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ECONOMIC SUSTAINABILITY OF COTTON CULTIVATION IN MAHARASHTRA, INDIA

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Abstract

The study examines the cost sustainability of cotton production in the Maharashtra state of India, which accounts for nearly one-third of the area under cotton cultivation. India has around 120.69 Lakh hectares of area under cotton cultivation. With a 25% contribution to global cotton production India is the leading producer of Cotton globally, providing livelihood to 58 lakh farmers and additionally, 4 to 5 crore persons are engaged in the occupation of cotton garments manufacturing and trade activities (Prakash, 2021). The study examines the secondary data from 2010-11 to 2021-22 and the limited literature review which showcases how over the years the cotton cultivation practices have not changed, resulting in stagnation and low yield in production and an increase in cultivation cost on account of high inflation. The study with the help of Situation – Actors – Process and Learning -Action – Performance (SAP-LAP) analysis assesses the cost and yield associated with cotton cultivation in Maharashtra and thereby attempts to analyze its economic sustainability. The basic analysis shows that cotton cultivation in Maharashtra is not sustainable and requires a high level of intervention to make it an economically viable crop for farmers.

Key words: Cotton, Production Cost, Yield, Sustainability, SAP LAP Model

1. Introduction

India is a major producer of Cotton globally, contributing more than 21% of global production and accounting for almost 38% of the global acreage. This is largely because the farming of cotton in the Indian subcontinent can be tracked back to the 4th millennium BC. In India, tetraploid species were introduced way back in the 18th century AD.(Santhanam & Sundaram, 2015). Cotton was a crucial part of trade and commerce in ancient India, it brought India on the map of traders and hence played a pivotal role in history. Impact of cotton on Indian trade dates to the 12thcentury (Raychaudhuri & Dharma, 2008).Indian subcontinent'srelationship with the Western world was

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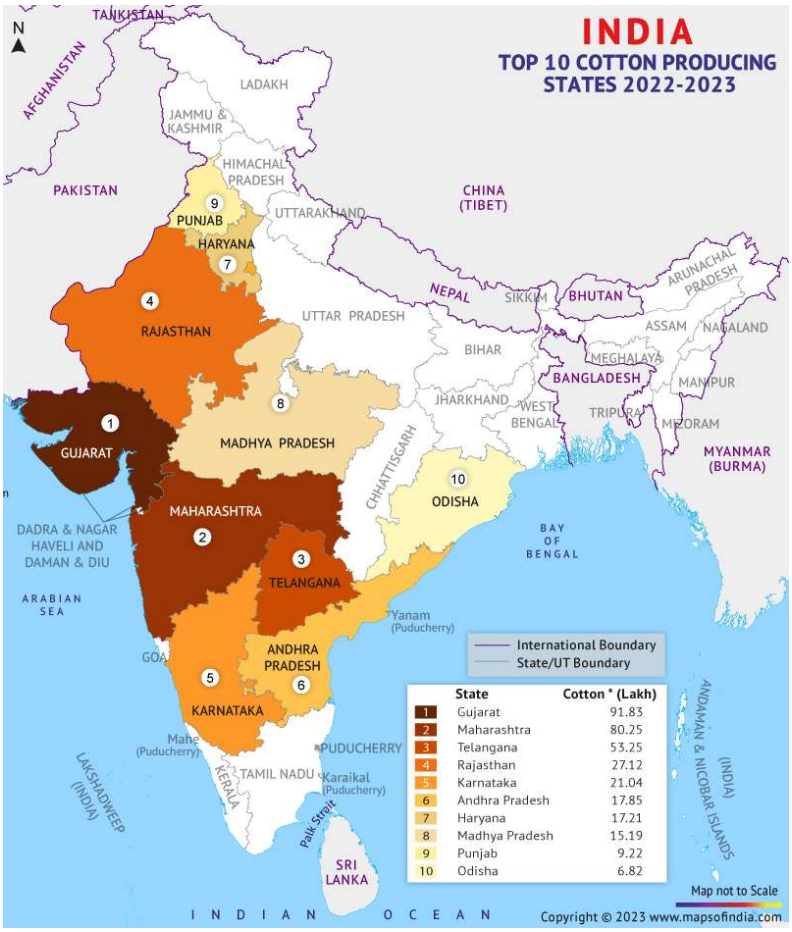
mainly developed due to the cotton trade as it was one of the major suppliers of cotton to the western world. Hence, the importance of trade also led cotton to become the most influential crop throughout the history of India and this in turn influenced the socio-economic aspect of Indian society.India is not only the main producer of cotton but also among the highest exporter and biggest consumer of cotton. Cotton provides livelihood for about 6 crore Indians including farming, cotton textile,commerce &trade sectors. (Sabesh, Prakash, &Bhaskaran, 2014). However, Indian cotton has its own set of challenges. Cotton is a labor-intensive crop and highly dependent on rainfall for cultivation, this results in high pest and disease attacks resulting in lower productivity, to top it all small farm size adds to the woes of farmers. (Ramasundaram, 2001).

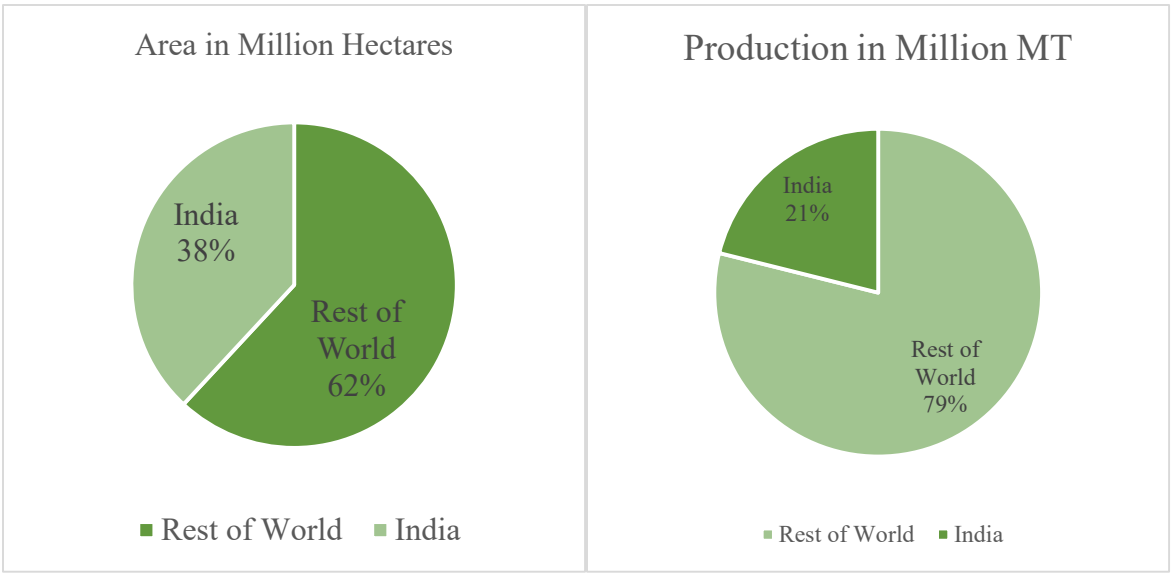
The present study examines the economic sustainability of cotton cultivation in the state of Maharashtra, by examining the yield of production and cost of cotton cultivation – in the second most populous state and the third largest in terms of geographical area, in India. The motivation for the study stems from the limited literature available on the cost of cotton cultivation in India. The paper is divided into four segments. While part one provides the introduction to the study and elaborates on the research question, part two throws light on the research method, question and objective, and use of forecasting methods adopted using the secondary data. The third segment discusses the analysis and findings along with the observations of the SAP-LAP analysis. The fourth and final segment gives conclusions and recommendations.

