# SMART MANAGEMENT OF ORCHARD AND PLANTATION CROPS IN INDIA USING ARTIFICIAL INTELLIGENCE DRIVEN PRECISION FARMING


## by Dr. Mukti Sadhan Basu, Dr. Shravani Basu & Dr. Sébastien Foucaud

### SBSF (Science, Business and Sustainable Future) Consultancy


India is a net producer of many fruits and vegetables. While vegetables can be grown at scale in open fields to climate controlled glasshouse/polyhouse/containers for commerce, they can also be produced in more restricted spaces like kitchen gardens, allotments and roof tops (mostly suited for personal consumption or catering to a premium market). Most fruit crops, on the other hand, are grown in orchards or plantations over sizeable land areas. Vegetables being short duration in nature, their cultivation can be better managed and shielded from the adversities of a changing climate when compared to orchard/plantation crops. The establishment costs and associated risks of an orchard are significantly higher than vegetable fields, and ROI delayed for years until it reaches the stage of fruit bearing. However, even after reaching fruit bearing, the phenomenon of irregular bearing (dominant in perennial fruit crops) and governed by flowering phenology owing to environmental conditions, germplasm, rootstocks, and cultural operations can greatly impact productivity and profitability of an orchard.

The major fruits grown in India (in terms of area under cultivation, in descending order) are mango, citrus fruits (mandarin, lime/lemon, orange, others), banana, apple, guava, pomegranate, jackfruit, papaya, grapes, pineapple, sapota and watermelon among others. Maharashtra, Andhra Pradesh, Uttar Pradesh, Karnataka, Gujarat, Odisha, Madhya Pradesh, Tamil Nadu, Bihar, Jammu & Kashmir, Telengana, West Bengal, Kerala, Himachal Pradesh and Chhatisgarh are the largest fruit producing states in India with area under cultivation greater than 200,000 hectares. Andhra Pradesh, Uttar Pradesh, Odisha, Telangana, Karnataka, Maharashtra, Gujarat, Bihar, Tamil Nadu and West Bengal are the top 10 mango growing states in India (in terms of area). Karnataka, Tamil Nadu, Kerala, Andhra Pradesh, Maharashtra and Gujarat are the largest Banana growing states (in terms of area). While Telangana, Maharashtra and Andhra Pradesh are the largest orange growing states, the area under cultivation (using 2014-15 as a base) in these states have seen a sharp decline. The area under cultivation (in '000 ha) in AP declined from 72.86 to 70.11 in 2016-17, Telangana from 118.10 to 60.12, and Maharashtra from 61.82 to 54.89 for the same time period (Source: Horticulture Statistics Division, Ministry of Agriculture, Cooperation and Farmers Welfare).

Zooming in on mango, banana and orange cultivation across India, the size of the majority of holdings ranges from below 0.5-4.0 ha (Source: Horticulture Statistics Division, Ministry of Agriculture, Cooperation and Farmers Welfare), which are best classified as marginal to small to medium holdings. Owing to this very nature of the holdings, large scale mechanization poses critical challenges. Also noteworthy is the fact that average harvest and post-harvest loses has increased over the years for Banana, Citrus, Sapota and other crops. Change in weather patterns with warmer temperatures, intense sunshine and erratic rainfall with uneven distribution has led to a spurt of pest and diseases, some even hitherto unknown to that particular crop. Citrus dieback and Huanglongbing (HLB is vector borne) are currently the two major diseases destroying several hectares of orange crops, causing short supply and sharp increase in price of the fruit even in domestic markets, and inflicting severe economic losses for the growers and the country (exports). On the other hand, Tropical race 4 (TR4), the virulent strain of fungus Fusarium oxysporumcubense that is threatening banana crop globally with the fusarium wilt disease has killed off millions of bananas in Africa and Asia (from the 1980s onwards). It had surfaced in the Cavendish group of bananas in parts of Bihar and is now spreading to Uttar Pradesh, Madhya Pradesh and even Gujarat, which could spell havoc for the country's banana industry.

Even though India is the largest banana producing country in the world and 3rd largest orange producing country, our exports for these crops are mainly to the Middle East and some neighboring countries. Very little, if not any, is exported to the US or EU. In spite of such a high production, India's banana exports generate a meager US$49.8 million, with the United Arab Emirates alone buying bananas worth US$16.3 million. Ecuador, whose banana output is one fourth of India, raked in exports worth US$3.0 billion in 2017.

In view of existing and new edaphological, climatological, biotic and technological challenges which characterize the 15 or more Agro-climatic zones of India, we have to think on our feet to mitigate losses, increase output while putting the greatest emphasis on quality, make production systems sustainable, reduce carbon footprint, and boost farm incomes by also aiming for better prices (based on differentials) through diversification of the product (organic or conventional, raw or processed, value addition, etc.), customer (domestic and international) and export base. Climate change is a reality and the threat to agriculture and, Horticulture in particular, has to be dealt with on a priority basis. The only way to achieve this is through technological innovation leading to precision agriculture as it has been proven beyond doubt that more input doesn't translate to more output and very often leaves behind a trail of problems like residue, toxicity, resistance buildups, which have already rendered vast swathes of land unfit for use. In food producing countries like India, China and other Asian countries where the average land holding is less than 1 ha, this could also mean the complete loss of livelihoods and income for majority of farmers as the cost of soil reclamation could be cost prohibitive.


AFP/GETTY IMAGES

Experts in SBSF Consultancy understands the inherent problems that reside within each and every agricultural production system and has a successful track record of mitigating them. We do so by leveraging a rich network of agricultural research scientists and experts spread across the world in the field of crop sciences, data science (DS), machine learning (ML), artificial intelligence (AI), regulatory affairs (RA), food safety, and business strategy. We assist companies, not-for-profit organizations, governments, and international bodies in areas related to agricultural production, business and market development across production systems and crops. Going beyond traditional consulting, by applying DS, we have supported project development based on ML and data engineering applied to the agricultural sector in particular (Digital Farming and Precision Agriculture).

SBSF Consultancy can bring about the enhancement of productivity, quality and sustainability of existing fields and orchards by promoting technological solutions in project mode. AI is steadily emerging as part of the agriculture industry's technological evolution. By leveraging computer vision and deep-learning algorithms to process data captured by satellites/drones and or software-based technology (databases) we can assist in monitoring crop and soil health while making active and timely recommendations for better outcomes. ML models can also be developed and deployed (on a project basis) to track and predict various biotic and abiotic factors affecting or likely to affect crop yield: a predictive rather than reactive approach to crop management!

By being agricultural domain focused, we are better positioned to take advantage of a large part of the processes in ML and AI that are open-sourced. With growing access to efficient cloud-based infrastructure and large computation power, technology is rarely the showstopper for building ML solutions, but rather understanding the business case and the data available, along with the know-how of implementing solutions at scale. This is spurring the growth of small, but highly differentiated service providers who can support organizations to accelerate their journey to ML by providing very niche and specific know-how in business and technology, but with a much lower cost base than conventional large service providers.