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Scope for Post Harvest Management in North East India through Zero Energy Cool Chamber

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ABSTRACT

To reduce the problems of post harvest losses at farmer level, Zero Energy Cool Chamber (ZECC) system of storage was taken for study for storage of vegetable and fruits at Wokha district of Nagaland and Imphal West district of Manipur. It is eco friendly and zero energy requirements for storage of vegetables and fruits. ZECC improves the quality and productivity of vegetables and fruits by reducing field heat, increasing shelf life and checking post harvest losses respectively. The study in Wokha, Nagaland found that shelf life of cucumber was 18 days in ZECC condition and as in room condition it was 13 days and weight loss was 33.3% and 33.5% respectively. Shelf life of French bean was same for both in ZECC condition and room condition, but weight loss was 15.0% in ZECC condition and 33.3% loss in room condition. In case of passion fruit it was 9 days for ZECC condition and 5 days for room condition and weight loss was found to be 6.7% and 8.3% respectively. The study in Imphal West, Manipur revealed that Shelf life of cabbage was 10 days in ZECC condition and 4 days in room condition. Storage duration of cauliflower was found 15 days under ZECC condition and 6 days under room condition. Shelf life of mushroom under ZECC condition was 5 days and one day under room condition. There is big scope for study for storage of different vegetables and fruits for different region and its suitability by using Zero Energy Cool Chamber storage system.

1. Introduction

North east India comprises of seven states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura (Figure 1). The region lies between 21°45′ to 29°45′ N latitude and 89°36′ to 97°5′ E longitude. The average annual rain in the region is about 2450 mm. Due to lack of sufficient storage and processing facilities in north east India, considerable amount of fruits and vegetables are being spoiled after harvest. Losses occur in both ways *i.e.* qualitative and quantitative terms. According to the FAO report the global food losses and wastages in the year 2012 is 30 – 40% and food losses are more in low-income countries. Post harvest losses in developing countries are more than 40% (Narayana, 2014).

Prevention of such losses is most appropriate method to make available more quality vegetables and fruits and is a complementary means of increased production. The farmers of north east India have poor resource availability particularly where the vegetables are grown as subsistence crop by the small and marginal land holders. In absence of proper storage technique the farmers usually sell their vegetables in the local markets soon after the harvest. Transporting their harvest in gunny bags on local transport to markets induced a considerable stress on them. Storage and upkeep of fruits and vegetables are most important post harvest activity. Due to lack of sufficient storage and processing facilities in north east region, considerable amount of fruits and vegetables are being spoiled after harvest. The spoilage of fruits and vegetables can be controlled by reducing the storage temperature and increasing relative humidity.

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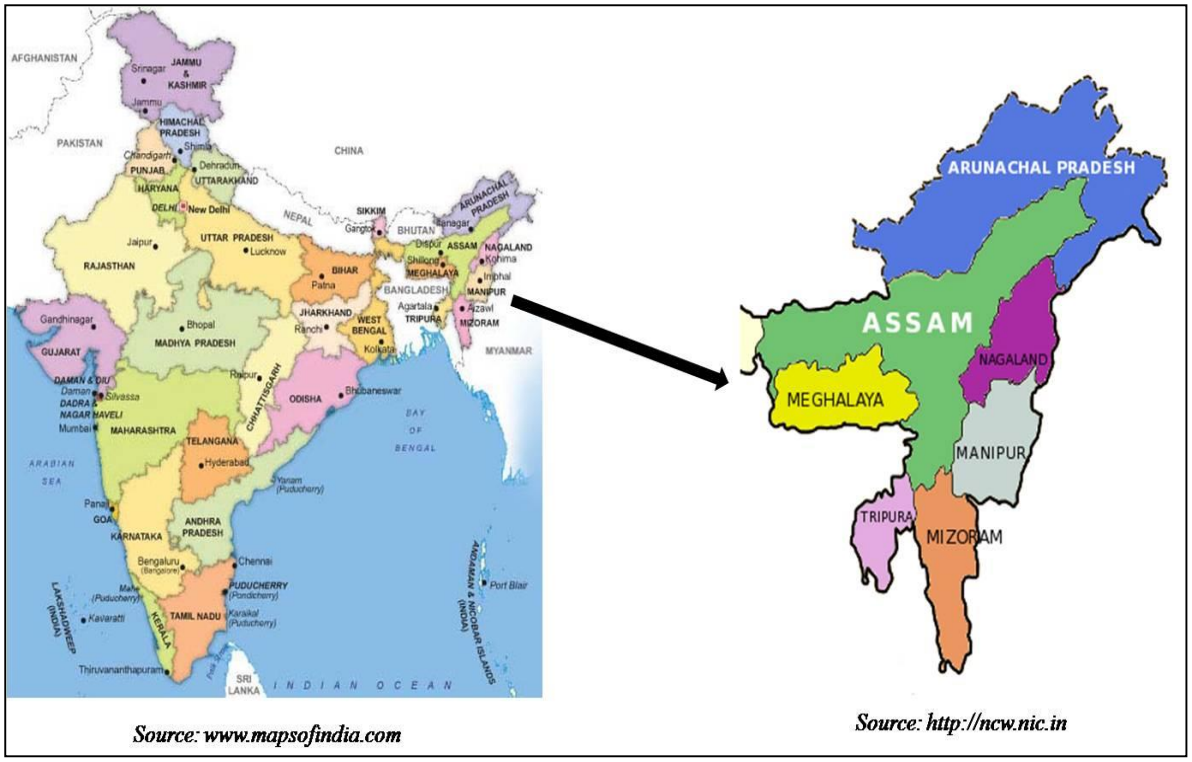

