

Assessing Surplus Production Areas for Fruits in Himalayan Kashmir and Sub-Himalayan Jammu

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ABSTRACT

This study employs a comprehensive analysis to assess the fruit production landscape in the Northwestern Himalayas *vis-à-vis* Jammu and Kashmir, utilizing data from the Agricultural Department and the Statistical Digest of the region (Anonymous, 2022b). The methodology integrates QGIS mapping and mathematical formulas to determine surplus and deficit areas. Districts are individually mapped based on key fruits, and a combined overview is derived for the entire Union Territory. Color-coded symbology, including violet circles for production levels, green for surplus, and red for deficit, visually represents fruit concentrations on maps. The study reveals pronounced disparities in fruit distribution across Kashmir, with Apple exhibiting the highest surplus in all the 10 districts of Kashmir followed by Walnut except Srinagar which exhibits a deficit scenario in all the fruits. In contrast, the Jammu region predominantly faces deficits in all kinds of fruits. Kashmir, with nine surplus districts except Srinagar, emphasizes the need for strategic interventions, including value addition, storage capacity augmentation, cold-chain technologies, infrastructure investment, and awareness campaigns. The study advocates for transforming surplus vegetables into value-added products and formulating district-specific policies to address post-harvest losses in the fruit supply chain. This research contributes valuable insights for policymakers and stakeholders to enhance fruit production dynamics, promote sustainability, and optimize resource allocation in the Jammu and Kashmir region.

Keywords: Deficit, QGIS, Surplus, Jammu and Kashmir

The economic foundation of Jammu and Kashmir primarily revolves around agriculture, engaging approximately 70 percent of its population directly or indirectly (Tak, 2023). The region strategically capitalizes on supplying off-season fruits, affording farmers a market monopoly and thereby obtaining better prices for their produce. Fruit cultivation spans an approximate net area of 84,000 hectares, resulting in a production of around 1,339 thousand metric tons (Anonymous, 2022a). To maintain competitiveness in the contemporary market atmosphere, farmers

must transition their market linkage approach from a Commodity-Based paradigm to a Product-Based one. This necessitates the establishment of a robust food processing industry, the conversion of surplus produce into value-added products, and simultaneous enhancements in post-harvest

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storage to reduce wastage and decrease reliance on imports during seasonal demands. The Indian food processing industry, valued at USD 180 billion and growing at an annual rate of approximately 9.3%, significantly contributes to national exports, constituting 25 percent of the total (Anonymous, 2024). Employing 60 percent of the country's working population directly or indirectly, plays a pivotal role in employment generation (Khan, 2021). Despite the potential to catalyze sustainable development, inclusive growth, and mitigate food inflation, the true potential of this sector, particularly in perishables constituting half of India's farm produce, remains largely untapped. Within perishables, fruits, and vegetables constitute approximately 60 percent, with processing levels at a meagre 2 percent (Selvaraj *et al.* 2019). Value chain interventions, supported by financial institutions, encompassing farm gate operations, post-harvest management, and modernization in food processing, are imperative. Adequate policy and regulatory enablers further amplify the potential for sustainable development and economic growth. In the context of Jammu and Kashmir, characterized by distinct climatic conditions and topography, the region presents both opportunities and challenges for fruit cultivation. The climatic conditions and topography significantly impact the cultivation of fruits. The Jammu region, benefiting from a favourable climate, excels in the cultivation of Mangoes but is largely a deficit region. In contrast, Kashmir excels in the production of fruits like Apples, Pear, and Walnut. Nine districts in Kashmir are in surplus except for Srinagar district which is largely in deficit. This makes the Himalayan region of Kashmir a potential region for the development of the food processing industry at a large scale. Apple tops in terms of surplus fruit in the Kashmir region (Wani *et al.* 2021). A robust and dynamic food processing sector assumes a pivotal role in achieving higher value-addition, reducing agricultural wastage, extending the shelf life of food products, promoting employment, and augmenting farmers' income. Recognized as a focal area for development, the food processing sector necessitates substantial investments in logistics to support the entire value chain, spanning from farm to plate. This integration, coupled with allied interventions in post-harvest management, cold chain, logistics, and distribution, forms the foundation of an efficient

and integrated food supply chain. The introduction of the Fruit Availability Map in this study represents a significant stride towards planning regionwide food infrastructure and supply chain arrangements by mapping the production patterns of key fruits and assessing the availability of prominent fruits at the regional level.

