar males over the age of forty can speak Tibetan. Salar people's traditional culture has been well-known for its traditional dances, marriage style, traditional clothing, or traditional home architecture and homegarden management. Salar people engaged in agriculture especially skilled in horticulture and their homegardens, who was the first people in Qinghai-Tibet plateau to practice horticulture. They hold a singular place in the culture of the Salar people, and reflect their pride in a rich gardening tradition. The traditional Salar house is called "Wattle-wall house" which has been recognized as a cultural heritage in Qinghai Province [1–2]. So far, Salar's traditional ecological knowledge is poorly documented. The existing research is restricted to its history, religion, art, society and other fields. However, there are few studies on natural science disciplines or traditional knowledge protection. The cultivation of different plants in homegarden for self-sufficiency has a long tradition in China's rural area especially in some mountainous area.

HGs are traditional farming systems and also supplementary food production system, presumably one of the oldest land use system [3] and are characterized by highly diverse cultivated plants [4] and within the compounds of individual houses and livestock, regarded as sustainable agricultural production systems [5]. Many studies about HGs has typically emphasized the description and inventorying of the plant diversity, multiple functions, and other benefits for peasant farmers [6–9]. Some recent research on agroforestry and traditional production systems has also begun to consider the capacity of HGs to help adapt to ecosystem and climate change-related challenges [10]. The diverse plant species within homegarden used in overlapping ways as food, spices, stimulants, medicines, beverages, fodder and shelter [11].

HGs researches have been aimed primarily at agriculture, ecology, nutrition and biodiversity, especially ethnobotanical documentation of the diversity and uses of garden species and at the promotion of homegardening for nutritional improvement of low-income groups. HGs is the primary source of food supplementary, providing a diverse diet for rural marginalized poor and are always located in human dwellings, often delimited from their surroundings by hedges, fences or other barriers. The more or less separation, coupled with repeated tending from the household create specialized edaphic, microclimatic and biotic conditions which make HGs markedly different from the surrounding landscape [12]. HGs provides a bridge between the social and biological, linking cultivated species and natural ecosystems, combining and conserving species diversity and genetic diversity [13]. However, the increasing human population, urbanization and pressure on the earth's ecosystems, has resulted in the breakdown of these traditional agroforestry systems, accompanied by increasing economic, cultural, nutritional, and environmental problems, there is little awareness that homegarden are under similar threats [14]. Although research on homegarden systems in Salar region is less intensive than what their importance to the economy, ecology, and livelihoods would warrant, homegardens are a vital source for subsistence economy and self-sufficiency of many Salar households, owing to their diverse products, and this also is true for many other poor rural regions in China. Rural homegardens contribute to the functioning and

sustainability of the larger agricultural ecosystem[15], providing services such as pollination, refuge for micro- and macro-fauna and allowing for gene-flow between plant populations inside and out of the garden. Traditional home-gardens typically have a multilayered arrangement, resembling an agro-forestry system, which brings different plant species together in a temporal and/or spatial succession; this stratified and dynamic architecture, more than the identity of single species, has been shown to make a homegarden a sustainable and resilient ecosystem [16].

HGs are distributed around the world, but are predominantly a tropical phenomenon. There is little study has been done in arid and semi-arid areas, especially in Qinghai-Tibet Plateau, in these areas HGs caring an important source of production and in situ conservation of biodiversity. Salar people are the first linguistic group engaged in horticulture on the Qinghai-Tibet Plateau. Historically, Salar people have a tradition of operating orchards and managing their HGs in the small and narrow Yellow River valley, where the climate is warm and the soil is fertile. HGs can effectively realize the optimal use of resources. Although, the uniqueness of households and their homegardens has made it difficult to implement commonly accepted research frameworks and methods for understanding HGs ecosystem services, the HGs of Salar people are ideal locations for the study of traditional agroecosystems and human interactions regarding traditional knowledge in Qinghai-Tibet plateau. The HGs of Salar people are important examples of such systems for protection of agricultural biodiversity in this region. According to our research, we can influence people's cognition, management, protection and inheritance of HGs agroecosystem to achieve sustainable development. Otherwise, as mentioned in the IPBES report: we should consider the perspectives, visions and rights of indigenous peoples and local communities, their knowledge and understanding of large areas and ecosystems, and the patterns they expect to benefit from in the future. By investigating the HGs of the Salar people, surveying and analyzing cultivated plant diversity in these HGs, explaining how the Salar people recognize, manage, use plants in homegardens and discusses the significance of HGs for food supply, exploring the cultural connotation of the HGs has practical significance for the protection of the plant culture of the HGs, the ecological environment protection of the villages and the protection of plant diversity. There are two reasons why the study of Salar people's homegarden is of great importance. Firstly, we need a better understanding of homegarden agroecosystem in Qinghai-Tibet region. Secondly, the contribution of cultural and socioeconomic factors in generating and maintaining crop diversity in homegarden agroecosystem has received little attention. These issues will be argued in the present study at family and community levels.

## Methods

The study was started with preparatory phase which includes problem definition and goal setting, followed by doing a preliminary study to collect secondary data about history and culture associated with the Salar ethnic group traditional homegarden agroecosystem. The next step in this study was data collection through the literature study, interviews with informants, as well as field observation. Studies conducted to explore written sources which are obtained from journals and books recommended by the key informants. Interviews were conducted to obtain cultural and historical information about Salar people. This stage was conducted using in-depth interview directly and deeply to the informant related

about the character and culture of the Salar householders, we asked about socio-demographic characteristics of the participants (age, gender, education level, gardening history, and length of residency in the village). Forming elements, plant constitute, as well as cultural activities that are still carried out by the Salar people. Five researchers lived in one or another of the study sites participating in local life. The rest of the team, occasionally also collaborated in data collection. Field observation was conducted to determine the composition of elements, structure, function and ecosystem services of the traditional Salar HGs [17] and allowed the understanding of the different activities and tasks around gardening by providing ample opportunities – other than during the formal interviews – to interact with gardeners and to discuss garden's progress and other issues such as cultural practices and their changes, products grown and their evolution, destination of these products, and economic implications of homegardening, among others.

