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Diversity of Vegetable Crop in Home Gardens of Sub Himalayan Districts of West Bengal, India

Ranjit Chatterjee*, Partha Choudhuri[2], Riman Saha Chowdhury[3] and Ravi Kiran Thirumdasu[4]

Department of Vegetable and Spice Crops, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar-736165, W.B., INDIA

**Corresponding author: ranchat22@rediffmail.com*

ABSTRACT

Home gardens are the reservoir of diverse multipurpose annual and perennial plant species and act as important in situ conservation sites for agricultural and horticultural biodiversity. Climate of sub Himalayan districts of West Bengal is highly suitable for cultivation of different seasonal and perennial vegetables round the year. The region has the diverse plant species utilized for fresh vegetable and ethno medicinal use. Among individual crop, variability exists in plant morphology, flowering behavior, fruit shape, size, colour and seed characteristics etc. The rich diversity remains unexploited for crop improvement programme. To understand biodiversity pattern of vegetable crops under different home garden system, an exploration was carried out during 2011 and 2012 covering two districts namely Coochbehar and Jalpaiguri. Information was collected through questionnaire survey and field observation of selected households. The detailed investigation into the variability of different vegetable crops has been highlighted. The study revealed that the indigenous knowledge and belief of the farming community encourage growing diverse vegetable crops. But in the present system there is a need of proper documentation of the existing diversity so that it can be utilized for future crop improvement programme as well as for rural subsistence, livelihood security, heath benefits and conservation of biodiversity.

Keywords: Home garden, vegetable crops, biodiversity conservation, rural livelihood

Home gardens are the small scale multi-storied and multi-use production system of diverse plant species composed of fruits, plantation crops, vegetable crops, spices, ornamental and medicinal plants and small livestock within the house compounds for supplementary source of food and income. The home garden caters the need of food, fodder, fuel, fibre, ornamental, and indigenous medicine for common ailments (Das and Das, 2005). Apart from these it also fulfils the social, cultural, ritual and traditional need of the society. The indigenous knowledge and belief of the farming community encourages growing diverse traditional crops, semi domesticated, minor, underutilized species, wild relatives, land races and obsolete cultivars that contributes *in situ* conservation of plant species. The differentiated root structures of diverse plant species utilized the nutrients from various soil levels and both ground and aerial space are efficiently utilized (Eyzaguirre and Linares, 2004).

Vegetable crops are the important component of the home garden. They are the cheaper source of natural protective nutrients like carbohydrates (cassava, sweet potato, potato, colocasia), protein (peas, beans, drum stick, agathi flower, fenugreek leaves), fat (taro leaves, drum stick leaves), minerals (palak, amaranth, fenugreek, coriander), vitamins (carrot, beet, cabbage, tomato, chilli) and dietary fibre (amaranthus, okra, ridge gourd and sponge gourd). Besides they are rich in several nutraceuticals and phytomedicinal compounds (Prem Nath *et al.*, 2008; Rubatzky and Yamaguchi, 1997). Vegetable crops which are mostly short lived produce tonnes of biomass at rapid rate and are highly fittest component for intercropping, mixed cropping or multitier cropping system of home garden.

Sub Himalayan districts of West Bengal is characterized by high annual rainfall (2100-3000 mm), high relative humidity, moderate temperature (max: 24-33^{o}C min: 7-8^{o}C), prolonged winter and high residual soil moisture which favours cultivation of diverse group of vegetable crops round the year. Apart from fulfilling daily kitchen need and nutritional security of the family members,

home garden also engages the household women in the production system and helps to earn additional income through sell of excess output.

The rich diversity of home gardens is still unexploited for crop improvement. These plant genetic resources can be better utilized for food and nutritional security, higher profitability, stability in production and lowering the risk of biotic and abiotic stress. The present study was tried to have an understanding, idea and to find out the treasure of plant species richness and existing pattern of biodiversity in different vegetable crops under different home garden system and their utilization pattern under sub Himalayan tract of West Bengal towards nutritional security and livelihood development.

