



P-ISSN: 2349-8528
 E-ISSN: 2321-4902
 IJCS 2019; 7(4): 66-70
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 Received: 13-05-2019
 Accepted: 15-06-2019

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Maize research and development in Assam

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Abstract

Assam's economy is fundamentally based on agriculture. About 89 per cent of state's population of about 3 cores lives in rural areas and about 70 per cent of the total work force is engaged in agriculture and allied activities. Maize is the third important cereal crop in the world after wheat and rice with respect to area and production. India is the fifth largest producer of maize in the world, contributing 3% of the global production, though productivity is much lower than other potential maize growing countries like USA, Argentina and China. In Assam, maize is the second most important crop, next to rice and is mostly grown under rainfed hilly upland conditions. In the region, maize production plays a significant role in ensuring food security and is used both for direct consumption and as well as for second cycle produce in piggery and poultry farming. The popular several varieties presently cultivated in the region are from private sectors only. The crop is now in a status of emerging crop in the state and constant increase in acreage is being observed in recent years. Maize being a crop of high potential can give a boost to the economy of the state. The main limiting factors like suitable hybrids and seasonal heavy rainfall.

Keywords: Agriculture, production, crop, food security, economy

Introduction

Maize is presently the crop with growing importance in the state. Earlier it was primarily grown for human consumption only. In view of rapidly increasing demand of poultry feeds and fodder in Assam it is having more use presently in some small industries. It is the raw material for most of the feed industries. Presently the crop has state acreage of 31000 ha and production of 91000 tones with a productivity of 2911 kg/ha (2017-18).

While most other states in India are gradually moving away from their traditional agriculture based economy toward industry or service oriented economy, Assam is still heavily dependent on the agricultural sector. While the sociopolitical problems afflicting the state since the last few decades are partly to blame for a lack of conducive environment for economic development of the state, particularly in industry or service oriented areas, there are various economic reasons (e.g., fragmented land) responsible for the lagging agricultural sector in the state.

Assam's economy is fundamentally based on agriculture. Over 70 percent of the state's population relies on agriculture as farmers, agricultural laborers, or both for their livelihood.

Assam produces both food and cash crops. The principal food crops produced in the state are rice (paddy), maize (corn), pulses, potato, wheat, etc., while the principal cash crops are tea, jute, oilseeds, sugarcane, cotton, and tobacco. Although rice is the most important and staple crop of Assam, its productivity over the years has not increased while other crops have seen a slight rise in both productivity and acreage.

Area, Production and Yield scenario of maize in Assam

The crop acreage in the state is growing year wise in the present scenario. The area increased by 52%, production by a massive 600% and the yield by 360% in 7-8 years from 2007-08 to 2014-15 in the state. It is mainly because of shifting of maize cultivation from OPVs and composites to Hybrids. Table 1 shows the change in area, production and yield of the crop year wise in the districts and the state as whole.

In addition to some of the major problems such as land fragmentation, lack of modern technology, or continued reliance on rain for irrigation, there are several other problems that hinder the development of agricultural sector in Assam are as follows:

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(1) Natural calamities

Floods and dry spells are the principal natural disasters faced by farmers in Assam every year. The principal source of floods is the Brahmaputra river and its tributaries. Although it has been decades since the proposal to dredge the Brahmaputra came out, its progress and impacts are unknown. The loss of crop, livestock, house, cultivable land, and human lives are common during the yearly flood, which also takes a toll on human spirit. Then, is whether dredging in selected areas is beneficial, i.e., is the cost of dredging per year is lower than the estimated yearly losses from flood? If the answer is yes, then it is time to put the dredging plan into action.

(2) Capital deficiency

Commercial capital, i.e., loans from banks or other credit agencies, is not generally accessible to farmers in Assam. As a result, borrowing from unscrupulous lenders, who are not regulated by the state, at an extremely high interest rate is common in the state. Tragically, in many instances some borrowers lose their livelihood, i.e., their cultivable land, to these unscrupulous lenders. However, the need for agricultural loan remains largely unfulfilled in Assam.

