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Review Article

An overview of the unexplored underutilized fruit crops of Assam, India

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Abstract
Assam is the largest state of North-East India. This state is considered as one of the most extravagant biodiversity hotspots of the world because of its different geography, atmosphere and agro-environmental conditions. Various plant species that incorporate natural products have their starting point in this locale. A considerable number of these are yet to be developed in wild or semi-wild states. Regardless of the huge hereditary decent variety of these natural products, just a couple have been grown as business crops for their monetary, social and strict significance. Some of the explored fruit crops of Assam that have many potentials of being used not only in culinary purpose but also in much Ayurvedic medicine which is still underutilized Some of the underutilized fruit (UUF) crops of Assam are Kordoi/Carambola (*Averrhoa Carambola*), Leteku/Burmese grape (*Baccurea sapida*), Amra/Hog plum (*Spondius mangifera*), Jalphai/Olive (*Olea europaea*), Bael/Stone apple (*Aegle marmelos*), Imli/Tamarind (*Tamarindus indica*), Jamun/Wild Jamun (*Sygium cuminii*), Thekera/Garcinia *spp*., Poniol/Govorners plum (*Falcourita jangomas*), Outenga/Elephant fruit (*Delinia indica*) and Amlokhi/ Indian Goose berry (*Phyllanthus emblica*) etc. Fruits have multipurpose utilisations and consequently assume critical job, particularly, for the prosperity of country individuals by giving sustenance, family pay and business. Huge numbers of these natural fruits have been utilised as customary restorative plants and some have discovered a significant spot in the Indian arrangement of Ayurvedic medicine and Unani since days of yore. Regardless of their latent capacity, these indigenous fruit crops are less known both at scientific and farmers level particularly in our region and some of them like wild jackfruit (*Artocarpus hirsutus),* Rattan *(Calamus rotang)* , *Naga tenga* (*Myrica esculenta)* etc. which are nearer to extinction.

Keywords: Assam, Ayurvedic, Extinction, Minor fruits, Underutilized fruits

INTRODUCTION

In the present scenario, the fast development and busy nature of the human race has led to imbalance not in their health but also to the environment in which they are living. Wild and domesticated diversity is composed of nearly 3000 tropical fruit species; only a few are cultivated on a large scale (Mishra *et al*., 2003). These species (approximately 600 tropical and

subtropical) are better known in their domains of assorted diversity and have not yet been utilised to their most extreme limit. There exists a rich assorted varietal diversity of fruits over the tropical and sub-tropical areas of the world, with in excess of 500 types of fruits evaluated to be found in South East Asia alone. South and Southeast Asia represent above 300 species of native minor fruits (Barua *et al.,* 2019). Assam has been the point of convergence of different tropical and temperate fruit species, a huge part of which still remain in a wild or semi-wild state. Regardless of the wide varying assortment of these fruits, simply some critical fruits like mango, banana, citrus and guava have gained popularity (Beluhan and Ranogajec, 2010).

Due to the wide agro-climatic condition prevailed in the state of Assam, this underutilized fruit (UUF) crop grows in the wild nature and is considered as one of the hot spots in India (Asati and Yadav, 2004). The region has a rich source of diverse Kordoi/Carambola (*Avverhoea carambola*), Leteku/Burmese grape (*Bacearuia sapida*), Amra/Hog plum (*Spondius cytherа*), Jalphai/Olive (*Elacocarpus floribunda*), Bael/Stone apple (*Aegle mermelos*), Imli/Tamarind (*Tamarindus indica*), Jamun/Wild Jamun (*Sygium cuminii*), Thekera/ Garcinia *spp*., Poniol/Govorners plum (*Falcourita jangomas*) Outenga/Elephant fruit (*Delinia indica*) and Amlokhi (*Phyllanthus emblica*) etc. For example, in Assam *Garcinia spp*. grow extensively in wild and semi -wild state, the sundried slice of fruit pieces are being used in culinary purpose and also used in folk medicine. Species, like *Garcinia pedunculata*, *G. kydia*, *G. cowa* and *G. lancifolia* are the most important species found in Assam (Barua *et al.,* 2019).

UNDERUTILIZED FRUITS

The potential underutilized fruits (Plate 1) have been discussed in brief including their habitat, dissemination, morphological depiction, quality attributes and potential uses.

Bael (*Aegle marmelos*): Bilva (*Aegle marmelos* Corr.) commonly known as bael tree belonging to Rutaceae family. The tree grows wild in dry forests on hills and plains of central and southern India, Burma, Pakistan and Bangladesh, also in mixed deciduous and dry dipterocarp forests (Neha *et al*., 2014). It is a medium-size tree achieving tallness up to 20 feet and accepted to originate in India (Plate 1, a). The mash of the organic product is expended crude and prepared to make different worth included items like sharbat, squash, jam and so forth. The squash is profoundly nutritious, and it gives relief from constipation. The unripe Fruit is endorsed for looseness of the bowels and diarrhoea. The ripe Fruit is diuretic and useful for heart and mind. Bael is utilised in almost 60 protected medications. A crystalline substance 'Marmelosin' present in Fruit has remedial/nutraceutical properties. It is assessed that each 100 gm of the pulp of Bael contain 61.5 gm of water, 1.80 gm of protein, 0.39 gm of fats, 1.70 gm of minerals, 31.8 gm of sugars, 55 mg of carotene, 0.13 gm of thiamine, 1.19 gm riboflavin, 1.1 mg of niacin and 8 gm. of nutrient C (Barua *et al*., 2019). Likewise, trifoliate leaves are utilised in puja and petitions of Lord Shiva (Neha *et al*., 2014).

