

Analysis of Climate Change Management and its implications on Agriculture Tourism in India with reference to genetic diversity in banana

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Analysis of Climate Change Management and its implications on Agriculture Tourism in India with reference to genetic diversity in banana

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Abstract

The study deals with the productivity in banana to changes in climate and its associated factors. The production and the condition for growth of banana varieties and various produces are vital for growth and development of Agriculture tourism in India. On the other hand, management of climate change and its impacts, and conditions are analyzed using authentic secondary data. The management methods differ from various regions according to climatic condition. The banana cultivation in tropical region is ideal for more income to the farmers. An anecdote of South Africa is included to have a comprehensive overview of the topic undertaken and for a comprehensive and comparative understanding for Indian context. The conditions of climate change and factors like soil type, region and area identified for determining the effect on banana production due to changes in climatic factor are also mentioned therein. To identify an appropriate adaptation strategy and in managing climate justice associated factors are considered and a SWOT Analysis is performed. The variation owing to productivity of banana is also interpreted. When the environmental condition does not suit the yield and appropriate adaption techniques to be followed either by organic agricultural practices or technology driven climate management production orientation. Lastly even change in methods of production and towards optimisation of banana produce, can mitigate the challenges to bio-diversity. Finally, this study is another attempt in offering categorized suggestion to various sections of the society towards growth of Agriculture tourism in the India context.

Keywords: Banana, Banana varieties, Management of Climate change, SWOT Analysis, Productivity, Biodiversity, Agriculture Tourism.

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1. INTRODUCTION

Climate has played a vital role in production of genetically diversified banana. Bananas are the tropical origin when grown in sub tropic terrains like India, Africa and so on, are subject to strong environmental constraints, mainly low temperature and also droughts. Banana botanical name is 'Musa paradisiaca' and is one of the most important crops in India. Presently the banana production in 2016-17 as per national horticulture data survey shows as 29163 million tons from 24.9 million hectares in India. There are approximately 18 different variety of culinary banana due to breeding purpose. The overall characteristics of banana are discussed and the different climatic conditions are also discussed. The methods and the detailed views are presented in the following sections. Bananas are one of the most popular types of fruit in the world. As a result, banana production can be an extremely lucrative industry for a country. The country that produces the most bananas per year is the nation of India, in 2023, as per World population review. The concept of Agritourism is very simple. Here the urban tourists go to the homes of the farmers. Stay like a farmer and engage in activities relating to farming. The farms in turn reciprocate with farm and home hygiene. Sells the farm produce to the tourists arriving, produce at a better price and maintains the livelihood all through the year and sustain the agricultural activities which facilitate tourism development and growth.

2. METHODOLOGY

The only prime objective of this paper is to explore the impact of climate change management and its impact on agriculture tourism with reference to genetic diversity in banana in the Indian context. The impact of management to climate change in banana is gathered through different sources of available and authentic secondary data. viz., productivity data, adaptive method and agricultural practices etc. Thus, with the help of these indicators, the productivity patterns are identified which shall be suitable for challenges arising to management of climatic conditions. The case of South Africa is also taken into account. The following details are presented below, in the following Section 3 viz Discussion.

3. DISCUSSION

The Great Lakes region in East Africa is the largest banana- producing and consuming region in Africa (AATF 2009). Banana is the most important food crop in Uganda and Rwanda, where annual per capita consumption exceeds 135 kg (FAO 2013a). Studies conducted in some of the FTF countries have revealed that drought stress is either the most important or the second most important constraint in banana production in the region (Van Asten et al. 2011). Optimal banana production is believed to require a constant and ample supply of water due to its permanent green vegetation and shallow root system (Robinson 1996). Though banana can survive water stress for long periods of time, low soil moisture and extended exposure to extreme temperatures (above 35°C) can reduce banana production (Thornton and Cramer 2012). As such, in the East African highlands, where annual rainfall is below 1100 mm, drought- induced yield reduction on rainfed bananas can reach up to 65% compared to wetter areas (Van Asten et al. 2011).

Table 1 showing Top 10 countries in the world, India being the highest producer of Bananas in the world during 2023

Country	2023 Population	GLOBAL RANK
India	1,428,627,663	1
China	1,425,671,352	2
United States	339,996,563	3
Indonesia	277,534,122	4
Pakistan	240,485,658	5
Nigeria	223,804,632	6
Brazil	216,422,446	7
Bangladesh	172,954,319	8
Russia	144,444,359	9
Mexico	128,455,567	10

Source: <https://worldpopulationreview.com/country-rankings/banana-production-by-country>

From Table 1 above which shows the data regarding the highest production of bananas in India currently, in 2023 This justifies that the study undertaken is suitable for the Indian context and to the development of Agriculture Tourism in India to be taken to the next level. Hence the scope for the study is justified.