(3) Marketing problems

Agricultural markets in Assam are underdeveloped. Farmers sell to the nearest dealer/buyer immediately after harvesting when the price is at the lowest, instead of trying to find the best market for their products. Geographical isolation, weak transportation and communication systems, poor marketing facilities, poor or nonexistent market intelligence (e.g., information on price and place to sell) are some of the principal marketing related problems. In terms of the role of government, earlier studies have shown that government efforts are more focused on collecting revenue (in the form of tax in the daily or weekly markets or through check gates) than facilitating the marketing of agricultural products in Assam (Bhuyan, 1990; Bhuyan, *et al.*, 1990; Bhuyan, *et al.*, 1988) [5, 6, 7]. A reorientation of the government's focus from revenue collection to marketing facilitation will be necessary if farmers are too benefitted.

(4) Non-economic factors

Lack of education, ignorance about the changing economic conditions, outdated thinking, prejudiced cultural values, disturbed law and order situation, and lack of scrupulous legislative and administrative machinery are some of the principal noneconomic factors that hinder agricultural development in Assam. While the first four factors are mostly socio cultural, which may take time to change for the better, the latter two factors are political. All these factors adversely affect agricultural as well as economic development of the state.

Key production problems of maize in the state

As mentioned above, the natural calamities and marketing problem are two main key constrains in maize growing in

Assam. The crop is mainly grown in *kharif* season, and sown during June-August. During the time the state receives most of the rainfalls and the areas of medium to low lands get inundated. Hence, sowing time got delayed. Even if the sowing is done, the continuous rainfall makes the crop vulnerable for early damage during germination to seedling stage. Again in some parts though *rabi* maize is practiced, germination got affected due to low temperature and drought. As there is no regulated market for maize, the growers have to sell their produce in local market or to some middle man. Thus the appropriate price for the crop is not received by the farmers. Nowadays some small industries are coming up (like feed industries), which are making the marketing a bit ease for the growers. Still, the cases of middle agents are there where the farmers have to sell their products in a low price are in the process.

AICRP center and mandate

AICRP maize center started in 1st November, 1979 at Assam Agricultural University Campus at Jorhat. Later on it shifted to Gossainga on in the year of 2010.

The mandates of the center are as follows

- i. To undertake research for genetic enhancement in maize of yield and its important attributes
- ii. To develop efficient package of practices for increasing maize production in the state
- iii. To popularize the crop in the region through frontline demonstration of high yielding varieties

Popular hybrids

The popular varieties presently cultivated in the region are from private sectors only. The Monsanto varieties under DKC series are performing well and are the front runners in the popularity chart. Maize hybrids from Adavanta seed company Ltd. are also doing good business in the region. Some of the popular varieties worth mentioning are *viz.* DKC 9081, DKC 9035, DKC 9120, Jwala, PAC 751, PAC 712, PAC 740, Kavari, Hishel, Bioseed 9662, CP 808 etc.

Changes in cropping system over the years

The cropping system in a region changes gradually with the change of environmental factors, peoples' choice of food materials, availability of resources and ease of cultivation process etc. Based on these factors only, the cropping system of the state has been changed with time in a gradual manner over the years. The growing population and limited resources compelled people to grow more than one crop in a single plot of land. As per the crop maize, it is now being grown in place of summer rice in many areas of the state. The *kharif* maize is also getting popularity as it needs less water than some other major crops. In places people are practicing *kharif* maize followed by rapeseed and mustard and then *rabi* maize. As per land situation maize crop is being done in upland to medium land situation rather than the typical rice growing low land areas. Thus in the changing scenario maize is replacing the rice-rice cropping system in recent days.

Table 1: Production technologies recommended for the zone

New Hybrid
Vivek Maize Hybrid 53, Vivek Maize Hybrid 47, Bio 9544.
Intercropping and residue management:
Paired row Intercropping of Maize and Black Gram along with 5 ton residues retention which gives more yield and income.