Kordoi (*Averrhoa Carambola*): It has a place with family Oxalidaceae and is also known as 'Kordoi' in Assamese (Assam). It is found all over the north eastern area. The Carambola or "star fruit" (Plate 1, b), an elongated fruit is made out of 5 carpels with a star-moulded cross section. It is popularly called as star fruit due to the special shape of the Fruit that resembles a star. The pungency in Fruit is because of calcium oxalate crystals present in the flesh, which forms oxalic acid when get dissolved in saliva (Patel *et al*., 2008). It is a slow-growing, short-trunked evergreen tree with moderate to heavy branching, fully mature trees surpass 25-30 feet vertically and 20-25 feet horizontally. Carambola fruits are oval to ellipsoid, with 5 to 6 longitudinal ribs. The skin is thin, pale to profound yellow and smooth with a waxy cuticle like skin. The fruit flesh is a light yellow-to-bright golden yellow, clear, fresh and juicy, fibreless. Root concentrate of Carambola is utilised as a cure for poisoning, and squashed leaves are utilised for relieving chickenpox, ringworm and scabies. It is a rich source of reducing sugar, ascorbic acids and minerals, for instance, potassium, calcium, magnesium and phosphate and furthermore nutrient A (560 IU/100 gm) (Das and Prakash, 2009). The natural products are broadly utilised for planning of squash and pickles. The rough natural items are astringent to the gut, stop detachment of the insides and hurling causes biliousness. The Fruit and squashes prepared are useful for draining heaps or piles and accepted to be a decent solution for jaundice, throat inflammation, mouth ulcer, toothache, cough, asthma, hiccups, indigestion, food poisoning, colic, diarrhoea, (Dasgupta *et al.,* 2013). Carambola is broadly utilised in ancient Ayurveda (Sheth and Ashok, 2005).

Amlokhi (*Phyllanthus emblica*): Amla is the first tree to be created in the universe; which belongs to the family of Euphorbiaceae and is also known as *Phyllanthus emblica* or Indian gooseberry (Khan 2009). Amla is native to India and also grows in tropical and subtropical regions of Pakistan, Uzbekistan, Sri Lanka, South East Asia, China and Malaysia The plant grows wild furthermore as cultivated crops in Assam (Khan 2009). It is a deciduous tree in subtropical climate with sparse foliage. It is also called Fruit of 21st century and Amritphal Fruit (Plate 1, c). Due to hardy prolific bearing nature amlokhi is becoming high-

ly remunerative. The Fruit is very nutritive and rich in vitamin C (600mg/100g). The fruits are made into morraba, sauce, candy, dried chips, tablets, jellies and pickles etc. The antioxidant and other constituents are well retained in dried Amlokhi. They are highly valued as vitality restorer, antiscorbutic, diuretic, alternative and antibiotic and are employed within the treatment of chronic dysentery, diarrhoea, jaundice, dyspepsia, diabetes and cough etc (Deka *et al*., 2012). Only astringent Fruit is employed for Ayurvedic medicine. It is also employed in tanning and dyeing industries (Deka *et al.,* 2012).

Amora *(Spondius mangifera)*: It is a tree allied to *Manigifera*, commonly known as Wild mango, Bile-tree, Hog-plum or Amrata in Ayurvedic system of medicine (Anonyms, 2001). It is distributed widely in the tropics and abundantly in the eastern and north-east regions of India (Muhammad *et al.,* 2015). It is very useful for treatment against Shigellosis, Tuberculosis infection as they're blood purifier and also effective against scurvy, rickets, diseases. The Fruit may be a rich source of vitamins (Deka *et al*., 2012). Fruits may be eaten raw and may be used for preparation of pickles (Patel *et al.,* 2008) (Plate 1, d).

Leteku *(Baccurea sapida)*: It is a medium sized tree found wild within the state. Fruits are round in shape and creamy to yellow in colour, average weight being 11.9 gms (Plate 1, e). The Fruit is known to content high antioxidant properties (Mitra *et al*., 2008a).

Outenga (*Dillenia indica*): The fruits are eaten cooked. Excellent jams are often prepared from this Fruit. The juice of the Fruit mixed with sugar and water is employed as cooling beverage in fevers and brought as a cough mixture. It is also used as mild laxative. Fruits are rich in protein and vitamin C (Plate1, f) (Deka *et al*., 2012).

Poniol (*Flacourtia jangomos*): It is a medium estimated tree with hard spring branches. hardy prolific bearer The fruits are dull earthy colored in shading when ripe, tissue is firm, caramel green and moderately delicious (Plate 1, g). Brushing between hands rendered the Fruit much astringent but rather more satisfactory and palatable. It is a rich in protein (3.65%), antioxidant (217.99 mg/100 gm) and mineral like Phosphorous (146.80 mg/100 gm), Calcium (175.50 mg/100 gm), Potassium (158.10 mg/100 gm) and Iron (118.30 mg/100 gm) (Sasi *et al.,* 2018). The iron substance of Poniol is 280 multiple times of very apples. It additionally contains a few fundamental amino acids (Rathore, 2012).