MATERIALS AND METHODS

Study Area

The current study aims to evaluate the surplus and deficit areas of production in the Jammu and Kashmir UT. Situated in the northwestern region of the Himalayan mountain range, this study area is distinguished by notable fluctuations in terrain elevation, snow-covered peaks, intricate geological formations, river systems, and a rich diversity of temperate plant and animal life. This area is located in the Himalayas' far north. It makes up roughly 67.5% of the Himalayan region to the northwest. The agroclimatic conditions of the region are diverse, with sub-tropical conditions found in Jammu and temperate conditions in Kashmir. Nonetheless, there are significant regional differences in the shift in microclimatic conditions. The research area's physical boundaries are divided into 20 sub-regions/districts, with a net area of approximately 222,236 km² (Fig. 1).

This study is based on benchmark secondary data. The cartographic representations were formulated utilizing Geographic Information System (GIS) software, specifically QGIS. Geospatial data, in shapefiles, was acquired from the Survey of India. Concurrently, attribute data sourced from a pre-prepared Excel sheet was seamlessly integrated into QGIS, facilitating the generation of comprehensive fruit distribution maps for the Jammu and Kashmir regions. Data about vegetable production was procured from the Departments of Agriculture/Horticulture across all districts within Jammu and Kashmir (Table 1). Complementing this, population statistics were extracted from the Digest of Statistics 2022 (Anonymous, 2022b). The daily per capita fruit consumption was standardized at 150 grams, aligning with the guidelines set forth by the Indian Council of Medical Research (ICMR), the World Health Organization (WHO), and other anonymous sources.

