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GREEN HOT SPOT : EASTERN UTTAR PRADESH — A CORE SITE FOR INTENSIVE VEGETABLE CULTIVATION AND PRODUCTION

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With ever-increasing population pressure and fast depletion of natural resources in many areas especially where traditional crops are being replaced by HYVs, it has become extremely important to diversify the present day agriculture in order to meet various human needs. Some important vegetables are fully acclimatized and dominated in a particular area where its maximum production potential (fresh marketable fruit yield and vegetable seed production) is expressed and commercial intensive sustainable vegetable cultivation is becoming common among growers. The 'Green Hot Spot' areas are specific pockets for specific crop with intensive cultivation and high harvest potential. Specific local landraces must be conserved in that area. An application of appropriate approaches (inputs like seed, fertilizers, plant protection measures, infrastructure and market network) in core site of vegetable can increase production of vegetables to a large extent which can meet the domestic need and cater the export as well.

Key words : Vegetables, Eastern U.P., green hot spot, agri-diversity, wild relatives, selection

India with a wide variety of climate and soil provides ample scope for growing a wide range of vegetable crops. However, the major emphasis after independence has been for attaining self sufficiency in cereals to provide national food security. Now the time has come to give special attention towards nutritional security by assigning specific emphasis on vegetable crops. Vegetables are important in human diet as the sources of vitamins, proteins, minerals, carbohydrates and crude fibers. It also enhances natural resistance system in our body. The vegetable crops play a very vital role in increasing the income, providing employment opportunities, uplifting the small and marginal farmers providing balanced diet, value added products and valuable foreign exchange.

India stands second in vegetable production after China. As per FAO Year book (1992), India produces 59 million tonnes of vegetable including melons. The corresponding figures for China and world are 56 and 120 million tones respectively. Considering the population of India as 100 crores, per capita availability of vegetables comes to 180 g/day against a minimum of about 300 g recommended by the dieticians. According to Eighth plan Working group report for Horticulture and Plantation crops, vegetable will have to be grown in 8.0 million hectares producing 120.0 million tonnes with productivity level of 15 tonnes/ha. However, vegetables are grown in hardly 2 per cent of total area of the country which is very low seeing the national need.

Period	Area (million ha)	Production (million tonnes)	Productivity (t/ha)
1987-88	4.0	45.0	10.00
Short term (1990-95)	6.0	75.0	12.50
Long term (2000 AD)	8.0	120.0	15.00

Source : Eighth Plan Working Group Report for Horticulture & Plantation Crops, Govt. of India

Uttar Pradesh is the leading state in terms of vegetable growing area (including potato and onion). The common vegetables crops grown in U.P. included tomato, brinjal, chillies, peas, beans, okra, cabbage, cauliflower, pumpkin, bottle gourd, bitter gourd cucumber, muskmelon, water melon, palak, fenugreek, carrot, radish, pointed gourd, cowpeas, *Luffa*, *Coccinia*, onion, garlic etc.

Table 1. Extensive vegetable growing states of India

Vegetables	States
Tomato	Uttar Pradesh, Maharashtra, Karnataka, A.P. and Bihar
Brinjal	Uttar Pradesh, Rajasthan, A.P., Maharashtra, Karnataka, Tamil Nadu and Bihar
Chillies	Andhra Pradesh, Maharashtra, M.P., Rajasthan, U.P. and Bihar
Onions	Maharashtra, Gujarat, Orissa, Uttar Pradesh
Peas & Beans	U.P., Haryana, Punjab, M.P., Bihar and Rajasthan
Okra	Haryana, Punjab, Uttar Pradesh, Maharashtra and Andhra Pradesh
Cabbage & Cauliflower	Uttar Pradesh, Haryana, Punjab, M.P., Maharashtra and Gujarat
Palak & Methi	Eastern India, Tamil Nadu and Northern India
Pointed gourd	Bihar, West Bengal, Uttar Pradesh, Orissa, Madhya Pradesh
Other Cucurbits	Uttar Pradesh, M.P., Bihar, Rajasthan, Punjab, Haryana, A.P., Karnataka, Tamil Nadu

Specific vegetables like-onion, tomato, brinjal chillies, peas and beans, okra, cabbage and cauliflower, palak and methi, pointed gourd and other cucurbits are being grown extensively in following states (Table 1). Area and production of some important vegetables are given in Table 2.

