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# Fostering Sustainable Growth: Evaluating Financing Strategies for Tamarind Value Chains in Rayagada District of Odisha

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**Abstract**

This study focuses on incorporating finance into the analysis of Tamarind's value chain, aiming to develop an effective methodological approach. Finance plays a crucial role as a significant obstacle to economic progress and acts as the backbone of the value chain. Understanding the financial structures within and between enterprises in the value chain is essential for designing upgrading strategies that enhance competitiveness. In this paper, we examine the potential effects of Value Chain Finance (VCF) on tamarind production in the Rayagada district of Odisha. By utilizing the MODEXC software, we calculate the anticipated benefits based on the economic surplus model.

Our findings indicate that effective management of Tamarind trees in the Rayagada district has the potential to generate substantial profits. The study further reveals the positive effects of implementing Value Chain Finance, as evidenced by increased producer and consumer surplus, as well as net benefits evaluated through net present value analysis. These results highlight the practicality and advantages of utilizing Value Chain Finance as an innovative financing solution for tamarind production and processing in Rayagada.

Based on the study's conclusions, we recommend the establishment of a dedicated Value Chain Financing organization to provide farmers with access to financing options specifically tailored to increase Tamarind production in Rayagada. Such an organization would play a crucial role in supporting farmers and facilitating their financial needs. This, in turn, would contribute to the growth and development of the Tamarind value chain in the region.

Keywords: Tamarind, Value Chain, Finance, Production, Economic Surplus

**Introduction**

The tamarind (Tamarindus indica L.), one of the widely planted fruit trees in India, is largely grown in rainfed environments, particularly in Tamil Nadu, Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh, and Orissa. While raw tamarind is traded throughout the months of March, April, and May, the harvesting season lasts from February through April.

Rayagada contributes 14% of the tamarind procurement in Odisha. Agriculture, NTFP collection, and cattle are the district's main economic drivers. The FAO defines NTFPs as marketable or subsistence commodities for domestic and industrial use made from biomass and renewable forest resources. In the district and block, NTFPs such as tamarind, siali leaf, mahua flower, wild aromatics, and medicinal plants are all readily available. Due to issues such as high operating expenses, a lack of expertise and skills, a lack of effort to add value, and a lack of collective marketing, households are not making much money from the NTFP collection. The procurement, such as Podu or shifting agriculture by tribals, brings in the desertification of natural forests. The large-scale planting and cultivation of tamarind is the solution. There are two tamarind grades: one is for export and the other is for home use. In this study, we are focusing on export-quality tamarind because it is acceptable for financing, and the second one is automatically disqualified due to consumption.

With a production of 1610 quintals in FY 2021–2022, there are about 15 PGs (Producer Groups) active in the acquisition and processing of tamarind. With a ₹ 6.44 lakh direct benefit to beneficiaries, the overall turnover is ₹ 57.96 lakhs. Local traders in Rayagada and Bhubaneswar as well as Adisa, Bhubaneswar, TDCC, Reliance, Odisha Hand Made, and Berhampur have marketing agreements. In addition to producing useful fruits and wood, it is one of the most well-liked avenue trees.

In Indian cuisine, the tamarind fruit is a crucial condiment or adjunct that is utilised as an acidic or flavouring element. About 2.5 lakh tonnes of tamarind pulp are produced in India each year.

When dried thoroughly and salted to preserve it, tamarind pulp has a superb keeping quality. Glucose makes up 47.7% of the total sugar in pulp, along with D-mannose (24.5%), and D-maltose (20.4%). Tartaric acid (8-18%), malic and citric acids (2%) are responsible for the pulp's sour flavour. Iron, phosphorus, and calcium are all present in good amounts in the fruit. It is possible to eat both flowers and fragile leaves. In the textile business, tamarind seeds can be utilised as a less expensive substitute for grain starch.

Tamarind trees may be grown in humid to dry, hot climates due to their acid environmental flexibility. Frost is really hard on it. The ideal amount of rainfall is between 750 to 1900 mm, however, plants can survive in areas with only 500 to 750 mm of annual precipitation.

While it has the ability to thrive in various soil types, the optimal conditions for the growth of its extensive tap roots are found in deep loamy or alluvial soils. Additionally, it can tolerate alkaline and slightly saline soils to a certain extent.

There aren't many tamarind types that are well-known. On the basis of fruit quality and productivity, a few seedling selections have been identified recently, though. Which is: The Fruit Research Station in Aurangabad, Tree No. 38 at the College of Agriculture in Pune (Maharashtra), and Coimbatore Agriculture University (Tamil Nadu) have all contributed to the development of the high-yielding kind PKM-1 by Prathisthan.