Cotton is mainly grown in areas with low irrigation availability. (Suresh et al., n.d.) India has three major zones cultivating cotton, they are south, central, and north zones. Tamil Nadu, Karnataka Andhra Pradesh, and Telangana states are included in the south zones, Gujarat, Maharashtra, and Madhya Pradesh are included in the central zone and Rajasthan, Haryana, and Punjab are inthe north zone (Refer to Figure 1). Of all the states cultivating cotton in India, Maharashtra has the maximum area under Cotton i.e., about 44.1 lakh hectares or 37% of the 119.1 lakh hectares in the 2021-22 season. This is equal to 13.5% of the global cotton acreage for the same yearFood and Agriculture Organization (FAO), USDA 2021-22 report. However, the yield level in Maharashtra is very low due to rainfed cotton cultivation, as a result, the state contributes only 23% of India's production or 5.29% of the global production. The yield levels of Maharashtra are just ~64% of all India's average. This is a major cause of concern as it not only brings down the national and global production average but also impacts the livelihood of the large farming population which is dependent on it. The state agriculture census conducted in 2015-16, estimated that there are about 15.3 million farmers in Maharashtra out of which approximately 4.2 million (27.5%) farmers are engaged in cotton cultivation. Cotton is an important raw material for textiles, Maharashtra is also home to several major textile industriesdue to the high production of cotton, with 188 spinning and 36 composite textile mills with the production of about 324 million kg of cotton yarn in the 2017-18 season. Cotton and allied industries have created direct and indirect employment for about 3 lakh individuals. (Maharashtra, 2019)

Figure 1 Top 10 Cotton Producing States in India



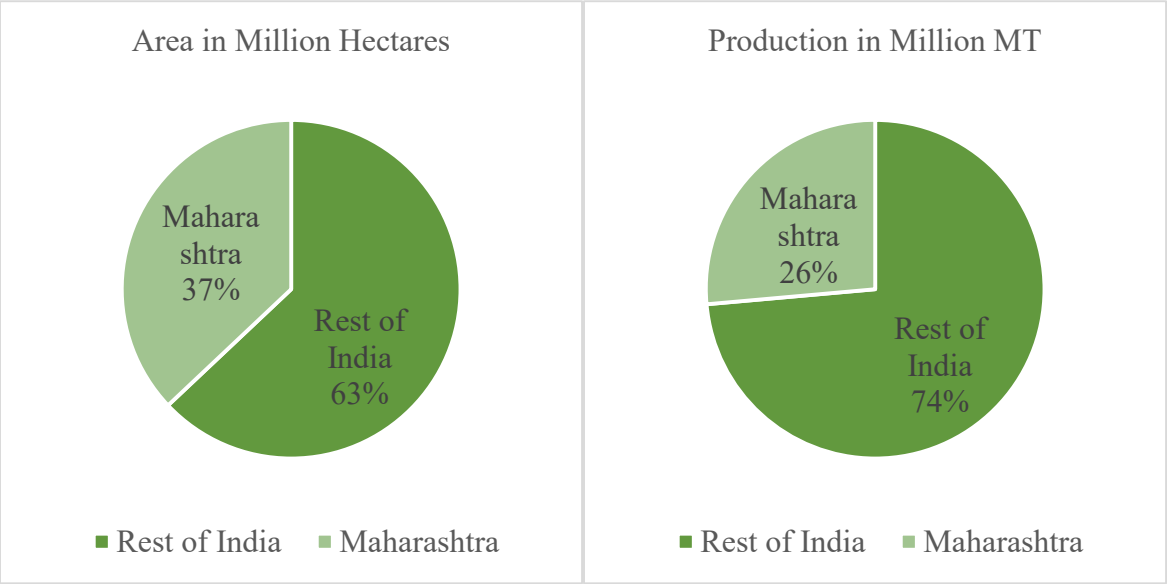
Source: https://www.mapsofindia.com/top-ten/india-crops/cotton.html, Est. 2022-23*Figure 2 India's Position in World Cotton Acreage and Production*



Source: Food and Agriculture Organization (FAO), USDA 2021-22

Figure 2shows 38% of the area under cotton cultivation globally is with India, accounting for only 21% of global production.

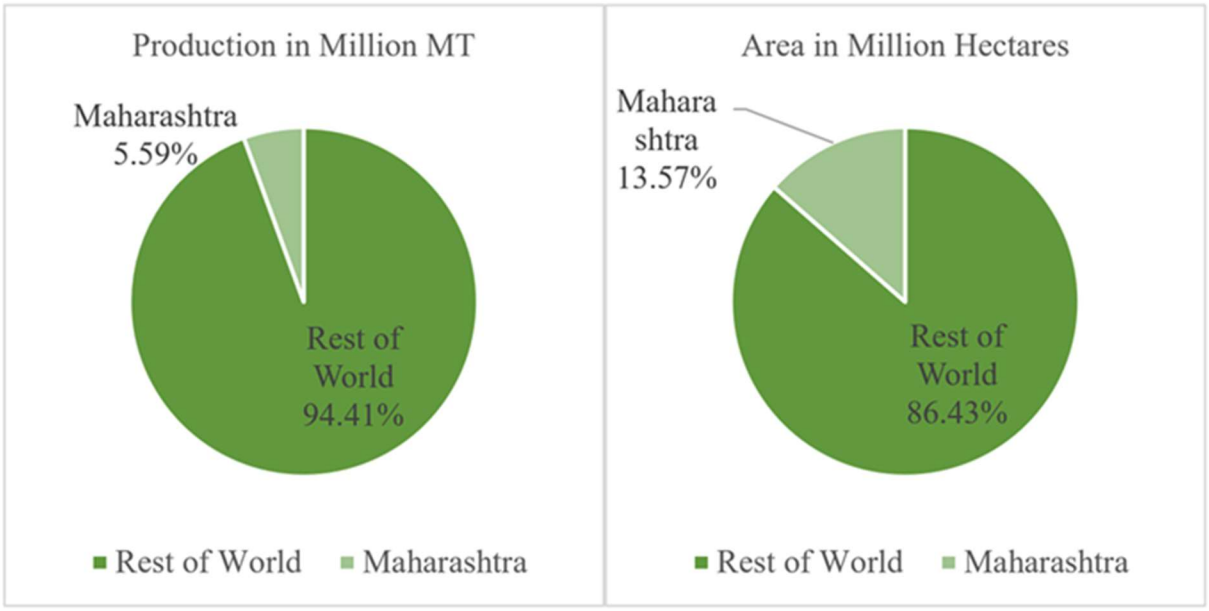
Figure 3 Maharashtra's Position in India's Cotton Acreage and Production



Source: Cotton Advisory Board, 2021-22

Figure 3 shows Maharashtra accounts for 37% in terms of the area under cotton cultivation in India, contributing only 26% in terms of production. While Figure 5 reveals that 13.57% is