MATERIALS AND METHODS

To study the existing the pattern of biodiversity in vegetable crops around home gardens of sub Himalayan districts of West Bengal, India sample village level survey was conducted in Cooch Behar (89°23′53″ East longitude and 26°19′86″ North latitude) and Jalpaiguri (88°4' and 89°53' East longitudes and 26°16′ and 27°0' North latitudes) districts during 2011 and 2012. Twenty four number of villages namely Dhalaguri, Haripur, Khagribari, Pundibari, Jatrapur, Raserkuthi, Dhangdhinguri, Konamalli, Satmile, Bararangras, Madhupur, Atialiguri, Kholta, Baneswar, Sakunibala, Okhrabari, Nishiganj, Barbisha, Kunjanagar, Jateshwar, Kamakhyaguri, Bhutnir Ghat, Salbari and Chakuakheti etc were purposively selected considering the intensity of home garden. Fifty home gardeners from different villages were selected randomly. Information was collected through participatory field observation and questionnaire survey.

RESULTS AND DISCUSSION

The traditional farming practices of home garden encourage the introduction and maintenance of underutilized, wild species (Guijt *et al.* 1995), indigenous crops (Juma, 1989) and traditional varieties (Negri, 2003; Negri and Polegri 2009) that enriches the species diversity within the garden. Selection and cultivation of diverse traditional crops, semi domesticated, minor, underutilized species, weedy species, wild relatives, land races and obsolete cultivars offered opportunity to create species diversity (Altieri and Merrick, 1987). Again within crop species, plant types different in morphological and physiological characteristics, adaptability and reactions to diseases and pests are found in the garden (Eyzaguirre and Watson 2001). These gardens are also utilized for testing new crop, variety or edible wild species or domesticated land races before regular cultivation that also add species richness in the garden.

Among the different component of home garden, vegetable crops have maximum demand in the production system as more number of crops can be grown in limited time span and space of home garden. Selection of vegetable crops in home garden depends on the choice and daily need of the family members for food and nutritional security. Small-scale marketing opportunity encourages crop intensification and eagerness for cultivation of diverse crop. In the present work, diversity of different group of annual and perennial vegetable crops are presented in Table 1 and discussed here under.

Solanaceous vegetables

Among solanaceous vegetables Potato, tomato, brinjal and chilli are the major cultivated crops round the year in most of the home gardens. The soil and climatic condition of the region is highly conducive for cultivation of solaneceous vegetables. Potato is most demanding winter season crop of the region. The tubers are the staple food for year round consumption as it supplies good amount of starch with higher calorie value. Mainly round white, long red round type and the pea nut type or *Badam alu* are grown in the home stead areas. Tomato is cultivated during winter months as the ripe fruit is rich in vitamins and antioxidants and largely used for cooking purposes as well as making chutney, homemade sauces, ketch up etc. Round or globular shaped thin skinned types are more demanding compared to thick skinned hybrid varieties. Marble sized deep red cherry tomatoes are also found in some of the garden of this region. Brinjal is cultivated throughout the year as an essential ingredient for daily kitchen. A wide variation is observed among brinjal cultivars grown in home gardens. Purple coloured single and cluster bearing long or round types are largely grown. Medium to bigger size purple or green or purple stripped brinjal are also popular among some gardener. Pencil thick slender purple or green types are mostly grown during rainy season as this type can tolerate the standing water better than others. Chilli is also a major item of daily culinary preparations of sub Himalayan people. Hence a diverse chilli types are available in the home gardens according to taste and preference of the family

members. Medium to large size, pendent, single bearing, moderately pungent annual type *Capsicum annuum* and small size, upright, cluster bearing, highly pungent, perennial type *Capsicum frutescence* are widely grown in the gardens. A typical small round, highly pungent *dole* type *Capsicum chinense* is also popular among the gardens of the *Nepali* community of the foot hills areas.

Cucurbitaceous vegetables

Cucurbits are group of vegetable crops under Cucurbitaceae family. These crops are rich in several minerals, vitamins and dietary fibres and possess nutraceuticals and phytomedicinal properties (Chakravarthy, 1990; Prior and Cao, 2000). The major cucurbits available in the region are cucumber, bottle gourd, pumpkin, ridge gourd, sponge gourd, pointed gourd, spine gourd, ash gourd, bitter gourd, snake gourd, water melon, muskmelon, chow chow, ivy gourd etc. Cucurbits are essential components of diverse daily uses such as delicious curries, salad (cucumber), dessert (watermelon and muskmelon), candy (wax gourd), etc. and dry and matured fruits are used for making of utensils (bottle gourd) and musical instruments (bottle gourd). The crops are having diverse sex form ranging from monoecious, dioecious, hermaphrodite, androecious, gynoecious, gynomonoecious etc. Among individual crop, variability exists in fruit shape, fruit size, fruit colour, fruit length, fruit lustre, stem shape, seed size and seed weight (Chatterjee and Maitra, 2014). Some wild cucurbits like *Citrullus colosynthus, Cucumis hardwickii*, naturally gown around household, are utilized for the treatment of different human ailments. Soups of some of the cucurbits like bottle gourds, chow chow, etc. are also served to the patients suffering from stomach upset or gastrointestinal disorders.