We also carried out semi-structured interviews with more than 120 informants (about 40 per study area) regarding traditional management of homegardens and changes on management techniques over the last two years. We selected 65 local homegarden managers living and cultivating a homegarden in the study areas. Data collections took place in 2018 and 2019. Plant use categorization was based on farmers' cited primary uses (usually the first use mentioned) resulted into a list with a single use for each plant per homegarden. The main plant use classes included 4 categories. They are fruit, vegetable, flower, and others (ornamentals, spice, medicine, shade, dye, or perfume).

## Site selection

These criteria were developed to select Salar homegarden site that covered the cultural and socio-economic area, cultivated land and garden plot area [18]. Three townships were chosen, each site containing several villages. The selection criteria were listed below, in order of importance:

*Cultural and socio-economic diversity.* At least one site should include Salar people's culture and origins and the site selected should reflect a range of socioeconomic status.

*Diverse agrobiodiversity ecosystem.* Homegarden should contain species and genetic diversity as well as horizontal and vertical heterogeneity.

*Strong homegardening traditions.* Sites should reflect the existence of indigenous knowledge, skills and traditions in managing the homegarden system.

*Importance of homegarden for livelihoods and community.* Sites should reflect a range of homegardens from somewhat commercialized to primarily used for home consumption.

*The willingness of householders.* Communities have already expressed interest in the project and willingness to cooperate with research partners

*Accessibility.* Local transportation between villages should be convenient.

# Site descriptions

The present study was carried out in three townships of Xunhua County in Qinghai Province (Fig. 1). These areas are known for its widespread homegarden and rich indigenous knowledge. Xunhua Salar Autonomous County is located on eastern Qinghai-Tibet Plateau, characterized by many steep mountains. The geographic location is between 102°1'E – 102°7'E and 35°4'N – 35°8'N. It is approximately 90 km long and 40 km wide. The total area is about 2100 square kilometers. It is about 150 km far from the provincial capital city. The mean annual temperature and rainfall of the Salar communities are about 8.5°C and 264.4 mm respectively. The area is characterized by ecological and cultural richness, in conjunction with high levels of both poverty and malnutrition.

Most Salar people are farmers. Agriculture is the main economic activity in the study area. off-farm employment opportunities are small business. Background data shows 12% of the population lives below the poverty line. The study area has a population of around 140,000 people, most of Salar people living in Jiezi, Qingshui, and Mengda townships. We also identified several key informants with detailed and specialist knowledge, including a mix of village chairpersons, elders, farmers and intangible cultural heritage inheritors.

## Household survey

It began with meetings with farmers (managers of homegarden) and local chairpersons, to discuss and plan the research. A total 60 homegardens in each 9 villages. 65 homegarden managers were surveyed (Table 1). Each household had 4–12 family members. Homegarden managers aged 20–86 years, 90.8% are females. Homegarden size between 200 to 1200 m<sup>2</sup>. The study followed site selection criteria; it was developed previously. Interviews then took place with the head gardener of the household (usually the eldest woman in the house). Interviews generally lasted 60 to 90 min when the researcher could communicate directly with the informants. Householders also answered basic demographic and socio-economic questions regarding their households and homegardens (i.e. number of household members, age, level of education, income). Questions were asked in a semi-structured conversational format, allowing us to gather consistent data across gardens, while also learning about qualitative aspects of homegardens through farmers' perspectives and insights.

Table 1  
Socio-economic characteristics of homegardens managers interviewed in Xunhua County.

Socio-Economic Characteristics		Number (%) of Respondents
Sex	Male	6(9.2)
	Female	59(90.8)
Age	20–35	8(12.3)
	36–50	32(49.2)
	51–65	13(20.0)
	66–86	12(18.4)
Literacy status	Literate	15(23.1)
	Illiterate	50(76.9)
Wealth	Poor	14(23.3)
	Moderately endowed	31(51.7)
Family member	Rich	15(25.0)
	3–6 people	37(61.6)
	7–9 people	17(28.3)
History of home-garden	10–12 people	5(10.1)
	10–35	25(41.6)
	36–55	20(33.3)
House size (m <sup>2</sup> )	56–100	15(25.1)
	200–400	32(53.3)
	410–660	20(33.3)
	670–1200	8(13.4)
Home-garden size (m <sup>2</sup> )	Small	35(58.3)
	middle	20(33.3)
	large	15(8.4)

## Plant Species Survey

A botanical inventory was conducted in the Salar people's homegarden and was conducted only once in each selected household. For each garden, an exhaustive inventory of plant species was carried out with

the assistance of homegarden owner/manager. The plants studied in the homegarden included those for human consumption such as fruits, vegetables, flowers and dye as well as spices and medicinal plants. Weedy plant species, i.e., spontaneous plant species declared as unwanted in the gardens, were not inventoried. In each homegarden, all used plant species and their uses were recorded by semi-structured interviews and personal observation with all family members available at the time of the visit. A plant species was included in this study if the homegarden owner could indicate its use. Vouchers of plants that could not be clearly identified were collected and preserved and sent to the national herbarium for identification by botanists.