Table 2 showing various Banana Types in India and its Utility for Agriculture Tourism

Sl.No	Banana Type	Name of Banana Variety	Description Duration (in Months)	Category of Utilisation Productivity Range (in kgs)		
				Low Upto 10	Medium 11 to 20	High 21 to 30
1	BT 1	Dwarf Carvendish	The duration of crop is 11 months and produce a bunch weighted 20 kg	-----	√	-----
2	BT 2	Robusta	A slightly curved crop and produce a bunch weighted 25-30 kg			√
3	BT 3	Rasthali	The duration of crop is 13-15 months and produce a bunch weighted 17 kg	-----	√	-----
4	BT 4	Nendran	This fruit have distinct neck & produce a bunch weighted 10kg	√	-----	-----
5	BT 5	Poovan	The specialty of this crop is pink pigmentation on ventral side of leaves. The bunch produce weighted 22 kg.	-----	√	-----
6	BT 6	Ney Poovan	The duration of crop is 12-13 months and produce a bunch weighted 20 kg	-----	√	-----
7	BT 7	Grand Naine	The duration of crop is 11 months and produce a bunch weighted 30 kg. It's a high yielding crop.	-----	-----	√
8	BT 8	Red Banana	Unique taste and color crop. This crop produce a bunch weighted 25 kg.	-----	-----	√
9	BT 9	Karpuravalli	Highly tolerance to saline water, drought and wind. Its duration is 16 months and produces a bunch weighted 30 kg	-----	-----	√
10	BT 10	Virupakshi	The duration of crop is 14 months and produce a bunch weighted 12 kg.	-----	√	-----

Source: Data from National Horticultural Board of India, <https://www.nhb.gov.in/#/>

Table 2 above shows the comprehensive data with interpretation on the various types of bananas produced in India. The utility for agriculture tourism is also categorised based on the understanding and assumptions of the author. This study undertaken will have an immense future scope for researchers in this industrial domain.

Table 3 showing the productivity pattern of banana in various states of India
for facilitating Agriculture Tourism

S.No	States in India	Area (Hector)	Production (Metric ton)	Productivity (Metric ton/Hector)	Managerial Considerations for Agricultural Tourism
1	Maharashtra	74.6	3072.4	41.1	Dwarf Cavendish and Red banana have more yield point.
2	Tamil Nadu	94.9	3640.7	38.3	Karpuravalli is grown only in Tamil Nadu. Unique crop
3	Karnataka	101.5	2489.5	24.5	Dwarf Cavendish & Rasthali are grown in normal climatic conditions
4	Gujarat	64.6	4185.5	64.7	Dwarf Cavendish & Robusta grown with available resources.
5	Andhra Pradesh	86.3	4143.5	48.1	Dwarf Cavendish, Robusta & Rasthali a combination of all the genetic variety of crop.
6	Madhya Pradesh	24.3	1646.8	67.7	Single variety of grown here with high yield ratio.
7	Assam	55.4	979.3	17.6	The distribution in the management of climatic condition are less suited for growth. Here, the yield ratio is minimum.
8	Bihar	35.1	1550.6	44.1	Dwarf Cavendish is grown with minimal management of climate .
9	Kerala	81.5	1224.1	15.0	Nendran, Poovan and other crops are grown here. More number of crops compared with classification of crop has minimal yield point.
10	Other states	5.0	57.1	-	The overall growth with available resources with appropriate management of climate factors.

Table 3 above clearly shows the comparative data of productivity patterns and the managerial implications for agriculture tourism in India. Banana is grown in about 120 countries and India leads the world in banana production with an annual output of about 14.2 million tons. The managerial considerations for planning the production and crop augmentation strategy are justified in SWOT Analysis are included in the ensuing sections of this research paper.