Table 1: Identified diverse vegetable crops in home gardens of Sub Himalayan districts of West Bengal

Vernacular name	Botanical name	Family	Seasonality	Range of diversities	Remarks
Solanaceous vegetables					
Potato	*Solanum tuberosum*	Solanaceae	Winter	Moderate	Staple food
Tomato	*Lycopersicon esculentum*	Solanaceae	Year round	Moderate	Used fresh or cooked, rich in antioxidant
Brinjal	*Solanum melongena*	Solanaceae	Year round	Wide	Cooked vegetable
Chilli	*Capsicum annuum*	Solanaceae	Year round	Moderate	Fresh or powdered, vitamin C rich
Dole chilli	*Capsicum chinense*	Solanaceae	Year round	Limited	Highly pungent, pickle preparation
Cucurbitaceous vegetables					
Cucumber	*Cucumis sativus*	Cucurbitaceae	Year round	Limited	Salad vegetable
Bottle gourd	*Lagenaria siceraria*	Cucurbitaceae	Year round	Moderate	Cooked vegetable
Pumpkin	*Cucurbita moschata*	Cucurbitaceae	Year round	Wide	Cooked vegetable
Ridge gourd	*Luffa acutangula*	Cucurbitaceae	Summer -rainy	Moderate	Cooked vegetable
Sponge gourd	*Luffa cylindrical*	Cucurbitaceae	Year round	Limited	Cooked vegetable
Pointed gourd	*Trichosanthes dioica*	Cucurbitaceae	Summer -rainy	Moderate	Cooked vegetable, anti cancerous
Spine gourd	*Momordica dioica*	Cucurbitaceae	Summer -rainy	Limited	Cooked vegetable
Ash gourd	*Benincasa hispida*	Cucurbitaceae	Summer -rainy	Limited	Cooked vegetable, *Petha* preparation
Bitter gourd	*Momordica charantia*	Cucurbitaceae	Year round	Moderate	Cooked vegetable anti diabetic
Snake gourd	*Trichosanthes anguina*	Cucurbitaceae	Summer -rainy	Limited	Cooked vegetable
Water melon	*Citrullus lanatus*	Cucurbitaceae	Summer	Limited	Used as desert ,cooling effect

Vernacular name	Botanical name	Family	Seasonality	Range of diversities	Remarks
Muskmelon	*Cucumis melo*	Cucurbitaceae	Summer	Limited	Used as desert, cooling effect
Chow chow	*Sechium edule*	Cucurbitaceae	Winter	Limited	Fruit, root and leaves are used, easily digestible
Ivy gourd	*Coccinia indica*	Cucurbitaceae	Year round	Limited	Cooked vegetable
Wild watermelon	*Citrullus colosynthus*	Cucurbitaceae	Summer -rainy	Limited	Ethno medicinal use
Wild cucumber	*Cucumis hardwickii*	Cucurbitaceae	Summer -rainy	Limited	Ethno medicinal use
Legume vegetables					
Garden pea	*Pisum sativum* var. *hortense*	Leguminosae	Winter	Limited	Rich in protein
Field pea	(*Pisum sativum* var. *arvense*)	Leguminosae	Winter	Limited	Rich in protein
French bean	*Phaseolus vulgaris*	Leguminosae	Winter	Limited	Rich in protein
Cow pea	*Vigna anguiculata*	Leguminosae	Summer -rainy	Limited	Rich in protein, green manure crop
Dolichos bean	*Dolichus lablab*	Leguminosae	Summer -rainy	Wide	Rich in protein
Root vegetables					
Radish	*Raphanus sativus*	Cruciferae	Year round	Moderate	Salad and cooked
Carrot	*Daucus carota*	Apiaceae	Winter	Limited	Salad and cooked, rich in beta carotene
Beet	*Beta vulgaris*	Chenopodiaceae	Winter	Limited	Salad and cooked
Turnip	*Brassica compestris* var. *rapa*	Cruciferae	Winter	Limited	Salad, cooked and pickled
Tuber crops					
Sweet potato	*Ipomoea batatas*	Convulvulaceae	Rainy and Winter	Limited	Cooked vegetable
Cassava	*Manihot esculanta*	Euphorbiaceae	Year round	Limited	Cooked vegetable
Colocasia	*Colocasia esculenta*	Araceae	Summer -rainy	Wide	Cooked vegetable, leaves, corms and suckers are used
Elephant foot yam	*Amorphophallus campanulatus*	Araceae	Summer -rainy	Limited	Cooked vegetable
Greater yam	*Dioscorea alata*	Dioscoriaceae	Summer -rainy	Limited	Cooked vegetable
Yam bean	*Pachyrhizus erosus*	Leguminosae	Winter	Limited	Used fresh
Bulb vegetables					
Common onion	*Allium cepa*	Alliaceae	Winter	Limited	Salad and cooked, flower stalks also used
Multiplier onion	*Allium cepa var. aggregatum*	Alliaceae	Winter	Limited	Immature bulb and leaves are used
Garlic	*Allium sativum*	Alliaceae	Winter	Moderate	Used in curries, anti rheumatic and insect repellant
Leafy vegetables					
Amaranthus	*Amaranthus tricolor*	Amaranthaceae	Summer -rainy	Wide	Leafy vegetable, rich in minerals