## **Survey of functions and ecosystem services**

Identification and characterization of Salar people's homegarden functions and ecosystem services were made by a triangulation of information obtained from literature review, participant and non-participant observation, and semi-structured interviews. First, we reviewed literatures addressing ecosystem services provided by agroecosystems in general and by homegardens in particular. During fieldwork we used participant and non-participant observation methods, typically used to establish contact with the community, the culture, and the local social organization in an active or not active way [19]. Through participatory observation, we observed the homegarden work performed by Salar people in order to improve our understanding of the activities related to the provision of homegarden ecosystem services [20]. We also participated and experienced in the actual homegarden work as much as possible.

## **Results**

### **Traditional knowledge and homegarden management**

According to semi-structured interviews with three intangible cultural heritage inheritors and about 120 knowledgeable informants, we collected traditional knowledge about Salar people and their homegardens.

Salar people maintain that during the thirteenth century their ancestors left Samarkand in present-day Uzbekistan and eventually settled in what is now Xunhua Autonomous County. Linguistic similarities between Salar, Turkoman, and Uzbek suggest a close relationship at some time in the past. The 'Camel dance' is a type of play that relates directly to the Salar's migration reminding them of their ancestors' trek from Samarkand and helping them remember their Central Asian origins. Salar people believe that there are three life duties need to follow: marriage should occur at a young age and the engagement should send agreement tea. The deceased must be buried quickly. Debts should be paid on time.

The agriculture of Salar people is mainly based on planting. When their ancestors migrated from Central Asia to Xunhua County, they brought black and white wheat, which proved that their ancestors were engaged in planting when they lived in Central Asia. Salar people cultivate fruit and vegetable in homegarden. They called "Bahe" for homegarden, which is first one on the Qinghai-Tibet Plateau. The cultivation and management of homegarden has transformed the unique culture and livelihood of Salar

people through the transformation of several generations. For Salar people, most older females participate in the establishment, care and management of homegarden. It requires little time and labor relative to primary farming activities and are mostly maintained by household members during free time to flexible schedules. Males are increasingly engaging in small business or go out for work. Upon their return, bring new ideas and plants that might transform the homegarden biodiversity and landscape. Due to large purchases of potted plants and climate change, crop pests and diseases are increasing year by year, especially fruit trees. Householders cited a labor shortage (e.g. lack of labor and physical exhaustion) as a challenge for both pest and disease management. Many HGs managers also intended to plant new crop species, and buy seeds from the town markets, and there is also a small amount from the government benefits and internet. Farmers in the surveyed homegardens continuously exchange and select species and varieties of homegarden crops. Planting materials were largely inherited from family members or received from neighbors. Some planting materials were purchased locally or from local markets and markets in another place. Traditional management practices for soil fertility were surveyed in some homegardens, including applications of pit-composted household, Livestock manure and farm wastes and farmyard manure, as well as intercropping.

## **Species diversity in homegarden**

Homegarden are recognized worldwide as sustainable agroforestry systems that are repositories of species and genetic diversity. During household survey, in total 108 (excluding weeds and bonsai) plant species were recorded in Salar communities, with 43 families and an average number of 4 to 32 species per home-garden in three townships. The 60 surveyed gardens contained 42 ornamental species (Table 2), 27 vegetable species (Table 3), 24 fruit species (Table 4), and 15 species with other purposes (Table 5). Ornamentals were the most species-rich use category followed by vegetables, fruits, and 15 species for other purposes.

Table 2  
Ornamentals recorded and used in homegardens

No.	Scientific name	Family	Uses
1	<i>Acorus calamus</i>	Acoraceae	Ornamental
2	<i>Alcea rosea</i> L.	Malvaceae	Ornamental
3	<i>Amygdalus triloba</i> (Lindl.) Ricker	Rosaceae	Ornamental
4	<i>Belamcanda chinensis</i> (L.) Redouté	Iridaceae	Ornamental
5	<i>Bougainvillea glabra</i> Choisy	Nyctaginaceae	Ornamental
6	<i>Calendula officinalis</i> L.	Compositae	Ornamental
7	<i>Callistephus chinensis</i> (L.) Nees	Compositae	Ornamental
8	<i>Canna indica</i> L.	Cannaceae	Ornamental
9	<i>Celosia cristata</i> L.	Amaranthaceae	Ornamental, Experimental
10	<i>Chrysanthemum morifolium</i> Ramat.	Compositae	Ornamental
11	<i>Cosmos bipinnata</i> Cav.	Compositae	Ornamental
12	<i>Dahlia pinnata</i> Cav.	Compositae	Ornamental
13	<i>Dicentra spectabilis</i> (L.) Lem.	Papaveraceae	Ornamental
14	<i>Eschscholtzia californica</i> Cham.	Papaveraceae	Ornamental
15	<i>Fuchsia hybrida</i> Hort. ex Sieb. et Voss.	Onagraceae	Ornamental
16	<i>Helianthus annuus</i> L.	Compositae	Ornamental, snacks
17	<i>Hemerocallis fulva</i> (L.) L.	Liliaceae	Ornamental
18	<i>Hosta plantaginea</i> (Lam.) Aschers.	Liliaceae	Ornamental
19	<i>Ipomoea nil</i> (L.) Roth	Convolvulaceae	Ornamental
20	<i>Iris tectorum</i>	Iridaceae	Ornamental
21	<i>Lilium brownii</i> var. <i>viridulum</i> Baker.	Liliaceae	Ornamental
22	<i>Lilium pumilum</i> DC.	Liliaceae	Ornamental
23	<i>Lilium tigrinum</i> Ker Gawl.	Liliaceae	Ornamental
24	<i>Nerium oleander</i> L.	Apocynaceae	Ornamental
25	<i>Osmanthus fragrans</i> (Thunb.) Lour.	Oleaceae	Ornamental, Perfume

