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Cocoa Cultivation in Northeast Region

INDIA has vast potential to promote cocoa in Northeast region, where the agro climatic condition is suitable with high rainfall, short dry spell and sub tropic humid climate. Palms and local, native, region specific fruit/ forest trees are also available which provide 50% shade required by cocoa and accommodate it as agro-forestry system as well. Realizing its potential, the Ministry of Agriculture & Farmers Welfare, GoI, has proposed an area of 50,000 ha to be expanded in Northeast region. With this background, this article analyzed the scope and prospects of cocoa in Northeast region.

COCOA (*Theobroma cacao* L.), the chocolate tree, is currently being cultivated as a mixed crop in palm based cropping systems of India comprising arecanut, coconut and oil palm gardens. Cocoa plantations are confined to Western Ghats hills and plains of Southern states, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. Current area under cocoa is 1,03,376 Ha and the demand in chocolate industry is 60,000 MT of dry beans as against the production of 27,000 MT. Contribution of cocoa to the national income is around ₹ 2000 million and the industry expanded considerably in recent years, with 10-15 entrepreneurs and firms, which exhalated the demand against the 40% availability of beans. This scenario necessitates further encouragement of cocoa cultivation in non-traditional areas.

Cocoa in Assam

In 1963, Forastero and Amelonado type of cocoa was introduced from Malaysia in Cachar and Lushai hills of Assam, which were found to be suitable with alluvial soils in valley bottoms. ICAR-CPCRI initiated its systematic cocoa-based cropping system trials in 1962-64 at Vittal, Karnataka under arecanut, Peechi, Kerala, under coconut, Palode, Kerala, under oil palm and Kahikuchi, Assam under arecanut. Thirty year old, thirty cocoa trees of the above trials are available in the Kahikuchi centre of Assam, which survived the weather vagaries over the years. It is showing a positive sign for expanding the area for successful cultivation of cocoa in the region. Currently, cocoa is grown in an area of about 16 Ha in Assam and the maximum area in Goalpara district, under arecanut and to some extent in rubber plantations. Cocoa planted during 2011 with the convergence of three schemes under MNREGA, Coconut Development Board (CDB) and State Horticulture Department in Bongaigaon district. Farmers have started raising cocoa seedlings from few existing trees maintained in Abhaypuri, Bongaigaon district and distributed to neighboring villages and other districts. In Baksa district, cocoa is grown as a sole crop in Daragaon village near Bhutan border in Mushalpur block. ICAR-CPCRI, RC, Kahikuchi in collaboration with Directorate of Cashewnut and Cocoa Development (DCCD), Kochi has taken up intensive transfer of technology programs in Assam through cocoa trainings, district level seminars, FLDs and exposure visits of NE farmers to southern cocoa growing states. With this effort, from 2017 onwards commercial cultivation of cocoa has started in the region and most of the gardens are in their early years of bearing.

Table 1. Cocoa growing districts in Assam

District	Area (ha.)
Goalpara	10.0
Baksa	1.0
Kamrup	2.0
Nalbari	1.0
Udalguri	1.2
Bongaigaon	0.5

Potential to scale up cocoa cultivation in Assam

Assam being located in the sub tropical region favors many fruits and plantation crops and the arecanut and coconut palms are mostly under monocropping system, except few intercrops like Assam lemon and banana. Some major arecanut and coconut growing districts, Cachar, Sonitpur, Barpeta, Golaghat, Nalbari, Bongaigaon, Udalguri, Chirang, Baksa, K. Anglong, Lakhimpur, Dima Hasao, Sibsagar, Darrang, Jorhat, Kamrup, Nagaon and Goalpara can serve as potential areas for expansion of cocoa in Assam (Table 1 & 2). Systematic cultivation of cocoa was started in Kamrup, Udalguri, Nalbari, Baksa and Goalpara districts with the intervention of ICAR-CPCRI, RC, Kahikuchi.

Agro-climatic suitability

Soil: Cocoa can be grown in wide variety of soils.

Table 2. Major coconut and arecanut growing district of Assam

Districts	Arecanut (Ha)	Coconut (Ha)
Cachar	4,186	990
Kamrup (R)	3,825	1,240
Barpeta	2,897	1,622
Sonitpur	5,425	2,036
Nagaon	3,674	2,941
Golaghat	5,223	1,047
Nalbari	1,490	1,390
Goalpara	2,208	754
Bongaigaon	1,580	637
Udalguri	2,458	720
Chirang	3,143	549
Baksa	2,687	561
K. Anglong	1,565	516
Lakhimpur	2,880	289
Dima Hasao	1,770	164
Sibsagar	2,162	466
Darrang	1,533	598
Jorhat	2,890	453