Figure 4 Maharashtra's Share in World Cotton Acreage and Production

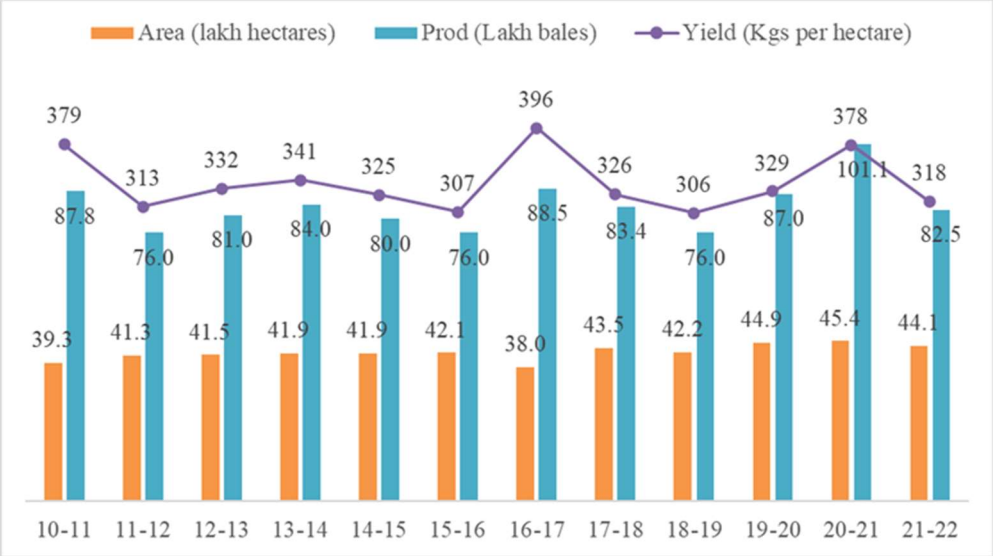


Source: Food and Agriculture Organization (FAO), USDA, Cotton Advisory Board, 2021-22

Maharashtra's sharein terms of area under cotton cultivation globally, and only accounts for 5.59% in terms of production. This gap in area under production and actual production brings out the challenge of lower production in Maharashtra.

Being a cash crop,cotton cultivation must provide residual profitability to the farmers. However, the productivity data as given in Figure 4 depicts a grim picture, which became the source of motivation for theresearchers to study and understand the issue of sustainability of cotton cultivation in Maharashtra.

Figure 5 Area, Production & Yield in Maharashtra

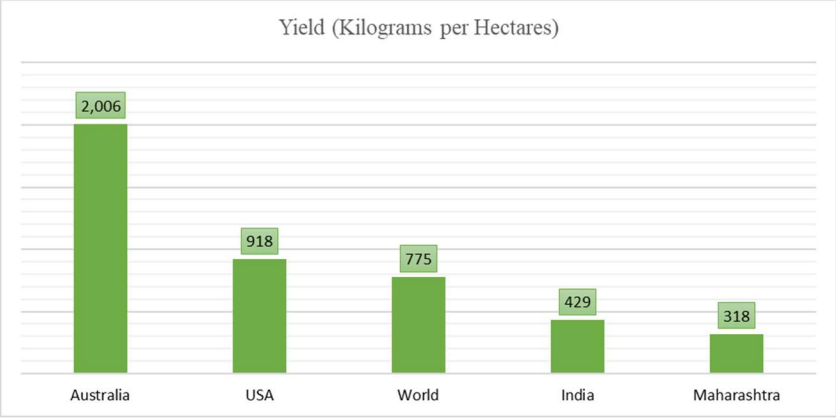


The above figure shows the area under cotton production and productivity has remained stagnant over the past 12 years.

2. Research Method

The global comparative analysis of the yield of cotton in India and Maharashtra showcases very low yield of cotton cultivation in the state.

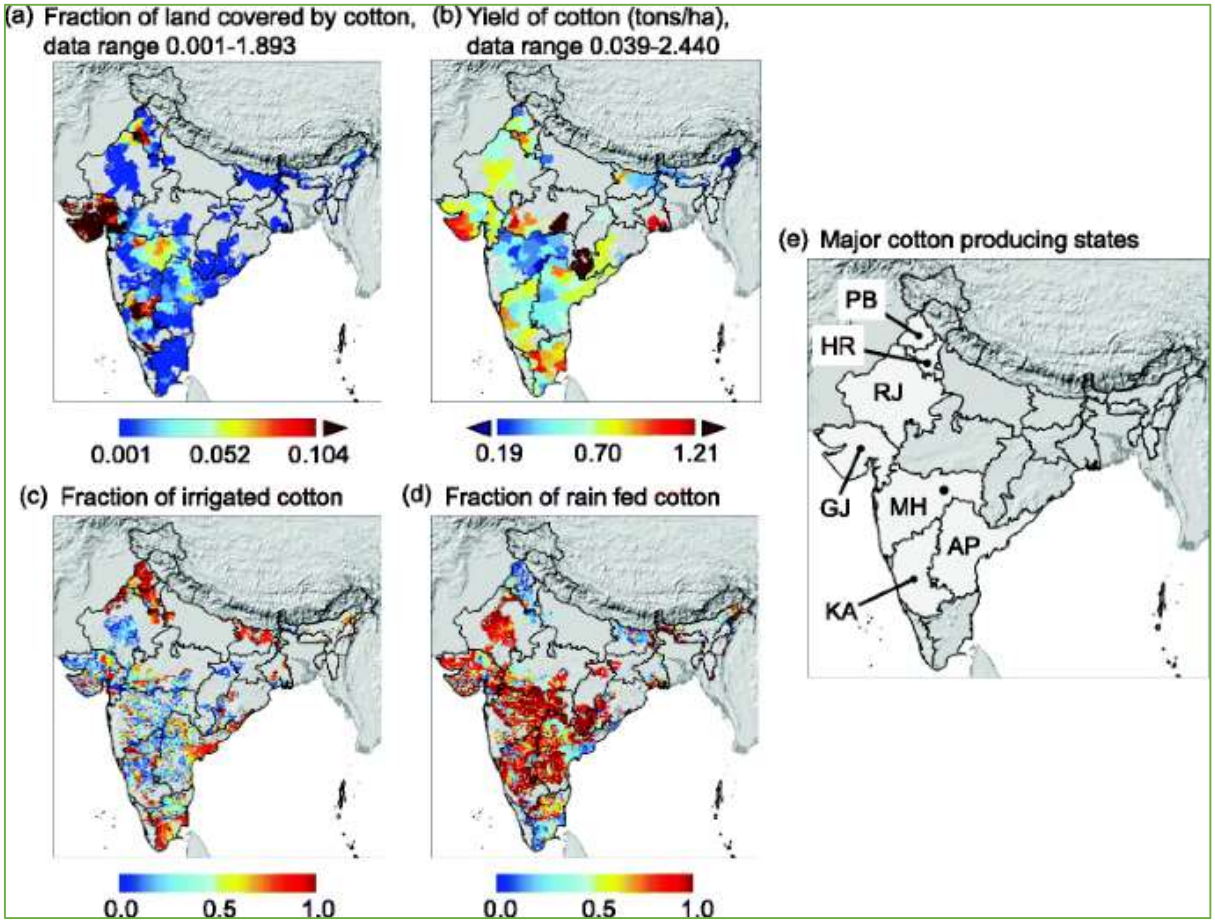
Figure 6 Yield Comparison



Source: Food and Agriculture Organization (FAO), USDA, Cotton Advisory Board, 2021-22

Figure 7, highlights the fact that the major area under cotton cultivation in Maharashtra is under rainfed irrigation, thereby resulting in higher dependency on the weather for the production of cotton and the risk associated with the vagaries and uncertainties in this regard.

