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Cultivate the uptake of labour-saving technologies

How scale-neutral farm mechanization will benefit FCV tobacco farmers

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Introduction

Technological innovation is crucial for the improvement of agricultural productivity, thereby farmers' welfare, and ultimately the economic prosperity of a country. Globally, the modern agricultural industry is currently more efficient than ever before, largely due to the implementation of labour-saving technologies (Edan *et al.*, 2009). However, agriculture is distinct from other industry sectors, and the development of labour-saving technologies in farming must be prioritized given the complexity, nature-dependent, biological process, and highly variable phenomena. Investment in farm mechanization faces the challenge of lower returns, lack of R&D support, and high risks due to the seasonal nature, accessibility, and affordability of small farmers in developing countries. However, over the years, the technological revolution in other aspects of agriculture resulted in increased productivity, improved quality of agricultural output, reduced production costs, and better control of environmental factors (Edan *et al.*, 2009). Labour-saving technologies exhibit a considerable impact on labour demand and supply and therefore typically have significant policy implications in commercial agriculture. From a policy perspective, farm mechanization might lead to decreased demand for labour and consequent reduction in the cost of cultivation. (Sunding and Zilberman, 2001).

Scale-neutral farm mechanization

- Scale-neutral farm mechanization means the technologies that are equally beneficial for small-scale farmers, medium-scale farmers, and large-scale farmers.
- In case of FCV tobacco, mechanization technologies need to be equally beneficial for farmers with 1 barn, farmers with 2 barns and farmers with 5 barns.
- The term 'scale-neutral' is now reappearing in debates on agricultural development in many countries across the world.
- Farm mechanization is indispensable to decrease the cost of cultivation and increase farmers' income in FCV tobacco farming.

FCV Tobacco Production Landscape

FCV tobacco is grown as a commercial crop, an integral part of commerce, a symbol of economic prosperity and livelihood security, with high-farm income generating potential. However, it is grown in limited pockets in the southern states of Andhra Pradesh and Karnataka with a production of around 241 million kg during 2022-23. Unlike other commercial crops, the FCV tobacco production system is unique in India, where area allocation and crop size are regulated by the Tobacco Board, Ministry of Commerce and Industry. In Andhra Pradesh, FCV tobacco is cultivated in distinctive geographic regions namely, Northern Light Soil (NLS), Southern Light Soil (SLS), and Southern Black Soil (SBS) and KLS (Karnataka Light Soil) region in Karnataka. The climatic conditions, resource availability, varieties cultivated, size of land holding, and socio-economic conditions of the farmers vary across each growing region. As a result of variation in these factors, the cost of cultivation per unit area significantly differs in FCV tobacco cultivation in each region.

Estimation and quantification of different cost components in tobacco cultivation in NLS region

NLS region encompasses the East Godavari and West Godavari districts of Andhra Pradesh and Khammam district of Telangana. In this region, FCV tobacco is grown under a well-endowed system with irrigated conditions during winter from October to March. Currently, it is grown in an area of nearly 21 thousand ha with a production of 55 million kg during the year 2022-23. For the reckoning of cost of cultivation in FCV tobacco, a multi-stage stratified random sampling design was employed for a selection of tobacco growers in data collection process. Further, 40 sample farmers were selected under each auction platform based on the number of barns. A barn is a standard unit for fixing the crop size and production targets in each soil region. A total of 200 farmers were surveyed in 5 auction platforms namely, Devarapalli, Gopalapuram, Jangareddygudem-1, Jangareddygudem-2, and Koyalagudem. Regarding historical experience in tobacco farming, among the sampled farmers, the highest percentage of farmers (48%) had more than a decade of experience in tobacco cultivation in the NLS region. The farm costs concepts classified by the Commission for Agricultural Costs and Prices (CACP), Ministry of Agriculture, and Farmers' Welfare, were employed to estimate the cost of cultivation of FCV tobacco in the NLS region. A field survey was carried out in different villages under each auction platform to estimate the costs in FCV tobacco cultivation during 2022-23. From the analysis, among major variable costs incurred by the farmers namely material inputs, labour inputs, and fuel input, it was found that the material input cost (seedlings, fertilizers, and pesticides) is around Rs. 31820/ acre, labour cost is around Rs. 71050/acre and curing cost is around Rs. 34430/acre. The share of the material input cost was 23%, the share of labour cost was 52% whereas the remaining 24% was incurred on curing costs (Table 1 and Figure 1). This clearly infers that labour costs account for more than 50% of the total cost of cultivation in the NLS region. Hence, there is a need for the development and deployment of labour-saving farm mechanization technologies to bring a significant dent in the cost of cultivation and sustain FCV tobacco cultivation.