The primary method of propagation for this plant is through seeds, although it does not exhibit true-to-type characteristics due to its heterozygous nature. The longer juvenile phase experienced is partly attributed to the prevalence of seed propagation. Seedling trees require a span of 15 to 20 years to reach economic productivity. In contrast, vegetative

propagation techniques result in earlier fruit-bearing, typically observed after 3-4 years. Approach grafting, air layering, and budding are successful methods for vegetative propagation. However, for dryland environments where deep tap roots are absent, layering is a suitable planting technique. To establish tamarind orchards with consistent growth, reduced pre-bearing age, and improved yield, it is recommended to utilize vegetative methods like budding and grafting to ensure true-to-type plants.

To provide the space and ideal conditions for the development of a strong and deep tap root system, planting should be done in pits that are 1 x 1 x 1 metre in size. In the summer, the trenches should be dug, and the topsoil should be combined with 2 kg of single superphosphate and well-decomposed farmyard manure as the base. 100g of 10% carbonyl powder should be incorporated into the soil mixture to combat the termite problem. The planting distance can vary from 8 X 8 to 10 X 10m depending on the kind of soil; deeper soils require wider spacing, while shallower soils require closer spacing. During the monsoon season (June to July), rootstock seedlings are planted.

Weeding and hoeing are intercultural duties that should be performed frequently[3]. Cover crops, such as cowpea, horse gram, and others, can be grown during the rainy season to reduce weed growth, halt soil erosion, and enhance soil health. Tamarind is a semi-forest tree that can thrive in a variety of soil types and agro-climatic conditions; therefore it doesn't need any specific upkeep. Tamarinds are typically not watered because they are a dry land (rainfed) crop. However, new orchards require irrigation, particularly during the summer during dry spells. Plants that are one year old in the summer require 10 litres of water every 6 to 8 days; by the time they are two and three years old, they require 20 litres. After then, irrigation might not be required.

The precise nutritional needs of tamarind trees are not currently determined by any guidelines. It is advised to modify the fertiliser dosage as the tree grows older, though. For instance, 10 kg of farmyard manure (FYM), 100 g of nitrogen (N), 50 g of P2O5, and 100 g of potassium (K2O) should be applied to a tree that is one year old. A ten-year-old tree, in contrast, would need 50 kg of FYM, 1 kilogramme of N, 500 g of P2O5, and 1 kg of K2O. During the months of September through October, an extra 500 g of nitrogen should be supplied, if irrigation is practical. Since tamarind plants are typically resistant to pests and illnesses, there haven't been any major infestations or illnesses documented to date. As a result, the plant seldom requires extensive plant protection measures due to its inherent ability to naturally combat various diseases.