Table 2. Area and production of some vegetables in India

Vegetable	Area (000 ha)		Production (000 mt.)	
	1990	1991	1990	1991
Tomato	290	3000	3000	3100
Onion	320	326	3150	3400
Cabbage	93	94	556	563
Cauliflower	95	92	700	680
Garden Pea	97	97	264	265
Green Bean	22	23	48	48

Source : FAO Production Year Book (1990-91)

During acclimatization of several vegetable crops and their varieties, farmers applied selection pressure voluntarily to market preference. Such type of pressure indicates highly specialized adaptation, resulting in a narrow genetic base that lead to an evolutionary blind alley and thereby to ultimate extinction (Swaminathan, 1978). The 'Green Hot Spot' is probably a new term coined with a core sites (specific pockets) of intensive sustainable cultivation of green vegetables where per unit area production and productivity is very high. Vegetable crops expressed their maximum production potential in these core sites due to genotype x environment (g x e) interaction in positive direction. Crops perform well due to conducive climate, soil fertility, availability of quality water, rational application of inputs, plant protection measures and better management. In these specific pockets (areas), farmers have increased the yield many fold by use of high yielding varieties/hybrids/own selection and adoption of standard scientific agro-technique/ practices. There had been no linkage between vegetable seed production areas and commercial

vegetable production pockets. In some pockets, ability to produce seed indigenously has played an important role in the adoption of different kinds of vegetable crops and their several high yielding open pollinated varieties/hybrids/own selected materials (Seshadri, 1990). An attempt has been made here to assess the core vegetable production site (Green Hot Spot) and degree of adoption in some vegetable crops of the surveyed area, so that in future vegetable breeders and growers can have better idea of the genetic variability and impact of diversification which will greatly influence the improvement programme.

A survey of intensive vegetable cultivation was accomplished in the 16 district i.e., Varanasi, Mirzapur, Allahabad, Kausambi, Pratapgarh, Sultanpur, Faizabad, Ambedkar Nagar, Basti, Sant Kabir Nagar, Gorakhpur, Deoria, Mau, Jaunpur, Ghazipur and Ballia in Eastern Uttar Pradesh. Surveyed area has varied agro-ecological condition and have predominantly vegetarian population, which have high dependence on vegetable as a food source. The highly diverse ecology in the region from submountain to riverine (river bed and *diara* land cultivation) expressed much variation in vegetable diversity. As a consequence, wild relative of vegetable crops, have also an impressive array of diversity e.g., in *Cucumis* sp., *Cucurbita* sp., *Momordica dioica, Solanum melongena, Lycopersicon* sp., *Vicia* sp., *Lablab* sp. etc. In the above districts, important vegetable mandies (market) were also surveyed besides field visit of core sites. In addition, several District Horticulture Officer (DHOs), District Agriculture Officer (DAOs), Block Development Officer (BDOs), Non-Govt. Organization (NGOs) and Chief Training Officer (CTOs) etc. were also interviewed in most of the district (Table 3).

Production potential of different vegetable crops in core sires, reason of adoption, basic constraints to growers, infrastructure availability and vegetable marketing network etc. were thoroughly discussed.

Table 3. List of University/Institution/KVKs surveyed

University	N.D. Univ. of Agric. & Tech., Kumarganj, Faizabad
Institute	Institute of Agricultural Sciences, B.H.U., Varanasi; Allahabad Agricultural Institute, Naini, Allahabad; Indian Institute of Vegetable Research, Varanasi
Krishi Vigyan Kendra	Basti, Pulkuwa, Ballia and Varanasi

1. Soil : In core cultivation of vegetables (Green Hot Spot), soil and its management play a vital role for improvement of crops. For intensive cultivation of vegetable; farmers create micro-climate by providing mulches, using FYM and compost, summer ploughing for destroying soil born pathogen, heavy bunding of field for conservation of moisture etc. With all these factors, farmers harvest bumper yield of vegetables. The riverine or river bed cultivation is highly successful due to heavy deposition of fine and well rotten rich organic matter, highly nutritions during flood. In rainy season, water flows from forest area towards river and carry a lot of composed organic matter. During flood, it spreads over the soil and provide nourishment to the grown vegetables after flood. It is highly suitable for sustainable vegetable production. The soil texture in surveyed districts pertains to sandy, sandy loam, loam, clay, clay loam (plains) and sands, and sand mixed with soil in riverine area.