Table 1: Main cost components in FCV tobacco cultivation in the NLS region of AP during 2022-23

Particulars	Cost of Cultivation (Rs/acre)
Material input cost	31820
Labour cost	71050
Curing cost	34430
Total	**137300**

Source: Field survey, 2023

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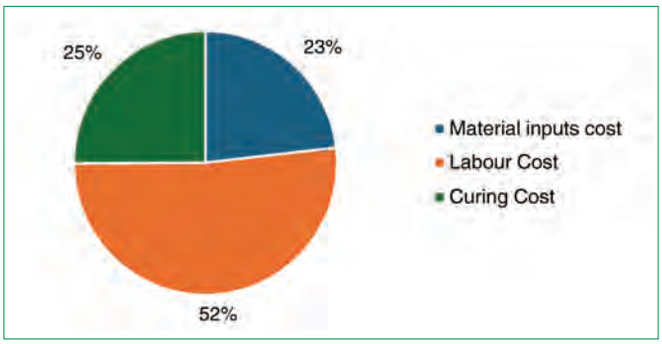

Figure 1: Share of major cost components in FCV tobacco cultivation in NLS region

Labour intensity and its implication on cost structure in FCV tobacco cultivation

Understanding the labour requirement in farming is instrumental for R&D organizations and policymakers in developing suitable technological interventions to reduce the labour involved in different farm operations, subsequently, the costs incurred on them. Moreover, labour cost is one of the major costs, which accounts for more than 50% of the total cost, incurred by the farmers in FCV tobacco cultivation in NLS region. In this contextual background, the policy brief is envisioned to explain the need for the development and promotion of labour-saving technologies for sustainable FCV tobacco farming. In this brief, we are going to deliberate about different possible labour-saving and farmers' friendly technologies/ techniques in FCV tobacco cultivation, which is highly important from the farmers' point of view to address the paucity of labour, especially the skilled labour, high labour wages and needs the attention of R&D organizations and policymakers to address the researchable issues in farm mechanization. Besides, labour-saving technologies/techniques would create a significant positive impact not only on labour-saving, but also on cost-saving, time-saving, and enhancing the production efficiency of the farmers. This kind of farm mechanization intervention will have a cascading effect on the cost of cultivation in FCV tobacco cultivation.

FCV tobacco is a highly labour-intensive crop, which demands more labour (human, animal, machine labour) in its cultivation from crop sowing to the marketing of cured tobacco leaves. At each stage of the crop cycle, labour is needed, starting from nursery management, main field crop management, harvest and post-harvest operations. Especially, a skilled labour force is needed for specific harvest and post-harvest operations which are highly specific and unique to tobacco cultivation such as tobacco leaf stringing, loading, and unloading of leaf to and from different tiers of the curing barn and untying and grading of the cured leaf. Thus, this reveals the need for developing technologies/ techniques/ practices to solve the problem of paucity of skilled labour requirements, which is a regular phenomenon faced by FVC tobacco farmers across the growing regions in recent years.

Different forms of labour in FCV tobacco cultivation

In FCV tobacco cultivation, different types of labour are involved at different stages of the crop cycle, which can be classified into human labour (men and women), animal labour (bullocks), and machine labour (tractor, power tiller). Further, within the labour cost, the major share of cost accounts for human labour as a greater number of men and women labours are required in the cultivation of FCV tobacco. In this region, human labour is mainly employed in nursery management, transplanting, irrigation, weeding, and inter-cultivation operations, and harvest and post-harvest operations namely leaf stringing, loading and unloading of green leaf in different tiers of the curing barn, untying, and bulking of the cured leaf. Machine labour is mostly employed for green leaf transportation to the barn, land preparation, marking, and inter-cultivation operations while bullock labour is employed in some inter-cultivation and marking operations in FCV tobacco cultivation. However, over the years, the usage of bullock labour in FCV tobacco cultivation has reduced significantly.

Immense need for the development of possible labour-saving technologies in FCV tobacco farming

The development and deployment of possible labour-saving interventions in different stages of the crop cycle will address the problem of shortage of skilled labour, and high labour wages and have a huge impact on reducing the cost of cultivation in FCV tobacco. The possible labour-saving technologies in different stages of the crop cycle and their cost implications in the NLS region are presented in detail in Table 2 and Figure-2.

Nursery management

Labour-saving interventions such as the practice of poly tray seedling technology compared to the traditional method in tobacco nursery, the cost of labour can be reduced by Rs.2400/acre and the additional benefit of less weed infestation and uniform crop establishment can be achieved in the main field. The use of poly tray pressing tools in the nursery compared to the traditional practice of manual filling can reduce the cost by Rs.800/acre. Under nursery management, with the use of poly tray seedling technology and poly tray pressing tools together, the costs can be saved to the tune of Rs. 3200/acre. In addition, irrigation through micro sprinklers/ bublers instead of manual water application would drastically reduce the labour and time. This technology further help in application of fungicides on to the beds uniformly. Employing this technology improve water application efficiency thus saving water and other inouts.