Figure1. Location of the north eastern region of India showing the seven states

Refrigerated cold storage is considered to be the best for storing fruits and vegetables, but this method is not only highly energy intensive, but also requires huge capital investment. Besides, it is not suitable for on-farm storage in rural areas, where the producer would like to store the commodities only for a couple of days in order to make it sufficient quantities before carrying them to nearest market. Considering acute energy shortage and inadequate cold storage facilities in rural areas, there is tremendous scope for adoption of low cost "Zero Energy Cooling Chamber" for short term on farm storage of perishable farm produce.

2. Materials and Methods

The study was carried out in 2 districts of north east India, one hill district at Wokha, Nagaland (25° 60′ to 27° 40′ north latitude and 93° 20′ to 95° 15′ east longitudes) and another valley district at Imphal West, Manipur (24° 33′ to 25° 00′ north latitudes and 93° 45′ E to 94° 15′ east longitudes). The main occupations of the people of both the districts are cultivation.

2.1 Cropping pattern of Wokha district, Nagaland

People in the district mainly depend on shifting cultivation or *jhum* but horticultural plantation and other non-agricultural resources are also being practiced at minor scale.

Jhum cultivation has been devised over generations through the innate experience and knowledge gained by the rural people over the land, labour, environment resources available and the cropping requirements. The main crop is rice and various other crops like maize, millets and pulses are grown in the same field with the rice. Vegetables like cabbage, chilies, bhindis are grown along with rice. The people practice backyard poultry farming and some of the people practice piggery and dairy farming in a small scale.Peach, plums, pineapple and citrus also do well in this district and the productions of these are sold to local market.

The other vegetables such as French beans, cauliflower, chow-chow, colocasia, tapioca, radish, leafy vegetables are commonly planted near homestead and ridge boundary of the *jhum* field. Till date agriculture continues to be the main source of livelihood however, the district is not self sufficient in production of food grains. The details fruits and vegetable productions in Wokha district are shown in Table 1 and Table 2. The Table 1 and Table 2 show that Wokha district Nagaland has enough potential to produced vegetables and fruits.

2.2 Cropping pattern of Imphal West district, Manipur

The Imphal west district has two categories of land classifications, valley plains are the major portion of the district and another is the foot hills, which has little higher elevation than the valley plain.

Table 1. Area and production of fruit crops of Wokha district, Nagaland (Source: Statistical Hand Book of Nagaland, 2013)

Sl. No.	Fruit Crops	Year 2010-2011		Year 2011-2012		Year 2012-2013		Average	
		Area (Ha)	Production (MT)	Area (Ha)	Production (MT)	Area (Ha)	Production (MT)	Area (Ha)	Production (MT)
1.	Pear	23	46	25	50	30	240	26.00	112.00
2.	Plum	40	80	45	90	55	550	46.67	240.00
3.	Peach	25	65	25	65	35	175	28.33	101.67
4.	Orange	650	5500	650	5500	800	7300	700.00	6100.00
5.	Lemon	250	2000	250	2000	300	1980	266.67	1993.33
6.	Pomelo	115	245	115	245	115	470	115.00	320.00
7.	Pomegranate	10	40	10	40	10	40	10.00	40.00
8.	Papaya	210	1400	210	1500	260	1612	226.67	1504.00
9.	Banana	1010	6100	1020	7500	1020	12250	1016.67	8616.67
10.	Guava	30	150	30	150	40	200	33.33	166.67
11.	Mango	30	60	30	60	40	280	33.33	133.33
12.	Litchi	40	20	40	20	20	200	33.33	80.00
13.	Jack Fruits	10	45	10	45	10	35	10.00	41.67
14.	Pineapple	820	7300	830	7350	830	7870	826.67	7506.67
15.	Mosambi	50	130	50	130	70	560	56.67	273.33
16.	Passion Fruit	1120	2240	1120	2240	1170	2691	1136.67	2390.33
17.	Grapes	20	20	20	20	20	210	20.00	83.33
18.	Gooseberry	20	300	20	300	30	240	23.33	280.00
	Total	4473	25741	4500	27305	4855	36903	4609	29983

