

A Detailed Review on: Pineapple Production System/Challenges and opportunities in tropical Regions

Aman Singh¹, Deepak Lall² and Uddeshy Singh³

Research Scholar¹, Assistant Professor² & Ph.D. Scholar³

Department of Horticulture, Faculty of Agriculture (FoA)

Naini Agricultural Institute (NAI)

Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS),

Naini, Prayagraj, (U.P.), India – 211007

Corresponding author: asingh872684@gmail.com

ABSTRACT

Pineapple (Ananas comosus) (Linn.) (Merr.), is one of the commercially important fruit crops of the world, especially in India. It is the third most important tropical fruit in the world after banana and citrus with fine flavor and high nutritive value. Pineapple is a good source of carotene (Vitamin A) and vitamin B and is fairly rich in ascorbic acid (Vitamin C) and it also contains a proteolytic enzyme, bromelain, a digestive enzyme that digests food by breaking down protein. Bromelain also has anti-inflammatory, anti-clotting and anti-cancer properties. Consumption of pineapple regularly helps fight against arthritis, indigestion and worm infestation. Microwave-assisted extraction has further improved efficiency by achieving high levels of specific activities for bromelain (127.8 U/mL) in relatively short times. Bio-refinery systems converting processing residues into enzymes, fibers, biofuels, and biodegradable plastics are being studied for waste minimization and value addition to yield both environmental benefits plus economic benefits. Such an industry encounters existing challenges comprising mycotoxin contamination, post-harvest losses exacerbated by inadequate technology scaling up, simultaneously with innovations in premium pineapple cultivars together with green processing technologies toward by-product-based products that promise a circular pineapple economy. The present study was undertaken with an aim to find out the pineapple production system, challenges, and opportunities in tropical regions.

Keywords: Pineapple, Production system, challenges, opportunities, post-harvest, processing technologies

INTRODUCTION

Pineapple (*Ananas comosus* (L. Merr)) belongs to Family – Bromeliaceae and popularly known as ‘Golden Queen’ is one of the most wanted tropical fruits. Contribute 20 % of world production of tropical fruits. It is a very delicious fruit and used as a table fruit. Very rich source of Vitamin C, fairly good source of Vitamin A and B and also minerals. The origin of pineapple is the American continent, probably Brazil and Paraguay. It has spread throughout tropical and subtropical regions

as a commercial fruit crop. The juice has a worldwide market. Dried waste after juice extraction is a valuable cattle feed. Fresh pineapple flesh, juice and pineapple stem contain a protein-digesting enzyme, bromelin. Bromelin is used like the papain enzyme from papaya for tenderizing meat and chill-proofing beer and in the leather tanning process. Leaves yield 2-3 % strong white silky fibre. This fibre is used in Philippines and Taiwan. But in India, this fibre is extracted to a limited extent.

Other by-products are alcohol, calcium citrate, citric acid and vinegared for making a fine fabric called pina cloth in the Philippines and Taiwan. But in India this fibre is extracted to a limited extent. Other by-products are alcohol, calcium citrate, citric acid and vinegar.

Production System in Tropical Regions

The production of pineapple in tropical countries is not homogeneous. It varies with the scale of production, the technology available, and whether the market is domestic or export. Tropical pineapple production can be conveniently classified into three broad systems: smallholder mixed farming, large-scale commercial monocultures, and organic or low-input production systems. Smallholder Mixed Systems (Africa, India and Southeast Asia): Pineapple is mainly grown in the smallholder farm sector in most parts of Africa, India and Southeast Asia. These farms range from 0.2 to 5 hectares and pineapples are seldom grown as a pure stand but rather as an intercrop with bananas or coconuts or cassava or spices for diversified income generation and better utilization of land. Under such systems, planting material is usually obtained from traditional slips, suckers or crowns saved from previous harvests. Mechanization is very limited because of fragmented landholding and hilly areas where pineapples are grown, such as Meghalaya (India) and Cameroon; hence, family labor predominates per FAO technical notes, this type of cultivation sustains millions of rural households but with low yields (generally between 20-40 tonnes per hectare) as compared with commercial farms that often exceed 70 tonnes per hectare. The principal challenges here are inadequate extension services, limited cold chain infrastructure, and dependency on seasonal price fluctuations. Commercial Monocultures for Export (Latin America and Parts of Southeast Asia) Countries such as Costa Rica, the Philippines, and Indonesia have developed highly commercial pineapple industries oriented toward the global export

market. Costa Rica contributes about 75% of the fresh pineapple exports to the world by volume shipped predominantly into North America and Europe.