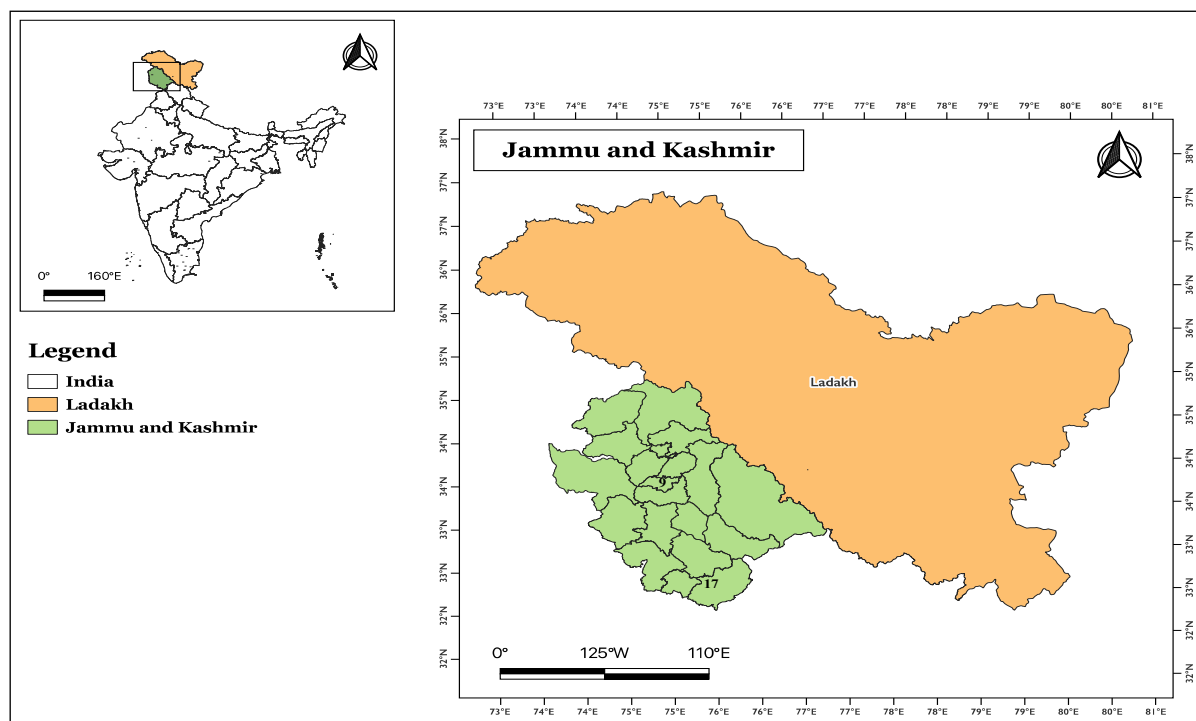


Fig. 1: Map of the studied area

Table 1: The global location of the districts in the studied area

District	Lat., Long.	District	Lat., Long.
Anantnag	33°49'N, 75°15'E	Doda	33°8'N, 75°35'E
Bandipora	34°25'N, 74°38'E	Jammu	32°44'N, 74°51'E
Baramulla	34°10'N, 74°22'E	Kathua	32°35'N, 75°37'E
Budgam	33°55'N, 74°38'E	Kishtwar	33°19'N, 75°46'E
Ganderbal	34°13'N, 74°47'E	Poonch	33°42'N, 74°15'E
Kulgam	33°39'N, 75°0'E	Rajouri	33°16'N, 74°21'E
Kupwara	34°31'N, 74°11'E	Ramban	33°20'N, 75°12'E
Pulwama	33°57'N, 75°3'E	Reasi	33°4'N, 74°50'E
Shopian	33°49'N, 74°50'E	Samba	32°35'N, 75°7'E
Srinagar	34°5'N, 74°48'E	Udhampur	32°55'N, 75°20'E

After this, the fruit requirement was systematically computed, culminating in the derivation of surplus and deficit figures. Initially, surplus and deficit assessments were conducted individually for each of the 20 districts. This involved a meticulous selection of predominant fruits cultivated in both regions. The aggregate surplus or deficit for the entire set of 20 districts in the Jammu and Kashmir regions was subsequently calculated, offering a consolidated overview. The fundamental formula underpinning

the computation of consumption, population, and requirement data is expressed as follows:

Fruit Requirement per Year × Average Daily Per Capita (150 gms for all types of fruits according to ICMR/WHO guidelines & other anonymous sources)

This formula has served as the foundation for estimating fruit availability across all maps, thereby contributing to the formulation of a comprehensive

depiction of surplus and deficit scenarios within the Union Territory of Jammu and Kashmir.

RESULTS AND DISCUSSION

The agro-climatic intricacies influence vegetable cultivation in the Union Territory (UT) of Jammu and Kashmir. The diverse agro-climatic conditions, physiographic classifications, and cultivation patterns are spread across the three primary macro-climatic zones: Sub-Tropical, Valley Temperate, and Intermediate. The geographic diversity, shaped by factors such as altitude, temperature gradients, and soil characteristics, results in a broad climatic spectrum within the UT.

Agro-climatic Zones: The Jammu region is delineated into two major agro-climatic zones, *the low altitude subtropical zone*, and *the mid to high intermediate zone*. The former, characterized by monsoon, concentration of precipitation, and pronounced winter, covers the entire Jammu district and lower parts of Kathua, Udhampur, Poonch, and Rajouri districts. The latter, a subtropical-temperate transition, encompasses the mid and high-altitude areas of the Panjal trap,

exhibiting relatively wetter conditions, cold winters, and higher mean annual rainfall. This zone includes Doda, Poonch, and parts of Rajouri, Udhampur, and Kathua districts. The Kashmir region, categorized as a *mid to high-altitude temperate zone*, covers the valley of Kashmir, including Anantnag, Pulwama, Srinagar, Budgam, Baramulla, and Kupwara districts. This zone experiences wet and severe winters with frost, snow, and rain, while summers are dry and warm. The alluvial soils of the Kashmir valley, constituting approximately 62 percent irrigated area, contribute to the distinctive agricultural characteristics of this region.

Seasonal Dynamics: The cultivation seasons, namely Rabi (November to April), Kharif (May to October), and Zaid (June to September), align with the climatic variations in Jammu & Kashmir. These seasons witness the cultivation of a diverse array of vegetables, with farmers strategically planning crop cycles to optimize yields based on post-monsoon moisture and temperature fluctuations.

Vegetable Crop Taxonomy: The study categorizes major vegetable crop groups in the region, including

Table 2: Surplus/deficit districts of UT of Jammu & Kashmir

Districts	Production (MT)	Population	Consumption (g)	Requirement	Surplus/Deficit
Jammu	28418	1529958	150	83765.2005	-55347.201
Samba	12394	318898	150	17459.6655	-5065.6655
Kathua	32426	616435	150	33749.8163	-1323.8163
Udhampur	25782	554985	150	30385.4288	-4603.4288
Reasi	13926	314667	150	17228.0183	-3302.0183
Ramban	21007	283713	150	15533.2868	5473.71325
Doda	21202	409936	150	22443.996	-1241.996
Kishtwar	20323	230696	150	12630.606	7692.394
Rajouri	38617	642415	150	35172.2213	3444.77875
Poonch	26965	476835	150	26106.7163	858.28375
Srinagar	31265	1236829	150	135432.776	-104167.78
Baramulla	511343	1008039	150	110380.271	400962.73
Kupwara	230042	870354	150	95303.763	134738.237
Bandipora	75896	392232	150	42949.404	32946.596
Ganderbal	121546	297446	150	32570.337	88975.663
Pulwama	230475	560440	150	61368.18	169106.82
Anantnag	318248	1078692.00	150	118116.774	200131.226
Budgam	192851	753745	150	82535.0775	110315.923
Kulgam	258527	424483	150	46480.8885	212046.112
Shopian	313211	266215	150	29150.5425	284060.458