(Contd...)

Vernacular name	Botanical name	Family	Seasonality	Range of diversities	Remarks
Basella	*Basella alba*	Basellaceae	Summer -rainy	Limited	Leafy vegetable, rich in minerals
Bathua	*Chenopodium album*	Chenopodiaceae	Winter	Limited	Grown wild, used as leafy vegetable
Spinach beet	*Beta vulgaris var. bengalensis*	Chenopodiaceae	Winter	Limited	Leafy vegetable, rich in minerals
water spinach	*Ipomea spp.*	Convulvulaceae	Rainy	Limited	Leafy vegetable, rich in minerals
Rai sak	*Brassica sp*	Brassicaceae	Winter	Limited	Leafy vegetable, rich in minerals
Jute leaves	*Corchorus spp.*	Tiliaceae	Summer -rainy	Limited	Yong leaves as potherb
Perennial and Under exploited vegetables					
Gima-sak	*Glinus oppositifolius*	Molluginaceae.	Spring, Summer, Rainy	Limited	Leafy vegetable and ethno medicinal use
Helencha-sak	*Enhydra fluctuans*	Asteraceae	Winter, Spring	Limited	Leafy vegetable and ethno medicinal use
Brahmi-sak	*Bacopa monnieri*	Scrophulariaceae	Throughout the year	Limited	Leafy vegetable and ethno medicinal use
Gandal-pata	*Paederia foetida*	Rubiaceae	Spring, Summer, Rainy	Limited	Leafy vegetable and ethno medicinal use
Kanta-nate	*Amaranthus spinosus*	Amaranthaceae	Spring, Summer, Rainy	Limited	Leafy vegetable and ethno medicinal use
Kharkol	*Typhonium trilobatum*	Araceae	Spring, Summer, Rainy	Limited	Leafy vegetable and ethno medicinal use
Kulekhara	*Asteracantha longifolia*	Acanthaceae	Throughout the year	Limited	Leafy vegetable and ethno medicinal use
Drum stick	*Moringa oleifera*	Moriangaceae	Spring, Summer, Rainy	Limited	Leafy vegetable and ethno medicinal use
Agathi	*Sesbania grandiflora*	Leguminosae	Year round	Limited	Leafy vegetable and ethno medicinal use
Curry leaf	*Murraya koenigi*	Rutaceae	Year round	Limited	Leafy vegetable and ethno medicinal use
Green plantain	*Musa Spp.*	Musaceae	Year round	Moderate	Leafy vegetable and ethno medicinal use
Papaya	*Carica papaya*	Caricaceae	Year round	Limited	Leafy vegetable and ethno medicinal use
Jackfruit	*Artocarpus hetero-phyllus*	Moraceae	Year round	Moderate	Leafy vegetable and ethno medicinal use
Vegetable fig	*Ficus spp.*	Moraceae	Year round	Limited	Leafy vegetable and ethno medicinal use
Hog plum	*Spondius spp*	Anacardiaceae	Perennial	Limited	Leafy vegetable and ethno medicinal use
Elephant apple(*Chalta)*	*Dillenia indica*	Dilleniaceae	Perennial	Limited	Leafy vegetable and ethno medicinal use
Buck wheat/Dhemchi	*Fagopyrum esculentum*	Polygonaceae	Winter and Spring	Limited	Leafy vegetable and ethno medicinal use

(Contd...)

