# Land Utilization, Cropping Intensity and Cropping Pattern in Assam: Trend of Diversification towards High Valued Horticulture Crops

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## Abstract

In Assam, horticulture crops are produced in six agro-climatic zones. However, only in Lower Brahmaputra Valley and Central Brahmaputra Valley Zone, some of horticulture produce are included in the major crops categories. Again, cropping intensity for Assam is remaining stagnant over decades. No significant positive trend is associated with cropping intensity from 1991-92 to 2014-15. Food grain dominated in Assam's agriculture. Almost 68 percent of total cropped area is covered by food grain production and Rice constitutes the major portion of it. However, a positive move is that diversification is taking place in favor of horticulture crops. There is increase in acreage share under fruits, vegetables, spices and tuber crops. On the other hand, acreage share under traditional crops, total food grain, total oilseeds and sugarcane has been declining from 2001-02 to 2014-15. To some extent, the changing cropping patter is clearly indication of diversification of Assam's agriculture to high valued horticulture crops.

Key word: Land utilization, Cropping intensity, Cropping pattern, Diversification

## Introduction:

Land has always been a subject of interest, a sensitive one, in Assam, given the size and diversity of population, history and culture. It is also an important one, considering the large percentage of population directly involved in it and dependent on it for their livelihood. Land and its utilization are crucial and occupy an important factor as the source of livelihood and in turn, production of different crops depends upon the availability of land its distribution among different crops. Land being a scare commodity and its complex problem of demand and supply requires rational and scientific classification and scientific utilization, a matter of utmost necessary **(Das, 1984)**. The government of India adopted classification of land in the line with the recommendation of the Standing Advisory Committee on Statistics, F.A.O **(Mamoria, 1972)**. According to this classification, land in Assam is classified under nine

categories, viz.(i) Forest, (ii) Area put to non-agricultural uses, (iii) Barren and uncultivable land, (iv) Permanent pastures and other grazing land,(v) Land under Miscellaneous tree crops and groves, (vi) Cultivable waste lands, (vii) Fallow land other than current fallow, (viii) Current fallow and (ix) Net area sown.

Agriculture, in Assam, is the core sector, providing livelihood to significant proportion of population. In contrast, in national level there has been a decline in the growth of agriculture during the 1990's till the recent past **(Mathur et al., 2006)**. Indian agriculture being diversified from traditional agriculture to the more remunerative high valued horticulture crops[1]. Fruits, vegetables, and livestock products have been processing at a faster pace, which reflected in the high share of high-value crops in agriculture production **(Rao et al., 2006)**. Crop diversification spreads the national sources of income and is seen as an important means of avoiding over-reliance on a limited number of agricultural commodities. **(Wainwright, 1994)**. There are some factors that cause the diversification from agriculture to horticulture. They are first; rapid economic growth in many Asian countries has allowed consumers to shift from traditional food grains and some other starchy staples to high-value foods. The second factor is urbanization that takes place at the faster rate. Third, the change towards more outward-looking trade policies has affected production. Fourth, liberalization opens up FDI that affected food-marketing channels **(Gulati et al., 2005)**. **(Joshi et al., 2006)** states that urbanization and infrastructure play an important role in shifting cropping pattern towards high-value commodity. High-value agriculture has a comparative advantage in production and labour absorption over staples and thus recognized as an important strategy for smallholders can boost their income and employment **(Pingali and Rosegrant, 1995; Mellor, 2004)**. The high value produces like fruit, vegetable, egg, dairy, meat, and fish provide remunerative price than cereals as there is a continuous increase in demand for these crops. Thus, farmers are able to receive higher market price than the traditional crops and the diversification is found to be profitable **(Raju, 2005; Singh et al., 2007; Jha et al., 2009)**. There is scope for raise income of the farming community and employment opportunities associated with the high-valued sector **(Choudhary, 2013)**. However high-valued crops involved market risks due to its perishability nature which causes considerable price fluctuation or instability.

[1] High valued horticultural crops, which include vegetables, fruits and spices/condiments **(Gautam, 2016)**.