Silikha (*Terminilia chebula*): It is a tall tree, developed wild in the state yet appreciated by all over India for its high restorative and medicinal worth (Deka *et al*., 2012). Fruits are small, oval and tightening towards the two ends, green when fresh and dark and hard subsequent when dried (Plate 1, h). It has a wide scope of medicinal uses and it is significant segment of numerous Ayurvedic drugs. It assists with restoring gastric difficulty, acid reflux and answered to be gainful against Asthma, Piles, Worm, Colic Pain, Heart Diseases, Scabies, Lever Jaundice, Stone, and CUPS (Chronic Ulcerative Paradental Stomatitis), Eye Diseases and Vomiting and so forth (Roy *et al.,* 1998).

Jamun (*Syzygium cuminii*): It is a tall tree; growing both in wild and semi-wild state. It is utilised as both avenue or as a breeze break. The fruits are little oval fit as a fiddle with dark purple shading (Plate 1, i). The Fruit held a significant situation towards wellbeing. It is utilised as a viable medication against diabetes, heart and liver difficulty (Rathore, 2012). Aside from Fruit, seed likewise have benefits. The seeds contain an alkaloid Jambosin and a glycoside Jambolin or Antimellin which diminishes the diastatic transformation of starch to sugars. The seed powder is accepted to decrease the amount of sugar in the urine rapidly (Mazumdar, 2004).

Garcinia species: *Garcinia L*. has a place with the family Clusiaceae found all through in the tropical areas of the world. *Garcinia L*. is evergreen trees or bushes with greenish gum saps. The individuals from the class *Garcinia L*. are potential, high worth therapeutic plants and have antimicrobial action (Anonymous, 2002).

In India, 30 species announced by T. Anderson in Flora of British India (1874). Among the 35 species detailed by Maheswhari (1964), 15 species are remembered for North-East India. Kanjilal *et al.,* (1934) revealed 9 species from unified Assam. Kar *et al*., (2008) revealed 8 species from Sonitpur locale of Assam.

A very few species types are domesticated either for fruits, vegetables, customary drugs or other residential uses like for making house, firewood and landscaping. Domesticated species includes *Garcinia atroviridis*, *G. cowa*, *G. morella*, *G. lanceaefolia*, *G. hombroniana*, *G. prainiana* and *G. mangostana*. Individuals from *Garcinia L.* species created eatable foods grown from the ground. *G. mangostana* is most well-known Fruit among other species of *Garcinia*. Individuals from *Garcinia L*. utilised for medication of childbirth, for menstrual issues, looseness of the bowels and fever in conventional arrangement of medication (Burkill 1935) and furthermore recorded that a few species have possible treatment for HIV (Rukachaisirikul *et al* ., 2003) and Cancer (Nabandith *et al*., 2004). The Garcinia species available in Assam is tabulated in Table 1and shown in Plate 1, j.

UNEXPLORED FRUITS

The following fruits have been known to be found in North East region with limited information to the local as well as to the scientific community.

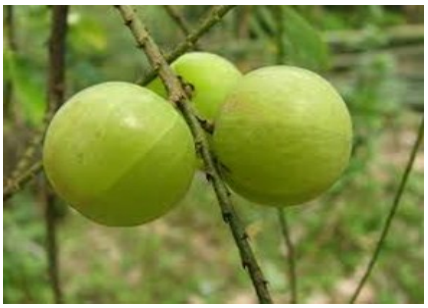
Table 1. List of *Garcinia Species* available in Assam along with local name, their habitat, and ethno-botany.