No.	Scientific name	Family	Uses
26	<i>Paeonia anomala</i> L. subsp. <i>veitchii</i> (Lynch) D. Y. Hong et K. Y. Pan	Paeoniaceae	Ornamental
27	<i>Paeonia lactiflora</i> Pall.	Ranunculaceae	Ornamental
28	<i>Paeonia suffruticosa</i> Andr.	Ranunculaceae	Ornamental
29	<i>Pelargonium hortorum</i> Bailey	Ranunculaceae	Ornamental
30	<i>Rosa chinensis</i> Jacq.	Rosaceae	Ornamental
31	<i>Rosa multiflora</i> Thunb.	Rosaceae	Ornamental
32	<i>Rosa multiflora</i> Thunb. var. <i>carnea</i> Thory	Rosaceae	Ornamental
33	<i>Rosa rugosa</i> Thunb.	Rosaceae	Ornamental
34	<i>Rosa xanthina</i> Lindl.	Rosaceae	Ornamental
35	<i>Rudbeckia laciniata</i> L.	Compositae	Ornamental
36	<i>Salvia splendens</i> Ker-Gawl.	Labiatae	Ornamental
37	<i>Sorbaria sorbifolia</i> (L.) A. Br.	Rosaceae	Ornamental
38	<i>Syringa reticulata</i> subsp. <i>amurensis</i> (Rupr.) P. S. Green et M. C. Chang.	Oleaceae	Ornamental
39	<i>Tagetes erecta</i> L.	Compositae	Ornamental
40	<i>Tropaeolum majus</i> L.	Tropaeolaceae	Ornamental
41	<i>Viola tricolor</i> L.	Violaceae	Ornamental
42	<i>Zinnia elegans</i> Jacq.	Compositae	Ornamental

Table 3  
Fruit species recorded from homegardens

No.	Scientific name	Family	Uses
1	<i>Amygdalus persica</i> L.	Rosaceae	Fruit, Shade
2	<i>Armeniaca vulgaris</i> Lam.	Rosaceae	Fruit, Shade
3	<i>Cerasus pseudocerasus</i> (Lindl.) G. Don	Rosaceae	Fruit
4	<i>Chaenomeles sinensis</i> (Thouin) Koehne	Rosaceae	Experimental
5	<i>Citrullus lanatus</i> (Thunb.) Matsum. et Nakai	Cucurbitaceae	Fruit
6	<i>Citrus reticulata</i> Blanco	Rutaceae	Fruit, Ornamental
7	<i>Crataegus pinnatifida</i> Bge.	Rosaceae	Fruit, Shade
8	<i>Diospyros kaki</i> Thunb.	Ebenaceae	Fruit, Shade
9	<i>Elaeagnus angustifolia</i> L.	Elaeagnaceae	Fruit, Perfume
10	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Rosaceae	Experimental
11	<i>Ficus carica</i> L.	Moraceae	Dry fruit
12	<i>Fragaria × ananassa</i> Duch.	Rosaceae	Fruit
13	<i>Juglans regia</i> L.	Juglandaceae	Dry fruit, shade
14	<i>Malus pumila</i> Mill.	Rosacea	Fruit
15	<i>Morus alba</i> L.	Moraceae	Fruit
16	<i>Prunus cerasifera</i> Ehrhar f. <i>atropurpurea</i> (Jacq.) Rehd.	Rosacea	Fruit, Shade
17	<i>Prunus domestica</i> L.	Rosaceae	Fruit
18	<i>Prunus persica</i> var. <i>nectarina</i> Maxim.	Rosaceae	Fruit
19	<i>Prunus salicina</i> Lindl.	Rosaceae	Fruit
20	<i>Punica granatum</i> L.	Punicaceae	Experimental, Fruit
21	<i>Pyrus ussuriensis</i> Maxim.	Rosaceae	Fruit
22	<i>Sorbus alnifolia</i> (Sieb. et Zucc.) K. Koch	Rosaceae	Fruit, Shade
23	<i>Vitis vinifera</i> L.	Vitaceae	Fruit, Ornamental
24	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	Fruit

Table 4  
Vegetables recorded from homegardens

No.	Scientific name	Family	Uses
1	<i>Allium fistulosum</i>	Liliaceae	Vegetable, Spice
2	<i>Allium tuberosum</i>	Liliaceae	Vegetable, Spice
3	<i>Apium graveolens</i> L.	Umbelliferae	Vegetable, Medicinal
4	<i>Beta vulgaris</i> L.	Chenopodiaceae	Vegetable, Spice
5	<i>Brassica chinensis</i> L. var. <i>oleifera</i> Makino et Namot	Cruciferae	Vegetable
6	<i>Brassica oleracea</i> L.	Cruciferae	Vegetable
7	<i>Brassica oleracea</i> L. var. <i>botrytis</i> L.	Cruciferae	Vegetable
8	<i>Capsicum annuum</i> L.	Solanaceae	Vegetable, Spice
9	<i>Chrysanthemum coronarium</i> L.	Compositae	Vegetable
10	<i>Cichorium endivia</i> L.	Compositae	Vegetable
11	<i>Coriandrum sativum</i> L.	Umbelliferae	Vegetable, Spice
12	<i>Cucumis sativus</i> L.	Cucurbitaceae	Vegetable, Ornamental
13	<i>Cucurbita moschata</i> (Duch. ex Lam.) Duch. ex Poiret	Cucurbitaceae	Vegetable
14	<i>Cucurbita pepo</i> L.	Cucurbitaceae	Vegetable
15	<i>Lactuca sativa</i> L. var. <i>ramosa</i> Hort.	Compositae	Vegetable
16	<i>Lactuca sativa</i> var. <i>longifolia</i> Lam	Compositae	Vegetable
17	<i>Luffa cylindrica</i> (L.) Roem.	Cucurbitaceae	Vegetable
18	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	Vegetable
19	<i>Phaseolus vulgaris</i> L.	Leguminosae	Vegetable
20	<i>Pisum sativum</i> L.	Leguminosae	Vegetable
21	<i>Raphanus sativus</i> L.	Cruciferae	Vegetable
22	<i>Solanum melongena</i> L.	Solanaceae	Vegetable
23	<i>Spinacia oleracea</i> L.	Chenopodiaceae	Vegetable
24	<i>Vicia faba</i> L.	Leguminosae	Vegetable
25	<i>Vigna unguiculata</i> (L.) Walp.	Leguminosae	Vegetable