Agricultural diversification can be seen as an instrument to raise farm income, generate employment opportunities, alleviate poverty and for conservation of natural resources **(Braun, 1995; Pingali and Rosegrant, 1995; Ryan and Spencer, 2001; Birthal et al., 2005)**. In Assam, **Maldal (2010)** observed an increase in the acreage share of Rabi food grain, oilseeds, fruits, spices, vegetables and the corresponding decline in the Kharif food grains. **Bhattacharyya (2008)** states that diversification not only enhances income but diversification towards high-value crops such as vegetables helps in preserving and managing soil fertility. However, for state like Assam, limited numbers of studies has been done in this regard. Thus, in the contest of diversification , we will examine the cropping pattern in Assam in terms of possible diversification from traditional agriculture towards horticulture crops.

## Objectives, Data sources and Methodology:

The specific objectives of this paper are-

(a) To observe land utilization statistics in Assam.

(b) To estimate the cropping intensity in Assam and check whether significant trend is associated with cropping intensity or not.

(c) To observe cropping pattern in Assam in terms of possible diversification from traditional agriculture to high valued horticulture crops.

The paper intends to provide a picture of land utilization, cropping intensity and cropping pattern in Assam and is based on secondary data. Data pertaining to the study are collected from various reports and publications of different government and other organizations such as Directorate of Agriculture; Assam, Directorate of Horticulture & FP; Assam, Directorate of Economics and Statistics; Assam, Budget Reports of Government of Assam, Economic Survey Assam and indiastat.com .

In this paper, we compute cropping intensity with the help of following formula-

$$\text{Cropping intensity } = \frac{\text{Gross Cropped Area}}{\text{Net Sown Area}} \times 100$$

To checking whether significant trend is associated with cropping intensity or not, simple regression model in the form of $Y = \beta_0 + \beta_1 t + e$ is used **(Hirsch et.al, 1991)**. Again, to capture the possible diversification from traditional agriculture to horticulture in terms of

changing cropping pattern of Assam agriculture, the study incorporate the method of percent distribution of gross crop area under different crops and changes in the distribution over time.

## Agro-climatic Zone Wise Cropping Sequence in Assam:

Cropping Pattern refers to the proportion of area under different crops at a point of time. Changing cropping pattern means a change in the proportion of area under different crops. In Assam, cropping pattern is determined by natural factors such as soil, climate and rainfall. Based on the characteristics the state of Assam is comprised of three physical divisions, via, Brahmaputra Valley, Barak Valley and the Hill Range with a geographical area of 78,438 sq. km, which is 2.4 percent of the country's total geographical area. The Brahmaputra valley being the largest strip of plain extending its land from west to north-east covers 72 percent of total area of the state through a distance of 450 km. and about 85 percent of population in total geographical area. Besides the state of Assam constituting by the above mention three board natural divisions, it has been divided into six agro climatic zones based on the state reside in this region **(Das, 1984).** The Barak valley is in the southern part of the state accounting about 9 percent of the state and the Hill constitutes 19 percent of patterns of climatic condition and rainfall, terrain and soil type. The six agro climatic zone wise cropping sequence are presented in the Table 1.1. It will be observed from Table 1.1; that, rice has traditionally been considered as the principal crop in these zones. The method of cultivation in Plains almost similar to the most part of India. Rainfall is determinant factor of scale of cultivation in Assam Agriculture. During winter season, the scale of cultivation is much smaller as major crops are dependent on rainfall. Again, the method of cultivation in hills is