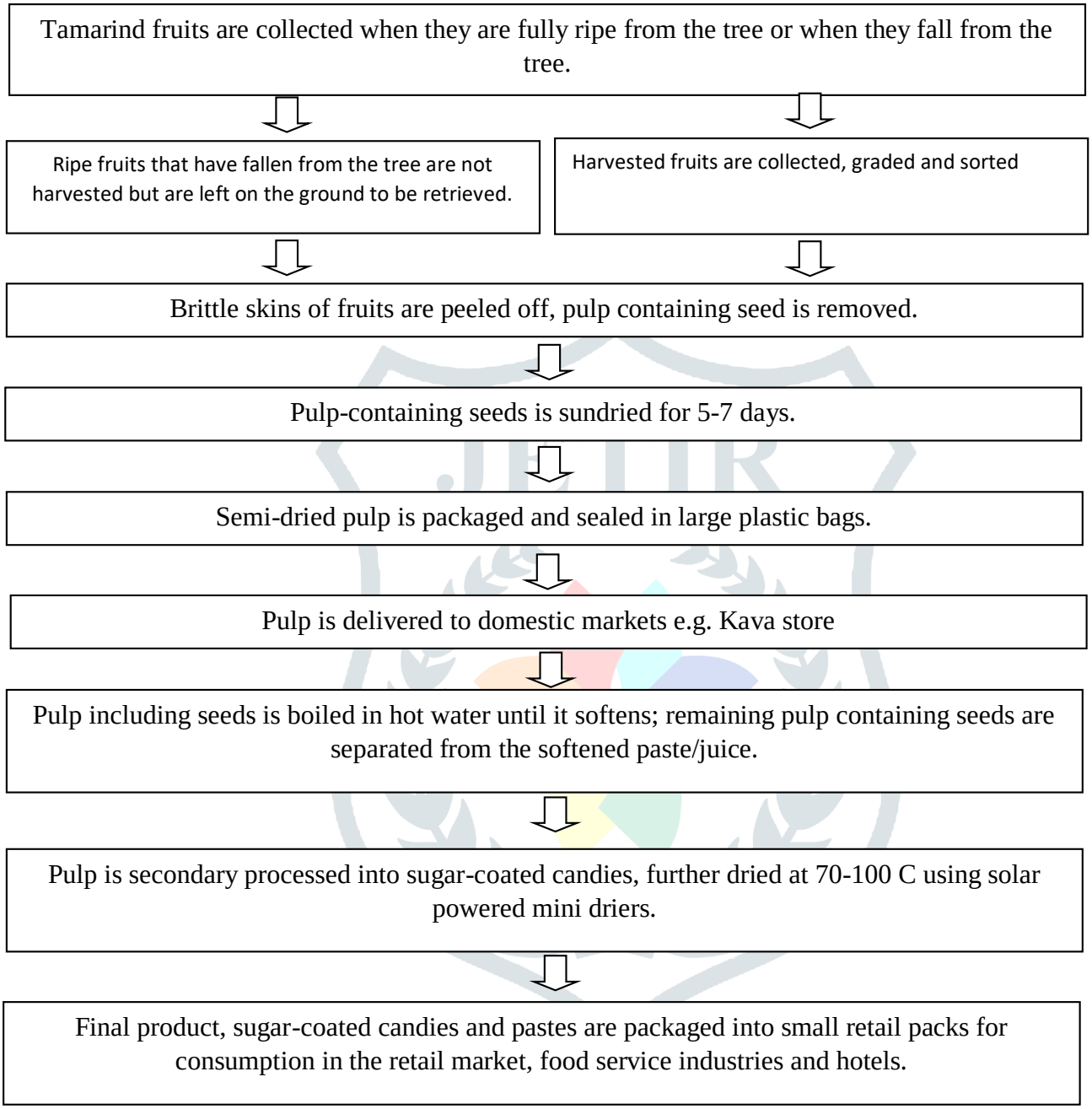
Pods are spread out on the ground and cut for 6-7 days after harvest. After being properly dried in the sun and having the shell, seeds, and fibrous debris removed, the pulp can be kept for a period of 6 to 12 months. The merchants in charge of harvesting and marketing regularly receive trees or entire plantations through auctions.

While banks and other formal financial institutions are having difficulties in this area, informal lending relationships with high capital costs are pervasive in all subsectors. One of the most difficult areas for small and emerging business owners to navigate has emerged as access to credit, which is a significant barrier to the promotion of clusters. It is uncommon for multiple stakeholders in agriculture and horticulture to receive enough value chain financing, especially for commercial crops like cotton, maize, ginger, turmeric, etc. (OTELP, 2011). Value chain financing (VCF), which permits comprehension of both financing inside a value chain and financing tailored to match a value chain, is a novel approach to rural and agricultural financing (Jennifer Bernhardt, 2009). Using agricultural value chain finance, it is possible to reach smallholder farmers at lower cost and risk. Value chain finance gives financial institutions the push to develop solutions that are best suited to the needs of the businesses in the chain by encouraging them to look beyond the direct beneficiary of financing to better understand the competitiveness and risks in the industry as a whole. Value chain finance is not the only source of this

[3] (Indiaagronet.com, n.d.)

more thorough approach to agricultural financing; some of the top financial institutions in the industry also use this focus in their loan assessment procedures, though this is less frequently the case. In actuality, value chains receive a significant amount of their funding from individuals rather than financial institutions (Miller, 2010).

**Process Flow Chart:**




Source: Pacific Agribusiness Research & Development Initiative

Farmers in Rayagada are currently underutilizing the numerous funding windows offered by the Central and State government through various schemes and institutions because of a lack of knowledge. A lot of the previous finance attempts, as well, were created from a "intervention viewpoint" as opposed to a participatory approach, frequently omitting the necessity of farmer input in the development of financing projects.

The transaction, which was illegal until March 2000, is now run by neighborhood intermediaries and sahukars who have earned the title of "friend in need" for tribal members, particularly when TDCC or other authorised leaseholders refuse to buy. It's interesting that tamarind trees are offered to sahukars for dirt cheap when the fruit is still not even halfway mature. These sahukars use the same tribe to harvest mature fruit, and it appears that the cost of labour was previously negotiated into the price when the trees were purchased. Tamarind processing was designed to give the primary NTFP collectors, who work extremely hard to make ends meet, more cash. Some of the cooperatives have started processing ventures like tamarind

cake production and de-seeding. The vendors in Raygada are buying the deseeded tamarind cakes. Tamarind may be stored more effectively by being kept in a cool environment, and to maximise profits, the final product can be sold in the largest market in the world, Jagdalpur, in Vishakhapatnam, Karnataka (belagavi wholesale tamarind market).