Figure 7 Area, Production, Yield, Irrigation, and Rainfed areas with cotton cultivation



Source: (Gutierrez et al., 2015)

2.1 Objective

The major objective of the paper is to study and understand the economic sustainability of cotton cultivation in the state of Maharashtra. As evident from the above analysis, the state of Maharashtra experiencesyields levels much below the national average of 429 kilograms per hectare, which raises the question of the viability of its production economics.

The concept of sustainability has multiple dimensions from climatic to resources and from economic to political. However, at its basic, sustainability can be defined as focusing on the present situation and resources without impacting the future. It can also simply be framed as using current resources judiciously so that future requirements are not stressed. Sustainability as a concept is based on three pillars of economics, social and environmental which are alsocasually referred to as people, profits, and planet. (Grant, 2020).

2.3 Methods and Approach

The study adopts a two-stage approach to understanding the economics of cotton production economics in the state of Maharashtra. Stage one of thestudy deals with the cost of cultivation and stage two is a case study method thatapplies the SAP – LAP analysis for cotton production in the state of Maharashtra as explained in the following segment.

2.3.1 Cost of cultivation

The cost of cultivation can be determined by various methods such as collecting primary data or by using the Government of India's (GOI) data which is published by the Ministry of Agriculture and Farmers' Welfare regularly. The ministry calculates the cost of cultivation for cotton in India primarily by two different methods. These methods are C1 and C2, although both methods consider the major cost incurred by the farmers but C2 additionally considers the rental value of owned land by the farmer. Principally only a single parameter looks different but both methods have support in different sections of scholars.

Below is the detail of all the particulars used to determine the cost concept:

- Cost "A1":
  i. Cost/rate of rentedmanuallabor.
  ii. Cost/rate of rented bullocks
  iii. Cost/rate of owned bullock labor
  iv. Cost/rate of owned machinery labor
  v. Rented machinery fees.
  vi. Cost of Seed (Both owned and purchased)
  vii. Cost of plant protection chemicals
  viii. Cost of manure (purchased and owned)
  ix. Cost of fertilizer
  x. Depreciation on tools and farm structures.
  xi. Irrigation cost
  xii. Land income and taxes/charges
  xiii. Interest on investments.
  xiv. Miscellaneous expenditure
- Cost "A2": Cost "A1" + amount paid for land lease.
- Cost "B1": Cost "A1" + interest on the amount of owned assets (excluding land).
- Cost "B2": Cost "B1" + leaseamount of owned land (net of taxes) and lease paid for rented land.

- Cost "C1": Cost "B1" + imputed value of family labour
- Cost "C2": Cost "B2" + Assumedcost of family workers.
- Cost "C2" *: Cost "C2"amended to reflectthe cost of labor at market rate or legalbare minimumpay rate whichever is higher.
- Cost "C3": Cost "C2" + managerial cost at 10% of total cost (C2*)

The government agencies i.e., Commission for Agricultural Costs & Prices (CACP) attached to the Ministry of Agriculture and Farmers Welfare mainly use the C1 method for determining the Minimum Support Price (MSP) of any crop; however, the Committee constituted by the National Commission on Farmers under the Chairmanship of Professor M.S. Swaminathan on 18th November 2004 to address the issue of farmer suicides in India recommended the C2 method for determining the MSP. However, there is also a third school of thought which says C3 is the better way of determining the cost of cultivation because in addition to components of C2, it also considers the managerial functions performed by farmers and adds 10% of C2 cost under that heading. The Chart below gives an overview of C1 and C2 costs. (*State of Indian Agriculture 2012-13 Government of India Ministry of Agriculture Department of Agriculture and Cooperation Directorate of Economics and Statistics New Delhi*, n.d.)

Figure 8 Cost C1 and C2 illustration

C1 Method	**C2 Method**
• Cost "A1": All expenditures in cash or kind occurred in production. • Cost "B1": Cost A1 + Interest charges on the cost of own investment on assets (not including land.) • Cost "C1": Cost "B1" + Attributed value of Family workers.	• Cost "A1": All expenditures in cash or kind occurred in production. • Cost "B1": Cost "A1" + Interest charges on the cost of own investmenton assets (not including land.) • Cost "B2": Cost "B1" + Lease value of own land (net of taxes) • Cost "C2": Cost "B2" + attributed value of family workers.

The paper considers and applies both the cost of cultivation C1 and C2 for the cotton farmers in Maharashtra from 2002 to 2017 to examine the economic sustainability of cotton cultivation in the state, with the help of data, which is regularly published by the Ministry of Agriculture and Farmers' Welfare (MoAFW), GOI. The cost of cultivation and yield is directly derived from the data whereas revenues are estimated based on the prevailing minimum support price during that season.

2.3.2 Case Study Method by SAP-LAP Analysis

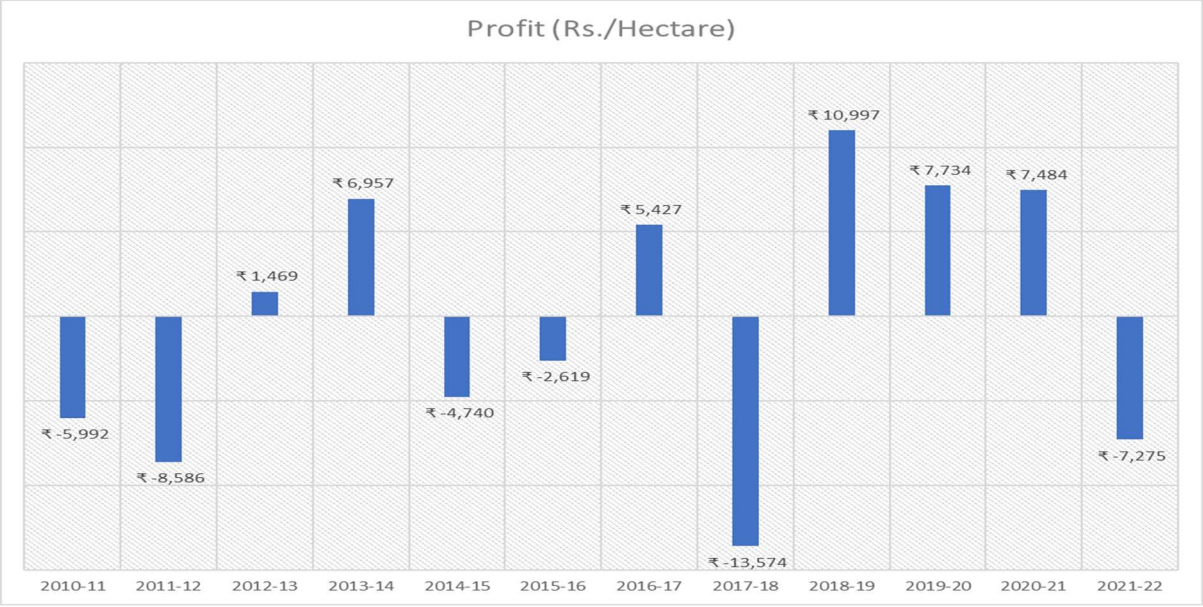
To critically understand the eco-system of cotton cultivation and further conduct a deep dive breakdown the Situation-Actor-Process & Learning-Action-Performance (SAP – LAP) Analysis

framework is utilized. A holistic approach is needed to study the entire production system of Cotton i.e., from land preparation to final marketing of the product. As this system needs high-level scrutiny of all the components involved, SAP – LAP analysis framework has been considered. The SAP-LAP framework consists of three basic sections in any condition, i.e., a situation to be dealt with, an 'actor' or group of actors who deal with it, and a 'process' or processes that reconstruct the condition. In this context, liberty of choice lies with the actor. A combination of SAP leads to LAP which deals with learning, action, and performance (Sushil, 2001). Within the SAP-LAP structure, there are multiple models like exploratory and normative models, which are based on the goal. In terms of application focus, the model can be either generic or specific in nature, and in terms of extensiveness, it can be either a naïve or integrative model. For the present study of cotton cultivation, the authors have usedthe exploratory model, carrying out a managerial inquiry at the high level of the production system then identifying the general problems in the system, carrying out a preliminary study of basic actors independently and the process without getting into the details of inter dependability of each actor.