Table 2: Production technology and package of practices

Production practice/technology	Recommendation		
Selection of Site and Land Preparation	Well drained sandy and sandy loam soils.		
Seed Rate	18-22.5 kg /ha		
Seed Treatment	Seeds should be dressed with carbendazim @ 2g/kg of seed or captan @ 2.5-3 g/kg of seed.		
Sowing Time (<i>kharif</i>)	Agro-climatic Zone	LBVZ	UBVZ
	Sowing time	Feb-	Mar-
		Apr	Apr
Sowing Time (<i>rabi</i>)	September-October and may extend to middle of November		
Method of Sowing	Seeds should be dibbled at a depth of 3-4 cm in rows at 65-75 cm apart and at a distance of 20-25 cm from seed to seed		
Manures and Fertilizers	Compost or FYM @ 5t/ha should be applied		
	Nutrient	Requirement (kg/ha)	
	N	60	
	P ₂ O ₅	40	
	K ₂ O	40	
	For Hills Zone, 90:40:40 kg / NPK per hectare.		
Method of Fertilizer Application	<p>FYM or compost should be applied during land preparation. The entire quantity of SSP and MOP and half of the total urea is to be applied in furrows (8-10 cm deep) and covered with 4-5 cm of soil. Sowing of seed should be done at least 2 days after fertilizer application.</p> <p>The remaining half of urea should be top dressed in two equal doses followed by earthing up in each case. The first ¼ at 35 days after germination or when the plants are at knee high stage and the second ¼ at the tassel initiation stage of the crop i.e. 45-60 days after germination or at the time of elongation of the flag leaf whichever is earlier</p>		
Weeding and Interculture	Light hoeing and earthing up should be done. For further and adequate control of weed, atrazine should be applied @ 0.5 – 1.0 kg a.i/ha in 900 litres of water as pre-emergence spray.		
Irrigation and Drainage	<p>Application of irrigation at the time of soil moisture deficit ensures optimum yield. Silking stages and grain filling period are the two critical stage of the maize crop. In <i>rabi</i> irrigation is needed at grand growth, tasselling and grain setting stage.</p> <p>Excess water can be drained out through surface drainage of 25 cm with, 15 cm deep spaced at 6 m distance.</p>		
Harvesting:	Harvesting should be done as soon as the husk covers turn brown and the silks are completely dry. Ears (cobs) should be thoroughly dried in the sun before shelling.		

*LBVZ: Lower Brahmaputra Valley Zone; UBVZ: Upper Brahmaputra Valley Zone;
CVZ: Central Valley Zone; NBPZ: North Bank Plain Zone; BVZ: Barak Valley Zone;
HZ: Hill Zone

Pest and disease management

Stem borer: When stem borer infestation is noticed any one of the following insecticides may be sprayed.

Table 3: Insecticide used for control of Stem borer

Insecticide	Quantity	Volume of water (l/h)	
		Power sprayer	Hand sprayer
Phosphamidon 100 EC	500 ml	200-250	400-500
Fenitrothion 50 EC	1.0 l	200-500	400-500

In addition to this all the dead hearts should be pulled out and destroyed to kill the lingering stage, of the pest in the stubbles.

Termites: Termites take a heavy toll of the crop especially in the *rabi* season.

Aphids, cob borers, jassids and mites: Use of Methyl demeton 25 EC, monocrotophos 36 WSC, phosphamidon 100 EC should be sprayed @ 1ml/l against these pests.

Maydis leaf blight: Use of protective fungicides of thiocarbamate group (Mancozeb, zineb) @ of 2.0-3.0 kg a.i./ha in 500-600 litres of water at the time of appearance of the disease symptoms or at knee high stages.

Sclerotial disease: In areas where banded sclerotial disease (*Rhizoctonia solani*) is noticed, the plants should be sprayed with carbendazim 0.05% (0.5 g/lit water) @ 700 l/ha of spray

solution at an interval of 12-15 days. Matured cobs can be protected from bird damage by tying cobs with leaves of the same plant.

Turicum leaf blight (southern corn blight): The disease can be controlled by 2-3 foliar sprays with 0.25% to 0.3% mancozeb or zineb at 10-15 days interval. Application of urea followed by a light irrigation also helps to minimize the disease as it sometimes becomes serious due to poor management.

Seed rot and seedling blight: The best recourse to these problems is to sow certified seeds from a reliable source, which is pretreated with desired fungicides. If one wants to use his own seed, seed treatment is a must.