Table 1.1: Agro-climatic Zone Wise Cropping Sequence

| Zone | Districts | Important Crops |
|---|---|---|
| Lower Brahmaputra Valley Zone | Kamrup-Rural, Kamrup-Metro, Nalbari, Baksa, Barpeta, Bongaigaon, Chirang, Kokrajhar, Goalpara & Dhubri | • Major crops – Winter (Sali) Paddy, Summer (Boro) Paddy, Autumn (Ahu) Paddy, Maize, Pulses, Oilseeds, Jute & Vegetables.<br>• Other crops –Sugarcane.<br>• Other horticultural crops - Cashew nut, Banana, Assam Lemon, Orange, Pineapple, Arecanut & Coconut. |
| North Bank Plains Zone | Darrang, Udalguri, Sonitpur, Lakhimpur & Dhemaji | • Major crops – Winter (Sali) Paddy, Deep Water (Bao) Paddy, Autumn (Ahu),Paddy, Boro Paddy<br>• Other crops – Mustard, Pulses, Maize & Jute.<br>• Horticultural crops - Black Pepper, Banana, Ginger, Pineapple, Orange, Litchi, Assam Lemon, & Vegetables. |
| Upper Brahmaputra Valley Zone | Tinsukia, Dibrugarh, Sibsagar, Jorhat & Golaghat | • Major crops – Winter (Sali) Paddy.<br>• Other crops – Mustard, Pulses, Sugarcane & Maize<br>• Horticultural crops - Black Pepper, Banana, Ginger, Orange, Assam Lemon, Vegetables & Arecanut. |
| Central Brahmaputra Valley Zone | Nagaon & Morigaon | • Major crops – Winter & Summer Paddy, Jute, Sugarcane,Vegetables &Oilseeds.<br>• Other crops – Maize & Pulses<br>• Other horticultural crops - Banana, Assam Lemon, Arecanut & Coconut. |
| Barak Valley Zone | Cachar, Karimganj & Hailakandi | • Major crops – Winter (Sali) Paddy, Autumn (Ahu) Paddy<br>• Other crops – Summer (Boro) Paddy, Sugarcane<br>• Other horticultural crops –French Bean, Ginger, Vegetables Pineapple & Arecanut. |
| Hill Zone | Karbi Anglong & North Cachar Hills | • Major crops – Winter (Sali) Paddy, Autumn (Ahu) Paddy, Summer (Boro) Paddy, Maize, Sugarcane<br>• Other crops - Oilseeds & Pulses.<br>• Other horticultural crops – Pineapple, Orange & other citrus crops, Ginger, Vegetables & Arecanut |

**Source:** *Directorate of Agriculture, Government of Assam*

different from Plains. In the hills, the traditional practice of shifting 'jhum' cultivation is the predominant mode of farming **(Bezbaruah, 1994)**. In all six zones, horticulture crops are produced. However only in Lower Brahmaputra Valley Zone and Central Brahmaputra Valley Zone, some of horticulture produce are included in major crops category.

## Results and Discussion:

Land Use Pattern and Cropping Intensity of Assam:

As per the Land Utilization Statistics for the year 2014-15**,** Assam compromise 78.44 lakh hectares of total geographical area. Out of the total geographical area, net sown area[2] constitutes 36.04 percent, 23.62 percent was under forest, 31.36 percent was 'land not available for cultivation' and 6.74 percent was other uncultivable area. Fallow land constitutes 2.23 percent, land under still water and water logged area together constitutes 2.74 percent. The area under Social forestry was 0.14 percent of the total geographical area. The Gross Cropped Area[3] in the State was 40.83 lakh hectare in 2014-15 compared to 41.00 lakh hectare in 2013-14 showing and decline of 0.17 lakh hectare in 2014-15 **(Economic Survey Assam, 2016-17)**. Further, the cropping intensity of Assam from 1991-92 to 2014-15 are calculated which are presented in Figure 1.1. Fluctuation of cropping intensity is observed in the range between 139.79 and 145.46 at 95 percent confidence interval. However, no significant positive trend[4] is associated with cropping intensity from 1991-92 to 2014-15. Thus, we can say the cropping intensity is remaining static in Assam over decades.

