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Evaluation of technology gap in cashew farming in Chitradurga District

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Abstract
The study assessed the technological gap in the adoption of recommended cashew cultivation practices in Chitradurga district of Karnataka. Results revealed a high technological gap (94.44%) in the adoption of the Ullal variety, while a minimal gap (5.55%) was found for the Vengurla series, indicating varietal preference suited to local conditions. Farmers exhibited full adoption of grafted plants and pit size, with high compliance in spacing (92.22%), plant population (92.23%), and drip irrigation (73.33%). However, major gaps persisted in fertilizer management, particularly split-dose application (81.11%) and recommended NPK use (61.61%). Pest and disease control showed moderate to high gaps, especially in die-back disease management (77.77%). While yield and harvesting practices were largely adopted, processing techniques recorded a complete technological gap (100%). The findings suggest that enhanced training, demonstrations, and extension efforts are essential to improve adoption of advanced cultivation and processing technologies for higher cashew productivity.

Keywords: Cashew cultivation, technological gap, adoption, recommended practices, Chitradurga

Introduction
The cashew (*Anacardium occidentale* L.), often referred to as 'wonder nut', is one of the most valuable processed nuts traded on the global commodity markets. Beginning largely as a neglected crop, it ends up as a favourite snack food all over the world. The average global productivity of cashew is about 500 kg/ha while in India it is about 772 kg/ ha (DCCD 2014). The crop involves wider social and economic significance in India as cashew plantation engages around 0.3 million people and cashew processing provides employment to another 0.3 million people (NABARD, 2007).

The cashew cultivation in India mainly confines to peninsular region covering the states of Kerala, Karnataka, Maharashtra and Goa along the West Coast, whereas in Tamil Nadu, Andhra Pradesh, Odisha, West Bengal along the East Coast region. It is also grown in plains like Chhattisgarh, Jharkhand, Gujarat, Bihar and Northeast Hill Regions like Meghalaya, Manipur and Tripura and also in Andaman and Nicobar Islands (DCR, 2011). In India, it is cultivated in an area of 9.82 lakh ha with a production of 7.28 lakh tonnes and productivity of 772 kg/ha (DCCD, 2024). India has the maximum area (21.6%) under cashew nut and is the third largest producer (17.3%) of raw nuts in the world. After Vietnam, India is the second largest exporter, accounting for 34 per cent of the world's export of cashew kernels. India has a comparative advantage in the production and processing of cashew nuts on account of its cheap and skilled labour force (Jaffee, 1995).

The cashew nut (*Anacardium occidentale* L.) is native to north eastern Brazil, particularly the Amazon basin. It belongs to the family *Anacardiaceae*, which also includes mango and pistachio. Portuguese explorers introduced the cashew tree to various parts of the world during the 16th century. From its native land in Brazil, cashew was spread to tropical regions across the globe, particularly in areas suitable for its cultivation — warm climates with well-drained soils. Major cashew-producing countries include: India – One of the largest producers and processors of cashew nuts. Vietnam – A global leader in cashew processing and exports. Ivory Coast– The top producer of raw cashew nuts in recent years. Nigeria, Benin, Tanzania, and other African nations – Emerging cashew producers. Brazil – Although native, Brazil has become a modest

producer today.

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The cashew tree is a low, spreading, evergreen tree that can grow up to 10–12 meters in height, though dwarf varieties are also cultivated commercially. Its key components include: Leaves: Simple, alternate, and oval with a leathery texture. Flowers: Small, pinkish-red or yellowish, and borne on panicles. Fruits the edible part commonly referred to as the cashew apple is a swollen pedicel, while the true fruit is the kidney-shaped drupe attached to the end. Nut: The seed inside the fruit's hard shell is the cashew nut, which is processed and consumed as a delicacy. Cashew trees start yielding within 3 to 5 years of planting and can remain productive for 30–40 years under good management practices. Cashewnut is highly nutritious among all the fruits. It is one of the concentrated forms of food providing substantial amount of energy. The cashewnut kernels have a pleasant taste and flavour and can be eaten as raw, fried, salted or sweetened with sugar. It also contains invisible fat and proteins. There has been growing demand for cashew in temperate countries where the demand is increasing. The cashewnut contains acid compound which is vesicant that is abrasive to the skin. Cashew shell contains 25 per cent reddish brown oil known as CNSL (Cashew Nut Shell Liquid).

The overall composition of cashew apple and kernel are rich in Vit 'C' and various nutrients as well as proteins, fats, minerals, vitamins and amino acids which are beneficial and part of healthy as well as complete diet. The total nutritive content of 100 gm of cashewnut is presented.