Si. No	Garcinia Species available in Assam	Local name	Habitat	Fruits	Ethno botany
1	*Garcinia cowa* Roxb. (*Garcinia kydia* Roxb.)	Kau thekera (Ass.)	An middle sized evergreen tree	Fruits size small orange like 4-5 cm in diameter globose but slightly tapering and somewhat oblique towards to the apex, dull red outside and orange inside when ripe.	The fruits are edible. Preserved after sun-dried slices in Assamese house hold. The fruits and leaves used in dysentery, diarrhea. Young leaves are eaten by hill people of Assam. Fruits are also used in headache.
2	*Garcinia lanceaefolia* Roxb.	Rupohi thekera (Ass.)	A small evergreen tree	Fruits small ovoid about 2 cm. in diameter, orange-yellow in colour.	The fruits are acidic and eaten raw or dried, good for dysentery; the gum resin is called 'gamboge' isused as medicine and as yellow dye; oil and juice of fruits are cooling for fever, jaundice and urinary troubles.
3	*Garcinia orella* Desr.	Kuji thekera (Ass.)	A small middle sized evergreen tree	Fruits 1.5-2cm. in diameter globose or slightly elongated, yellow when in ripe.	The fruits are eaten raw or dried, good for dysentery. A commercial source of 'gamboge' occurs as a yellowish colour; oil and juice of fruits are cooling for fever, diabetes and jaundice
4	*Garcinia paniculata* Roxb.	Schopa tenga (Ass.), Marlo (K.)	A small evergreen tree	Fruits small (3-41x12-15) cm in size, cherry, yellow, succulent with granular stigma.	The ripe fruits are eaten and very delicious. Leaves are used to treated round-worm. Wood is moderately hard used for house building, fire wood (Dutta, 1985).
5	*Garcinia pedunculata* Roxb.	Bor thekera (Ass.), Prumang (K.)	An ever green tree, rather short spreading branches	Fruits large, yellow in colour when ripe. Mature fruits (7-8.2x25-29.8) cm in size. Fresh wt. of the mature fruits av. 500gms.	The fruits are acidic and edible, preserved after sundried for local consumption. The old dried fruits are good for dysentery, digestive and cooling. The fruits are also used as fixative or as a mordant for saffron dye. Wood is hard has potential value used for making house, wooden furniture and traditional ricemill "Dheki" preparation.
6	*Garcinia xanthochymus* Hook. (*Garcinia tinctoria* Wight *Garcinia pictorius* Roxb.)	Tepor tenga (Ass.)	An evergreen middle sized tree	Fruits 3.5-6 cm.in diameter, sub globose, pointed, golden yellow in colour when ripe.	The fruits are acidic and edible. The ripe fruits used for making jams, delicious chutney in Assamese household. As herb made from ripens and dried fruits are given in dysentery. Bark of the tree and latex of unripe fruits are used to make yellow dye. Woods is hard, good for making house.
7.	*Garcinia assamica (this new species is allied to G. nigrolineata)*	-	An semi-evergreen tree grows up to a height of 15m	Fruits are turbinate and smooth with 2 to 5 seeds with a vertically grooved surface and tip mammillate	A new Garcinia species found in North East India, it is hitherto known from the type locality, the semi-evergreen forests in and adjacent to Manas National Park, Assam, India. It seems to be rare and is hitherto only known from very few individuals, near to a rivulet. The Fruit is edible and is used for making pickles by locals in Assam (Sarma *et al.,* 2016).

Abbreviations: Ass. for Assamese and K. for Karbi

a). Bael (*Aegle marmelos*)

b). Kordoi (*Averrhoa carambola*)

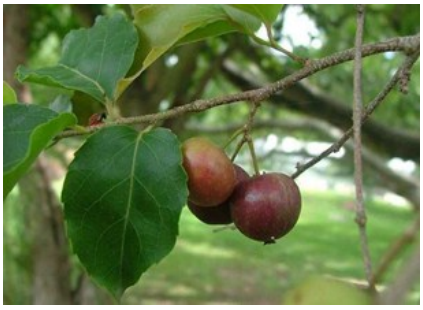


c). Amlokhi (*Phyllanthus emblica*)

d). Amora *(Spondius mangifera)*

e). Leteku *(Baccurea sapida)*

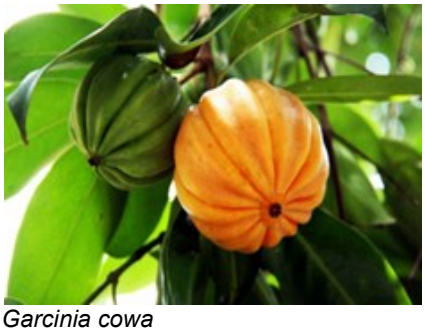
f). Outenga (*Dillenia indica*)



g). Poniol (*Flacourtia jangomos*)

h). Silikha (*Terminilia chebula*)

i). Jamun (*Syzygium cuminii*)



Garcinia cowa

Garcinia morella

Garcinia paniculata

Garcinia pedunculata

Garcinia xanthochymus

j. Different Garcinia species available in Assam

Plate 1 (a-j): *Showing minor and underutilized fruit crops available in Assam.*

Table 2. List of some of the minor and uncultivated fruits available in Assam.