**Literature Review**

(Bhattacharya, 2008) The diverse potential applications of tamarind seeds in various food and non-food industries, with a focus on their physical and engineering properties, hydration behavior, rheological properties, functional and nutritional characteristics, and processing methods. The chemical composition, physical properties, and engineering characteristics of both the tamarind seed and kernel play a crucial role in producing practical extracted raw materials and blended foods. It is essential to study these properties for efficient design and operation of processing equipment, seed coat removal, grinding into powder, and storage. Tamarind seeds offer extensive possibilities in both culinary and non-food industries. They are a by-product of the tamarind pulp industry, and tamarind kernel powder (TKP) is commonly derived from these seeds. The outer hard brown testa of the tamarind seed needs to be completely removed before use in food applications to avoid potential undesirable effects such as depression, constipation, and gastrointestinal inflammation.

(Mukadasi Buyinza, 2010) Managing T. indica trees as both open woodland and cropland in Uganda has the potential to generate positive financial returns. This is particularly significant considering that many rural areas, including the study site, are characterized by high poverty rates. Encouraging land use practices that prioritize income distribution to these marginalized populations is essential. By incorporating open woodland areas into the land use strategy, the income generated can help diversify the economic activities of rural households, mitigating the risks associated with crop and fodder failures caused by recurrent droughts. The analysis demonstrates that managing T. indica as a land-use activity, both in open woodland and cropland, yields higher net returns compared to traditional agricultural production methods.

(Chintala, 2020) The increasing population, evolving consumption patterns, and rising per capita income have created a greater demand for food and processed goods. However, to capitalize on this opportunity, India must confront the challenges within its agriculture value chain. Despite economic uncertainties, the agriculture industry has exhibited remarkable resilience, as evidenced by a growth rate of 3.4% according to the latest available GDP data from June 2020. Looking ahead, the demand for high-value foods, including horticulture, dairy, livestock, and fish, is expected to surge by over 100% by 2030. Addressing the complexities of the agriculture value chain will be crucial in meeting these growing demands and unlocking the potential of the industry.

(Libardo Rivas R., 1999) Scientific research plays a crucial role in identifying innovative technological solutions that can enhance output and productivity in a sustainable manner. To effectively prioritize and evaluate these technologies, the economic surplus model MODEXC serves as a valuable tool, enabling the measurement of various variables. This handbook specifically focuses on the latest version of MODEXC, which is Excel-based. The model is based on the Marshallian theory of economic surplus, which recognizes the fluctuation of supply and demand curves over time. According to this theory, in order to introduce increased output resulting from technological advancements into the market, a significant reduction in market price is necessary, particularly when producers exhibit a relatively low absolute price elasticity of demand. By employing MODEXC, stakeholders can make informed decisions to promote the adoption and dissemination of technologies that yield positive economic outcomes.

(Chartered Institute of Management Accountants, 2016) Value chain financing (VCF) was explored as a potential solution to enhance agricultural financing access for smallholder farmers in Zambia. However, the implementation of agricultural credit through the value chain approach presents certain challenges, notably the moral risk involved. This risk arises from the possibility of smallholder farmers selling their produce, receiving cash payments, but failing to repay their loan installments, thereby breaching their contractual obligations with the commercial bank. Additionally, the expansion of this financing option is hindered by the limited number of smallholder farmers who meet the necessary qualifications and are eligible for participation. Despite these challenges, the report concluded that VCF represents a viable model for improving agricultural finance accessibility for smallholder farmers in Zambia. It emphasizes the importance of raising awareness among financiers regarding the benefits and challenges associated with employing the VCF model in financing smallholder farmers. Ultimately, the adoption of VCF has the potential to enhance food security and stimulate economic growth in Zambia over the long term.

(Campion, 2007) The financial dynamics within the artichoke and citrus value chains in Peru shed light on how participants access finance within and outside the value chain and how this access, or lack thereof, impacts their overall competitiveness. Enhancing value chains' competitiveness often involves strategies such as improving cost efficiency, differentiating products or services, and capitalizing on changes in market demand. Through a study of the artichoke value chain and its contrasting access to finance with the citrus value chain's limited access, several key findings emerge.

Value chain actors, driven by goals of increased production, efficiency, and market expansion, exhibit a greater willingness to extend credit compared to formal financial institutions. This is due to their familiarity with the risks associated with rural and agricultural finance. In some cases, artichoke producers were able to secure loans from formal financial institutions due to their established sales agreements and fixed market prices. The study highlights how value chain firms, including wholesalers, processors, and input suppliers, collaborate to overcome the lack of formal finance within their value chain. They develop mutually beneficial solutions that address financing challenges and contribute to the success of the value chain as a whole. This demonstrates the potential for innovative approaches and cooperation to bridge the financing gap within value chains and enhance competitiveness.