No.	Scientific name	Family	Uses
26	<i>Zanthoxylum bungeanum</i> Maxim.	Rutaceae	Spice
27	<i>Zea mays</i> L.	Gramineae	Seed

Table 5  
Plant species recorded from homegardens for other purposes

No.	Scientific name	Family	Uses
1	<i>Artemisia argyi</i> Levl. et Van.	Compositae	Medicinal
2	<i>Buxus sinica</i> (Rehd. et Wils.) Cheng var. <i>parvifolia</i> M. Cheng	Buxaceae	Ornamental
3	<i>Eucommia ulmoides</i> Oliver	Eucommiaceae	Medicinal
4	<i>Euonymus japonicus</i> Thunb. var. <i>aurea-marginatus</i> Hort.	Celastraceae	Ornamental
5	<i>Gynostemma pentaphyllum</i> (Thunb.) Makino	Cucurbitaceae	Experimental, Medicinal
6	<i>Hordeum distichon</i> var. <i>nudum</i> L.	Gramineae	Seed
7	<i>Impatiens balsamina</i> L.	Balsaminaceae	Dye
8	<i>Mukdenia rossii</i>	Saxifragaceae	Ornamental
9	<i>Opuntia stricta</i> (Haw.) Haw. var. <i>dillenii</i> (Ker-Gawl.) Benson	Cactaceae	Medicinal
10	<i>Paulownia tomentosa</i> (Thunb.) Steud. var. <i>tsinlingensis</i> (Pai) Gong Tong	Scrophulariaceae	Shade
11	<i>Picea crassifolia</i> Kom.	Pinaceae	Shade
12	<i>Platycladus orientalis</i> (L.) Franco	Cupressaceae	Ornamental
13	<i>Potentilla glabra</i> Lodd.	Rosaceae	Ornamental
14	<i>Robinia pseudoacacia</i> L.	Leguminosae	Shade, Ornamental
15	<i>Trigonella foenum-graecum</i> L.	Leguminosae	Dye, Spice

According to participatory observation and semi-structure interview and background data analysis, species diversity and composition of Salar people's homegardens are also influenced by a number of environmental, socioeconomic, different cultural and traditions and determined by a complicated interplay of factors, such as the tastes preference of the family members, local food culture and customs, government agricultural policy and local development projects, and regional market forces. The contribution of cultural and socioeconomic factors in generating and maintaining agro-diversity in homegardens has received little attention, yet human cultures have profound influence on the diversity of the ecosystems they belong to. Selection is possibly the factor that most profoundly influences the evolution of agrobiodiversity, hence its conservation, due to its effects on population structure[21].

Householders' selection is a dynamic practice which depends on many variables such as the fields' size, the crop, the market's demand and may easily change depending on opportunities. Householders frequently mentioned labor shortage, problems with crop pests and diseases and poor trade and markets may reduce and influence crop diversity [22].

## **Salar people's homegarden structure**

Salar people's houses are typically oriented to the south which is common in northern China, where climatic conditions favor this arrangement. In the summer, the houses catch a cool wind that comes from the south, while in the winter, houses are protected from a cold wind that comes from the north.

As a small-scale agroecosystem, homegardening of salar community is an indigenous, integrated method of home production that often combines vegetable and fruit gardening with flowers. Salar people liking flowers, due to the climatic factors, many flower species can't grow in this area. Therefore, almost every household of the Salar people purchase some bonsai as decoration.

Types of HGs and variants of salar are numerous and diversified in Qinghai-Tibet Plateau, however, they can be classified into general categories based on primary production systems, crop composition and structure of homegardens (Fig. 2):

Ornamental focus (A): homegarden with flowers and fruit trees (27%)

Produce focus (B): homegarden with vegetables and fruit trees (12%)

Dual-purpose (C): homegarden with vegetables and flowers (11%)

Multi-purpose (D): compound planting homegarden (51%)

These merely reflect the major production system within a category of homegardens; by definition, they usually include aspects of all the categories mentioned. A garden is a micro-scale landscape, so that the constituent elements can be likened to the landscape forming element, such as landforms, plant materials, structures, hard elements, and water elements [23]. Regarding the horizontal structure, Salar people's homegarden were generally fenced with brick, Raw soil or cement, and made into fences of different shapes, many of the surveyed homegardens had a space in front of the house that was left bare or covered with grass, often with a few trees planted for shade. Fruit plantations were usually completely surrounding the yard and home, vegetable plots were mainly arranged close to the house. The vertical structure and main species present at different levels of the Salar HGs is show in Table 6.