Table 2. Area and production of vegetable crops of Wokha district, Nagaland (Source: Statistical Hand Book of Nagaland, 2013)

Sl. No.	Vegetable Crops	Year 2010-2011		Year 2011-2012		Year 2012-2013		Average	
		Area (Ha)	Production (MT)	Area (Ha)	Production (MT)	Area (Ha)	Production (MT)	Area (Ha)	Production (MT)
1.	Sweet Potato	110	1400	120	1440	155	1550	128.33	1463.33
2.	Cabbage	110	850	110	880	210	2100	143.33	1276.67
3.	Cauliflower	50	100	50	150	50	250	50.00	166.67
4.	Brinjal	30	220	35	245	35	350	33.33	271.67
5.	Chillies	400	2500	600	3000	500	3750	500.00	3083.33
6.	Bhindi	50	200	50	200	50	200	50.00	200.00
7.	Peas	110	900	100	600	110	1012	106.67	837.33
8.	Beans	100	700	150	750	150	1225	133.33	891.67
9.	Tomato	100	500	120	600	170	680	130.00	593.33
10.	Onion	40	320	40	320	50	500	43.33	380.00
11.	Ginger	200	3000	200	3500	200	3500	200.00	3333.33
12.	Garlic	5	15	5	15	5	15	5.00	15.00
13.	Radish	40	250	40	250	50	300	43.33	266.67
14.	Colocasia	300	6000	500	6000	500	6000	433.33	6000.00
15.	Tapioca	500	4000	500	4000	550	4500	516.67	4166.67
16.	Chowchow	300	2000	300	2000	400	4800	333.33	2933.33
17.	Leafy vegetables	500	1000	500	1000	500	4000	500.00	2000.00
	Total	2945	23955	3420	24950	3685	34732	3350	27879

The crops paddy, maize, wheat, pulses, oilseed, sugarcane and potato are grown in Imphal west district, Manipur. The district has rich varieties of vegetables, a wide range of herbs, shrubs and fruits. The important fruit crops of Imphal west district are gooseberry, papaya, pamelo, mango, plum, peach, pear, guava and tamarind. Paddy is the staple food of Manipuri and is cultivated extensively followed by oilseed crops like rapeseed mustard. Among pulses pea is most popular and is mainly grown for green pods. The important vegetable crops are cole crops including broccoli, cauliflowers cucurbits, solanicious crops like brinjal, chilli and tomato are grown. The details fruits and vegetable productions in Manipur are shown in Table 3 and Table 4. The Table 3 and Table 4 show that Manipur has the potential production of vegetables and fruits.

Table 3. Year-wise area and production of fruit crops in Manipur (source: http://manipursfac.com)

Year	Area (ha)	Production (MT)
2001-02	24340	101020
2002-03	25400	120560
2003-04	27080	167740
2004-05	30710	193230
2005-06	31160	189100
2006-07	33980	229120
2007-08	39100	273730
2008-09	42400	348490
2009-10	44790	283600
2010-11	45570	371600
2011-12	49480	405870

Table 4. Year-wise area and production of vegetable crops in Manipur (source: http://manipursfac.com)

Year	Area (ha)	Production (MT)
2001-02	6260	44830
2002-03	6930	48670
2003-04	7670	57020
2004-05	8020	62785
2005-06	8370	67340
2006-07	10340	91770
2007-08	12090	113670
2008-09	16620	174260
2009-10	19740	213040
2010-11	20180	192960
2011-12	20850	200340

2.3 Zero Energy Cool Chamber

Zero Energy Cool Chamber has been designed by IARI Pusa, New Delhi (Roy, 1988) on the principle of evaporative cooling *i.e.* cooling effect created due to evaporation of water.