Table 4 Year and productivity of Banana

S.No	Year	Productivity (Metric ton/Hector)	Managerial Implications for Agriculture Tourism
1	2007-08	34.8	The productivity of banana on year basis with yield ratio.
2	2009-08	36.2	There is increase in productivity on resources available with management climatic condition
3	2008-09	37.0	The year has reached the maximum productivity with sustainable crop of management climatic condition.
4	2009-10	34.4	There is decrease in productivity on climate change and its diversity.
5	2010-11	35.9	There is increase in productivity on resources available with management climatic condition
6	2011-12	35.7	Average productivity of the overall production.
7	2012-13	34.2	Decreased due to adaptation of management climatic condition
8	2013-14	37.0	The year has reached the maximum productivity with sustainable crop of management climatic condition.
9	2014-15	35.5	Decreased due to prevalence of appropriate climatic condition
10	2015-16	34.6	Decreased due to prevalence of appropriate climatic condition
11	2016-17	34.0	Decreased due to prevalence of appropriate climatic condition

Table 4 shows the productivity of banana in the last few years. The average productivity of banana is 35.0 MT/Hector. At 1991-92 report of national horticulture was 20.3 MT/Hector. Due to change in climate increase in temperature and agriculture advancement the production of banana had gradually increased. (Refer to Annexure 1 on comparative statistics during the years 2015-16,2016-17 & 2017-18, as this is the updated and currently available authentic data from, Government of India.)

Table 5 showing Year and temperature statistics in the Management and Implications towards Climate Change

S.No	Year	Temperature (°C)	Implications in Climate Change Management
1	2008	+0.96	The temperature range depends prevalence of climatic conditions
2	2009	+1.9	The rise in temperature is due to deforestation.
3	2010	+0.62	There is some reduction in temperature as compared to previous year for planning future initiatives and courses of action.
4	2011	+0.92	The initiatives are replicated slightly
5	2012	+0.62	Every year there is some changes in climate with global warming.
6	2013	+0.99	The rise in temperature is due to deforestation.
7	2014	+1.01	The rise in temperature is due to deforestation.
8	2015	+0.98	The initiatives are replicated slightly
9	2016	+1.26	The rise in temperature is due to deforestation.
10	2017	+0.92	Changes and variation in temperature directly impacts productivity.
11	2018	+0.83	For every consecutive year the temperature of earth gradually varies and it has a cause-effect relationship on sustainable environment and its challenges to managing production.

Table 5 above shows the data and the level of average temperature in every year varies depends on the amount of rainfall, number of trees and other climate factors. Some of the temperature results are given in the above table. With the variation in the temperature there is an effect on the productivity of diversified food crops. This will be a definite and prospective implication for future growth and development of agriculture tourism with reference to banana production and management in the Indian Context.

4. Agro-climatic requirements for Managerial Productivity

- Banana, basically a tropical crop, grows well in a temperature range of 15°C to 35°C with relative humidity of 75 to 85 % to manage the productivity for high yield ratio.
- It prefers tropical humid lowlands and it grown from the sea level to an elevation of 2000 m. In India this crop is being cultivated in climate ranging from humid tropical to dry mild sub-tropics through selection of appropriate varieties.
- Chilling injury occurs at temperature below 12°C. High velocity of wind which exceeds 80 km/hr. damages the crop. Measurement of climatic condition for growth.
- Four months of monsoon (June to September) with an average 650 to 750 mm rainfall are most important for vigorous vegetation growth of banana. Calculating the month of cultivation for high productivity behalf of management.
- At higher altitudes, banana cultivation is restricted to a few varieties.
- Deep, rich loamy soil with pH value of 6.5 to 7.5 is most preferred for banana cultivation. Soil for banana have good drainage, adequate fertility and moisture.
- The department of agriculture tourism estimate the condition for productivity of banana with genetic variety for various management climatic condition are adopted with sustainable optimization of resources used.

5. MANAGEMENT OF CLIMATE CHANGE

A change in global climate pattern due to increase in level of atmospheric carbon dioxide exhausted by using fossil fuels. The climate change is otherwise called as global warming. It is a human made disaster to earth's natural process.

5.1 Factors influencing Climate Change Management

The factors influencing climate changes are 5.1.1 Natural cause & 5.1.2 Human causes. These are explained briefly in this section as below:

5.1.1 Natural cause

There are a number of natural factors responsible for climate change. Some of the more prominent one are continental drift, volcanoes, ocean currents, earth's tilt and comets and meteorites.

5.1.1.1 Continental drift

The continents that we are familiar with today were formed when the landmass began gradually drifting apart, millions of years back. This drift also had an impact on the climate change because it changed the physical features of the landmass, their position and the position of water bodies. The separation of the landmasses changed the flow of ocean and winds, which affect the climate.

5.1.1.2 Volcanoes

When a volcano erupts it throws out large volume of Sulphur dioxide, water vapor, dust and ash. After a few days the large volume of gases and ash can influence climate pattern for years. The gas and dust particles partially block the incoming rays of the sun, leading to cooling.