(Ojo & Ayanwale, 2019) Smallholder farmers in developing countries often face challenges in accessing the necessary financing to increase their productivity. Their study sought to determine whether value chain financing (VCF) may help Nigerian plantain producers satisfy their financial needs and increase production. The study's findings repeatedly demonstrated the viability and benefits of VCF as a financing innovation for Nigerian plantain production.

By the third year after the investment was made in VCF, advantages had already begun to outweigh the initial investment cost. The total economic surplus for the 25-year simulation period was USD 2,173,900. The sensitivity analysis, which also took into account a high discount rate of 20% and a low success chance of 30%, further confirmed the robustness of the conclusions. The findings showed a favourable correlation between the net gain in the form of producer and consumer surplus and the effectiveness of VCF as evaluated by Net Present Value (NPV). Based on these findings, it can be concluded that there is substantial evidence that investing in VCF for plantain production yields economic returns that outweigh the costs associated with implementing the innovation. By investing in VCF, Nigeria can significantly enhance plantain production and its associated benefits.

Overall, their study highlights the potential of VCF as a financing solution to support smallholder farmers in Nigeria, contributing to increased agricultural productivity and overall economic development.

(Jones, 2010) Trade can continue to exist even in the absence of adequate institutional or other forms of financing, but its growth potential is significantly hindered. Recognizing the lessons learned from microfinance institutions, some countries have started addressing the financing needs of agricultural traders by offering flexible financing options, lines of credit, alternative collateral options, and diverse financial products, and establishing accessible offices in close proximity to the traders. These initiatives aim to facilitate and support the financial requirements of traders, enabling them to thrive in the market.

Collective action plays a crucial role in promoting market participation for smallholder farmers. By organizing themselves into Market Support Units, farmers can develop the necessary skills for strategic collective market entry. This includes understanding market dynamics, establishing consistent feedback channels for market information, and building partnerships with private players in the value chain. Through these efforts, smallholder farmers can enhance their voices and influence along the value chain, increasing their visibility and impact in the marketplace.

In addition to collective action, integrating financial services with market linkages is essential. Smallholder farmers often face significant challenges in accessing credit due to the existing traditional modes of savings and credit, particularly for those with seasonal income. Addressing these challenges by embedding financial services within market linkages can provide farmers with better access to credit and financial resources, enabling them to effectively manage their seasonal income fluctuations.

Overall, addressing the financing needs of agricultural traders and smallholder farmers, coupled with fostering collective action and integrating financial services with market linkages, can contribute to the growth and development of inclusive and sustainable agricultural markets. By providing adequate financial support and fostering an enabling environment, countries can empower traders and farmers alike, driving economic growth and improving livelihoods in the agricultural sector.

## Research Methodology

### Data Collection and Analysis

The research methodology employed in this study involved a multi-stage sample process to gather primary information from 89 tamarind growers in the Rayagada district of Odisha. This district was selected due to its significance as one of the main areas for tamarind cultivation within the state. A comprehensive questionnaire was utilized as a data collection tool to obtain valuable insights directly from the tamarind growers.

In addition to primary data, secondary data sources were leveraged to supplement the study. These sources included the Odisha Rural Development and Marketing Society (ORMAS), the Agriculture Department, as well as relevant journals and publications. These secondary data sources served as valuable references to support and enrich the research findings. To examine the anticipated effects of the Village Common Forest (VCF) program on tamarind production, the economic surplus model was applied, utilizing the MODEXC and DREAMS software. The economic surplus model is widely recognized as a robust analytical framework for evaluating the impact of policy interventions on agricultural production.

The MODEXC software was employed to estimate the expected changes in tamarind production resulting from the implementation of the VCF program. This software facilitated the simulation of different scenarios and allowed for the assessment of the program's potential effects on tamarind cultivation. Furthermore, the DREAMS software was utilized in conjunction with the economic surplus model to analyze the economic surplus generated by tamarind production under various conditions. This enabled the evaluation of the economic implications of implementing the VCF program in the study

area. By combining primary data collection through a questionnaire survey with secondary data analysis from reliable sources, and applying the economic surplus model using MODEXC and DREAMS, a comprehensive evaluation of the anticipated effects of the VCF program on tamarind production was conducted. This research methodology ensured a robust and evidence-based approach to examine the potential impact of the VCF program on tamarind growers in the Rayagada district of Odisha.