Table 6  
Vertical stratification in Salar people's homegarden

Stratum	Height in meters (m)	Homegardens
Ground level	< 3 m	Vegetables, Flowers, starch food plants,
Lower level	3–10 m	Fruit trees, or other shrub such as cloves, Chinese prickly ash
Upper lever	10–15 m	Other trees for building material and fuel wood, walnut trees

Table 7  
Functions of homegardens and associated practices

Function	Practices	Representative plants
Food supplement (93%)	<ol style="list-style-type: none"> <li>1. Most vegetables are subsidiary food</li> <li>2. Some plants are used as a seasoning for cooking meat.</li> </ol>	<p><i>Raphanus sativus</i> L.</p> <p><i>Zanthoxylum bungeanum</i> Maxim.</p>
Environmental regulation (55%)	<ol style="list-style-type: none"> <li>1. Plants are planted or allowed to grow in the contours of the land where the house is built, the roots of the plants stabilize the soil.</li> <li>2. When building the house, the piece of land is prepared so that trees are maintained for shade.</li> </ol>	<p><i>Picea crassifolia</i> Kom. <i>Robinia pseudoacacia</i></p>
Occasional income (20%)	<ol style="list-style-type: none"> <li>1. Women occasionally sell produce from the home garden.</li> <li>2. Livestock products.</li> </ol>	<p><i>Cerasus pseudocerasus</i> (Lindl.) G. Don</p> <p><i>Prunus domestica</i> L.</p>
Small-scale experimentation (43%)	<ol style="list-style-type: none"> <li>1. New plants are tested in the home garden.</li> <li>2. New plants are collected, bought or exchanged.</li> </ol>	<p><i>Eriobotrya japonica</i> (Thunb.) Lindl.</p>
Reservoirs of agrobiodiversity (35%)	<ol style="list-style-type: none"> <li>1. Seeds are selected and stored in the home garden</li> </ol>	<p><i>Zea mays</i> L.</p> <p><i>Hordeum distichon</i> var. <i>nudum</i> L.</p>
Aesthetics (100%)	<ol style="list-style-type: none"> <li>1. When travelling, plants are brought back home, (because they are different from the plants others have). Certain plants enhance the status of the person taking care of them</li> </ol>	<p><i>Buxus sinica</i> (Rehd. et Wils.) Cheng</p> <p><i>Celosia cristata</i> L.</p>

# Functions and ecosystem services of Salar people's homegarden

Salar HGs are managed and modified ecosystems providing a range of services that directly benefit households but are also an important habitat for maintaining and conserving local biodiversity and source of other regulating and supporting services. The possession of a functional type of HGs are closely related to socio-economic conditions (gender, age, economic activity, education level) of householders and the agro-ecological zone they belong to and cultural backgrounds. By combining HGs management and horticultural cultivation, Salar people have developed an integrated agricultural, horticultural, aesthetics and animal husbandry system in their homegarden which makes an optimal use of the soil production capacity, ensures multiple uses of natural resources, and provides multiple and sustained yields of different types of crops for subsistence and additional commercial use (Table 7). After investigation of 60 household of Salar people, summary the following functions:

Table 8  
Ecosystem services provided by homegardens

Category		Goods and services from HGs
Regulating services	Maintenance of essential ecological processes and life support systems	Maintenance of productive soils Regulate the temperature
Support services	Provision of habitat for wild plant and animal species and maintenance of biodiversity	Suitable living space for wild plants and animals Maintenance of landraces
Production services	Provision of natural resources	Provision of green pollution-free food Provision of fodder and green manure Provision of medicinal plants Provision of resources for decoration
Culture services	Provision of opportunities for cognitive development	Enjoyment of aesthetic features Hobby Use in folklore, art and design Connection with spiritual feelings Heritage value of home gardens and associated traditional ecological knowledge Place for creating and enhancing social networks Place for ceremonies and family activities

*Food supplement.* HGs are mostly known for their food production function considered to be their basic function. In Salar region, due to the climate, HGs can only provide food from April to October each year, and provide households with vegetables, fruits, flavors etc..

*Occasional income.* Salar woman usually sell fruits, Chinese prickly ash, pumpkin and chili paper from their HGs to increase their occasional income.

*Small-scale experimentation.* Salar HGs are often utilized as testing plots for new crops and species. For instance, some new crop species, some fruit trees such as *Diospyros lotus*, *Prunus domestica*, *Chaenomeles sinensis*, are still collected in other place or bought from market.

*Reservoirs of agrobiodiversity.* Salar HGs played an important role in biodiversity conservation, especially for conservation of local crop varieties and species germplasm.

*Livestock shed.* Livestock are an integral part of some homegardens, and their selection is determined by sociocultural, environmental, financial, and religious concerns. These mainly provide nutritional security but also a source of additional income. The ancestors of Salar were nomadic people, and they continue to keep the tradition of animal husbandry until now. Almost every household has cattle and sheep. The pastoralism is very important for Salar people's livelihood by earning income from milk, eggs, skin and meat of animals.

*Aesthetics area.* Salar people love flowers in their traditions, they are not only cultivated all kinds of flowers, but even decorated their houses with flowers pattern. Many plants selected by Salar people for cultivation reflect cultural preferences, to enjoyment of homegardens' aesthetic features, such as ornamental and eating preferences, rather than productive purpose.

*Culture service.* For Salar People, HGs also plays an important role in cultural festivals and religious activities. Salar people's marriage, funeral, festivals and religious ceremony must be carried out in their own HGs. The products are used for various ceremonies, especially fruits and meat for festival.

Because of the importance of HGs value for Salar people's everyday life, we focus at advancing the understanding of the value of homegardens ecosystem services. Although, the importance of HGs for ecosystems service distinctly, to our knowledge there has not been any attempt to systematically describe and value the ecosystem services provided by HGs. In this work we identify and characterize 16 services: two regulating services, two support services, four production services and 8 culture services (Table 8). The most valued ecosystem service provided by Salar HGs is the provision of green pollution-free food and the cultural service "hobby" is also amongst of the most valued homegarden services. Specifically, respondents felt that homegardens serve as a pleasant distraction and a relaxation space. We combine with reviewed scientific literature on agriculture-related ecosystem services [24] and available documentation on the ecology, economy, and with further services identified from fieldwork observations and from the interviews with local informants, and related Salar areas to draft this table of Salar people's homegarden ecosystem services. Table 8 was then expanded with further services identified from fieldwork observations and from the interviews with local informants.