Table 3: Overall surplus/deficit of fruits in Jammu & Kashmir

Fruits	Jammu production (MT)	Population	Consumption (g)	Requirement	Surplus/Deficit
Apple	24415	5378538	150	294474.96	-270059.96
Pear	21219	5378538	150	294474.96	-273255.96
Apricot	4876	5378538	150	294474.96	-289598.96
Peach	2645	5378538	150	294474.96	-291829.96
Plum	4357	5378538	150	294474.96	-290117.96
Cherry	0	5378538	150	294474.96	-294474.96
Citrus Fruits	16377	5378538	150	294474.96	-278097.96
Mango	29142	5378538	150	294474.96	-265332.96
Walnut	82306	5378538	150	294474.96	-212168.96
Almond	5	5378538	150	294474.96	-294469.96
Vegetables	Kashmir Production (MT)	Population	Consumption (g)	Requirement	Surplus/deficit
Apple	1708076	6888475	150	377144.01	1330931.99
Pear	48716	6888475	150	377144.01	-328428.01
Peach	4870	6888475	150	377144.01	-372274.01
Plum	8884	6888475	150	377144.01	-368260.01
Apricot	5897	6888475	150	377144.01	-371247.01
Cherry	23639	6888475	150	377144.01	-353505.01
Almond	9170	6888475	150	377144.01	-367974.01

Solanaceous, Root, Bulb, Legumes, Cucurbits, Leafy, Okra, and Colocasia vegetables. This taxonomy provides a foundational understanding of the varied cultivation practices prevalent in the Himalayan region.

Regional Disparities: District-wise analysis reveals significant disparities in fruit availability, with Jammu identified as a deficit region as evidenced in Fig. 2, which shows three districts – Rajouri, Ramban, and Kishtwar – to be in surplus and the remaining seven districts to be in deficit. Only Kishtwar is in surplus in Walnut production rest all the districts show a deficit trend (Fig. 2, Fig. 4). In contrast, the Kashmir region exhibits surplus production across all districts except Srinagar (Fig. 5). Baramulla district leads in the surplus of Apples followed by Kupwara, Budgam, and Bandipora. Anantnag is a surplus in Apple and Walnut, Pulwama in Apple, Walnut, Pear, and Almond, Kulgam is a surplus in Apple, Walnut, Cherry and Pear, Shopian is a surplus in Apple and Walnut, and Ganderbal is a surplus in

Apple and Walnut (Fig. 3). Srinagar faces a deficit with some amount of good production in apple, pear and cherry (Fig. 3). The overall analysis underscores the deficit status of the Jammu region with only a good amount of production in Apple, Mango and Walnut, juxtaposed with Kashmir's role as a major contributor to the nation's total fruit production having Apple fruit in surplus. (Fig. 6). Figures also show the top 3 highest-producing fruits in each district of UT of Jammu and Kashmir enclosed within a violet boundary. The district-wise overview of highest-producing fruits serves as a valuable tool for agricultural planning, aiding farmers and policymakers in tailoring cultivation strategies based on each district's unique agro-climatic conditions. The numerical values for district-wise surplus/deficit have been shown in Table 2, and Table 3 shows commodity-wise surplus/deficit in the Jammu and Kashmir regions individually.