5.1.1.3 The earth's tilt

The earth is tilted at an angle of 23.5 degree to the perpendicular plane of its orbit. The orbit of the earth is elliptical which makes the difference in distance between the sun and the earth. Thus, gradual change in axis of the earth, is responsible for change in climate.

5.1.1.4 Ocean current

The ocean is the major component for climate system. El-nino is an example for climate system that takes part in ocean current. Ocean currents have been known to change direction or slow down. Much of the heat escapes from the ocean in the form of water vapor and the most abundant greenhouse gas on earth. All these phenomena have an impact on climate.

5.1.2 Human Cause

The activity of the human enhances the growth of the organisation. The result of the growth has many impacts towards environment. Rarely the growth for human is only for human by deformation of natural changes. It results in global warming, change in weather pattern, management in productivity and the variation in food crops.

5.1.2.1 Deforestation

Humans for their growth and wellbeing cut trees and makes infrastructure. It leads to the rise in temperature of the earth. Sunrays contains uv rays when the trees are deforested those uv rays will penetrate to human and other living species. This enhances the rise in temperature which leads to change in climate.

5.1.2.2 Industrialisation

Nowadays there are many industries emitting more amount of carbon dioxide. The industrialisation is emerged from 18th century to till date. From there to till now the industry is emitting carbon dioxide enormously and exorbitantly. Carbon dioxide is a major gas which cause global warming. This causes the climatic change.

6. CLIMATE CHANGE MANAGEMENT AND ITS IMPACT ON BANANA PRODUCTIVITY

- Suitable temperature and humidity for banana production is 15 to 35°C and 75 to 87 % respectively. The change in climate can increase or decrease the productivity of banana.
- If the temperature goes high or lower the sustainable level then the productivity will decrease.
- This global warming can cause other region like temperate region can make the productivity of banana.
- For change in climate the cultivation method also to be changed for good productivity of banana.
- Sustainability of banana depends on climate pattern and the environment surrounding them.

7. SWOT ANALYSIS FOR BANANA PRODUCTION IN THE MANAGEMENT OF CLIMATE CHANGE

Strength	Weakness
<ul style="list-style-type: none"> • Produce big bunches • Tolerance of banana to climatic factor • Generate income • High yield ratio on suitable management climatic condition • Emergence of new variety is possible 	<ul style="list-style-type: none"> • High production cost on unsuitable environment • Variation in Climatic condition productivity occurs
Opportunity	Threats
<ul style="list-style-type: none"> • Technology and agricultural enhancement • Technology transfer for high productivity • Adaptation and sustainable condition are obtained • Chance of having more opportunity towards various banana related sectors 	<ul style="list-style-type: none"> • Chance of arise to new damaging species • New disease may occur to banana verities

8.CATEGORISED SUGGESTIONS:

Table 6 showing Suggestions and Managerial Implications to various categories

Serial Number	Name of the Category	Suggestions	Managerial Implications
1	Governments (Central & State)	Decision-makers to take into account and initiate actions that can facilitate climate justice	Prepare Short-term to Long-term plans and allocate funds for budgeting and meeting the requirements
2	Stake Holders	Involve in Awareness creation and initiative in the due course of time	Identification of communities which can involve and contribute to climate actions
3	Employers	Identify various new domains to offer job placement as a green job strategy	Creation of new Green Jobs will enhance the corporate social responsibility index for the employers
4	Employees	Young and dynamic job seekers can be aspiring for green jobs vis-a-vis traditional jobs	Post-Pandemic scenario will give a boost the employment avenues to various categories of job seekers
5	Entrepreneurs	A new domain of Green Jobs in the offering for attracting young and innovative workforce in agriculture tourism in India	Emergence of new Green Job Creation initiatives are likely to yield social support and community engagement in the future

9.DIRECTIONS FOR FUTURE RESEARCH:

Non availability of data due to COVID-19 pandemic was although a challenge and limitation for the study, at the same time this will be a definite future prospect for research to be undertaken by developing an information system to gather data in a systematic manner. Primary data may be collected within the states of India in this industrial domain, and further studies can be undertaken. A comparative and comprehensive analysis of all the states of India can be also attempted to have a more wholistic picture in the future to develop and sustain Agriculture tourism prospects in India.

10. CONCLUSION

The climate change has a positive effect on banana. Farmers had to adopt to climate change by changing the cultivation method of banana. New technology and innovation methods will help the productivity and the economic condition of the farmer. The only negative role of climate change is adaptability. The species and technological methods should be adaptable for better environmental constrain. The management of various climate associated factors pertaining to genetic variety of bananas enhance the banana productivity with adaptation strategies, sustainability and technological advancement, in the future for the benefit and growth of agriculture tourism sector.