Common or English name	Scientific name with Family	Characteristics	Yield/ tree	Origin and Distribution	Use and Remark
Anola	*Phyllanththus embelica* L Phyllanthaceae	Medium sized tree with small leaves, fruit matures in Jan – Feb.	1500-2000nos.	India	Wild and domesticated, sour, rich in Vit. C and Ca, fruits each weighs 30-50 g (Deka *et al.,* 2012).
Ber/Kul Indian Plum/ Jujube	*Zyzyphus mauritiana* Rhamnaceae	Thorny tree , matures in Jan – Feb	100kg fruits	India, S-E China MP, Jharkhand, Odisha, W.B., Assam	Cultivated, minor, good nutritive value, eaten fresh, 15 varieties are there (Roy *et al.,* 1998).
Bilimbi/Carambola Tree Sorrel	*Averrohoe carrmbole* L Oxilidiaceae	Big tree, elongated cucumber like fruits are in cluster, yellowish green when ripe,	500 nos.	Indo-China, Indo-Genetic plain, Assam	Wild and domesticated, sweet and sour in taste, used as *chutney*, high Vit. C (Das and Prakash, 2009).
Golap Jamun Rose Apple	*Syzgium jambos* L (Alstone) Myrtaceae	A big shrub, small-to-medium- sized tree, 15 m ht, with a tendency to low branching. Ripe Fruit gives rattling sound on shaking. The skin is thin and waxy. The flowers are like guava and it matures in June-July.	400 nos.	South East Asia WB, Assam, Bihar, Jharkhand, Meghalaya	Wild and domesticated. High medicinal value. The ripe Fruit has a strong, pleasant rose flower like smell hence the name Rose apple. Finds good market (Roy *et al.,* 1998).
Anjir Fig	*Ficus racemosa* L Moraceae	Big tree, reddish fruit bears on the trunk	100 kg	Asia minor Assam, WB, Tripura, Meghalaya	Domesticated and wild, apart from ripe Fruit, green fruits are eaten as vegetables not much in use as fruit (Malik *et al.,* 2010).
Karonda	*Cassia caranda* L Apocynaceae	Shrub, fruits ripe in July August	10kg	Indo – Java, throughout India	Minor, domesticated, sour in taste, rich in Vit. C used as *chutney* (Roy *et al.,* 1998).
Kokam Mangostene	*Garcinia mangostene* L Guttiferae	Medium sized tree, dense canopy, Fruit matures in April- May, fruits are berry, globose	500 nos.	Malaya W.B., Assam	Minor, domesticated, used for dying and strengthening the cotton thread of fishing net , rich in antioxidants (Mitra *et al.,* 2008b)
Lateku/ Latka Burmese grape	*Baccaruia sapida* MuellArg Euphorbiaceae	Matures in July-July, the Fruit is used for ritual purpose during the Holy Chariot procession of Lord Jagannath.	70kg	Burma region WB, Assam Meghalaya, Tripura	Minor and domesticated, also used as medicine and wine, edible seed with pulpy aril, eaten fresh (Mitra *et al.,* 2008a).
Poniol Govornor Plum	*Flaocortia indica* Merr *Flacortia jangomas* Flacortiaceae	Thorny shrubby hedge, 2m height	2-3 kg	India Assam, West Bengal	Wild, Fruits are generally improved by rollingbetween the palms before eating; excess eating may give narcotic effect (Sasi *et al.,* 2018).
Sitaphal Custard apple	*Annona squamosa* L Annonaceae	Shrub like tree, with small leaves, fruits have gritty structure with grainy pulp, matures in Sept-Oct	100 nos.	Tropical America W.B., Odisha, Jharkhand ,MP, Assam etc.	Wild and domesticated, leaves have insecticidal properties, eaten raw, good taste (Roy *et al.,* 1998).
Bread fruit	*Artocarpaus altilis* (Park) Fosb Moraceae	Big tree, like jack fruit, large pinnate leaves, latex	50-80 nos.	Malayan Archipelago Lateritic zones on India	Wild and minor, rich in Ca, beta carotene (Malik *et al.,* 2010).
Balatha Lasura	*Cordia myxa* L Boraginaceae	Shrub, the Fruit mature during July- August. Grow in different agro- climatic condition; It is a kind of a drupe, light pale to brown or even pink in colour. Used in *Ayurveda*. Tolerate arid weather	20 kg	Asia/ Africa Different parts on India WB., Assam, A.P.,	Fully ripe Fruit is quite sweet in taste having mucilaginous pulp and is fully enjoyed by children. The pulp in a half ripe fruit can even be used as an alternative to paper glue in office work (Chadha, 2001).

Contd…...

Table 2. Contd…...