Top Pineapple Production

In 2023, world production of Pineapple was 30 million tonnes, led by Indonesia, the Philippines, and Costa Rica, each producing about 3 million tonnes. Most of what Costa Rica produces is sold to the United States and Europe. Further back are Brazil and India with their respective productions of 2.3 million tonnes and just under 2 million tonnes; these two mainly produce for domestic consumption but also play a part in regional trade. The amount from Nigeria, China, and Thailand falls within the range of 1.7 to 1.9 million tonnes each, showing that production spreads across Asia and Africa; Mexico has an output of about 1.2 million tonnes while Colombia has an output close to 0.9 million tonnes. Although Indonesia leads by quantity produced, Costa Rica stands out because it dominates international exports. Other countries like India, Nigeria, and China produce large amounts basically for their local markets. In India, it is grown as commercial crop in few states only. It first reached in South India in 1548 by Portuguese people.

The important growing states are Assam, Kerala, Meghalaya, West Bengal, Manipur, Tripura, Mizoram, Karnatka, Tamil Nadu, Arunachal Pradesh and Bihar.

Harvesting and Yield

Pineapple is a non-climacteric fruit and harvested at correct maturity. The total duration of the crop is about 20-22 months for Kew i.e., harvesting 160-175 days after ethephon application (about 5 1/2 months). For Mauritius 12-13 months duration i.e. harvesting 125- 135 days after ethephon application (about 4 1/2 months). According to market proximity, purpose and mode of transportation, harvesting time should be adjusted. Harvesting is possible throughout the year.

For local market - at full maturity

For distant market - 75-80 % maturity

At maturity, lower most eyes show a colour change and get flattened

Kew- From dark green to orange yellow

Mauritius- From green to golden yellow

Harvesting is done with the help of a sharp knife along with the fruit stalk of about 5-6 cm. Peak season of harvest in Kerala is February - May. Application of growth regulator is during August - December. Adjust the harvest before the rainy season. Quality will be poor in fruits harvested during rains (sugar will be less, acidity will be more and price will be low). The yield depends on the plant population. If the population is 35000 – 40000 plants/ha, the yield expected is 40 - 50 t/ha. If the population is 43500-50000 plants/ha, the yield expected is 50 - 60 t/ha. There is a possibility of getting this much yield. But in India, the productivity is very low, only 15 t/ha.

Pests and Diseases

No serious pests or diseases are noticed in the crop except a light incidence of leaf spot disease, heart rot, fruit rot etc. and also of mealy bug and scale insects. However, the disease heart rot is very serious in recent days. We shall discuss this disease.

Disease:

Heart rot or stem rot or root rot. This is a fungal disease caused by *Phytophthora*. This has become serious in recent days, especially when pineapple is grown in low lying areas. The green leaves turn yellowish green and tips turn brown. The central whorl of leaves when affected will come out with a gentle pull. The basal portion of leaves shows signs of rotting and will have foul odour. When uprooted the roots are seen decayed. Poor physical condition of the soil and inadequate drainage are responsible for the spread of this disease.

Control Measures Include good drainage, proper selection of healthy planting materials, careful handling and prophylactic treatment of planting materials with copper fungicides. After the incidence of disease, uproot and destroy the affected plants and drench the soil with copper fungicides. (i.e. Phytolan @ 3g/litre).

Insects:

A few insects like mealy bugs & scales some time attack the crops. These can be control by spraying any insecticide on the crops.

Waste to Wealth

Pineapple as a fruit generates a large quantity of waste post-processing, which includes crown, core, peels, and pomace. The disposal of such organic wastes is one of the major concerns for the industry and countries like India as well. It involves a high amount of capital investment, including huge transportation costs to carry and dispose it in dumping grounds. Sometimes industries opt for burning them to minimise cost of transportation. This, however, contributes to severe environmental pollution.

Various value-added products which can be derived from the wastes are:

Production of biofuels from fruit waste streams:

Biomass, including pineapple waste, contributes to enormous renewable energy sources for the production of biofuels such as biogas, bioethanol, and briquettes. The use of renewable energy is among the few proven, cost-effective and available technologies to combat greenhouse gas emissions and their associated effects.