Pythium stalk rot: Apply Captan or Thiram @ 2.5 kg/100 litres of water/ha at the lower internodes of plants at 30-35 days after planting. Drain out excess rain water from the field.

Banded leaf and sheath blight: In areas where this disease is noticed the plant should be sprayed with carbendazim @ 0.05% @ 700 l/ha at an interval of 12-15 days.

Bird damage: The mature cobs can be protected from bird damage by tying the cobs with leaves of the same plant. Shinning, coloured strips may also be used to scare away the birds.

Post-Harvest management

Harvesting immediately after a shower should be avoided. Ears (cobs) should be thoroughly dried in the sun before shelling or storing unshelled. Keep the grain as clean as possible. Dry maize on cement floor or use tarpaulin to reduce chance of contamination.

At home, do not first heap the cobs in any room, kitchen or in the yard because this will expose them to all the dangers that cause post-harvest losses. Transfer them to the drying place (like the crib) immediately. Dry on concrete or canvas not directly on bare soil.

During storage, the grain must remain dry and clean. Grain storage can be extended for up to 2 years without any significant reduction in quantity and quality. However, the majority of farmers sells off their maize grains cheaply soon after harvesting due to anticipated losses in storage and later buy food at exorbitant prices. There are improved storage structures that can prolong the storage duration until market prices for grains are favorable.

Frontline Demonstration in Maize

The results of different demonstrations conducted during *rabi* and *kharif* seasons during 1990 to 2016. In an average more yields was observed in *kharif* compared to *rabi* season.

Table 4: Information of FLDs in maize conducted during *kharif* seasons

Year	FLD (ha)	Variety	Yield (q/ha)
1999	19	Vijay	24.4
2000	22	Vijay	20.89
2001	41	Ganga-11, Deccan-105	25.28
2002	19	Navjot	25.22
2003	47	Mahi Kanchan	33.36
2004	33	Vijay, Navjot	15.93
2007	15	Vijay	37.00
2008	10	Vijay	35.00
2009	60	PEHM 2 and Shaktiman 4	68.00
2010	15	Navjot	36.98

Table 5: Information of FLDs in maize conducted during *rabi* seasons

Year	FLD (ha)	Variety	Yield (q/ha)
1998-99	16	Vijay	11.94
1999-00	17	G-11, D-105	26.71
2000-01	40	Vijay	28.38
2001-02	1	Vijay	29.15
2013	04	Bio seed Hybrid	30.24
2014	80	HQPM-5 and PAC-740	35.7

Key R&D challenges and probable solutions

The crop is now in a status of emerging crop in the state and constant increase in acreage is being observed in recent years. Main factors determining its growth as a major crop can be outlined as followed.

Lack of suitable hybrids/composites

People are growing different varieties in the region. But a proper and suitable variety (hybrids/composites) is not established yet. The farmers are taking whatever is available in the market.

Presently some initiatives are being taken by the Agricultural University to find out suitable hybrids for the region. Some private sector companies are also coming up with some good hybrids.

Improper crop management

The farmers are not following a definite package of practices. The fertilizer dose etc. are not adhered to and thus the yield potential is not exploited to the fullest extent.

Awareness programmes/trainings have now been organized by the University Research Stations, KVKs and also by state Agricultural department to educate the people in maize growing.

Seasonal suitability

As the major season is *kharif*, varieties/technologies suitable for the season is limited. The crop is affected with continuous rainfall during sowing time and with drought during cob formation stage.

Calibration regarding sowing time and other agronomic practices is necessary to solve the problem. Concurrently, *rabi* maize also can be popularized in irrigated areas.

Researchable issues in maize

Maize being cultivated mainly in the Lower Brahmaputra Valley Zone, continuous feedback from farmers is received time to time. The researchable issues thus formulated are as followed:

- Suitable hybrid for the area
- An effective fertilizer dose for the hybrids
- Hybrids resistant or tolerant to pest and diseases
- Technologies to protect the harvested products from stored grain pests

Summary

Maize being a crop of high potential can give a boost to the economy of the state. The main limiting factors like suitable hybrids, seasonal heavy rainfall and proper agronomic practices could be dealt by a systematic study. The industrial use of the produce is helping the farmers to boost their cultivation.

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