Latabel Passion Fruit	*Plassiflora edulis* Sims Plassifloraceae	Vine, similarity with passion flower, Fruit is juicy with seeds having a flavour. Trellising is needed, flowers throughout the year, three months crop	60-80 fruits/ vine	Brazil W.B., Assam, Meghalaya	Minor, domesticated, good source of beta carotene, Vit C and iron. Lesser known. Gives fruiting after 10 months, live up to 6 years (Malik *et al.,* 2010).
Loquat Japanese Plum	*Eriobotrya japonica* L Rosaceae	Medium sized ever green tree, with short trunk, 10 m ht, matures in early spring , small round shaped yellow Fruit	50 kg	Central China, Japan W.B., States of N-E, Assam, Tripura	Wild and domesticated, eaten fresh, good taste (Roy *et al.,* 1998).
Mulberry	*Morus alba* L Moraceae	Small sized tree, small cylindrical black-reddish Fruit, leaves used for feeding the silk moth larva	3-4 kg	North China W.B., Assam, N-E states, Odisha, Karnataka	Domesticated, small fruits, eaten by small children, good taste birds, used for jam fodder and green leaf manure (Malik *et al.,* 2010).
Ramphal Custard apple	*Annona reticulata* L Annonaceae	Medium sized tree, bigger leaves, smooth Fruit with hexagonal markings, grainy pulp, matures in Mar- April.	80-100 nos.	Tropical America W.B., Odisha, Jharkhand ,MP, Assam etc.	Wild and domesticated, fruits are eaten raw, preferred by children (Malik *et al.,* 2010).
Phalsa	*Grewia asiatica* L Masters Tiliaceae	Medium tree, small fruits. mostly relished by small children, drought tolerant,	4-8 kg	India WB, Assam and Odisha,	Wild, domesticated, good market price, used as filler plants in Mango orchard (Roy *et al.,* 1998).
West Indian Cherry	*Malphigia punicifolia* L Malphigiaceae	Medium sized shrub, 4 m ht, withstand drought	10-15 kg	South America W.B., Assam ,Tripura	Wild and cultivated, richest sources of Vit. C, lesser known (Personal communication with local people)
Amra Hog Plum	*Spondius cythera* Sonn Anacardiaceae	Deciduous Tree, immature fruits are used in culinary art , July-Aug, immature fruits are eaten in culinary art, July Aug	30 quintal	Polynesia W.B., Assam, Meghalaya, Tripura	Sour, used in chutney, Ayurvedic properties (Roy *et al.,* 1998).
Anshfal Longan	*Euphoria longan* Lamk Sapindaceae	Big tree, matures in June, like litchi smaller in size but the pulp is less.	30kg	Indo Burma Region Assam, WB, Tripura	Wild and domesticated There are 300 varieties in China, eaten fresh, good taste (Chadha, 2001).
Bakul/ Maulsari Spanish Cherry	*Mimusops elengi* L Sapotaceae	Tree with dense leaf canopy, used as shade tree in gardens. The orange-red Fruit is hairy. Matures in April – May. Small fruits, each weighing 10-15 g.	10 kg	South Asia WB, Assam, Jharkhand, Tripura	Wild and domesticated, having *Ayurvedic* properties. It is eaten mostly by children. The wood is extremely hard, strong and tough, and rich deep red in color (Malik *et al.,* 2010).
Batabi Pumello	*Citrus grandis* Osbeck Ruatceae	Big sized fruit,500g- 1kg	50 nos.	S-E Asia WB, Assam, Odisha	Domesticated, sweet, eaten fresh, high medicinal value, use for de-worming in children (Chadha, 2001).
Bon Am/ Wild Mango Himalayan Mango	*Mangifera sylvatica* Anacardiaceae/ Irvingiaceae	Evergreen trees, up to 25 meters, threatened species, Fruit is very elongated	50 kg	India Nepal, Assam, Meghalaya, Tripura	Mainly used for jam, pickle (Roy *et al.,* 1998).
Chalta/karambel Dillenia	*Dillenia india* L Dilleniaceae	Big tree, fibrous calyx is eaten, matures in Jul- Aug	80-100 nos.	Assam, W.B.	Used for chutney (Personal communication with local people)
Durian	*Duraize bethinus* Bombaceae	Big tree, like jack fruit sweet aril with pulp but unpleasant odour	100-200 kg	Burma W.B., Assam, Odisha, Meghalaya	Unpleasant smell, eaten fresh, used as jam, jelly, gives energy (Malik *et al.,* 2010).

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Table 2. Contd…...

Jalpai Olive	*Elacocarpus floribunda* Elaeocarpaceae	Medium sized tree, Fruit matures during Sept –Oct, Fruit is light green drupe, 2 to 5 cm long and 1.5-2.5 cm in girth. Both ends of Fruit are pointed, outer surface smooth having a mesocarp fleshy	30-40 kg	Madagascar WB, Assam, Tripura, Meghalaya	Wild and domesticated, sour, used as chutney, pickles, rich in Fe (Chadha, 2001).
Kayeth Bael/Kaitha Elephant apple	*Feronia limonea* L Swingle Rutaceae	Big tree, fruits have a hard cover, matures Sept-Oct, succulent placenta and inner pericarp is eaten	1000 nos.	India/ Sri Lanka WB, Assam, Jharkhand, Tripura	Wild and domesticated, sweet and sour, eaten as fresh *Chutney*, cooked and pickles, bark has insecticidal properties (Roy *et al.,* 1998).
Putus Spanish flag	*Lantana camera* Vervinaceae	Shrub with small thorns around the stem.	300g	Central America WB, Assam, Tripura,	Invasive alien sp., grown road side, small fruits are edible preferred by children, leaves have insecticidal properties (Personal communication with local people).
Bael Stone apple	*Aegel marmelos* L Corr. Serr Rutaceae	Big deciduous tree, takes 11 months to mature in Mar- April, having hard shell, Numerous hairy seeds are encapsulated in a slimy mucilage, yellow pulp, one big Fruit may weigh 1kg	500 nos.	India WB, Odisha, Jharkhand, Assam, lateritic belts of India,	Widely used in *Ayurvedic* medicine, good laxative, mature and immature Fruit is eaten, ripe Fruit eaten fresh, Sacred tree for the Hindus, thrives well in extreme high and low temperature (Chadha, 2001).
Bilati Amra Hog Plum	*Spondius pinnata* Kurz Anacardiaceae	Deciduous Tree, immature fruits are used in culinary art , July-Aug , Fruit is bigger than*S cythera,*	40quintal	Tropical Asia WB, Assam, Meghalaya, Tripura	Sweet and sour, eaten raw with salt, used in Chutney, pickles, immature fruits are eaten in culinary art, July-Aug (Roy *et al.,* 1998).
Imli Tamarind	*Tamarindus indica* L Leguminoseae	Big tree,20-25 m ht, elongated ripe fruits matures in Mar-April, provides good shade	5-10 quintal	India Indo Gangetic plains, W.B., Assam, Odisha	Sour taste, raw consumption is less, used in culinary art, chutney, rich in K, Ca, P and Vit C (Malik *et al.,* 2010).
Jangli Badam Wild Indian Nut	*Sterculia foetida* L Sterculiaceae	The branches are whorled and usually horizontal, with palm like leaves gracefully up-curved and crowded at the ends with large. Fruit is an aggregate of follicle of 1-5, scarlet, boat shaped, woody. The seeds are edible after toasting and taste like chestnuts	100 nos.	East Africa/ Tropical Asia WB, Assam, Jharkhand	The seed contain oil used as medicine; the timber is used for making furniture and the bark for rope (Personal communication with local people).
Jilipfal/Ganga imli Sweet Tamarind	*Inga dulcis* Roxb Fabeace	Big tree also known as Madras thorn, drought resistant, gives fruiting in April – May.	100kg	Mexico/ Central America, W.B., Bihar, Assam, Jharkhand, Tripura	Wild, fruits are like tamarind pod with reddish coating, pulp is spongy, eaten mostly by children (Roy *et al.,* 1998).
Dampel/Asan Kandis False Mangostene	*Garcinia xanthochymus* Hook Clusiaceae	Big tree, fruits, soft, light yellow, grows in axils of branches, edible arils, pointed at rear end.	30 kg	India, Burma W.B., Assam, Odisha	Used as jams, and curries. The dried fruit sap is called gamboge and provides a dye that is used in water color paints, medicinal value (Malik *et al.,* 2010).