Methodology

The present study was conducted using the "Ex-post facto design". The study was conducted in Dakshina Kannada (traditional area) and Chitradurga (Non-traditional area) districts of Karnataka. These districts were purposively selected because of traditional and non-traditional cashew growing areas. The climate and soil of these two districts are more suitable for this crop and the district have large area of waste lands.

Technological gap refers to the proportion of gap in adoption of recommended cultivation practices. It has been conceived as the difference between the package of practices of Cashew cultivation practices recommended by University of Agricultural Sciences, GKVK Banglore, the extent of adoption of these recommended practices at farmer's level in traditional and non-traditional growing areas. Scale developed by Ray (1995) was used. In the present study, technological gap was operationalized on the division of 18 recommended cashew cultivation practices by the farmers and expressed in percentage. The total deviation of adoption of recommended cultivation practices was calculated by using the following formula;

$$\text{Technlogical gap} = \frac{\text{Recommended score} - \text{Actual score}}{\text{Total score}} \cdot \bar{X}100$$

$$\text{Mean technological gap} = \frac{\text{Total gap for all the practices considered}}{\text{Total score}} \cdot X100$$

Mean technological gap in critical farm operations of cashew cultivation was calculated. Based on the total score, the respondents were classified into three categories namely, low, medium and high using mean ($\bar{X}$) and half standard deviation (SD) as a measure of the check.

Category	Criteria	Score
Low	<(Mean – ½ SD)	<13.60
Medium	(Mean ± ½ SD)	13.60 to 40.39
High	>(Mean + ½ SD)	>40.39

Results and Discussion

Technological gap among cashew growers

Overall technological gap in adoption of recommended practices of cashew cultivation

The results pertaining to the Table 1 indicated that half of the respondents (61.11%) had medium overall technological gap, followed by high technological gap with 22.22 per cent of the respondents and 16.67 per cent of the respondents belonged to low overall technological gap category whereas, 53.33 per cent had medium overall technological gap, followed by high technological gap with 26.67 per cent of the respondents and 20.00 per cent of the respondents belonged to low overall technological gap category.

Table 1: Overall technological gap in recommended cultivation practices of cashewnut n=180

Sl. No.	Category	Dakshina Kannada n_1= 90		Chitradurga n_2= 90	
		Frequency	Percentage	Frequency	Percentage
Technological gap	Low	15	16.67	18	20.00
	Medium	55	61.11	48	53.33
	High	20	22.22	24	26.67
		Mean = 34, SD = 8.79		Mean =36, SD = 8.25	

Technological gap in adoption of individual recommended practices of cashew cultivation in Chitradurga

The data with respect to the technological gap for different practices of cashew cultivation is presented in the Table 2.

There was high technological gap of 94.44 per cent was found in adopting cultivation of Ullal variety, A gap of 5.55 per cent was found in cultivation of Vengurla series variety whereas with respect to other improved varieties (Bhaskara, Netra Jumbo, Priyanka, VRI), 90.00 per cent of technological gap was found. A technological gap of 22.22 per cent of gap found in June-July planting time. There was no technological gap found in use of grafted plants (6 leaves stage).In case of spacing, 7.77 per cent of technological gap was found in adopting recommended spacing of 5x5m and there was no gap in size of the pits for planting cashew. It was observed that there was 7.77 per cent technological gap in adopting 160 plants per hectare, as per the recommended number of plant population. Technological gap of 26.66 per cent gap in case of drip irrigation method.

Less technological gap was found in application of FYM (14.44%) and 61.61 per cent gap was found in application of recommended NPK fertilizers. Greater technological gap of 81.11 per cent was found in split dose of fertilizers application and 18.88 per cent gap was found in single dose application of

fertilizers. While, there was 17.77 per cent gap found in recommended time of application of NPK fertilizers. It was found that there was 11.11 per cent of technological gap in tea mosquito bug and in stem borer there was 62.22 per cent gap in pest control measures. In case of disease control measures, 77.77 per cent of technological gap was found for die-back disease management.

Lesser gap of 13.33 per cent was found in obtaining 10 kg yield of cashew per plant in less than 10 year old plant. But 86.66 per cent was found in obtaining 18 kg yield of cashew per plant in more than 10 old plants was found. A gap of cent per cent was found in the various processing techniques (steam boiling, shelling, drying, moisturing, peeling, grading and packing) of cashew and no technological gap was found at the time of harvest.