2. Vegetable genetic diversity : The sub mountane parts of Mirzapur has typical farming system (or sub system) comprising forest cover, crop land, livestock and kitchen garden of four components with organic linkages among them. No input from outside the system is required. For the intensive cultivation of vegetables, growers

have adopted advanced technology along with their own technique (Indigenous technology) viz., trailing of vegetable crops (specially cucurbitaceous vegetables), heavy earthing and mounting of soil in brinjal, chillies and tomato for profuse branching and bearing; 2-4 plant per hill for accommodating more plant and avoiding gap filling; angular support of 'sarpat or kans' for pole type of cowpea; ridge bed cultivation of okra, river bed cultivation of muskmelon and watermelon. Mixed cropping, multi level or three dimensional cropping of vegetable in these area (core sites) are common. In Varanasi, Allahabad and Pratapgarh, close cultivation of betel + kundru (*Coccinea* sp), betel + pointed gourd, guar + bajra and maize + spongegourd is being done in a scientific manner to utilize both vertical and horizontal space.

The cultivated vegetable in eastern Uttar Pradesh (Table 3) included tomato (*Lycopersicon esculentum* Mitt.), brinjal (*Solanum melongena*), chillies and capsicum (*Capsicum annum*), bhindi, okra (*Abelmoschus esculentum* L.), peas (*Pisum sativum var. arvense*), radish (*Raphanus sativus* L.), cabbage (*Brassica oleracea var. capitata*), cauliflower (*Brassica oleracea var. botrytis*), potato (*Solanum tuberosum* L.), beet root (*Beta vulgaris* L.), onion (*Allium cepa*), garlic (*Allium sativum*), ghuia (*Colocasia antiquorum* Schoff.), elephant foot yam (*Amorphophallus campanulatus* Blume), bottle

Table 3. Specific local landraces and improved varieties/hybrid popular among growers in in Eastern Uttar Pradesh

Vegetables	Specific local land races/ strain	Improved varieties/ hybrids
Tomato	Kajla, Lal sew, Deshi small	Punjab Chhuhara, Pusa Rubi, Sel- 7
Brinjal	Gola, Shyhai Lawa, Neelam, Barsati Tohafa, Ramnagarawa	Pusa Purple Long, Pusa Purple Round, Pusa Purple Cluster, Kranti
Chillies	Desi Lambi, Sathi Mirch	Pusa Jwala, Pusa Sadabahar
Cauliflower	Kunwari, Sawan-Bhado, Agahani, Maghi, Moti and Jawahar	Snowball, Pusa Parijat and Pusa Katki
Cabbage	Badi-Patharia, Mohani, Majhali	Pride of India, Pusa Mukta, Express
Okra	Panchh Dhari, Barsatia, Jethia	Parbhani Kranti, Makhmali, Arka Anamika
Radish	Jaunpuri Newar, Desi Safed, Barsati Mooli	Japanese White Long
Turnip	Safed Deo, Sosani	White Vienna
Carrot	Desi Gajar	Pusa Keshar
Lobia	Kala Jhabara, Gaj Lambi, Deshi Latar	Arka Garima, Rituraj
Peas	Kurse sweet, Desi Chhoti	Arkel, Azad Pea-1&2
Muskmelon	Naspati, Sangam, Retahawa	Hara Madhu, Pusa Madhuras
Watermelon	Tar Tarbooj, Daria Tarbooj, Sudhasai	Sugar Baby, Arka Manik
Cucumber	Dewras, Rasroop, Deshi Chhota	Poinsette, Green Long
Longmelon	Lucknow Lata, Lucknow special, Jaunpuri Long, Lambodari	—
Bottle gourd	Khet Ki Sundari, Barsatia, Chhapparala, Garmi Ka Gola	Pusa Summer prolific Long, Pusa Naveen
Bitter gourd	Harit Mani, Khet Ka Raja, Barsati Karisma, Barsati lamba Hara	Pusa Do Mausami
Sponge gourd	Hari Lambi, Desi Chhoti	Pusa Chikani
Ridge gourd	Tori Lambi, Arin Shili, Padmini	Pusa Nasdar
Pumpkin	Kamraj, Bhadai, Kaddu Desi Chhota	Nil
Spinach	Banarasi, Hari Patti	Palak All Green
Amarnath	Chhoti and Badi Chaulai, Lal Sag	Nil

Table 4. Some core sites (Green Hot Spot) of Vegetable production in Eastern Uttar Pradesh Districts