Vernacular name	Botanical name	Family	Seasonality	Range of diversities	Remarks
Laffa	*Malva verticillata*	Malvaceae	Winter	Limited	Leafy vegetable and ethno medicinal use
Dheki-sak	*Diplazium esculentum*	Athyriaceae	Year round	Limited	Leafy vegetable and ethno medicinal use
Kulekhara	*Asteracantha longifolia*	Acanthaceae	Year round	Limited	Leafy vegetable and ethno medicinal use

Legume vegetables

Legume vegetables are very rich in digestible protein and find an integral part in the home garden. They also ameliorate the soil by biological nitrogen fixation. Among the pea type, both wrinkle and smooth seeded varieties of garden pea (*Pisum sativum* var. *hortense*) and field pea (*Pisum sativum* var. *arvense*) are grown as fresh vegetables during winter months. Tender green leaves of peas are used as leafy vegetable. Cow pea is popular as summer and rainy season crop when high price and market scarcity reduce the regular supply of other vegetables in the market. Long vine-pole types are more popular as fence crop compared to upright bushy type. Diverse pod colours like red, dark green, light green, intermediate and creamy white are available in the home garden. The green biomass after harvest of pods is also used as fodder and green manure. Dolichos bean is the next important legume vegetable crop grown in winter season mainly in trellis or over the boundary walls of the household. It has wide range of diversity in terms of flower colour (white, purple and intermediate), pod colour (green, red, creamy white, green purple, etc.) and pod shape (oblong, flat, etc.). Long vine pole type french bean are very popular in home garden. Wide variation in seed coat colour (white, creamy white, brown, light brown. spotted brown etc) have been noticed in the garden.

Root vegetables

Sub Himalayan people of West Bengal grow different types of root vegetables for salad and vegetable purpose. Among the root vegetables, radish is very popular and grown almost round the year in the home garden. Highly pungent small rooted, mildly pungent big rooted and round/globe shaped sweet types are grown in the garden. Colour of pericarp varies from white, pale white, scarlet, pink etc. Radish leaves are integral part of kitchen as leafy vegetable which contains higher amount of minerals and vitamins. Carrot is a popular winter season root vegetable rich in vitamin A and good remedy for the asthmatic or respiratory troubles among children and old age people during winter months. Red, orange or light orange coloured roots are found in the garden. Beet and turnip are grown in small scale for fresh vegetables or home scale pickle preparation.

Tuber crops

Tuber crops are important components of home garden of the region as they fulfil the daily calorie need of the family members. Sweet potato, cassava, *Colocasia*, elephant foot yam, *Dioscoria*, yam bean etc. are the popular tubers crop of home garden. Sweet potato tubers are good source of starch and rich in vitamin A. Apart from root sweet potato leaves are taken as leafy vegetables. Variation found in tuber colour (white, red) and flesh colour (white, orange, creamy yellow etc.). *Colocasia* or taro is a starch rich crop and popular in marginal land of the home garden. Considerable amount of diversity is found among taro and yams group of vegetables. Single or multiple budded taro are commonly found in the area. Some large size perennial tubers (giant taro) are also grown in the backyard where leaves and tubers are utilized as food. A waterlogged taro, commonly found in the low lying areas known as swamp taro, has diversified use in kitchen. Leaf shape, colour as well as tuber colour and size vary among the plants. Big sized non acrid types or small cormed acrid type elephant foot yam is also raised in upland areas of home garden as fresh vegetable. *Dioscoria,* a perennial vine plant is found in the tall standard or fruit trees. The underground root tubers are used as vegetables. The leaf size, shape, colour as well as tuber size differ from plants to plant. A leguminous tuber crop yam bean (*Pachyrhizus erosus*) is grown in small scale during winter months for fresh consumption. The people of this one also offer the tubers to holy God during festivals or rituals. The tuberous roots are edible as the pods are harmful for human consumption. Roots vary in shape, size and colour.