While in, when it comes to adoption high adoption rate of recommended cultivation practices among respondents. Among the 100 per cent of respondents, 94.44 per cent of respondents cultivated the Vengurla series variety, while the remaining 10 per cent used other improved varieties (Bhaskara, Netra Jumbo, Priyanka, VRI), with 5.55 per cent adoption of the Ullal series. Planting time adherence was also high, with 77.78 per cent planting during the recommended June-July period. All respondents used grafted plants at the (6 leaves stage).

Regarding field layout, the majority of respondents (92.22%) followed the recommended 5x5 m spacing and all used the recommended pit size for planting. The plant population per hectare was also consistent with recommendations, as 92.23 per cent of respondents planted 160 plants per hectare. The data on irrigation indicates Drip irrigation was used by a majority (73.33%) of respondents. A significant portion of 85.56 per cent respondents adopted the recommended dose of FYM.

Fertilizer application practices showed mixed results. While all respondents followed the recommended timing and single-dose application, only 38.89 per cent applied the recommended NPK dosage, and only 18.89 per cent used a split-dose application. It can be observed from the Table 2 that 88.89 per cent of the respondents adopted control measure to tea mosquito bug, followed by 37.78 per cent of respondents adopted recommended control measures for stem borer pest management. While 22.22 per cent of the respondents followed recommended control measures to die back diseases.

Majority of the respondents (86.67%) harvested nearly 10 kg of yield per plant in less than 10 year old plant and 13.33 per cent respondents used to harvest 18 kg of cashew per plant in more than 10 year old plant. Cent per cent of the respondents followed suitable harvesting method. None of the respondents adopted various processing techniques (steam boiling, shelling, drying, moisturing, peeling, grading and packing) of cashew.

The results of the study are in agreement with the findings of Ajeet *et al.* (2015) [1], Ashwini *et al.* (2016), Bagya *et al.* (2016) [5], Basanayak *et al.* (2014) [6], Khandave *et al.* (2017) [7], Kulkarni *et al.* (2015) [8], Markana *et al.* (2016) [9], Sabi *et al* (2014), and Yadav *et al.* (2020) [10].

Technological gap with respect to individual cashew cultivation practices in Chitradurga

The results presented in Table 2 reveal that technological gaps in cashew cultivation practices varied widely across different components. With respect to varietal adoption, a very high technological gap of 94.44 per cent was recorded for Ullal series, while only 5.55 per cent gap was found for Vengurla series, and 90.00 per cent gap for other improved varieties. In terms of planting time, the gap was 22.22 per cent for June–July planting. No gap was observed in the use of grafted plants at the six-leaf stage, reflecting a complete shift away from the latter.In field layout, the gap only 7.77 per cent for 5×5 m spacing. No gap was observed in pit size. For plant population, only 7.77 per cent for 160 plants per hectare. Irrigation practices showed 26.66 per cent for drip irrigation.

Soil and nutrient management practices showed mixed levels of adoption. 14.44 per cent for FYM, 61.61 per cent for NPK fertilizers, 81.11 per cent for split-dose application, 18.88 per cent for single-dose application, and 17.77 per cent for timing of fertilizer application. Pest and disease management practices showed 11.11 per cent gap in tea mosquito bug control, 62.22 per cent for stem borer, and 77.77 per cent for dieback disease management. With respect to yield, the gap was lower (13.33%) in obtaining 10 kg per plant from orchards below 10 years, but much higher (86.66%) in achieving 18 kg per plant from older orchards. Post-harvest practices revealed cent per cent gap in processing techniques like boiling, drying, peeling, grading, and packing, though no gap was observed in harvesting methods.

Overall, the findings indicate that while farmers achieved full adoption in certain areas such as grafted plants, pit size, and harvesting, extremely high technological gaps persist in varieties (Ullal and other improved), irrigation, nutrient management and processing. These results stress the urgent need for targeted interventions, capacity-building programs, and improved access to modern technologies to bridge the gaps and enhance cashew cultivation efficiency and profitability.

While in, cashew growers in the study area exhibited a high adoption of several recommended cultivation practices, though variations exist in specific areas. With respect to varietal adoption, 94.44 per cent of the respondents cultivated the Vengurla series, while only 10.00 per cent grew other improved varieties, and 5.55 per cent adopted the Ullal series. Planting time was also well adhered to, with 77.78 per cent planting during June–July. Cent per cent of the respondents used grafted plants at the six-leaf stage, showing awareness of the importance of quality planting material.