**Economic Surplus Analysis**

Varieties and technologies are two of the most frequent interventions in agriculture that research organisations make (Vinayak Nikam, 2019). The most popular and widely used strategy for assessing the effects of investments in agricultural research is the economic surplus approach (GRILICHES, 1958). Value chain financing has had an impact on economic welfare, which has been measured using the concept of economic surplus. The methodology allows for the calculation of the economic gains brought about by the adoption of financial and technological breakthroughs in comparison to the pre-adoption state, where only conventional technology was accessible. Calculating the amount of change in supply as a result of financial and technological adoption requires information on productivity change brought about by research, the equilibrium price of the assessed product, adoption rate and costs, time between research and adoption, and price elasticity of supply and demand. The MODEXC model helps to analyze the benefits derived from value chain finance, which are measured as the economic surplus of producers and consumers. If the absolute value of price elasticity of demand faced by producers is very low, the market price will have to be lowered significantly if additional quantities of output derived from technological change are to be placed in the market. We have calculated the Annual growth rate of demand by using:

$$AGRD = \frac{du}{udt} + \varepsilon\frac{dy}{ydt} + \eta\frac{dp_r}{p_r dt} + \lambda\frac{dp_c}{p_c dt}$$

$\eta$ = Price elasticity of demand

$\varepsilon$ = Income elasticity of demand

$\lambda$ = Elasticity of substitution

$\frac{du}{udt}$ = Annual Population growth rate

$\frac{dy}{ydt}$ = Annual growth rate of real income

$\frac{dp_r}{p_r dt}$= Annual growth rate of real own price

$\frac{dp_c}{p_c dt}$ = Annual growth rate of price substitute

The model also incorporates indicators of social gains to estimate the impact of investments in VCF innovation. These indicators include the net present value (NPV), internal rate of return (IRR), and benefit-cost ratio (BCR), which are calculated by considering the investment flows associated with the deployment of VCF. By evaluating the expenses and benefits of the innovation over time, it is possible to assess its economic viability and profitability. By deducting the discounted flow of expenditures from the flow of benefits produced by the investment, the net present value (NPV) in a given year (t) is calculated. Investment in the VCF innovation is profitable, according to a positive NPV. The rate at which

the NPV equals 0, or when the present value of benefits equals the present value of costs, is represented by the IRR. The IRR must be higher than the market rates for other capital uses in order to consider an investment in the VCF invention profitable.

**Table I: List of the criteria for economic surplus analysis**

| Variables | Value | Description | Source |
|---|---|---|---|
| Base year | 2016 | The start year for simulation | Baseline data |
| Simulated period (years) | 20 | Number of projected years | Baseline data |
| Discount rate (%) | 15 | Derived from lending rate | Author |
| Price Po (₹/ton) | 35000 | Average price of tamarind per ton | Baseline data |
| Production Q0 (tons/year) | 161 | Average quantity of tamarind in tons | Baseline data |
| Consumption (tons/year) | 161 | Average quantity of tamarind consumed | Baseline data |
| Demand elasticity (ε) | 0.52 | Assumed for tamarind | Author |
| Supply elasticity (η) | 1 | Tamarind supply elasticity | (Julian M. Alston, 1995) |
| Annual crop growth rate (%) | 4 | Growth rate (2015–2016) | Baseline data |
| Consumption growth rate C0 (%) | 2.8 | Population growth rate used as proxy | Baseline data |
| Yield at present (Ton) | 21 | Yield at start of simulation | Baseline data |
| Percentage yield increase (ΔY) | 14 | Percentage change in yield of tamarind | Baseline data |
| Innovation time lag (years) | 3 | Time frame for VCF implementation | Author |
| Adoption lag (years) | 5 | Time frame for adoption of VCF | Baseline data |
| Maximum adoption level (%) | 50 | Projected maximum adoption level | (Adeolu B. Ayanwale, 2011) |
| Minimum adoption level (%) | 10 | Estimated minimum adoption level | (Adeolu B. Ayanwale, 2011) |
| Cost of VCF (₹) | 30 Lakhs | Estimated cost of deploying VCF | Author |

Source: Authors compilation

**Findings from the economic analysis**

Table II presents the analysis of value chain finance (VCF) for tamarind production over a 20-year period in an open economy, focusing on the costs and benefits involved. The study assumes that all tamarind produced by the farmers is sold in the market. The findings reveal interesting trends and patterns in terms of economic surplus.