Main field crop management

The deployment of a tobacco seedling transplanter can reduce cost by Rs 1800/acre compared to manual transplanting of tobacco seedlings. Adoption of drip irrigation and fertigation technologies, there is a scope to reduce the cost by Rs.2800/acre than compared to furrow method of irrigation and manual application of fertilizers. The drip irrigation and fertigation technologies have the positive effect of reducing weed infestation, consequently reducing the quantum of labour compared to manual weeding and together these technologies reduces the cost of cultivation to the tune of Rs.2000/acre. Employing a topping tool with efficient suckercide significantly reduces the labour cost by Rs 3400/acre. With the implementation of drone technology for the application of plant protection chemicals, the labour cost can also reduces to the tune of Rs 2000/acre. Drones can be used by farmers on a hiring basis as owning drones are costly for small farmers. In addition to this, intercultural operation through mini tractor-operated implements can significantly reduce the cost by Rs 1000/ acre. Thus, crop management in the main field with appropriate use of labour-saving technologies, costs incurred by the farmers can be saved to the tune of Rs 13000/acre. Thus the development and implementation of labour saving technology in nursery and main field, the cost can be saved to the tune of 16200/acre.

Table 2. Possible labour-saving interventions in different stages of the crop cycle in FCV tobacco cultivation and savings in the cost of cultivation

Tobacco crop cycle	Traditional Practice	Labour-saving interventions	Saving in cost of cultivation (Rs. / acre)
Nursery Management			
Tobacco seedling production	Traditional method of nursery (5 Mandays:3×Rs.400*+2x600$ =Rs.2400/bed). 3 beds are needed for producing seedlings for 1 acre (2400×3)=Rs. 7200/acre	Tray seedling production technology (12 Mandays×Rs.400) = Rs. 4800/acre.	Rs. 2400
	Filling of trays manually in poly trays. Manual labour. 6 Man-days ×400 = Rs. 2400/ acre	With a poly tray pressing tool, 4 man-days×Rs. 400= Rs. 1600/ acre	Rs. 800
Main Field Crop Management			
Transplanting	Man-days=10women + 2 men per acre Cost incurred= (10×400+3×600) =Rs. 5800/acre	With tobacco seedling transplanter 2 hours per acre through tractor-operated seedling transplanter (2×2000)Rs. 4000	Rs. 1800
Irrigation and fertilizer application	For irrigations, (10 man-days × Rs.600). Human labour costs around Rs. 6000/ acre Fertilizer application, 10 man-days × Rs 400=Rs4000/acre For irrigation and fertilizer application, the cost involved is Rs. 6000+Rs.4000 =Rs. 10000/acre	Under the drip method with fertigation, 9 man-days ×Rs.600) Human labour costs around Rs. 7200/ acre	Rs. 2800
Topping with suckercide application	Manual topping, 4 man-days × Rs. 400×3 times= Rs.4200	Topping tool with efficient suckercide, 2 man-days × Rs. 400=Rs.800	Rs. 3400
Weeding	10 female labour are required. 10 man-days ×Rs. 400=Rs. 4000	5 female labour are sufficient. 5 man-days ×Rs. 400=Rs.2000	Rs. 2000
Plant protection chemicals	6 times manual application. 6 man-days ×Rs. 600=Rs. 3600	With drone technology, Rs. 400/acre. 4 times application of plant protection chemicals= 4×Rs 400=Rs.1600	Rs. 2000
Intercultural Operations	Bullock labour for intercultural operation and ridge formation, Rs. 1000/day. Four times is required, and the cost is Rs. 4000/acre	Mini tractor-operated implements for intercultural operation and ridge formation for onetime is Rs. 1000, for three times, the cost involved is Rs. 3000/acre	Rs. 1000
		Total savings in the cost of cultivation	**Rs.16200**

Note: Differential wage rates are considered for female and male labour, *female wage rate =Rs.400 per day, $- male wage rate = Rs. 600 per day