3. Discussion and Analysis

To initiate the deep dive analysis, we begin with the basic analysis of the cost of cultivation under the C1 and C2 methods, explained earlier. The study undertakes a comparison with the cost of cultivation and revenue generated by the farmer by utilizing the prevailing MSP (Minimum Support Price) during the production years of 2010-11 to 2021-22. The objective is to understand at a high level how the profitability concerningyield levels and the MSP.

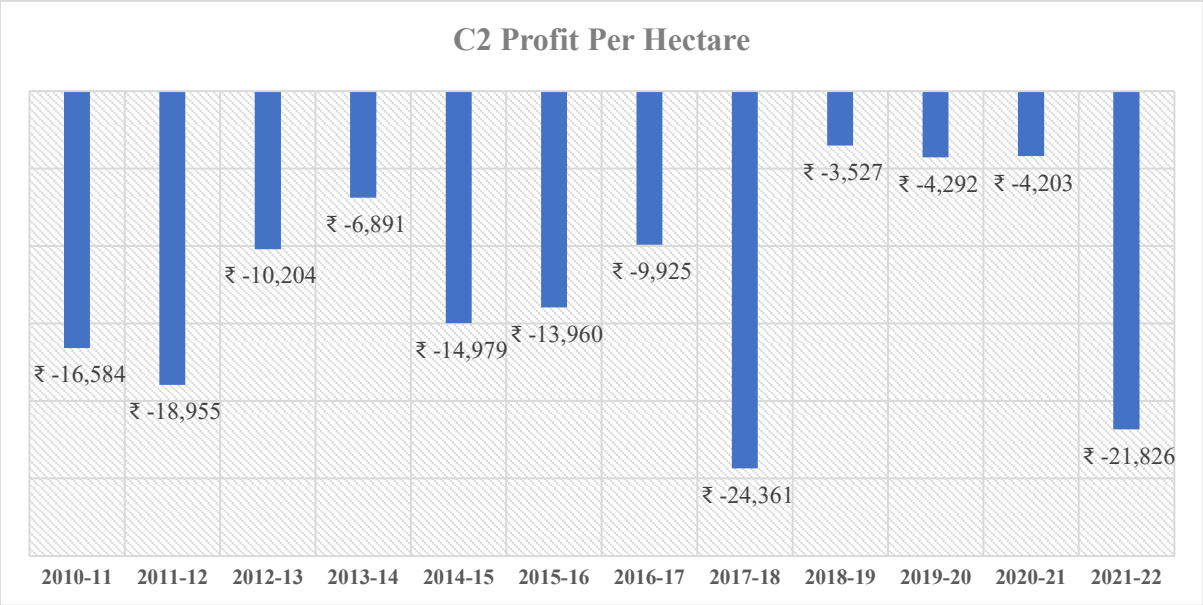
Figure 9 Profit of Cotton Farmer in Maharashtra expressed in C1



Source: Authors Calculation

The calculations in Figure 9, are carried out by the authors based on the government data available fromthe Ministry of Agriculture Department of Agriculture and Cooperationandthe Directorate of Economics and Statistics.

Figure 10 Profit for Cotton Farmer in Maharashtra expressed in C2



Source: Authors Calculation

Figure 9, clearly shows that when C1 cost is considered the farmer was in profit for six yearsor just for half of the period under study, whereas if we consider the cost C2 in Figure 10, the situation deteriorates drasticallyfor the farmers, as it translates into losses for all the 12 years under consideration for the study.

3.1 Forecasting of cost of cultivation

Forecasting the cost of cultivation was the next step undertaken by the authors. This is a very difficult process, due to the complex and dynamic nature of the parameters involved, such as cost of inputs to cost of operations which are highly dependent on the irregularities associated with the weather and economic conditions. Nevertheless, to understand the economics of the future of cotton cultivation in Maharashtra, forecasting the cost of cultivation was undertaken. Since historical data was available for 15 years, this gave thisprovided data points for one and half decade time horizonto plot the trend analysis to forecast the cultivation cost for cotton growers of Maharashtra, which has been elaborated in Figures 11 and 12.