## **Discussion**

Homegarden agroecosystem is an important contribution to sustainable agricultural production, because of their potential to meet several economic, social, ecological and institutional conditions for sustainability [25]. Salar HGs are important social and cultural spaces where knowledge related to agricultural practices is transmitted and through which households may improve their income and livelihoods. Traditional sociocultural and ecological knowledge often permits the farmer to decide the species choice and the spatial and time sequence of its growing [26]. Home is their most important place, building houses, managing and decorating gardens is the tradition of Salar people and the most important things in their daily life. Through investigation and observation, the selection of plant varieties in the Salar HGs is mainly for seed exchange, long-term planting traditions and market purchases.

Although only a part of Salar women sell homegarden products such as various fruits, chili peppers, Chinese prickly ash and walnuts to increase the family's extra income, the homegarden is still an important source of livelihood and nutritional supplements for Salar people.

Many plants found in the Salar HGs with high frequency are typical plants of home-gardens throughout the temperate zone, e.g. *Allium fistulosum*, *Coriandrum sativum* L., *Cucumis sativus* L., and *Cucurbita pepo* L.. They provide a broad basis for self-sufficiency of the households. In general, most people in the study villages rely on the products from their homegardens for food supplement. Due to the traditional customs of Salar people and the pursuit of the homegarden environment, every household has purchased and cultivated a large number of bonsai, although bonsai increases the plant diversity of homegarden and beautifies the living environment, it also brings many adverse effects such as new pests and diseases, but they have never been aware of the main reasons for the continued increase in pests and diseases. In the future work, we should strengthen publicity and education to maintain biodiversity and homegarden systems of Salar people.

Salar people's culture have profound influence on the diversity of the homegarden agroecosystem they belong. Different customs, traditions, preferences, education level and aesthetic preferences are instrumental in determining the overall aspect of the garden. Besides, homegarden is dynamic system, increasing population pressure, the transformation of farmers' thoughts under urbanization, the proximity of markets, the availability of modern agro-chemical inputs, the introduction of new crop and tree species, and the migration of rural labor to the cities may all exert their impact on homegardening [27]. For Salar HGs, diversity difference to each household is more affected by labor shortage, distance from farmland to homestead and homegarden size, However, the planting area of the Salar HGs has gradually decreased due to the build parking sheds in most of homestead, this is a more dangerous signal for Salar homegarden plant diversity. Different types of Salar HGs are also due to hobbies, family economic conditions and aesthetics. Although there are not many garden types, compound planting homegarden is the most common type, Salar people still hope that the HGs plants and functions are diversified.

Despite all these multifarious advantages, Salar homegarden are yet to receive recognition they deserve neither at the policy level nor at scientific front. The role of homegardens as repositories of biological diversity has been acknowledged but still a comprehensive, interdisciplinary investigation of their agrobiodiversity is lacking. For better sustainable production of homegarden, government should be take positive actions such as launching of agroforestry extension activities, education and training for farmers on agroforestry, and supply of quality plant propagules and technical know-how, for attaining farmers to diverse varieties of crops in their homesteads. Thus, while homegardens are declining in importance, it is not due to preference for cash-crops, but rather socio-economic, a cocktail of environmental, and political circumstances that have combined to make farming less appealing to smallholders. Influx of monoculture, low returns on investment, land fragmentation, unreliable climate change, increased prevalence of pests and diseases, alternative market avenue for homegarden products, and fast changing socio-economic and cultural equations have put serious threats on the future of these systems.

Salar people's homegardens provide a large set of ecosystem services in rural life, being cultural services the category most valued. The cultural value attached to homegardens has been reinforced by their important contribution to household food security, most Salar people argued that one of the main reasons to cultivate a homegarden was the better taste and nutrition of the vegetables and fruits and didn't use any chemical fertilizers. During our interviews householders also sustained that they produced their own food as a part of the way of understanding their dietary structure and their agriculture environment. HGs ecosystem services also show important differences when compared with services provided by conventional agriculture like contributing to enhance cultural identity and the development of sense of place, created through firsthand interaction between humans and their home. Most ecosystem services depend on wild species and ecosystems for their production, as a result, they often fail to include the services which are of most importance to local people and can therefore lead to incorrect policy decisions. Besides, these assessments often ignore ecosystem services that contribute significantly to human benefits but are difficult to measure, such as spiritual values and artistic inspiration. Therefore, there is a need to add some services to national-level ecosystem services assessments and conduct local assessments to link these ecosystem services directly to human health, livelihoods and happiness [28]. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), a joint global effort by governments, academic, and civil society to assess and promote knowledge of Earth's biodiversity and ecosystems and their contribution to human societies in order to inform policy formulation. One of the more recent key elements of the IPBES conceptual framework is the notion of nature's contributions to people (NCP), which builds on the ecosystem service concept popularized by the Millennium Ecosystem Assessment (MA). The NCP approach recognizes the central and pervasive role that culture plays in defining all links between people and nature. Second, use of NCP elevates, emphasizes, and operationalizes the role of indigenous and local knowledge in understanding nature's contribution to people [29]. Therefore, Homegarden ecosystem services contribute significantly to the immediate benefits of humanity, especially in remote rural areas. Salar people's homegardens contain more cultural and spiritual values which is one of the most important ecosystem services for Salar people.