Source: Department of Horticulture, Govt. of Assam

Since cocoa is an agro forestry crop originated from Amazon river basin, virgin, freshly cleared forest soils are suitable, which are rich in organic matter. Well-drained, acidic to neutral pH, depth of up to 1.5 m is necessary for cocoa. The soils of Assam are divided into four main groups, *viz.* alluvial, piedmont, hill and lateritic soils. The alluvial soils are extensively distributed over the Brahmaputra and Barak plain with some patches in Kokrajhar, Barpeta, Nalbari, Kamrup, Darrang, Sonitpur, Lakhimpur and Dhemaji districts The piedmont soils are confined to the northern narrow zone along the Himalayan foothills, which is deep and fine to clay loamy in texture. The hill soils are generally found in the southern hilly terrains along the border with Arunachal Pradesh and Nagaland. This soil is fine to clay loamy in texture. These soils are rich in organic matter and nitrogen. The lateritic soil in the state occurs almost entirely over the North Cachar Hills district. These soils are dark and fine textured with heavy loams. The well drained, deep, acidic alluvial soils of upper Assam with good proportion of phosphoric content are mostly suitable for plantation crops. Overall, the soils of Assam are suitable for cocoa cultivation.

Climate: Rainfall, temperature and humidity influence the cocoa flowering and fruiting. The optimum range of temperature is 15-32°C. The absolute minimum temperature for any reasonable period should be greater than 10°C, below which frost injury takes place. Assam is situated on the Northeastern corner of India between 89° 42′ E to 96° E longitude and 24° 8′ N to 28° 2′ N latitude. The region has moderate climate throughout the year, with warm summers and mild winters with average rainfall of more than 1500 mm per year. There are four distinct seasons, Summer, Monsoon, Autumn and Winter. In the plains of Assam, the average maximum temperature does not go beyond 32^{0}C and in winter the plains of Assam have a minimum temperature of about 8^{0}C. Its elevation ranges from 50-75 m above mean sea level in plains and 600-1350 m in hill areas. There is a slight variation of climate from region to region within the state. For instance, the climate of the region covering Kamrup, Nalbari and Barpeta district in west-central Assam is characterized by plentiful rains and foggy winter. In western Assam comprising the districts of Goalpara, Bongaigaon, Kokrajhar and Dhubri, the climate is intermediate between that of the North Bengal Plains and the West-Central Assam Valley. The climate of the East Central Assam comprising Darrang, Sonitpur, Morigaon and Nagaon is characterized by the absence of a dry hot summer season, the highest temperature being experienced during the period of south west monsoon along with abundant rains and a humid atmosphere throughout the year. The climate of the Eastern Assam districts (Golaghat, Jorhat, Sibsagar, Tinsukia, Dibrugarh, Dhemaji and Lakhimpur) is somewhat identical to Darrang and Nagaon. The tropic of Cancer, passes through the southernmost tip of Mizoram and as such, Assam falls within the sub-tropical zone; but having been dominated by tropical air masses, the area shows characteristics of both sub tropical humid zone and tropical climate which is required for cocoa cultivation.

Cocoa technologies available

- Cocoa varieties identified for the region for profitable production.
- Nursery techniques standardized for quality planting material production.
- Planting systems under palm based cropping systems and agro-forestry models are available.
- Recommended fertilizer schedule of 100: 40: 40 g NPK/ tree/ year and drip irrigation of 20 litres/ tree during rainless periods are successfully followed.
- Canopy architecture methods demonstrated in seedlings and grafted plants under different cropping system models.
- Crop cycle was studied and calendar of operations was demonstrated and recommended.
- Farm wastes, cocoa leaves, prunings, pod husk and bean shell can be successfully composted and recycled to the garden.
- Plant protection measures and biocontrol methods are available for major disease like black pod rot and pests, tea mosquito bug and mealy bugs etc. Cocoa gardens of Assam are so far reported with less squirrel damage.
- Mini processing unit (Bean to Bar chocolate making unit) is established at ICAR-CPCRI RC Kahikuchi centre which will serve as Agri Business Incubation Centre as well.
- Home/ farm level processing methods available with mini fermentation boxes, baskets and plastic tray to encourage dry bean sale to get more income.
- Regular training programs on cocoa from production to processing are being conducted at all ICAR-CPCRI




KHIC 21 KHIC 26

centres in the region with DCCD funding.

- National research institute, ICAR-CPCRI, developmental agency, DCCD and the chocolate industry, farmers co-operative CAMPCO will support the sustainability of cocoa in the region.
- Since GOI specifically allotted NE funds for research and development, it will definitely have an impact on cocoa sector as well in the region.
- Monopoly of cocoa industry in India was minimized with the involvement of multiple chocolate industries like Mars, Mondelez (Ex. Cadbury), CAMPCO, Nestle, Amul, Jindal, etc., in the marketing.

Cocoa varieties for the region

ICAR-CPCRI, Research Centre, Kahikuchi, Guwahati, Assam:

Based on the growth, pod yield and bean traits, KHIC 21, KHIC 13 and KHIC 26 are found to be good performers with dry bean yield of 2.98, 2.91 and 2.41 kg per tree per year respectively.

VTLC 19 showed high pod yield of 43 pods per tree per year in an optimal canopy of 9.83 m^2, with 34 beans per pod and 1.20 g single dry bean weight and yielded 1.76 kg dry beans at the age of seven years followed by genotypes VTLCH 2, VTLC 11 and VTLC 5 .