In terms of spacing and field layout, 92.22 per cent followed the recommended 5×5 m spacing. Cent per cent followed the recommended pit size, and 92.23 per cent planted 160 plants per hectare. Irrigation practices showed greater modernization compared to other areas, as 73.33 per cent of respondents adopted drip irrigation. 85.56 per cent applied FYM, reflecting good awareness of organic nutrient management. Fertilizer use patterns showed mixed adoption: though cent per cent of farmers applied fertilizers at the recommended time and in a single dose, only 38.89 per cent applied the recommended NPK dosage, and just 18.89 per cent followed split-dose application. Pest and disease management revealed that 88.89 per cent controlled tea mosquito bug, 37.78 per cent managed stem borer, and 22.22 per cent adopted measures against dieback disease. With respect to yield, 86.67 per cent harvested about 10 kg per plant from orchards less than 10 years old, while 13.33 per cent harvested 18 kg per plant from plantations more than 10 years old. Cent per cent of the respondents adopted suitable harvesting methods, but none followed any processing techniques such as steam boiling, drying, peeling, or grading, indicating a complete lack of value addition at the farmer level.

Overall, the results suggest that cashew growers in this region are progressive in adopting key practices such as grafted plants, pit size, spacing, drip irrigation, and pest control. However, adoption levels remain lower for fertilizer management, disease control, processing, and value addition. This highlights the need for strengthening extension services, promoting awareness on scientific nutrient management, and encouraging processing to improve profitability and sustainability of cashew cultivation.

Table 2: Technological gap in adoption of recommended practices of Cashew cultivation in Chitradurga (n=90)

Sl. No.	Recommended package of practices		Mean Technological gap (%)	Adoption (%)
1	**Varieties**			
a.	Vengurla Series		5.55	94.45
b.	Ullal series		94.44	5.56
c.	Other improved varieties (Bhaskara, Netra jumbo, Priyanka, VRI)		90	10
2.	**Planting time**			
b.	June-July		22.22	77.78
3.	**Planting Material**			
a.	Grafted plants (6 Leaves Stage)		0.00	100
4.	**Spacing**			
ii.	5m*5m		7.77	92.23
5.	**Size of the pits for planting cashew**			
a.	0.5m *0.5m *0.5m		0.00	100
6.	**Plant population/ha**			
ii.	160 plants /ha		7.77	92.23
7.	**Irrigation methods**			
i.	Drip irrigation		26.66	73.34
8.	FYM (10 Kg per plant)		14.44	85.56
9.	**Application of Fertilizers (per plant)**			
a.	Dosage (200:140:200 g)		61.61	38.89
b.	Time of application (May-June, August-September)		17.77	82.22
c.	Single dosage		18.88	81.11
d.	Split dosage		81.11	18.89
10.	**Measures to control the major pests**			
	Name of pest	**Chemicals/Bio agents used for control**		
a.	Tea mosquito bug	Lambdacyhalothrin 10% EC @ 0.5 ml/l	11.11	88.89
b.	Stem borer	Quinalphos 25 EC @ 2 ml/l Chlorpyriphos 20 EC @ 1.5-2.5 ml/l	62.22	37.78
11.	**Measures to control the major disease**			
a.	Die-back	Neem cake application + Phorate 10 G	77.77	22.22
12.	**Yield obtained per plant**			
a.	Less than 10-year plant (10 kg)		13.33	86.67
b.	More than 10-year plant (18 kg)		86.66	13.33
13.	**Harvesting and processing of cashew**			
i.	When the colour of good nuts are brown in colour.		0.00	100
ii.	1.Steam boiling 2. Shelling 3.Drying 4.Moisturing 5.Peeling 6.Grading 7.Drying 8.Packing		100	0.00

Conclusion

The following conclusions were emerged from the present study. The study revealed contrasting adoption trends between Dakshina Kannada and Chitradurga. Dakshina Kannada showed high adoption of Ullal varieties and traditional practices but large gaps in irrigation, spacing and processing technologies. Chitradurga farmers adopted Vengurla varieties, drip irrigation and closer spacing more effectively. However, both districts exhibited major gaps in split fertilizer application and post-harvest processing. Overall, Dakshina Kannada excelled in varietal adoption, while Chitradurga performed better in input and irrigation management.

Future scope

Future studies can be extended to other major cashew-growing districts for wider applicability of findings. Action research and large-scale field demonstrations should be undertaken to enhance farmer awareness and technology adoption. Social aspects like gender participation and marketing behavior of growers need deeper exploration. Additionally, studies on value addition, processing, and cropping systems offer significant future research potential.

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