## Conclusion

This paper reveals the floristic diversity of HGs of Salar communities. The HGs of Salar communities harbor high levels of plant biodiversity on Qinghai-Tibet Plateau, which are closely linked with household needs for food supplement and aesthetics. According to primary production systems, there are 4 different types of HGs, including ornamental focus, product focus, dual-purpose and multi-purpose. In total 108 (excluding weeds and bonsai) plant species were found in HGs of study area, within 43 families. The most important and frequency plants are *Rosa chinensis*, *Armeniaca vulgaris*, and *Capsicum annum*. The average number of plants varied from 4 to 32 species in each homegarden in three investigated townships. HGs of Salar people contain 8 different functions and we identify and characterize 16 services: 2 regulating services, 2 support services, 4 production services and 8 culture services. Ecosystem services and function research suggested that Salar homegarden agroecosystems provide

services mainly related to supply services and culture services. Salar HGs are important food supplement, aesthetics and cultural spaces where knowledge related to agricultural practices is transmitted and through which households may improve their leisure and livelihoods. Traditional agroecosystems such as rural HGs can be considered as a sustainable agroecosystem, learn and protect the traditional knowledge associated with the HGs is necessary for agrobiodiversity and rural livelihood.

## **Declarations**

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### **Availability of data and materials**

Raw and treated data generated during study are available from the corresponding author on reasonable request.

### **Authors' contributions**

CL and FL conceived the study; MZ conducted the field work, analyzed and interpreted the data, and drafted the manuscript. BL, BSL and RC participated in the discussions. All authors approved the final manuscript.

### **Ethics approval and consent to participate**

Not applicable.

### **Consent for publication**

Not applicable.

### **Competing interests**

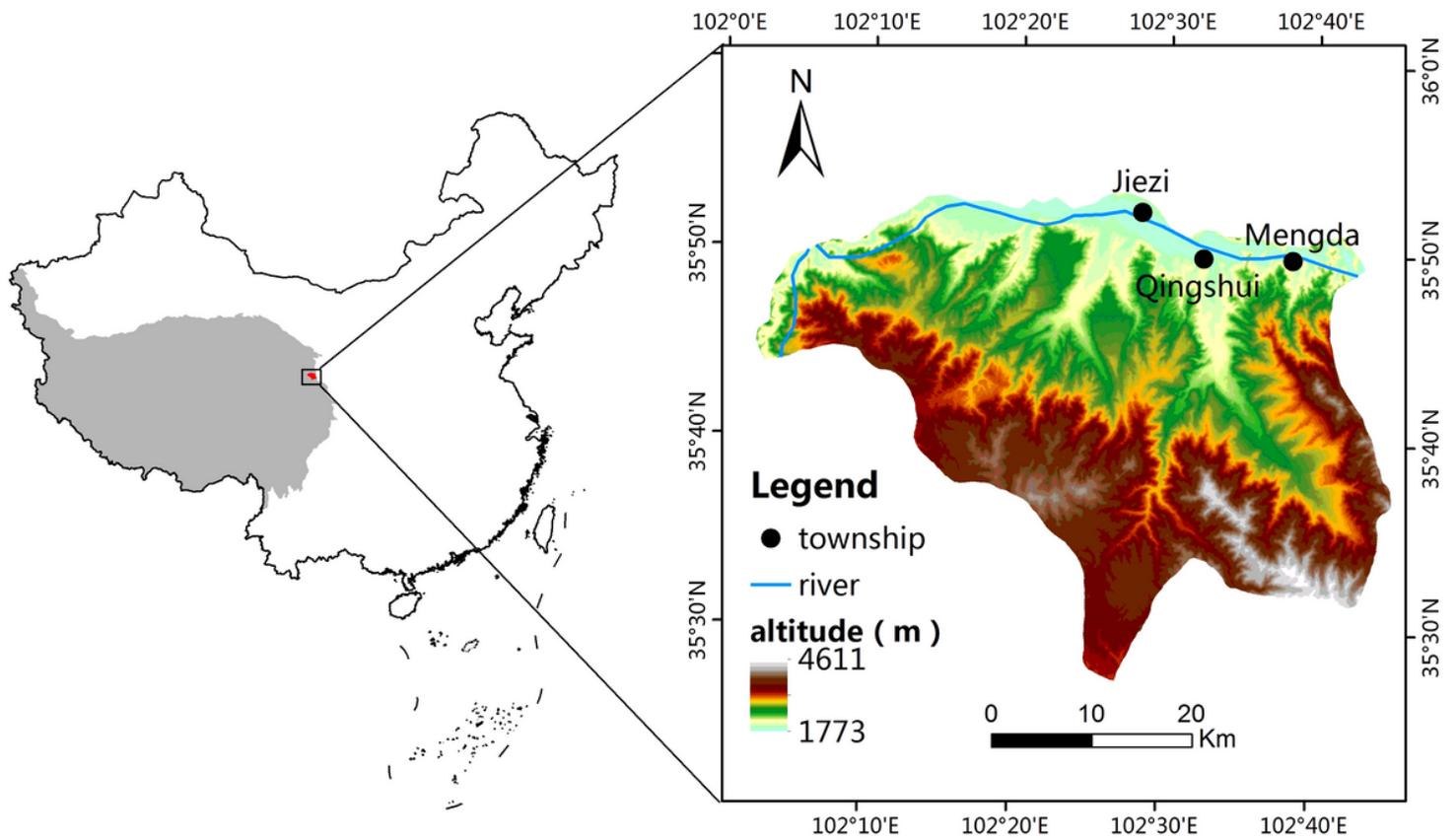
The authors declare that they have no competing interests.

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## Figures



**Figure 1**

These areas are known for its widespread homegarden and rich indigenous knowledge. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.



**Figure 2**

Ornamental focus (A): homegarden with flowers and fruit trees (27%) Produce focus (B): homegarden with vegetables and fruit trees (12%) Dual-purpose (C): homegarden with vegetables and flowers (11%) Multi-purpose (D): compound planting homegarden (51%)