The cool chamber maintains relatively lower temperature as compared to ambient temperature and unlike outside fluctuation in mercury, the temperature variations inside the cool chamber happen to be very low. Similarly, the relative humidity inside the cooling chamber is also relatively higher than that of outside. The Zero Energy Cool Chamber (ZECC) can be constructed easily with materials like bricks, sand, bamboo, thatch grass, etc (Figure 2). It was constructed by following steps:

- Selecting of an elevated space having a nearby source of water supply.
- Constructing of floor of 165 cm x 115 cm with bricks.
- Erecting of double brick wall up to height of 67.5 cm leaving gap of 7.5 cm in between two walls.
- Soaking of fine river bed sand with water.
- Filling up of the cavity between the double walls with wet sand.
- Making a top cover with bamboo straw and other locally available material to protect the chamber from direct sun or rain.

2.4 ZECC trial under Wokha condition

The data of ZECC trial under Wokha condition was taken from KVK Wokha. The trial was taken up as an on farm trial (OFT) which is a demonstration activity of KVK Wokha in the year 2008-09. About 10 numbers of ZECC were constructed under the KVK programme in different villages of Wokha. Singh et al. (2011) had earlier worked on low cost storage of vegetables and fruits in Wokha district.

2.5 ZECC trial under Imphal West condition

The data of ZECC trial under Imphal West condition was obtained from KVK Imphal West. Five numbers of ZECCs were constructed under KVK programme. The trial was taken up as an on farm trial (OFT) in the year 2011-12. ZECCs were constructed at different villages of Imphal west district, Manipur

3. Results and Discussion

3.1 Results of ZECC trial under Wokha condition

Shelf life of cucumber was 18 days in ZECC condition and 13 days in room condition. The weight loss of cucumber in ZECC condition was 33.33% and 33.50% weight loss in case of room condition.

Figure 2. Different stages of construction of Zero Energy Cool Chamber (ZECC)

Shelf life of French bean was found to be same for both cases under ZECC condition and room condition, but weight loss under ZECC condition was 15.0% , where as 33.3% weight loss in case of room condition. Trial on passion fruit was found that shelf life under ZECC condition was 9 days and 5 days under room condition. Further weight loss of passion fruit was measured and found 6.7% weight loss in case of ZECC condition and 8.3% weight loss under room condition (Singh et al. 2011). The graphical presentations of ZECC trial under Wokha condition are given in Figure 3 and Figure 4.

3.2 ZECC trial under Imphal West condition

Trial was conducted under Imphal west, Manipur condition in cabbage, cauliflower and mushroom.

These are the valuable horticultural crops of Manipur. Shelf life of cabbage was 10 days in ZECC condition and 4 days in room condition. Storage duration of cauliflower was found 15 days under ZECC condition and 6 days under room condition. Shelf life of mushroom under ZECC condition was 5 days and one day under room condition (Figure 5). ZECC condition could extension another six days in shelf life of cabbage and 9 days case in of cauliflower help the farmers in terms of controlling market supply and most importantly controlling the market price. Mushroom industry in the state is at infant stage. Fresh mushrooms are highly demand in the local market and most of the mushroom growers in the state are cultivated mushroom at the household level. ZECC can play big role in providing fresh mushroom in the market for the small mushroom growers.

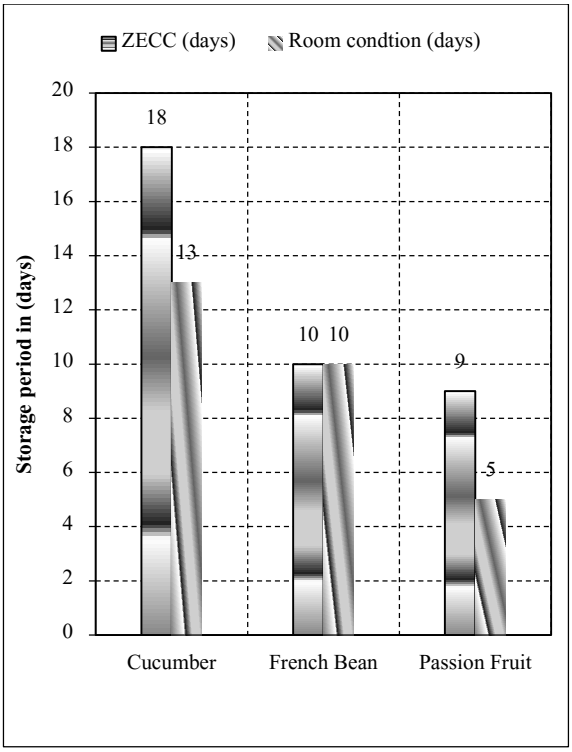

Figure 3. Comparison of shelf life of fruits and vegetables under ZECC condition and Room condition in Wokha district, Nagaland