Production of juice:

Conventionally, pineapple juice is produced from a ripe and fresh pineapple. Drying is the major pineapple processing activity for farmers in pineapple growing areas in Uganda. However, not all harvested pineapple is used for drying purposes. Defective pineapples are usually culled contributing to waste at the processing facility. Just like the good and selected pineapples, culled pineapple equally exhibits high moisture content, high sugar, vitamin C, and low fibres. The process for juice extraction from culled pineapple involves removal of crown, cleaning/washing in clean water, peeling, size reduction by cutting, juice extraction, juice filtration, pasteurization and storage.

Also, pineapple peelings generated during the preparation of pineapple slices for drying can effectively be used for juice production. Pineapple peelings have a moisture content of about 85%. Pineapple peels are cleaned, crushed to extract the juice, filtered to separate the solid part from the juice. The juice is then subjected to the rest of the processes including pasteurization and storage.

Pineapple wine:

Pineapple wine can be processed from culled pineapple, pineapple peelings, and the core. The moderately high sugar content in the pineapple waste and culled pineapple assists in the fermentation process to produce wine. Production of animal feeds: Several studies have reported the potential for use of pineapple waste for animal feed. Flesh pineapple waste is highly susceptible to deterioration given the high moisture content. Conversion of pineapple waste into shelf-stable animal feed helps improve the situation.

Another animal feed worth developing is the feed block. The feed block is composed of forage, concentrate, and other supplementary nutrients in desired proportions capable of fulfilling the nutrient requirements for the animal. Compressed pineapple waste (peels, crown, and pomace) with paddy straws at a moisture content of 8.7% (wet basis) into an animal feed block with molasses as a binding agent. Therefore, the use of pineapple waste is an attractive alternative to the conventional green fodder for livestock.

It was seen that in Assam some of the farmers actually utilized damaged pineapple as feed for animals, as Assam is well known for piggy and cattle rearing.

CONCLUSION

To sum up everything that has been stated so far, this review emphasised Pineapple production system challenges and opportunities in tropical region. Besides

providing vitamins A, B, C plus bromelain (the enzyme for digestion), this paper discusses large possibilities in waste valorization where residues from processing pineapples—crown core and peels—can be turned into useful products like biofuels animal feed wine juice etc. That would solve two problems: first environmentally by giving use to big wastes produced after processing; second economically by not losing money on such big wastes! The industry is still running into problems with diseases (mainly heart rot), pest control and post-harvest losses while better processing technology is needed to fully tap into the economic potential of this crop and reduce waste at the same time.

REFERENCES

- D. P., Paull, R. E., & Rohrbach, K. G. (Eds.). (2022).** *The pineapple: Botany, production and uses*. CABI.
- HDeb, P., & Bhowmick, N. (Eds.). (2025).** *Recent advances in pineapple production, postharvest and processing technology*. NIPA Publishers.
- Jaji, K., Man, N. and Nawi, N.M. (2018).** Factors affecting pineapple market supply in Johor, Malaysia. *International Food Research Journal*, 25(1)
- Lobo, M. G., & Paull, R. E. (Eds.). (2017).** *Handbook of pineapple technology: Production, postharvest science, processing and nutrition*. Wiley.
- Nakthong, N., Wongsagonsup, R. and Amornsakchai, T. (2017).** Characteristics and potential utilizations of starch from pineapple stem waste. *Industrial Crops and Products*, 105, 74-82. <https://doi.org/10.1016/j.indcrop.2017.04.048>.
- Praveena, J.R. and Estherlydia, D. (2014).** Comparative study of phytochemical screening and antioxidant capacities of vinegar made from peel and fruit of pineapple (*Ananas comosus l.*). *International*

Journal of Pharma. Biology Science,
5(4)

Ruslan, N.A., Aris, N.F.M., Othman, N., Sali, A.R., Muhamad, M.Z. and Aziz, N.B. (2017). *A preliminary study on sustainable management of pineapple waste: perspective of smallholders. International Journal of Academic Research in Business and Social Sciences*, 7(6), 2937. <https://doi.org/10.6007/IJARBS/v7-i6/2937>

Saravanan, P., Muthuvelayudham, R. and Viruthagiri, T. (2013). Enhanced production of cellulose from pineapple waste by response surface methodology. *Journal of Engineering*, 2013, 979547. <https://doi.org/10.1155/2013/979547>