Bulb vegetables

Low temperature during early vegetative growth and commencement of early monsoon restrict the onion cultivation in home gardens of sub Himalayan region. However growers of this region raise onion in small scale for vegetable or salad purpose. Among different groups common onion or multiplier onion are mostly grown in the home garden during winter months. Leaves and immature bulbs are consumed for multiple bulb onion. For common onion apart from bulb the flower stalks are also used as leafy vegetables. After fulfilling the household demand these flower stalks are sold in the market at higher rate. Garlic is popular winter season bulbous vegetable which is mainly used in different non vegetarian food items or used as home remedies of several ailments like gout, microbial infections or as mosquito repellent. Diversity exists in bulb colour, size, clove number maturity time and storage life. In the hilly areas of Darjeeling district cultivate the unique single cloved garlic which according to their belief has more medicinal value than the multiple cloved big size bulb.

Leafy vegetables

Foot hills and hilly tracts of sub Himalyan region of West Bengal is a reservoir of number of indigenous and exotic leafy vegetables. Leafy vegetables are rich in several minerals, vitamins, crude fibre, antioxidants and used as low cost protective food of human beings.The preferential use of herbal leafy species in remedial preparations may be due to their easy availability, inherent practice and fast relief (High and Shackleton, 2000). Use of *Amaranthus*, *Basella, Chenopodium,* spinach beet, water spinach, rai sak (*Brassica sp*), jute leaves are the common among the gardeners. Leaves of pumpkin, bottle gourd, chow chow, *Colocasia*, pea, cowpea, potato, onion, mustard, drum stick are indispensible item of daily kitchen. Some non traditional leafy plants like Gima-sak (*Glinus oppositifolius*), Helencha-sak (*Enhydra fluctuans*), Brahmi-sak (*Bacopa monnieri*), Gandal-pata (*Paederia foetida)*, Kanta-nate (*Amaranthus spinosus*), Kharkol (*Typhonium trilobatum*), Kulekhara (*Asteracantha longifolia*) are regularly grown in the home garden as vegetables as well as herbal remedy of ailments (Maitra and Chatterjee, 2014).

Perennial vegetables

Among the perennial vegetables drum stick, *agathi*, curry leaf, green plantain, papaya, jackfruit, vegetable fig, hog palm and elephant apple (c*halta)* are found in the boundaries of different home garden. Drum stick is a nutritious vegetable where every plant part like tender leaves, flower and pods are taken as vegetables. Variation exists in plant size, leaf colour and shape and pod characters. Green plantains are grown as multipurpose household purposes. Apart from green banana the leaves, stem and male flowers are also used as vegetables. Variation found in plant height, leaf size and fruit characters. Hog palm and elephant apple (*chalta)* are mostly used of chutney and pickle preparation.

Under exploited vegetables

A large number of underutilized or lesser known vegetables are available in the home gardens those are used in restricted household. Most of these vegetables contain multiple phytochemicals and exhibit antioxidant activities. Several leafy vegetable namely buck wheat/ dhemchi (*Fagopyrum esculentum*), laffa (*Malva verticillata*), dheki-sak (*Diplazium esculentum*), kulekhara (*Asteracantha longifolia*), lunia (*Portulaca oleracea*), punarnaba (*Boerhaavia diffusa*), salinche (*Alternanthera sessilis*) are popular among the home gardeners. Aquatic plants namely water lily and lotus have diversified use in daily life. A large variation is observed in water lily for petal colour, stalk length, flower size and time of availability. The flower stalk and petals of water lily are used as delicious vegetables. Lotus thalamus and roots are also popular dish in rural areas.

CONCLUSION

Home garden are the reservoir of crop biodiversity and the favourable climatic condition of sub Himalayan districts of West Bengal encourages cultivation diverse vegetables crops throughout the year. Individual family food preference, belief, tradition, culture and economic situation determine the crop diversity in home garden. Regular experimentation in the form of introduction of new crops, new varieties, underutilized crops and wild plants enriched the crop diversity in the garden. Diverse ethno medicinal use of the indigenous vegetables, wild and weedy crops also promoted the species diversity of the garden. Above all free gene flow among the cultivated, wild, weedy species and natural crossing between domesticated form and wild weedy relatives creates variation and develops new plant types. Gardner personal affection and commitment is the key for maintenance and enrichment of the existing crop

diversity. The variability exists within the crop species need to be documented properly so that it can be utilized for future crop improvement programme to alleviate the rural poverty and enhancing the livelihood support.

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CONFLICT OF INTERESTS

The authors declare that they have no competing interests for the work.

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