Figure 11 Forecast for C1 Cost

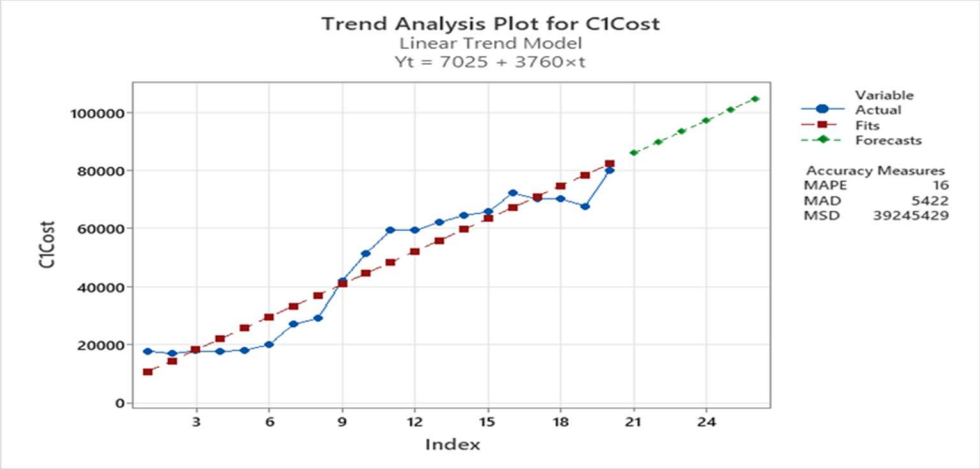


Figure 12 Forecast of C2 Cost

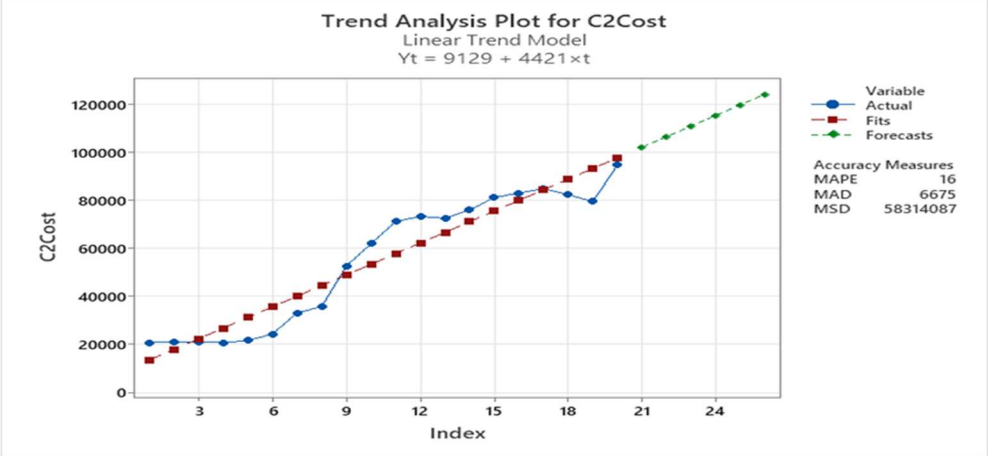
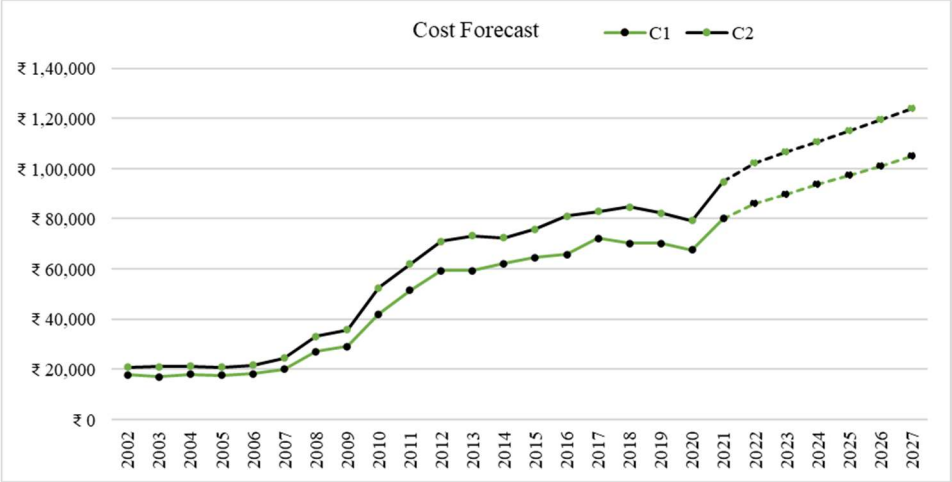


Figure 13 provides the cost of cultivation forecast using C1 and C2 till 2027.

Figure 13 Forecast of C1 & C2 Cost



The farmers need to getminimum returns for undertaking the cultivation process, which shouldnot only cover the expenses but also realize some residual surplus for economic sustainability. It

should also consider the weather vagaries and contingency funds required to take care of any emergency for the family. (Mishra, 2008) Hence the author is considering a minimum of 15% returns on his cost of cultivation. In Table 3 we have tried to understand what the profitability of farmers would be, based on the above derived cost of cultivation values. We have also assumed that due to the adoption of better practices, the yield of farmers will have 2% CAGR for the next 6 years, similarly the minimum support price is also considered with 3% CAGR for the next 6 years. This will give us a more realistic picture of what lies in the future for the cotton farmers in Maharashtra. In cases where the minimum target of 15% return on investment is not achieved, what should have been the yield or MSP for the product to achieve desired profit level?

Table 1 Required Yield or MSP to achieve 15% Return on Investment with C1 Cost

Year	Cost of CultivationC- 1	Target Revenue @ 15% RoI	Yield (Qtl/Ha) Increase @ 2% CAGR	MSP (₹/Qtl) Increase @ 3% CAGR	Revenue (₹/Ha)	Profit (₹/Ha)	RoI%	Required Yield for 15% RoI	Required MSP for 15 % RoI
2022	₹ 85,991	₹ 98,890	12.98	₹ 5,898	₹ 76,573	₹ -9,418	-22.6%	16.77	₹ 7,617
2023	₹ 89,751	₹ 1,03,214	13.24	₹ 6,075	₹ 80,447	₹ -9,304	-22.1%	16.99	₹ 7,794
2024	₹ 93,512	₹ 1,07,539	13.51	₹ 6,257	₹ 84,518	₹ -8,994	-21.4%	17.19	₹ 7,961
2025	₹ 97,272	₹ 1,11,863	13.78	₹ 6,445	₹ 88,794	₹ -8,478	-20.6%	17.36	₹ 8,119
2026	₹ 1,01,032	₹ 1,16,187	14.05	₹ 6,638	₹ 93,287	₹ -7,745	-19.7%	17.50	₹ 8,267
2027	₹ 1,04,792	₹ 1,20,511	14.33	₹ 6,837	₹ 98,008	₹ -6,784	-18.7%	17.63	₹ 8,407

The above calculation of the author clearly shows the expected yield or MSP required to reach the required profitability has a gap.

Table 2 Required Yield or MSP to achieve 15% Return on Investment with C2 Cost

Year	Cost of CultivationC- 1	Target Revenue @ 15% RoI	Yield (Quintal/Ha) Increase @ 2% CAGR	MSP (₹/Qtl) Increase @ 3% CAGR	Revenue (₹/Ha)	Profit (₹/Ha)	RoI%	Required Yield for 15% RoI	Required MSP for 15 % RoI
2022	₹ 1,01,961	₹ 1,17,255	12.98	₹ 5,898	₹ 76,573	₹ -25,388	-34.7%	19.88	₹ 9,031

2023	₹ 1,06,382	₹ 1,22,339	13.24	₹ 6,075	₹ 80,447	₹ -25,935	-34.2%	20.14	₹ 9,238
2024	₹ 1,10,802	₹ 1,27,422	13.51	₹ 6,257	₹ 84,518	₹ -26,284	-33.7%	20.36	₹ 9,433
2025	₹ 1,15,223	₹ 1,32,506	13.78	₹ 6,445	₹ 88,794	₹ -26,429	-33.0%	20.56	₹ 9,617
2026	₹ 1,19,643	₹ 1,37,589	14.05	₹ 6,638	₹ 93,287	₹ -26,356	-32.2%	20.73	₹ 9,790
2027	₹ 1,24,064	₹ 1,42,674	14.33	₹ 6,837	₹ 98,008	₹ -26,056	-31.3%	20.87	₹ 9,953

Cotton cultivation is not feasible soon. However, given the area coverage and number of farmers associated with cotton production steps should be taken to review the state of cotton cultivation in the state of Maharashtra. The first step in that direction would be to analyze the current production system of Cotton.