Name of District	Vegetable crops in order of importance	Green Hot Spot/Core Sites (areas)
Varanasi	Tomato, chillies, Brinjal, okra, cowpea, cauliflower, peas	Jakhini, Shahanshah pur, Gangapur, Govindpur, Karsara, Bhaupur, Gajapur Darekhu, Harsos, Banpurwa, Sattanpur
	Specific : Brinjal and tomato	Ganeshpur, Koali, Narottampur, Surasi Tandia
	Tomato	Kallipur, Mirza Murad, Arazi Line
	Chillies	Bhaupur, Lohata, Mishirpur
	Okra	Mandaw, Rudauli, Parampur
	Pointed gourd	Bishinpur, Mishirpur, Lohata
	Cowpea, muskmelon & watermelon	Muda Deo, Banpurawa
Mirzapur	Chillies, Tomato, brinjal, Sweet potato, watermelon muskmelon, ash gourd, bottle and bitter gourd	Adalpura, Maghraha, Mendia, Khaira, Jamua, Narayanpur, Aahi, Bidapur, Kachhawa, Jamuni, Bijruka
	Specific : Chillies, muskmelon and watermelon	Adalpura, Maghraha, Mendia, Baraini, Entire area of riverbed side from Rudauli to Baraini ghat
Gyanpur	Brinjal, chillies, watermelon, muskmelon, bittergourd, bottlegourd, cauliflower : **Specific** : Muskmelon, watermelon, chillies, bottlegourd	Saidabad, Gopiganj, Gyanpur, Aurai, Suriawan, Durgaganj and Bhadohi, Lakshmanpatti, Deonathpur
Allahabad	Brinjal, tomato, chillies, pumpkin, bottle gourd, cauliflower	Hakim patti, Morhum, Gathraj, Semari Ka Purwa, Parkhipur, Baharia Sarai Saudabad, Dusauti Phulpur, Malak Harhar
	Specific : Chillies, Tomato, musk melon & watermelon	30.0 Km. long riverbed from Naini to Mirzapur, Parsani, Patti, Sodaw, Mau-auila, Chandpur, Rudrapur, Ganga Ishpar, Baleri, Manauri
Pratapgarh	*Coccinia*, bottle gourd, chillies, tomato, elephant yam, pumpkin	Mallahaka, Chandapur, Semari Ka Purawa, Allapuri
	Specific : Bottle gourd	Rasulabad, Ghasipur, Ghanshyampur, Kuikal, Digha, Megari, Senendra
Sant Kabir Nagar	*Coccinia*, bitter gourd, onion, brinjal, cauliflower, pumpkin, watermelon, *Colocasia*	Sewara, Maghahar, Rasulpur
	Specific : *Coccinia*, onion	Nagar-Basti, Khalilabad, Garsauli, Chanu Hari, Banjaria, Harahiya, Chiraipur, Keshavpur
Basti	Sponge gourd, okra, bottle gourd, bitter gourd, brinjal, onion, *Coccinia*, pointed gourd, *Colocasia*	Keshav Pur,Sande Kalan Garhawa,Banjaria Garsauli
	Specific : Pointed gourd, *Coccinia*, elephant yam	Raghupur, Shelpur, Budanpur, Shekhpura, Jalalpur, Ranipur, Baidyapura, Jairampur, Sham Shuddinpur, Mirmahuwa, Ghandupur
Ambedkar Nagar	Pointed gourd, cauliflower, tomato, brinjal, okra, bottle gourd, palak	Chauri- chaura, Sripati, Phutahawa - Innar, Shatrughanpur, Bharatpur, Jai-purawa, Laxanmanpur

Gorakh-pur	Sponge gourd, ridge gourd, cauliflower, cabbage, bottle gourd, *colocassia*, chillies, pointed gourd, tomato, elephant yam	Chauri-chaura, Sripati, Phutahawa - Innar, Shatrughanpur
	Specific : Sponge/ridge gourd	
Ballia	Pointed gourd, tomato, chillies, brinjal, radish, bitter gourd, *Coccinia*, *Colocassia*, pumpkin	Janari, Ghorahara, Pandeypur, Nagawa, Suhaw, Narahi, Sahatawar, Jeerapur, Gopalpur, Sidhagarh, Sarai bharati, vayasi majhauwa
	Specific : Pointed gourd	Janari, Sidha garh, Pandeypur, Karnai
Mau	Pointed gourd, muskmelon, cowpea, brinjal, pumpkin, bottle gourd, bitter gourd, chillies, *Colocasia*, okra, peas	Mohamadpur, Alipur, Ratanpura, Khalishpur, Vamani Kol, Kopa Ganj, Falida, Ammila
	Specific : Pointed gourd, cowpea, muskmelon	Khalishpur, Vamani Kol, Alinagar, Pandeypur, Ratanpura Kopaganj
Sultan pur	Pointed gourd, tomato, chillies, okra, brinjal, elephant yam, cowpea, radish, palak, onion, garlic	Navaka Pura, Shahroj, Moradabad, Labari, Annaw, Tiwari pur, Kanaila, Koaridiha
	Specific : Pointed gourd	Navakapura, Shahroj, Moradabad
Faizabad	Cauliflower, bottle gourd, chillies, brinjal, onion, tomato, bitter gourd, palak, pointed gourd	Nanu Ka Pura, Aharauli, Mithegaon, Baragadhahi, Borun, Katipura, Dalpautpur, Pandeypur
	Specific : Bitter gourd, bottle gourd, pointed gourd, cucumber, cauliflower, (Seed Production)	
Ghazipur	Tomato, pointed gourd, cucumber, okra, chillies (stuff and hot), bottle gourd, cauliflower, pumpkin	Tajpur, Magha, Jamania, Saidpur, Rampur-Majha, Rewatipur, Karimuddinpur, Roza, Pimpar, Jamama riverbed, Gahamar, Tajpur, Janghipur
	Specific : Pointed gourd, pumpkin, chillies	
Jaunpur	Radish, long melon, tomato, chillies, brinjal, cowpea, pointed gourd, palak, onion, garlic, bottle gourd, pumpkin, *Colocasia*	Rampur, Jalalpur, Zafarabad, Kadaila, Ramaipur
	Specific : Radish, cowpea, pointed gourd	Rampur, Zafarabad, Jalalpur, Pradhanpur, Hauz, Tiwari Ka Pura, Kadaila