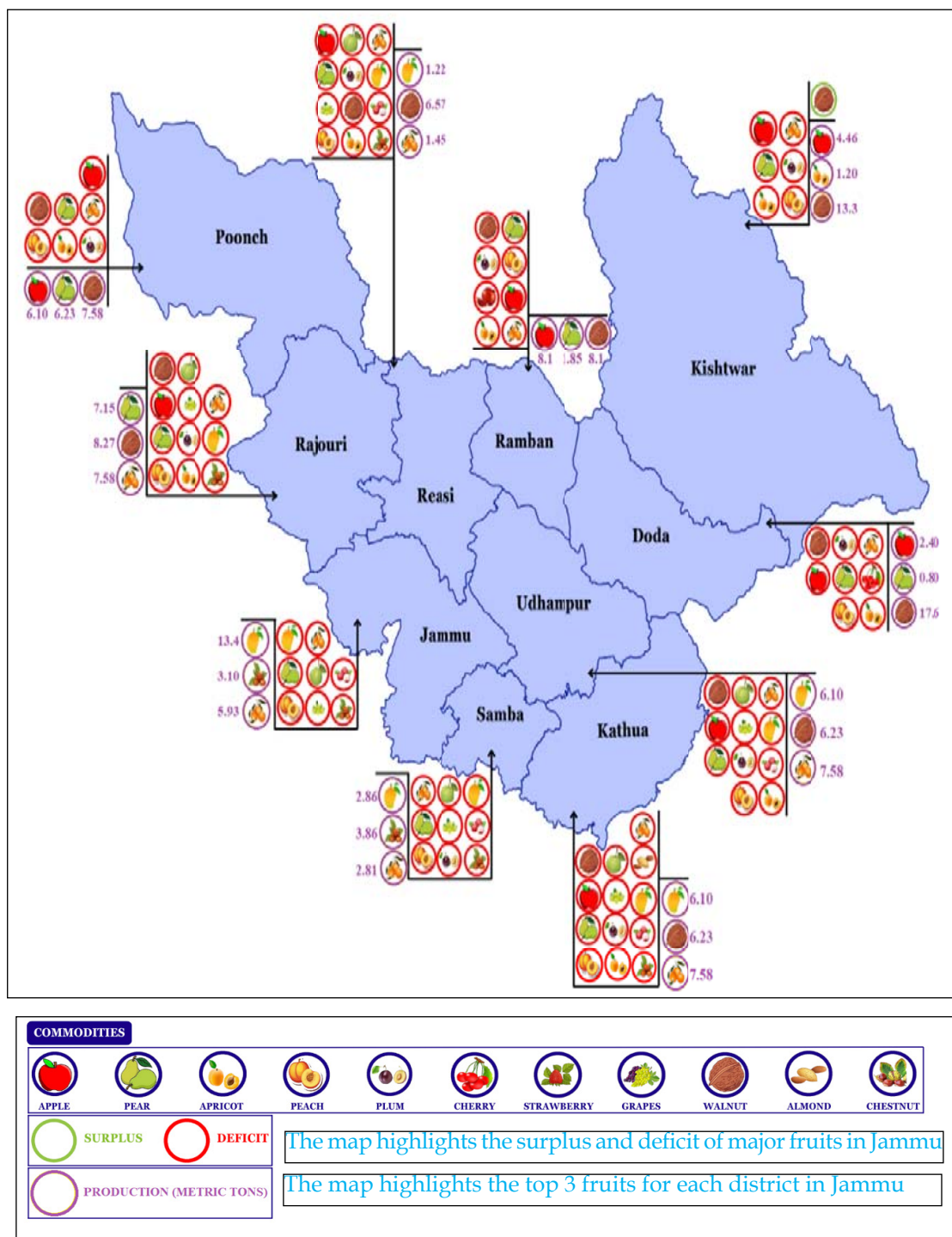


Fig. 2: Fruits Availability Map for Jammu

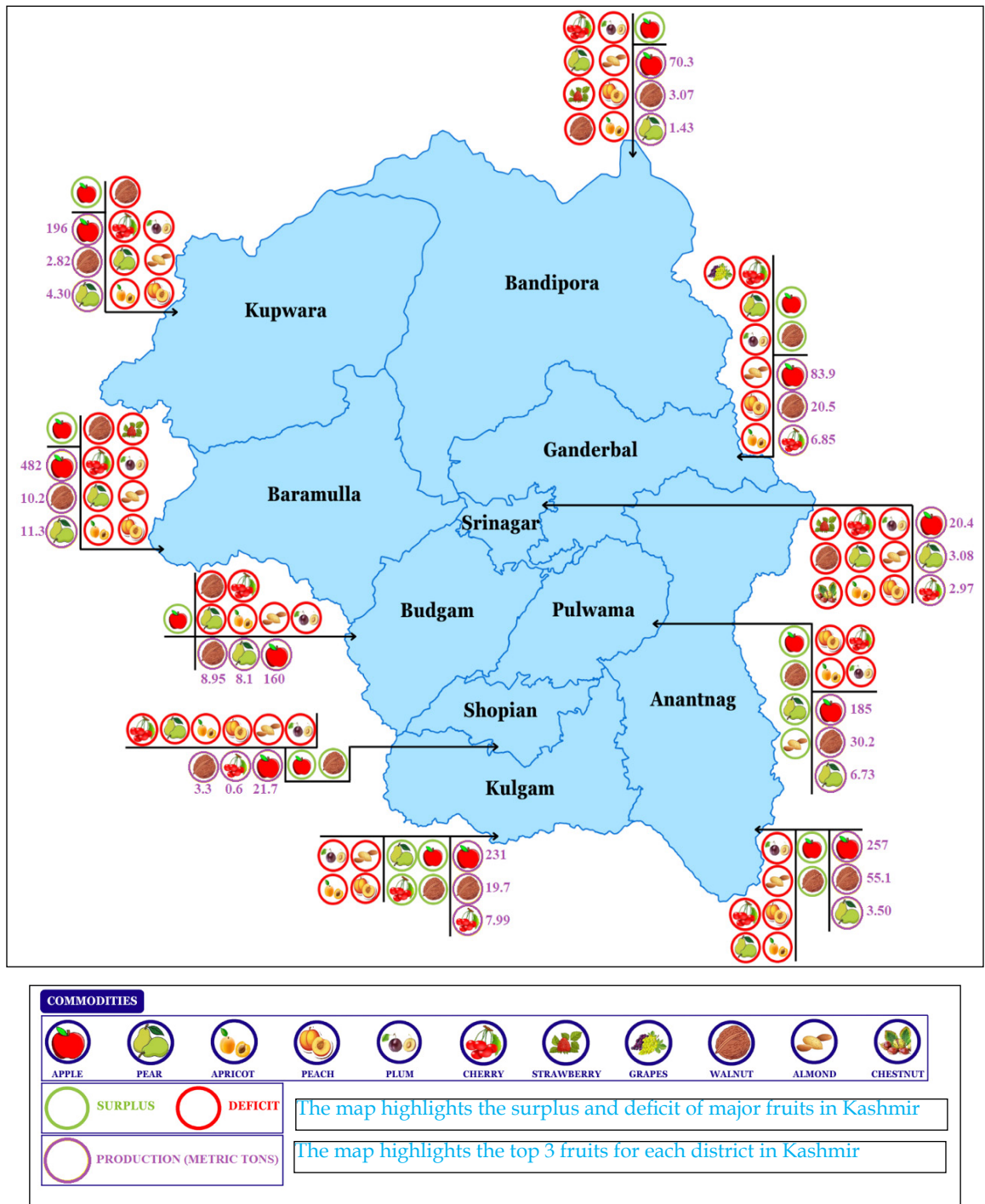


Fig. 3: Fruits Availability Map for Kashmir

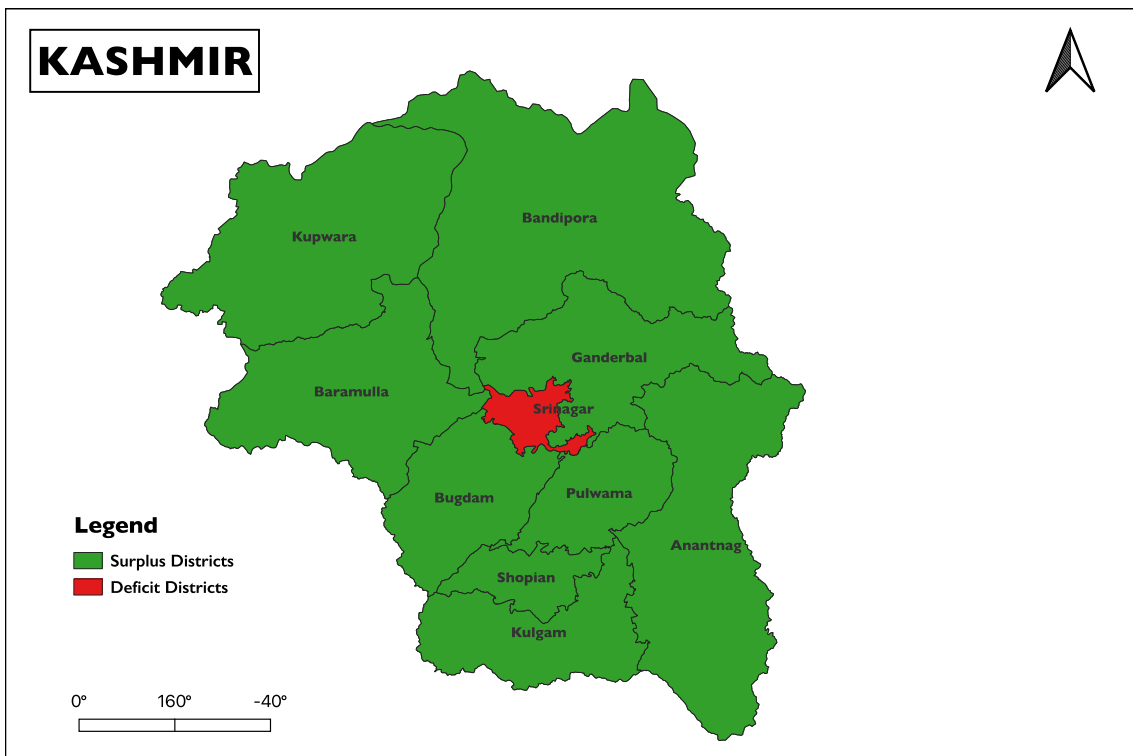


Fig. 4: District wise Fruits Availability Map for Jammu

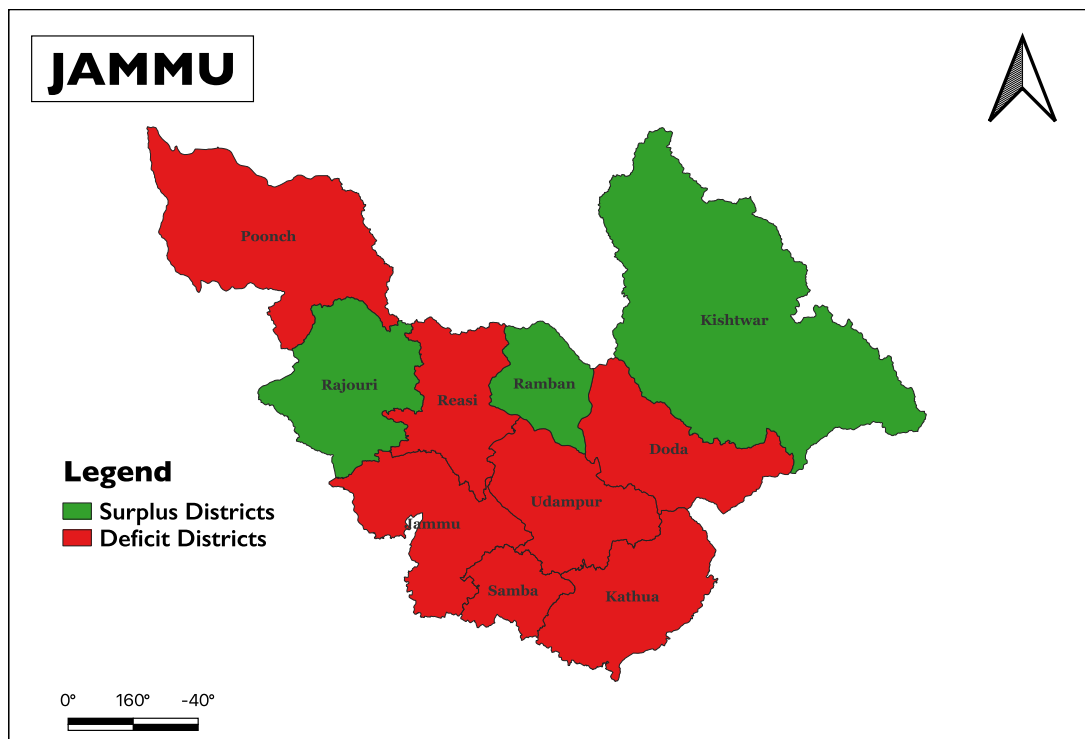


Fig. 5: District wise Fruits Availability Map for Kashmir

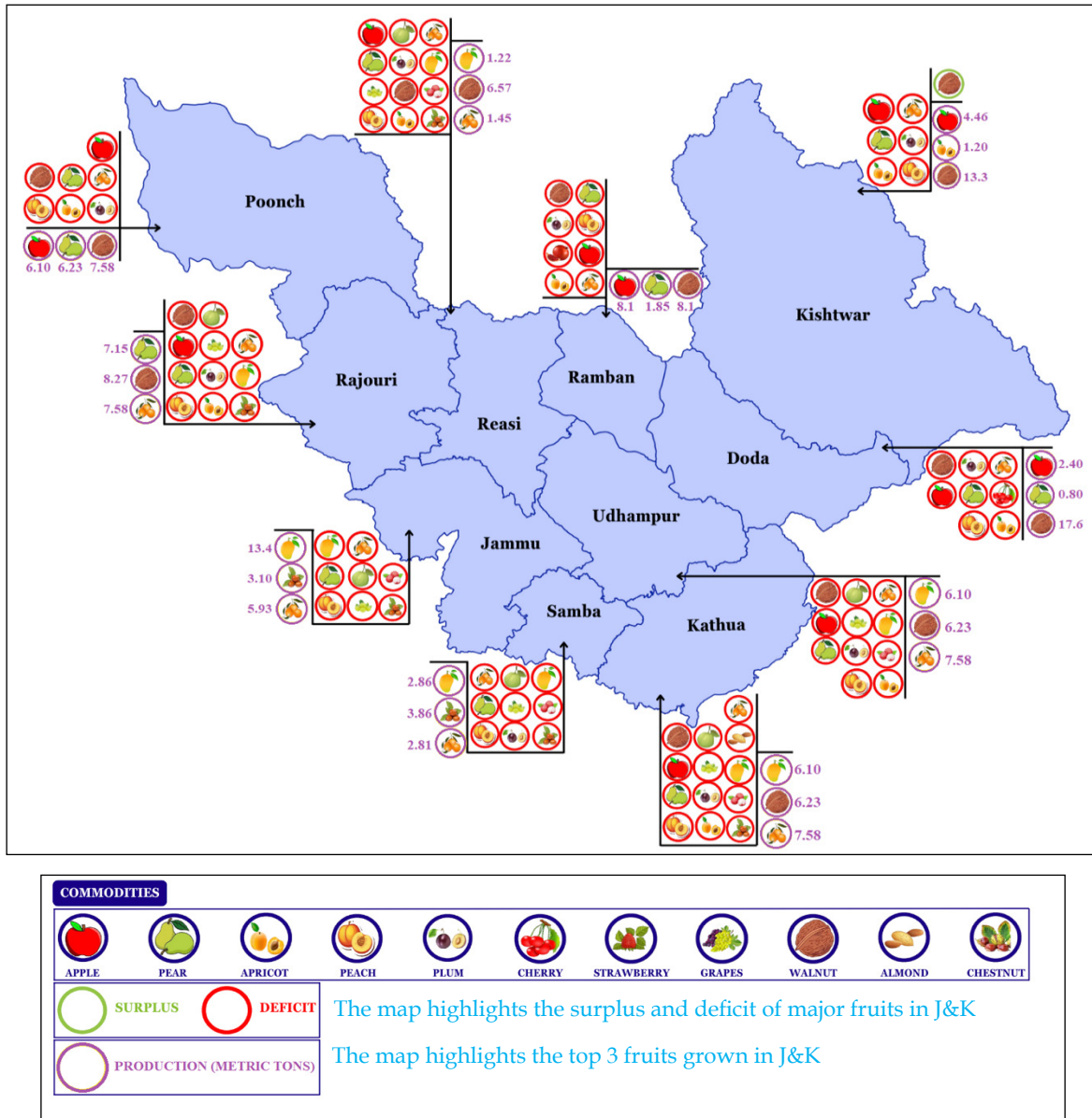


Fig. 6: Overall Fruits Availability Map for Jammu and Kashmir

CONCLUSION

This study, which was carried out in the framework of doctoral research, maps possible production areas for surplus and deficit commodities of fruits with a focus on Jammu and Kashmir’s food processing sector. The production and availability scenario of important commodities in J&K at the Union Territory (UT) and district levels are reviewed in detail in this paper. Presented as a means of encouraging cooperation between business executives, governments, and legislators, the paper highlights a long-term outlook with practical

solutions. It is expected that the study’s outcomes will open the door to strategic advancements that will greatly enhance the socioeconomic environment in the UT. The paper essentially serves to provide a road map for collaborative endeavors, encouraging long-term development and sustainable growth at J&K.

LIMITATION

Limitations include the use of previous year data in some cases due to unavailability, the surplus and deficit have been calculated based on the difference between production and consumption

of the commodities, generalized production and consumption numbers subject to cyclicity & seasonality, logical assumptions wherever data was unavailable, and a caution against making investment decisions solely based on the paper's information.

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