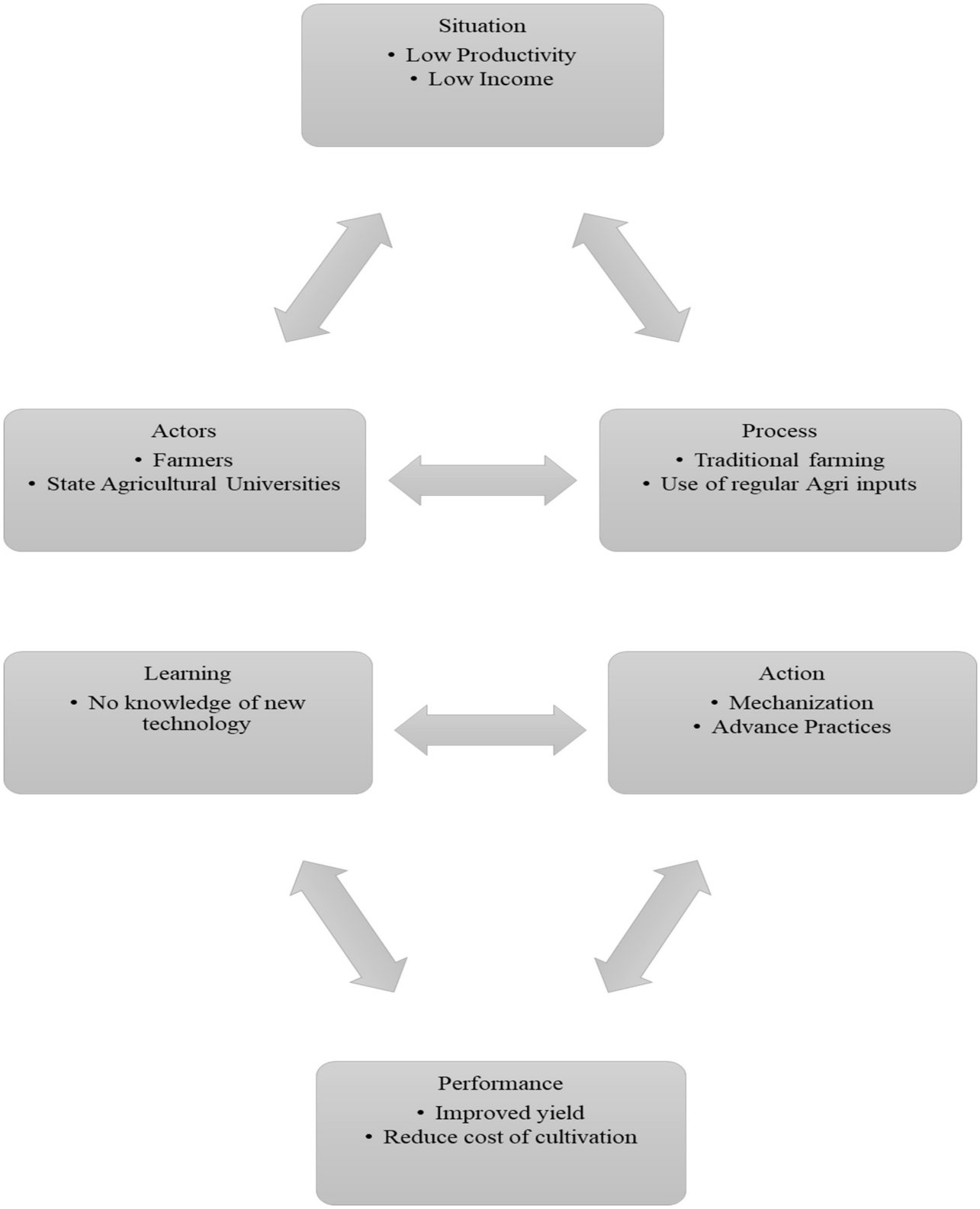
3.2SAP – LAP Analysis of Cotton Cultivation in Maharashtra

The SAP-LAP hypothesis in Figure 16, is explained in the framework of cotton cultivation in Maharashtra. The ‘Situation’ reflects the existingcircumstances, past, and scenarios that areanticipatedsoon, connecting to the issues underreflection. The ‘Actor’ comprises the mainaspects that would affect the situation and in turn,be altered by the situation. Under ‘Process’, the study of impact due to the actions of actors is considered, it also considers the reasons behind the impact and the process in which it is done, however, the actor drives all the decisions for the execution of the process which impacts the situation. (Chavan et al., 2019)

Further, SAP results inLAP which is a consequence of SAP. “Learning” relates to experience as an outcome of the condition, the actors engaged, and steps taken to handle the situation. ‘Action’ addresses the enhancement required in the circumstances and what endeavoursto be undertaken. ‘Performance’ infersa shift in the execution of the actorsand how the implementation can be adjusted in the future. The SAP-LAPstudy helps to understand the journey of cotton production in Maharashtra from the past, considers the present, and shows the future state.

To critically access the sustainability of cotton cultivation a detailed analysis of current cultivation practices is required along with the study of economics which goes into cotton production. SAP–LAP analysis would support us to gain the perspective required to undertake such a multi-dimensional study.

Figure 14 SAP-LAP Analysis



Situation

- India has 38% of the global area under cotton cultivation and only 21% of the output. Maharashtra has 34% of India's area under Cotton Cultivation and 23% of production is accounted for by Maharashtra.Maharashtra also accounts for 26.5% of the total net sown area and 18.3% of the Gross cropped area.
- No less than 6 million small-to-medium-sized Indian cotton farmers and farm workers, participate in the global cotton value chain. The country, therefore, has a responsibility to ensure that not only does it continue to strengthen its position in the global cotton trade but also plans for a strong, secure, and sustainable future.

  Source: https://www.orfonline.org/expert-speak/indias-cotton-production/
- Cotton is no more sustainable crop with reduced profitability as yields are not improving with the increasing cost of cultivation due to higher inflation, increased labor cost, etc. This is leading farmers to explore alternative crops.
- The current productivity level of Maharashtra is lower than the national average for India which is further lower than the global average productivity.
- Cotton is very highly dependent on the rainfall which directly impacts the productivity and cost of cultivation. The vagaries and the risk associated with rainfed farming are very high in cotton. The climatic changes due to global warming will further deteriorate cotton profitability.
- Cotton farmer is the weakest part of the value chain as he has minimum means to stock the produce. He is highly dependent on the available markets and the prevailing rates. The agents and the ginning industry further limit farmers profit by keeping information on prices asymmetrical.

Actor

- Cotton cultivators/farmers (4 million farmers), Farmers Producers Organisations (FPO), Middlemen/agents, Self Help Groups (SHG)
- Cotton ginning and pressing industry, Cotton spinning mills, textile industry, garment manufacturers, and traders along with retailers. Cotton seed manufacturers & Plant protection chemical industry also are major actors.
- Various state government and central government departments, along with the ministry of Agriculture and farmers' s welfare,Cotton Corporation of India (CCI), Central Institute of Cotton Research (CICR), ICAR-Central Institute for Research on Cotton Technology (CIRCOT) State agricultural universities (SAUs) Academicians, non-government organizations (NGO), think tanks, etc.

Process

- Current cultivation methodology used by farmers involves low mechanization and high dependency on labor with the use of inputs such as seeds, fertilizers, and pesticides.
- This primarily is due to less investment by Government and State agricultural universities in technology development and the risk-averse nature of farmers who tend to trust the traditional practices.
- The cotton textile industry which has a high dependency on cotton has not done backward integration. The private organizationsin the agriculture input sector have also not done much in improving cultivation practices.

Learning

- The economic sustainability of cotton cultivation is questionable given the current scenario of lower yield and higher cost of cultivation.
- The is a need to access the social cost-benefit analysis of cotton cultivation and the damage it has caused to the farming community and the Indian agricultural economy.
- The key issue is technology availability in terms of improved seed hybrids, fertilizers, plant protection chemicals, mechanizedequipment, etc, and its adoption by the farmer community.
- The main actors such as Farmers are risk-averse and not ready to experiment or adopt new methodologies. The other actors such as the agricultural input industry are also not supporting the introduction of new technologies because of farmers' reluctance and the huge cost involved in technology development.
- The entire process from seed selection to land preparation to cultivation to harvesting to marketing of the produce requires upgradation. This level of change requires major incentives which need to come from the government to work as an initial catalyst.
- Supporting farmers with higher MSP is not a long-term solution, it would give only short-term benefits by transferring the burden from one place to another. Working towards the realization of a better market rate for Indian cotton-like American or Egyptian cotton needs to be done by the Cotton Corporation of India.