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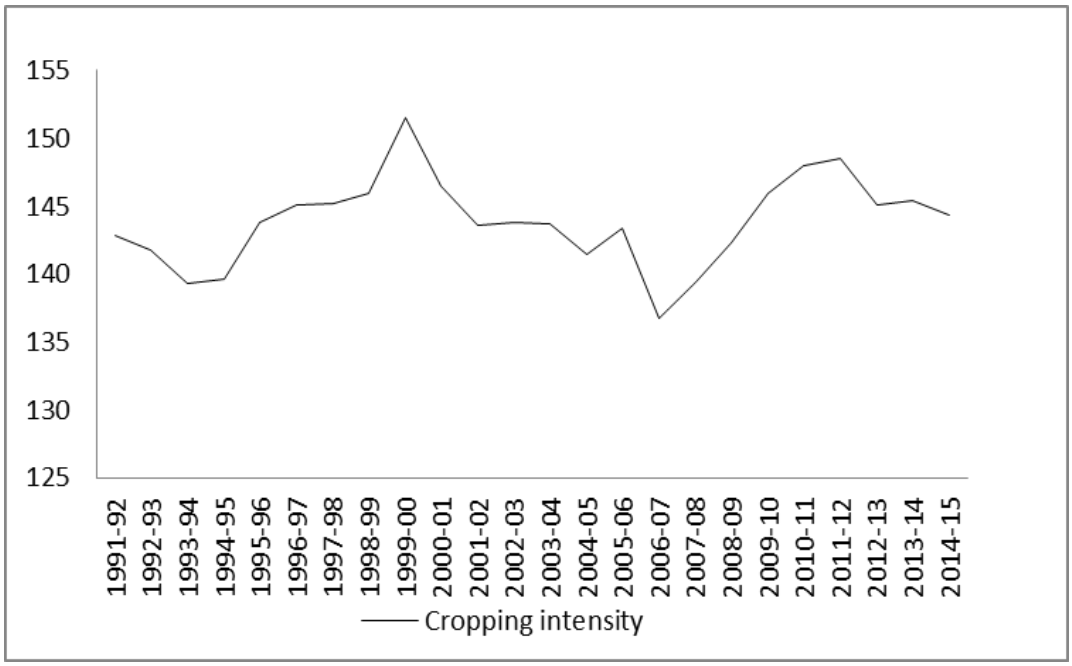
[2] Net sown area represents the total area sown with crops and orchards. Area sown more than once in the same year is counted only once.

[3] Gross Cropped Area represents the total area sown once or more than once in a particular year, that means, the area is counted, as many times as there are sowings in a year. This total area is also known as total cropped area or total area sown.

[4] Simple regression model in the form of $Y = \beta_0 + \beta_1 t + e$ is use to checking whether significant trend is associated with cropping intensity or not. Results found that coefficient value is not significant, the constant value which is 142.63 highly significant at 1 percent level of significant.

**Figure 1.1 : Cropping Intensity of Assam during 1991-92 to 2014-15**




**Source:** *Author 's calculation based on data collected from*
*(1)Directorate of Economics and Statistics, Government of Assam*
*(2) indiastat.com*

## Cropping Pattern in Assam: Trend towards High Valued Horticulture Crops:

The shares of different crops in the gross cropped area indicate the cropping pattern. This may undergo changes overtime in response to changes in economic, technological or other environmental factors. Table 1.2 the cropping pattern in Assam is examined from the period of 2001-02 to 2014-15. We examine the date from the year 2001 as because of there is rapid upscalling of number of cold storage as well as capacity expansion in Assam from the year 2001. Assam agriculture dominated by food grains. Almost 68 percent of total area is covered by food grain production and Rice constitutes the major portion of it. However, a noteworthy change has been observed from the period from 2001-02 to 2014-15. The percentage share of traditional crops[5] in the gross cropped area gradually decline, on the other hand the percentage share of high valued horticulture crops in the gross cropped area gradually increases. A noteworthy aspect of Assam agriculture is that diversification that has occurred in favour of horticulture crops**.** There is increase in acreage under fruits, vegetables, spices and tuber crops. While, acreage under

[5] The traditional crops, which include cereals, pulses, oilseeds, cotton and sugar cane **(Gautam, 2016)**.

traditional crops, total food grain, total oil seeds and sugarcane has been declining from 2001-02 to 2014-15. For food grains, the declining trend was observed from 2001-02 to 2007-08 and almost remain static from 2008-09. There is 28.22 percent increase in acreage under fruits from 1.13 lakh hectares in 2004-05 to 1.44 lakh hectares in 2015-16 and 25.88 percent increase in acreage under vegetables from 2.22 lakh hectares in 2004-05 to 2.80lh in 2015-16. The increase in percent area under tuber crops and spices in the same period was 34.07 percent and 29.68 percent respectively. The increase area under tuber crops was 0.84 lakh hectares in 2004-05 and 11.24 lakh hectares in 2015-16 and for spices; it was 0.84 lakh hectares to 10.87 lakh hectares during the same period. The same facts have been shown in the Figure. 1.2 for the four years.