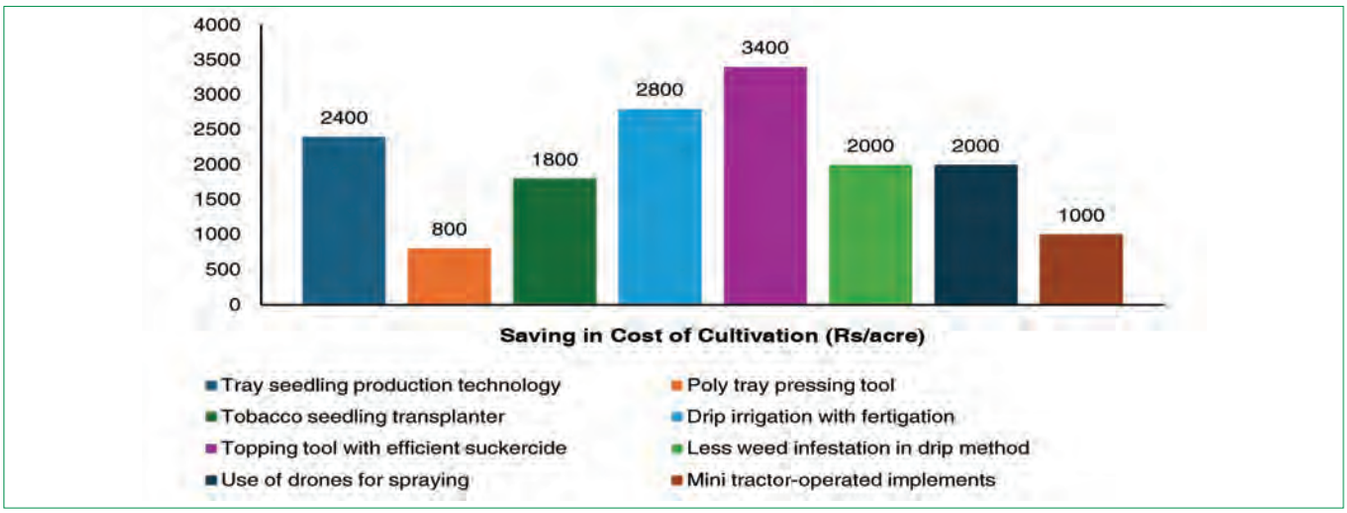

Figure 2: Savings in cost of cultivation due to labour saving technologies in FCV tobacco cultivation in the NLS region

Need for mechanization techniques in harvest and post-harvest management in FCV tobacco

Harvesting and post-harvest operations are important segments in FCV tobacco cultivation, which demands highly skilled labour and high wages. For harvesting operations, efficient indigenous harvesting machines suitable to different soil conditions need to be developed in the context of the non-availability of skilled labour. Under post-harvest management, different operations need skilled labour. Harvest and post-harvest operations in FCV tobacco demand highly skilled labour and major chunk of labour cost is incurred. Hence, mechanized or semi-mechanized machines for tying leaf, baling and sensor-based grading systems need to be developed and employed in view of paucity of skilled labour in the present context and very much needed for future tobacco cultivation due to futher decline in availability of skilled labour and high labour wages. Moreover, some of the farm mechanization tools/techniques are still at the experimental level, not yet reached the farmers' field. Hence, there is a need to explore possible mechanization options in harvest and post-harvest management in FCV tobacco for addressing the issue of cost escalation and non-availability of skilled labour for specific operations.

Research and development issues in the labour-saving technologies in the FCV tobacco cultivation

It is well known that FCV tobacco is labour intensive crop, to address this issue, over the years, some of labour intervention tools and techniques were developed, battery operated sucker control, poly tray pressing tool, and bale pressing tool, but, they need to be further upscaled and sensitized for wider adoption of FCV tobacco farming community. Moreover, there is lacuna in adequate R&D support both from the public sector and private sector in pushing farm mechanization in tobacco cultivation. Thus, there is an immense need for the development of labour-saving technologies, which are farmers' friendly and scale neutral. In this regard, high priority has to be given through R&D efforts for addressing farm mechanization in tobacco farming. Further, FCV tobacco farmers expressed their need for farm mechanization on a small scale such as small tractors and power tillers for labor-saving technologies in intercultural and post-harvest operations due to the shortage of labour and high labour wages in the NLS region. The development departments in tobacco growing regions needs to support farm mechanization in the form of subsidies and supplying advanced technologies such as agri-drones that are not affordable by small farmers on a community basis and custom hiring centers.

Conclusion and Policy Implications

From the above analysis, it can be concluded that with the deployment of labour-saving in tobacco cultivation, the cost incurred per acre can be brought down significantly by 23% in the labour cost component and by 12 % in total cost of cultivation in FCV tobacco farming in NLS region of Andhra Pradesh. Thus, it is clearly indicated that to sustain the profitability and to manage the non-availability of skilled labour requirement in FCV tobacco cultivation, there is a need for designing and implementation of labour-saving technologies suitable to not only the NLS region, but also other soil regions such as SLS, SBS of Andhra Pradesh and KLS of Karnataka, and their evaluation in the farmers' field is inevitable to reduce the cost incurred on labour on one side and overcome the problem of non-availability of skilled labour, on the other. This will have a positive impact on area coverage, time-saving, and timely farm operations. Thus, this will ultimately lead to addressing the problem of a shortage of skilled labour in the near future, which is highly anticipated by the tobacco farmers and sustain tobacco farming in the long run.

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