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Table 2. Contd…...

Jamun Wild Jumun	*Syzygium cuminii* L Skeels Myrtaceae	Big tree with dense foliage proving shade along the road side, soft black Fruit with skin and pulp not separable.	50 kg	India Indo Gangetic plains, W.B., Assam , Odisha	Highly perishable, eaten fresh, rich in Iodine, seed is used to cure diabetes, leaves used as fodder, one of sacred fruits of the Hindus (Rathore, 2012).
Khejur Wild Date	*Phonix sylvestris* L Roxb Arecaceae	Date palm tree, thrives well in drought condition, fruits matures in May- June, small brown cloured Fruit having less flesh,	50 kg	India WB, Assam, Odisha, Jharkhand	Wild cultivated and domesticated. sweet xylem sap is collected during winter months for making molasses and alcoholic drink (Chadha, 2001).
Rambutan	*Nephelium lappaceum*L Sapindaceae	Medium sized ever green tree, matures in July-Sept, ellipsoidal Fruit in cluster, like *litchi* with small hairs over it aril,		Indonesia WB, Assam, Meghalaya	Threatened *sp*, Eaten fresh as dessert, high vit. C used as syrup, Juicy pulp Roy *et al.,* 1998).
Rasbhari Cape Gooseberry	*Physalis peruviana*L Solanaceae	Herb, small seedy berries with papery calyx, resembling a miniature spherical yellow tomato. it is about the size of a marble about 1–2 cm in diameter. Like a tomato, it is bright yellow to orange in color, good shelf life	1-2 kg	Peru/ Columbia WB, Assam, and other parts of India	Recently introduced and cultivated in small pockets, rich in Vit C, used in folk medicine, used as jam (Roy *et al.,* 1998)
Taal Asian Palmyra palm/ Toddy palm	*Borassus flabellifer* L Arecaceae	Branch less palm, matures in July- Aug, the ripened fibrous outer layer of the palm fruits can also be eaten raw, boiled, or roasted. Immature Fruit is cut and three jelly like seeds are eaten after removing the thin layer. The white kernel of the germinated seed is also eaten..	200 nos.	Indian subcontinent W.B., Odisha, Assam	The inflorescence is cut and the xylem sap (juice) is collected by hanging earthen pot. The juice so collected early morning is a refreshing drink and light alcoholic drink is made from the juice. Ripened Fruit has fibrous outer layer, tolerate drought, eaten fresh by tribal people, the yellow pulp is processed (Malik *et al.,* 2010).
Bilati Gaab Indian Persimmon/ Velvet apple	*Diospyros blancoi* A. D.C. Ebenaceae	Dioecious tropical tree, grows well from the sea level to the 2,400 feet above the sea level, Sapota like fruits with reddish velvety layer, medium sized	80-100 nos.	Philippines W.B., Assam, Jharkhand	Wild and domesticated ,eaten fresh, timer is very hard called *iron wood* (Roy *et al.,* 1998)
Deoa Monkey Jack	*Artocarpus lakoocha* Roxb Moraceae	Big tree. The orange-yellow male flowers and reddish female flowers grow separately on the same trees. Velvety, dull yellow syncarp fruits are nearly round or irregular	70 kg / 250 nos. approx.	India WB, Assam, Tripura	Sweet sour pulp, like jack fruit, generally eaten fresh. Used as chutney. Each Fruit contains 20–30 seeds that are fleshy with thin seed coat, leaves used as fodder (Chadha, 2001).
Jamrul/Jaman Star Apple/ Wax apple	*Syzygium samarengense*(Blume) Merrill & Perry Myrtaceae	Evergreen tree with big leaves, berry bell shaped fruit matures in June-July (rainy) and in Jan – Feb (winter) for second flush , winter fruits are sweeter than rainy season size varies	40 kg, one big Fruit weigh 60 g	Malay, Andaman Island W.B., Assam, Tripura	Fruits are bell shaped, different Colors-purple, reddish, white. It does not taste like apple, finds a good market (Malik *et al.,* 2010).
Panifal Water chestnut	*Trapa bispinosa* Cyperaceae	A floating aquatic plant having nutlike Fruit and grown in low-lying water bodies, matures in Sept-Oct	24 t/ ha	Africa WB, Assam	Edible corms, rich in dietary fibre and Minerals (Personal communication with local people)