Table 1.2: Area under Major Crop Category as a Percentage of Gross Area Cultivated during 2001-02 to 2014-15

| Year | Total Fruits | Total Vegetables | Total Spices | Total Tuber Crops | Total Food Grains | Total Oil Seeds | Sugarc -ane | Other Crops |
|---|---|---|---|---|---|---|---|---|
| 2001-02 | 2.78 | 4.38 | 2.09 | 2.29 | 68.58 | 8.51 | 0.68 | 10.69 |
| 2002-03 | 2.76 | 4.30 | 2.12 | 2.19 | 68.87 | 8.56 | 0.66 | 10.54 |
| 2003-04 | 2.84 | 4.37 | 2.12 | 2.25 | 68.72 | 7.66 | 0.63 | 11.42 |
| 2004-05 | 2.89 | 4.30 | 2.15 | 2.15 | 66.45 | 7.29 | 0.62 | 14.15 |
| 2005-06 | 2.85 | 5.87 | 2.17 | 2.02 | 65.94 | 6.28 | 0.58 | 14.29 |
| 2006-07 | 3.15 | 6.27 | 2.29 | 2.35 | 63.51 | 7.33 | 0.72 | 14.38 |
| 2007-08 | 3.10 | 6.21 | 2.31 | 2.21 | 65.70 | 7.22 | 0.68 | 12.59 |
| 2008-09 | 3.11 | 6.00 | 2.31 | 2.19 | 66.07 | 6.68 | 0.73 | 12.91 |
| 2009-10 | 3.18 | 6.14 | 2.21 | 2.26 | 65.75 | 6.72 | 0.66 | 13.08 |
| 2010-11 | 3.30 | 6.18 | 2.43 | 2.29 | 66.49 | 6.54 | 0.72 | 12.04 |
| 2011-12 | 3.30 | 6.17 | 2.49 | 2.59 | 65.72 | 6.62 | 0.68 | 12.43 |
| 2012-13 | 3.43 | 6.33 | 2.56 | 2.59 | 66.64 | 7.51 | 0.71 | 10.24 |
| 2013-14 | 3.50 | 6.30 | 2.61 | 2.53 | 66.20 | 7.44 | 0.71 | 10.71 |
| *2014-15* | 3.53 | 6.81 | 2.79 | 2.65 | 66.15 | 7.52 | 0.73 | 09.82 |