gourd (*Lagenaria siceraria* Standl Moll), bitter gourd (*Momordica charantia* L.), cucumber (*Cucumis sativus* L.), snake cucumber tatkakri (*Cucumis sativus* var. *utilissimus*), sponge gourd (*Luffa aegyptiaca* Mill.), ridge gourd (*Luffa acutangula* Roxb), parwal, pointed gourd (*Trichosanthes dioica* Roxb.), snakegourd (*Trichosanthes anguina* L.), kundru or kundri (*Coccinia cordifolia*), pumpkin (*cucurbita moschata*) turnip (*Brassica rapa* L.) etc.

Few wild relatives of vegetables are also consumed as cooked which included snapmelon (*Cucumis mebs* var. *momordica*), kachari or pehanta (*Cucumis callosus*), drumstick (*Moringa* sp.), faba bean (*Vicia faba* L.), chaulai (*Amaranthes* sp.), and kulfa (*Portulaca oleracea* L.). Some core sites for vegetable production in Eastern Uttar Pradesh are depicted in Table 4.

Depletion of vegetable germplasm in the areas e.g., long radish (**Jaunpuri Mooli**), stuffed type chillies (**Bharuwa Mirch**), suhwal lal chillies (long and bright red colour), local tomato varieties

having high ascorbic acid, **panchdhari bhindi** (5-ridged okra), **Ramnagarawa baigan** (very big green brinjal), very long and soft cowpea-**kala jhabra** (40-50 cm.), a primitive landrace of muskmelon (**Naspati**) having high T.S.S. and drought resistance attributes, **safedwa parwar** (light green, less seeded, and soft pointed gourd), **tari tarbooj** (very big water melon with high T.S.S.) etc.

Potential Green Spot for vegetable growing

Eastern Uttar Pradesh has potential niche for vegetable growing e g., bitter gourd and bottle gourd in Faizabad; radish, cauliflower and spinach (palak) in Jaunpur; pointed gourd vine in **diara** of Ghazipur and Ballia etc. These vegetables are being grown due to number of known and unknown factors but river bed (**kachhar**) areas in each districts are the established green hot spot for several vegetables specially cucurbits. The riverine zones of Ganga, Gomti, Sai, Rapti and Yamuna which flow through Ballia, Ghazipur, Varanasi, Mirzapur, Gyanpur, Allahabad and Jaunpur districts have a very large track of watermelon, muskmelon, pointed gourd, sponge and ridge gourd cultivation. Similarly Ghaghra river belt in Faizabad, Azamgarh; the Rapti **diara** in Gorakhpur and Deoria and 'Gomti' river in Jaunpur district had similar potential. Besides river beds, some local landraces are prevalent in upland areas of this zone. All these landraces are disappearing due to spread of high yielding varieties/hybrids which need specific hunt immediately.

Local landraces/strain are more prevalent among the vegetable growers in these core sites due to local acceptance/preferences, less prone to disease or insect pest, better adaptability and easy availability of seeds etc. Besides, recently released varieties and hybrids had showed very good genotype × environment (G × E) interaction, leading to high production in the area (Table 3). The major constraints in adopting newly developed varieties and hybrids are non-availability of quality seed, high cost etc. The production can be doubled i.e. 66 to 130 million tonnes if improved varieties and hybrids, established local varieties suitable production technologies and plant protection measures are made available in these identified core sites (Table 4). Riverine beds may be exploited for intensive cultivation of muskmelon, watermelon, pointed gourd, bitter gourd, bottle gourd, long melon etc.

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