Index- ht- Height in meter, W.B.- West Bengal state of India, AP- Andhra Pradesh state, M.P.- Madhya Pradesh state

Naga tenga *(Myrica esculenta)* : It belongs to Myricaceae family and is commonly known as box berry or *kaphal* and Naga tenga in Assam is an important Indian medicinal plant. The plant is also reported to have innumerable significant pharmacological activities like analgesic, anxiolytic, antiallergic, antidiabetic, antimicrobial, antihypertensive, antiulcer, antioxidant and anti-inflammatory evaluated by using various animal models (Sood and Shri, 2018).

Wild jackfruit *(Artocarpus hirsutus)*: It belongs to the *Moraceae* family commonly known as wild jackfruit. The Artocarpus (Moraceae) comprises about 50 species of evergreen and deciduous trees. The genus is economically importance as a source of edible Fruit, timber and folk medicines *Artocarpus hirsutus* is a tall evergreen tree, generally 20-25 m in height and up to 5 m in girth; fruits are edible, bright yellow, ovoid covered with spines, seeds ovoid and white. It required warm humid climate heavy rainfall and thrived week in any type of soil (Thomas *et al.,* 2016).

Rattan *(Calamus rotang)*: It belongs to the family Arecaceae, a shrub-like species found mainly in coastal swamp forest which is indigenous to Southwest Asia like India, Bangladesh, Sri Lanka. It is a dioecious rattan palm that grows up to 10 m tall. Traditionally rattan is used as a vermifuge in tribal people in Assam (Basumatary *et al.,* 2004). Fresh root juice is used in asthma, insomnia and chronic fever (Patari *et al.,* 2016). For many years it has assisted in the treatment of various ailments like cough, leprosy and bleeding disorders whereas leaf sap of this medicinal plant is generally used for an eye problem (Gupta and Chaphalkas, 2015).

MINOR AND UNCULTIVATED FRUITS

Considering the importance of conservation and emphasizing their importance, brief information regarding the minor and uncultivated fruits available in Assam has been mentioned in table 2.

North-East India, more particularly Assam is honoured with tremendous plant hereditary assets, particularly underutilized Fruit (UUF) crops. Precise development of organic product crops is low when contrasted with all outcrops accessible in the state. These yields are playing an essential job in giving food security, nourishing security, wellbeing security, business and financial security to poor masses in rural regions. Their business significance, dietary status and market esteem are obscure to the rustic network. There is a huge degree to advocate these in non-conventional zones, and these yields might be helpful crude materials for food handling ventures. Further, the tremendous hereditary assorted variety in different organic product crops offers a tremendous extension for assortment, preservation, reproducing and improvement for the advantage of rustic and ancestral networks of Assam. The expansion in region and creation of these organic product harvests will give wholesome security, set aside cash and fare of new organic product harvests and lift the locale's economy. These organic product crops additionally give many-overlap business openings in agro-based enterprises, bundling, stockpiling, conservation, canning furthermore, transportation.

There are various minor fruits in Assam which have restorative, remedial and dietary benefit. These are additionally known for their superb flavour, deliciousness and alluring appearance (Barua *et al.,* 2019). Urban buyers today are getting progressively cognizant and mindful of their wellbeing and nourishing angles. There is an expanded accentuation by government and non-government offices to advocated customary and normal items. Taking into account all these ongoing improvements in customary wellbeing areas, underutilized fruits have splendid advertising prospect in the coming years. Be that as it may, these hereditary assets of the state are confronting an incredible danger of termination because of environmental change, urbanisation and the enormous scope of developmental projects. Additionally, these fruits have been ignored for a long time by specialists, strategy creators and subsidising offices and are as of now a considerable lot of these are undermined with eradication (Buragohain, 2011). So, to safeguard the existing minor fruits of the state and to achieve sustainable development based on the use of these species is of immense importance. Organised handling and production and value addition for esteem expansion of items would improve the pay of small and minor ranchers and business holder and help in on-farm preservation of these important natural minor fruits.

Conclusion

North-Eastern India is presented with the most amiable climatic conditions for the production of underutilized fruit crops. Other than this quality seeds and planting material, assortments of these fruit crops couldn't be produced and traded. The expansion in area and production of these crops not just give nutritional security and get a good deal on import but also export of fresh fruits and processed fruit products are additionally expected to boost the economy of the region. A large portion of these underutilized fruit trees established through natural regeneration of seeds develop gradually with no nutrition; begin bearing fruits after a long gestation period and produce fruits of substandard quality. Subsequently, these species remain disregarded with no commercial significance. Notwithstanding, there is further need to set up field demonstrations to give first-hand exposure to the farmers for popularising these species.

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