During the initial three years, which correspond to the innovation time lag, the overall economic surplus is negative, indicating that both consumers and producers did not experience any economic surplus during this period. However, in the fourth year, there is a noticeable shift, with a consumer surplus of $52,600 and a producer surplus of $27,300, resulting in an overall economic surplus of $79,900. This indicates that the adoption of VCF starts to yield positive results. The fifth year witnesses a substantial increase, with the overall economic surplus rising to $163,800. This is in line with the expected delay in the uptake of VCF innovation, suggesting that it takes at least three years for investments in VCF to generate positive returns. From the eighth year onward, the benefits resulting from the adoption of VCF surpass the implementation costs, indicating a turning point where the advantages outweigh the expenses. Over the entire 20-year simulation period, the total economic surplus for tamarind production through VCF innovation amounts to ₹4,64,000. This includes a producer benefit of ₹1,58,700 and a consumer benefit of ₹3,05,300. These results highlight the significant economic advantages associated with implementing VCF in tamarind production.

Examining the Benefit-Cost Ratio (BCR) for VCF at the end of the simulation period, it is found to be 2882.08, surpassing the cost of adoption starting from the fourth year of implementation. This signifies a highly favorable ratio, indicating that the benefits derived from adopting VCF far exceed the associated costs. These findings demonstrate the economic viability and positive impact of implementing VCF in tamarind production. The results indicate that although there may be an initial period of negative economic surplus during the innovation time lag, the benefits gradually outweigh the costs, resulting in

substantial economic gains. The overall economic surplus generated through VCF innovation highlights the potential for improved profitability and enhanced economic outcomes for both producers and consumers.

These findings underscore the significance of adopting VCF strategies in the tamarind value chain, emphasizing the importance of long-term planning and investment. Policymakers, agricultural practitioners, and stakeholders can utilize these insights to design and implement effective VCF interventions, ensuring sustainable growth and increased economic benefits in the tamarind sector.

Table II: Value Chain Finance Cost and Benefit of tamarind production

| | **Producers** | | | | | **Consumers** | | | | | **₹ (000)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Without VCF** | | **With VCF** | | | **Without VCF** | | **With VCF** | | | **Costs** | **B/C Ratio** |
| **Year** | **Price** | **Qty.** | **Price** | **Qty.** | **Benefits** | **Price** | **Qty.** | **Price** | **Qty** | **Benefits** | | |
| 2021 | 35000 | 1.6 | 35000 | 1.6 | 0 | 35000 | 1.6 | 35000 | 1.6 | 0 | 200 | -200 |
| 2022 | 34769.7 | 1.6 | 34769.7 | 1.6 | 0 | 34769.7 | 1.6 | 34769.7 | 1.6 | 0 | 200 | -200 |
| 2023 | 34540.9 | 1.6 | 34540.9 | 1.6 | 0 | 34540.9 | 1.6 | 34540.9 | 1.6 | 0 | 200 | -200 |
| 2024 | 34313.7 | 1.7 | 34283.2 | 1.7 | 27.3 | 34313.7 | 1.7 | 34283.2 | 1.7 | 52.6 | 0 | 79.9 |
| 2025 | 34087.9 | 1.7 | 34026.9 | 1.7 | 56 | 34087.9 | 1.7 | 34026.9 | 1.7 | 107.8 | 0 | 163.8 |
| 2026 | 33863.7 | 1.8 | 33772.2 | 1.8 | 86 | 33863.7 | 1.8 | 33772.2 | 1.8 | 165.5 | 0 | 251.5 |
| 2027 | 33640.9 | 1.8 | 33518.9 | 1.8 | 117.5 | 33640.9 | 1.8 | 33518.9 | 1.8 | 225.9 | 0 | 343.4 |
| 2028 | 33419.6 | 1.8 | 33297.5 | 1.8 | 120.2 | 33419.6 | 1.8 | 33297.5 | 1.8 | 231.2 | 0 | 351.4 |
| 2029 | 33199.7 | 1.9 | 33077.7 | 1.9 | 123 | 33199.7 | 1.9 | 33077.7 | 1.9 | 236.6 | 0 | 359.6 |
| 2030 | 32981.3 | 1.9 | 32859.2 | 1.9 | 125.9 | 32981.3 | 1.9 | 32859.2 | 1.9 | 242.2 | 0 | 368.1 |
| 2031 | 32764.3 | 2 | 32642.3 | 2 | 128.9 | 32764.3 | 2 | 32642.3 | 2 | 247.9 | 0 | 376.8 |
| 2032 | 32548.8 | 2 | 32426.7 | 2 | 131.9 | 32548.8 | 2 | 32426.7 | 2 | 253.7 | 0 | 385.6 |
| 2033 | 32334.6 | 2.1 | 32212.6 | 2.1 | 135 | 32334.6 | 2.1 | 32212.6 | 2.1 | 259.6 | 0 | 394.6 |
| 2034 | 32121.9 | 2.1 | 31999.8 | 2.1 | 138.1 | 32121.9 | 2.1 | 31999.8 | 2.1 | 265.7 | 0 | 403.8 |
| 2035 | 31910.6 | 2.2 | 31788.5 | 2.2 | 141.4 | 31910.6 | 2.2 | 31788.5 | 2.2 | 271.9 | 0 | 413.3 |
| 2036 | 31700.6 | 2.2 | 31578.6 | 2.2 | 144.7 | 31700.6 | 2.2 | 31578.6 | 2.2 | 278.3 | 0 | 423 |
| 2037 | 31492.1 | 2.3 | 31370 | 2.3 | 148.1 | 31492.1 | 2.3 | 31370 | 2.3 | 284.8 | 0 | 432.9 |
| 2038 | 31284.9 | 2.3 | 31162.8 | 2.3 | 151.5 | 31284.9 | 2.3 | 31162.8 | 2.3 | 291.5 | 0 | 443 |
| 2039 | 31079.1 | 2.4 | 30957 | 2.4 | 155.1 | 31079.1 | 2.4 | 30957 | 2.4 | 298.3 | 0 | 453.4 |
| 2040 | 30874.6 | 2.4 | 30752.5 | 2.5 | 158.7 | 30874.6 | 2.4 | 30752.5 | 2.5 | 305.3 | 0 | 464 |
| **NPV** | | | | | **1181.43** | | | | | **2272.54** | **571.88** | **2882.08** |