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ANNEXURE1

Table 7.A.2: State-wise Productivity of Banana

S. No.	STATES/UTs	Productivity in MT/Ha		
		2015-16	2016-17	2017-18
1	ANDHRA PRADESH	47.16	53.00	56.24
2	ARUNACHAL PRADESH	5.84	7.14	6.37
3	ASSAM	17.27	17.36	17.20
4	BIHAR	44.12	43.57	44.94
5	CHHATTISGARH	22.80	23.33	28.07
6	GUJARAT	64.70	64.75	65.63
7	HIMACHAL PRADESH	4.80	4.18	4.25
8	JHARKHAND	2.66	3.49	3.49
9	KARNATAKA	24.54	24.59	21.07
10	KERALA	15.38	14.72	10.24
11	MADHYA PRADESH	62.01	69.58	69.54
12	MAHARASHTRA	43.49	47.81	52.05
13	MANIPUR	13.51	13.40	13.68
14	MEGHALAYA	12.47	13.03	13.15
15	MIZORAM	12.93	12.82	12.83
16	NAGALAND	14.96	14.07	14.03
17	ODISHA	18.91	19.07	18.59
18	PUNJAB	57.37	57.93	57.95
19	RAJASTHAN	11.91	9.58	20.61
20	SIKKIM	3.09	3.20	2.90
21	TAMIL NADU	45.78	36.85	38.79
22	TELANGANA	39.47	35.47	39.38
23	TRIPURA	10.51	10.67	10.63
24	UTTAR PRADESH	45.69	45.74	45.73
25	WEST BENGAL	24.39	24.39	24.34
	OTHERS	10.65	9.49	12.60
	TOTAL	34.64	35.44	34.86

Source : Horticulture Statistics Division, Department of Agri. & Cooperation.

ANNEXURE 2

446 Horticultural Statistics at a Glance 2018

14.1 BANANA

➤ **Origin** : Asia

Major Producing States/Districts in India :

- 1) Tamil Nadu (Tiruchirappalli, Coimbatore, Tuticorin, Pudukkottai etc.)
- 2) Gujarat (Bharuch, Anand, Narmada, Surat, Vadodra etc.)
- 3) Andhra Pradesh (Kadapa, Anantapur, East Godavari, West Godavari, Vijayanagara etc.)
- 4) Uttar Pradesh (Gorakhpur, Kashi Nagar, Fatehpur, Kanhanbi, Maharaipur etc.)
- 5) Maharashtra (Jalgaon, Nanded, Solapur, Akola, Pune etc.)

➤ **Total Area in India** : 859.87 Thousand Ha. (2016-17)

➤ **Total Production in India** : 30477.22 Thousand MT (2016-17)

➤ **Commercial varieties** : Major commercially cultivated varieties are listed below.

State	Varieties grown
Tamil Nadu	Virupakshi, Robusta, Red Banana, Poovan, Easthali, Nendran, Monthan, Karpanasoli, Sakka, Peppan, Mann
Gujarat	Dwarf Cavendish, Lacatan, Harichal (Lokhandi), Gandevi Selection, Basrai, Robusta, G-9, Harichal, Shrivati
Andhra Pradesh	Dwarf Cavendish, Robusta, Easthali, Anantapur, Thollachakakeli, Karpanasoli, Poovan, Chakrakeli, Monthan and Venaga Bontha
Uttar Pradesh	G-9 (Tissue Cultured), Dwarf Cavendish, Alpana, Chitra, Chitra Champa etc.
Maharashtra	Dwarf Cavendish, Basrai, Robusta, Lal Velcha, Safed Velcha, Rajesh Nendran, Grand Naine, Shreeamati, Red Banana

➤ **Advance Technology** : Planting of tissue cultured plants.

➤ **Pre-cooling** : Forced air

➤ **Storage conditions:**

Holding Room : 13° to 14°C

Ripening Room : 15° to 18°C

Relative Humidity : 90-95%

Storage Period : Mature green bananas can be stored upto 3 weeks in ethylene free air or up to 6 weeks in a controlled atmosphere at 14° C

➤ **Peak Harvesting Season:**

1) Gujarat : September to November

2) Andhra Pradesh : Round the year

3) Tamil Nadu : Round the year

4) Uttar Pradesh : July, August

5) Maharashtra : Round the year

➤ **Export from India (2017-18):**

Quantity : 161.51 Thousand MT

Value : 34,877.39 Lakh Rupees