

Growth dynamics analysis of cauliflower in Himachal Pradesh

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India, one of the top producers of cauliflower (*Brassica oleracea* var. botrytis) has made a significant contribution to the agricultural, nutritional and commercial value. The present study examines the growth dynamics of cauliflower production, pricing, productivity and area in the state of Himachal Pradesh. It focuses on the Solan district for data on pricing, productivity and output from 2003 to 2020, and on area, production and productivity from 1995 to 2020. The study projects future scenarios and analyses previous trends using statistical tools, such as seasonal indices, decomposition analysis, Cuddy-Della Valle Index (CDVI), compound annual growth rate (CAGR) and autoregressive integrated moving average (ARIMA) modelling. Results indicate that the growth rate in production (8.77%) surpassed the growth in area (6.48%), whereas productivity growth stood at 7%. Despite fluctuations, cauliflower cultivation remains relatively stable, with area expansion being the primary driver of production growth. The optimal ARIMA models for forecasting area, production and productivity were identified as ARIMA (0, 2, 1), ARIMA (2, 2, 2) and ARIMA (2, 2, 1) respectively, suggesting an increasing trend in area and productivity, whereas production is projected to decline. Price growth rates ranged from 4.45% to 7.51%, exhibiting low variation, and seasonal indices revealed higher off-season variability compared to peak season. The selected ARIMA model for price forecasting is ARIMA (0, 0, 1) (0, 1, 2) with drift. These insights provide valuable information for policymakers and stakeholders in the cauliflower market.

Keywords: ARIMA, cauliflower, decomposition analysis, forecasting, seasonal indices.

In 2021–22, India cultivated 0.48 million hectares (m ha) of cauliflower, producing 9.53 million metric tonnes at a productivity rate of 19.6 metric tonnes per hectare. This represents 32.5% of global cauliflower production, making India the largest producer worldwide, significantly boosts farmers' income and generates employment opportunities^{6,7}. The major cauliflower-producing states in India include West Bengal (26%), Bihar (17%), Madhya Pradesh (10%) and Odisha (10%)⁸. Himachal Pradesh stands out as a significant region for cauliflower cultivation, distinguished by its unique agro-climatic conditions and farming practices^{9,10}. However, the marketing aspects, including price dynamics and arrival forecasting, have not been adequately explored within this context. Notably, Himachal Pradesh is emerging as a hub for vegetable marketing, indicating a growing need for comprehensive studies in this area to support its development.

Cauliflower in Himachal Pradesh serves as a primary source of income for smallholder farmers^{11,12}; with cultivation spanning 5.92 thousand hectares and a production output of 139.14 thousand metric tonnes, cauliflower holds significant economic importance in the state. Particularly in the Solan district, cauliflower is a key crop, cultivated on 0.17 thousand hectares with a production of 4.37 thousand metric tonnes¹³. A substantial gap exists in the literature regarding comprehensive studies that investigate the intricate relationships among vegetable production, marketing practices and the economic dynamics experienced by farmers. This lack of thorough research hampers understanding of the challenges and opportunities within the agricultural sector, resulting in insufficient data for effective policy formulation. The absence of detailed analyses limits the ability to develop strategies