Source: Authors Computation through MS Excel.

**Conclusion:**

This study sought to evaluate the potential benefits of implementing the Variable Capital Fund (VCF) as a means to address the financial requirements of tamarind farmers in Rayagada, Odisha, with the ultimate aim of boosting tamarind production. The conclusions drawn from this research provide compelling evidence that utilizing innovative financial approaches like VCF could effectively support tamarind production in Rayagada. Over the course of the 20-year simulation period, the study found that the benefits derived from investing in VCF exceeded the initial investment costs. By the seventh year, the accumulated benefits began to surpass the expenses incurred, and by the end of the simulation period, a substantial total economic surplus of $464,000 was generated as a direct outcome of implementing the VCF. These findings underscore the long-term economic viability and attractiveness of utilizing VCF as a financing mechanism for tamarind production.

The sensitivity analysis conducted further substantiated the robustness of the research findings, revealing an Internal Rate of Return (IRR) of 30.29%. This signifies a positive return on investment and indicates the financial viability of utilizing

VCF as a means to enhance tamarind production in Rayagada. Additionally, the study demonstrated a positive correlation between the net benefits, encompassing producer and consumer surplus, and the effectiveness of VCF, as measured by the Net Present Value (NPV). These findings provide substantial evidence that investing in VCF for tamarind production yields economic advantages that outweigh the associated costs, ultimately leading to a significant increase in tamarind production in Rayagada.

Based on these conclusions, several recommendations can be made to further support and promote tamarind production in the region. It is advisable to involve more producer groups in tamarind cultivation, as their collective efforts and participation can enhance productivity and facilitate the implementation of VCF strategies. Additionally, the formulation and implementation of a comprehensive policy framework for commodities value chains, with a specific focus on tamarind, would provide a structured approach to guide and support farmers. Furthermore, the establishment of a dedicated value chain financing organization is crucial. This entity would facilitate access to financing options tailored to the needs of tamarind farmers, ensuring that financial resources are readily available when required. Simultaneously, it is imperative to closely monitor the effective implementation of existing government schemes and financial support mechanisms, ensuring that the intended benefits reach the farmers in a timely and efficient manner.

By adopting these recommendations, stakeholders can work towards enhancing food production, improving the income and livelihoods of smallholder tamarind farmers, and fostering sustainable agricultural practices in Rayagada. This study serves as a valuable reference for policymakers, agricultural practitioners, and other relevant stakeholders seeking to explore innovative financial mechanisms like VCF as catalysts for agricultural development and increased productivity.

**Abbreviations**

VCA- Value Chain Analysis

VCF- Value Chain Finance/Value Chain Financing

MODEXC- Model of Economic surplus analysis

VCFO- Value Chain Financing Organisation

NTFP- Non Timber Forest Products

FAO- Food & Agricultural Organisation

FY- Financial Year

PGs- Producer Groups

TDCC- Tribal Development Cooperative Corporation

PKM- Pyruvate Kinase expression (M)

FYM- Farmyard manure

TKP -Tamarind Kernel Powder

GDP- Gross Domestic Product

USD- United State's Dollar

NPV- Net Present Value

ORMAS- Orissa Rural Development & Marketing Society

DREAMS- Dedication Responsibility Education Attitude and Motivation

IRR- Internal Rate of Return

BCR- Benefit to Cost Ratio

MS- Microsoft

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