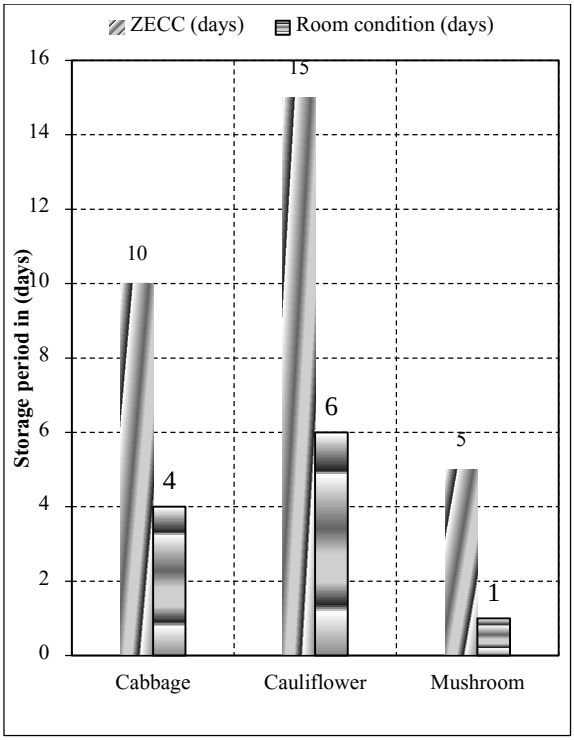

Figure 5. Comparison of shelf life of vegetables and mushroom under ZECC condition and Room condition in Imphal west district, Manipur

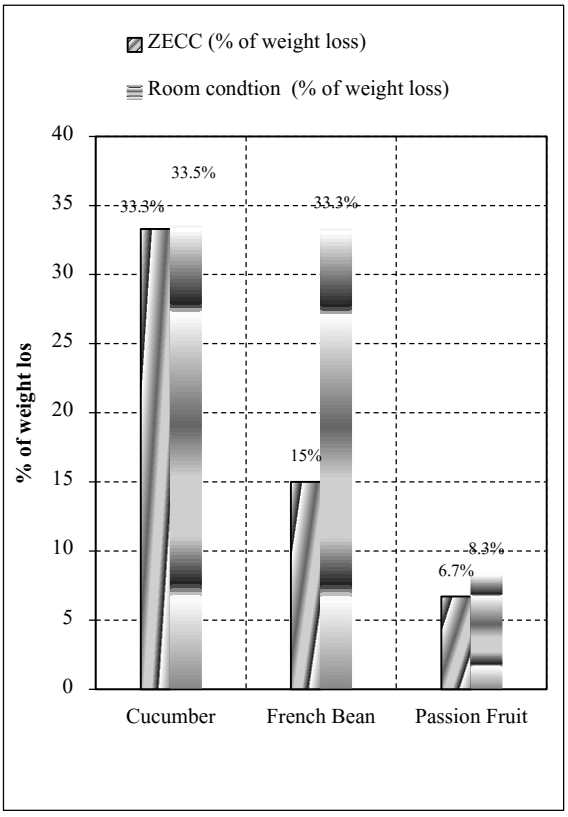

Figure 4. Comparison of percent of weight loss of fruits and vegetables under ZECC condition and Room condition in Wokha district, Nagaland

4. Conclusion

The above data show that north east India has sufficient potential to produce enough quantity and quality of fruits and vegetables in the region. Still there is lack of post harvest management. Due to lack of proper storage and processing facilities considerable amount of horticultural produces goes waste. Farmers are forced to sell their produce immediately after harvest, which lead to glut in market and resulting into lower return of their produced. The road side sellers and farmers could be benefited by using low cost storage technology. Thus there is large scope for popularization of Zero Energy Cool Chamber in the entire north east India.

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References

Anonymous, (2013). Statistical Hand Book of Nagaland, Directorate of Economics & Statistics, Government of Nagaland, Kohima.

http://manipursfac.com/wp-content/uploads/2013/11/Area-Prdn-Hort-Crops.pdf (assessed October 10, 2015).

http://www.mapsofindia.com/images2/india-map.jpg (assessed on October 03, 2015).

http://ncw.nic.in/images/NER.png (assessed on October 03, 2015).

Narayana, C.K. (2014). A step towards prevention of food losses. Current Science, 106(1):15-16.

Roy, S.K. (1988). Postharvest technology of vegetable crops in India. Indian Horticulture. Jan-June: 7678.

Singh, L.K., Raman, S.K., Devi S.R. and Meyase, M. (2011). Low Cost Storage of Vegetables and Fruits in Wokha District of Nagaland-A Case Study. Developing the Potential of Underutilized Horticultural Crops of Hill regions, National Workshop cum Seminar, Imphal Manipur (14 - 16 February, 2011).