Horticultural Research Station (HRS) (ICAR-AICRP on Palms & Cocoa), Kahikuchi, Assam:

At HRS, 16 cocoa genotypes were evaluated under coconut from 2015 onwards. Among them, VTLC 20 recorded a significantly higher dry bean yield of 2.2 kg per tree per year followed by VTLC 18 (1.5 kg/tree/year) and eight clones yielded more than 1.0 kg dry beans at the age of six years.

ICAR-CPCRI, Research Centre, Mohitnagar, Jalpaiguri, West Bengal:

At Mohitnagar, MLT on cocoa is running from 2015 onwards and the performance of different cocoa genotypes is depicted in the figure below. Among the 14 cocoa genotypes, the performance of VTLC 5 VTLCC 11, VTLCH 1 and VTLC 5 is better and is on par in terms of dry bean yield/ tree/ year under arecanut garden, however, the performance of VTLCH 4, VTLC 5, VTLC 11 and VTLCH 1 was better under coconut (ICAR-CPCRI, 2022).

All the above trials showed the potential of cocoa in the region for long term sustainable palm based cropping system models. Front Line Demonstration (FLD) gardens are already established in MGMG villages by the centres with DCCD funds. These parental clones and hybrids can be assembled both as bi-clonal and poly-clonal orchards in nearby ICAR institutes, KVK's and State Agricultural Universities will enhance the supply of quality planting materials for the region. This offers a great opportunity for NE region to be an upcoming cocoa hub in the near future.

Recommended cropping systems

(i) Mixed Crop Under Palms:

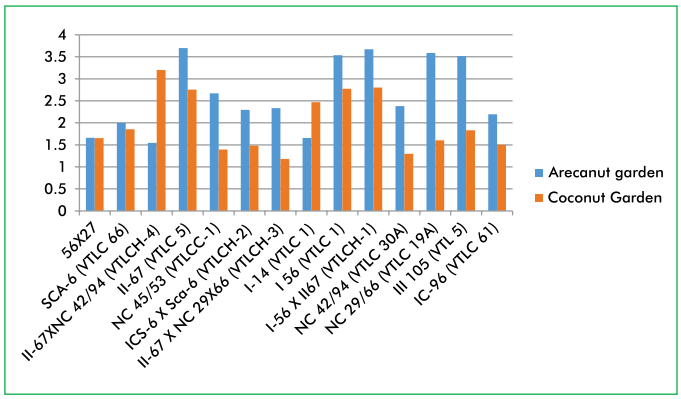
Under Arecanut: Arecanut spacing 2.7 × 2.7 m, cocoa in centre of four areca palms at 2.7 × 5.4 m (9 × 18 ft) normal spacing, 686 plants/ ha.


VTLC 19

DDG (Hort.) at ICAR-CPCRI Kahikuchi Cocoa Plot

Cocoa plot under coconut at HRS, Kahikuchi

VTLC 20



Dry bean yield/ tree/ year of different cocoa genotypes under arecanut and coconut

2.7 × 2.7 m high density, 5.4 × 5.4 m wide spacing, 3 × 3 m new garden with same time planting of arecanut and cocoa and arecanut based multi species cropping system- Areca + Cocoa + Banana + Pepper.

Under Coconut*:* Coconut spacing 7.5 × 7.5 m

Single hedge cocoa 2.5-3 × 7.5 m, 3 × 7.5 m (10 × 25 ft)= 444 trees/ ha.

Double hedge cocoa 2.5-3 m square/ triangle, 2.5-2.7 m (8 × 9 ft) = 800 trees/ ha

and coconut based multi species cropping system- Coconut + Cocoa + Banana + Pepper

Under Oil Palm: Oil Palm spacing 9.9 or 10.5 m in triangular system. Cocoa spacing 2.4-3 m = 400 plants/ ha, >15 years old oil palm at square system is preferred to avoid heavy shade.

(ii) Monocrop: In lower hills and valley bottoms with temporary shade trees upto 15 years.

(iii) Agro Forestry model: To be grown as under storey crop under permanent shade trees along with native fruit/ beneficial forest/ timber trees, 3 m spacing for cocoa

Strategies for promoting cocoa cultivation

- Establishment of mother gardens (both bi-clonal and poly-clonal orchards) for supply of quality planting materials in research centres as well as through regional nurseries with DCCD funding.
- Creating awareness on cocoa cultivation in different cropping models and scientific production and protection technologies.
- Promotion of primary farm level processing and home scale chocolate making.
- Trainings and demonstrations through linking research institutes, developmental agencies and industries.

CONCLUSION

In a state like Assam and other states in NE region, arecanut and coconut are mainly cultivated in the backyards or as mono crops. It is rather essential that suitable mixed cropping systems or intercropping should be followed in order to increase the net profit and to improve socio-economic status of the farmers. Existing gardens and natural resources are very well utilized for the high value crop like cocoa, which will be one of the best option to increase unit area income. With farm level primary processing trainings or community based processing, high remuneration could be obtained. Small farmers and women groups can take up homemade chocolate units along with other value added products. Gradually with more area under cocoa, linkages can be created with confectionaries, both public and private industries for marketing of cocoa products.

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