Action

- To improve the situation, action should be taken to bring the latest technologies from advanced countries to India. Technology such as high-density planting systems, short and high-yielding hybrids, plant protection chemicals to support high-yieldingcrops, and mechanization methods to reduce labor dependency and improve efficiency should be brought on priority along with irrigation facilities.
- The actors such as Farmers and Agri input providers would require initial incentivization to adopt the technology and experience its benefits.

- The government of India under the Technology Mission of Cotton (TMC) should showcase the end-to-end use of technology and its benefits to the farming community. This kind of front-end demonstration should be done across various geographies.

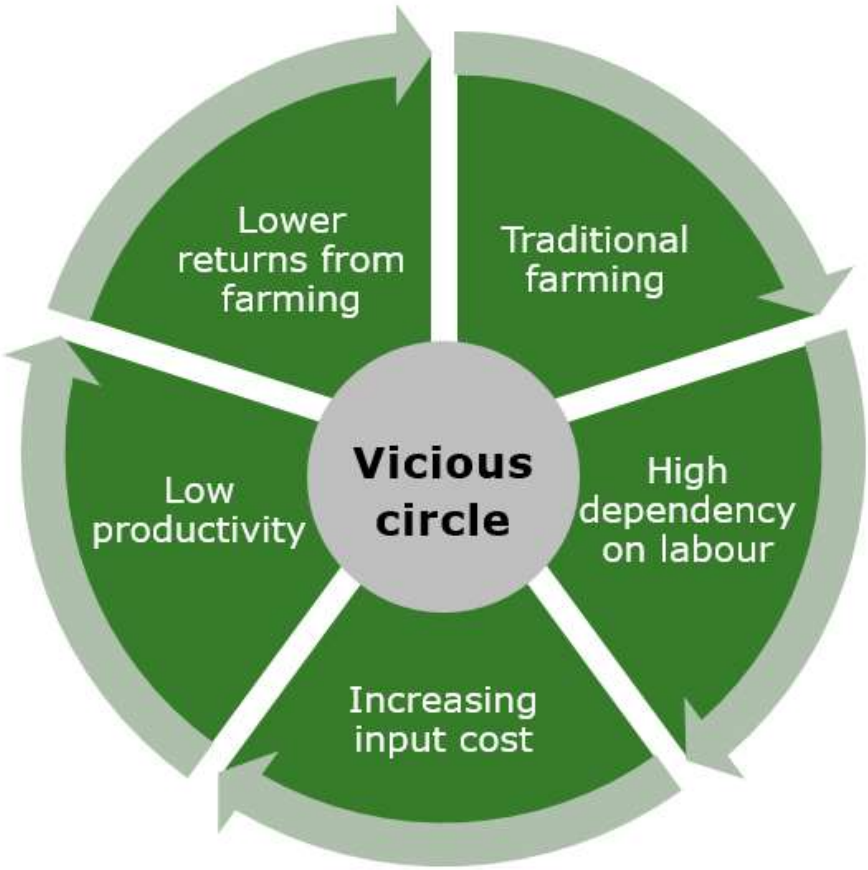
Performance

- This action would enable the farming community to experience the benefits of adopting new technology and let them understand the chances that they need to do in their current cultivation practices.
- The most important effect will be on the income of the farmers, they would be able to improve it substantially. The agricultural input providers would be able to have an expanded portfolio with newer products.
- The process of cotton cultivation would be revamped. The entire end-to-end practices will undergo modification which in return would be at par with the practices followed by the other developed nations. It will mainly improve the cotton production and income associated with all the stakeholders such as farmers, agricultural inputs manufacturers, sellers, the textile industry, etc.

3.3 Expert views on cotton cultivation in Maharashtra

Cotton is themost important crop for agriculturalists in Maharashtra and is mainly grown in the Vidarbha and Marathwada region of Maharashtra. These regions are mostly rainfed and lack basic irrigation facilities, the soil and climatic conditions mostly favor cotton cultivation. This leads farmers to concentrate on cotton cultivation as a major crop and restricts them from exploring other options. The prevailing conditions are also not encouraging farmers to explore practicing or experimenting with the new technology of cotton cultivation such as high-density planting or the use of mechanized cultivation practices to improve profitability. This also makes farmers more dependent on the labor for cultivation of cotton. Furthermore, it has been observed that the cost of cultivation is also increasing at a constant pace with the rising cost of inputs such as seeds, fertilizers, and crop protection chemicals. It is recommended to have high-intensity(higher population of plants per acre) varieties of cotton that could improve the yield and lower the input costs for irrigated as well as rainfed cotton (Gutierrez et al., 2015). This overall scenario creates a vicious circle depicted in the below figure.

Figure 15 Predicament of Cotton Farmers



4.0 Conclusion and Recommendations

The above analysis clearly shows that in the case of Cost C-1, farmers cannot expect any profit in the next 5 years above 15% from the cultivation of cotton. However, the situation is further serious if we consider the Cost C-2; as losses would be on the higher side, in fact, the farmer will not even be recovering his cost of cultivation in this case.

The study poses a pertinent question as to why 18% of the gross cropped area and 26.5% of the net cropped area is still under cotton cultivation when the economic analysis shows that cotton cultivation is unsustainable.

The expert also suggests that cotton farming needs to undergo a major transformation to overcome the vicious circle of traditional farming leading to losses and high cost of technology adoption to improve the yields.

Cotton has a very large ecosystem from farmers to retailers and from seed processing to garment processors. This eco-system now needs further integration to improve profitability at each step. Particularly for farmers it has now become apparent that forward integration with ginners and spinners is developed so that they can also reap the benefits of higher income and understand the market dynamics as done in other crops like sugarcane or potato which are highly commercialized.

Farmers from developed countries are very well integrated with the forward value chain and they are reaping the benefits of this integration. It's now high time in India we start working on such integration.

Given the focus of government policy on "Doubling the Income" of farmers in India, the above analysis is showing quite a contrast. On one hand, the farmer is struggling to recover his essential cost of cultivation in cotton, and on another, the government is discussing doubling the farmer's income. The focus of the government on just increasing the minimum support price (MSP) will not be able to bring farmers out of this vicious circle. This now requires very strong steps from the government with an integrated approach i.e.,

- Focus on making technology or mechanizations affordable to small-scale farmers to reduce the cost of cultivation this could incur more funding for research and development,
- Introduce cultivation practices to increase the yield level to bring it at par with the global average and introduction of crop insurance to offset the risk taken by farmers in the purchase or deployment of high-costtechnology.
- Irrigation management is also critical for improving cotton production. The focus should be given tothe usage of technology such as sprinklersor drip irrigation during the critical growth stages of cotton is important. Proper rainwater harvesting along with the use of moisture sensors can have a significant impact on cotton production.
- Continued support on minimum support prices or better rates for produced cotton may impact government finance and have a spiralling effect on inflation.
- Crop diversification into more economically sustainable crops can also be explored this will also reduce the area under cotton cultivation. Crop rotation is also a viable alternative like the cultivation of pulses, oilseeds, or legumes. This not only improves soil fertility but also supports integrated pest management by breaking the life cycles of pests and diseases.

This integrated approach may be the best change to revolutionise the cotton cultivation in Maharashtra and make it sustainable for farmers to cultivate cotton.

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