**Source:** *Author 's calculation based on data collected from*

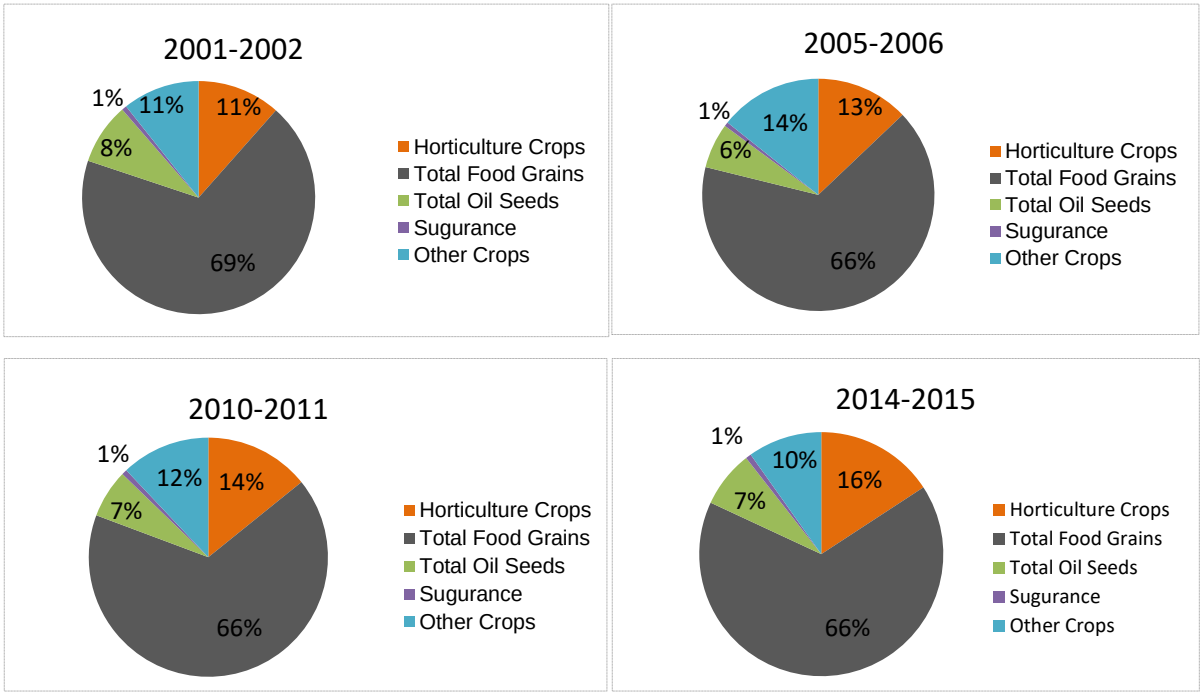
*(1) Directorate of Agriculture, Government of Assam*

*(2) Directorate of Horticulture & FP, Government of Assam*

*(3) Statistical Handbook Assam 2016, Directorate of Economics and Statistics, Government of Assam*

*(4) indiastat.com*

Figure 1.2: Area under Major Crop Category as a Percentage of Gross Area Cultivated during 2001-02, 2005-06, 2010-11 and 2015-16




**Source:** *Author 's calculation based on data collected from*

*(1) Directorate of Agriculture, Government of Assam*

*(2) Directorate of Horticulture & FP, Government of Assam*

*(3) Statistical Handbook Assam 2016, Directorate of Economics and Statistics, Government of Assam*

*(4) indiastat.com*

## Conclusion

To sum up, in Assam, horticulture crops are produced in all six agro-climatic zones. However, only in Lower Brahmaputra Valley Zone and Central Brahmaputra Valley Zone, some of horticulture produce are included in the major crops categories. Again, cropping intensity for Assam is remaining stagnant over decades. No significant positive trend is associated with cropping intensity from 1991-92 to 2014-15. Food grain dominated in Assam's agriculture. Almost 68 percent of total cropped area is covered by food grain production and Rice constitutes the major portion of it. However, a positive move is that diversification is taking place in favor of horticulture crops. There is increase in acreage share under fruits, vegetables, spices and tuber crops. While acreage share under traditional crops, total food grain, total oilseeds and sugarcane has been declining from 2001-02 to 2014-15.

To some extent, the changing cropping patter is clearly indication of diversification of Assam's agriculture to high valued horticulture. The growing market demand, high remunerative nature of such crop and positive influence of various government initiatives to expand the area may be the factors behind this. However, there are some other explanations behind the diversification. Due to frequent flood in every year in Assam farmers faces production risks. Many farmers have adopted a risk-averse strategy of not using purchased inputs such as HYV seeds, chemical fertilizers, pesticides, etc. They do not want to apply costly inputs such as chemical fertilizers and HYV seeds for the fear of their being washed away by floods **(Goyari, 2005)**. That forces farmers in the flood prone areas to diversify their cropping pattern **(Bezbaruah and Mandal, 2013)**. Profitability from traditional crops, if negative may be another cause for such diversification. Thus, by incorporating the changing area share of the gross cultivated area of different crop groups of state's agriculture we are able to explain some picture of the diversification that has take place in Assam agriculture.

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