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Drivers and Barriers for Adoption of Apical Rooted Cuttings Technology for Potato Seed Production in Karnataka

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ABSTRACT

The present study investigates the factors influencing the adoption of Apical Rooted Cuttings (ARC) technology for potato seed production. A purposive multistage sampling method was employed for data collection from 80 farmers (40 using ARC method and 40 using traditional method). The findings revealed that younger and middle-aged farmers predominantly adopted ARC technology, suggesting a generational shift towards modern agricultural practices. Logistic regression analysis performed to identify significant predictors of ARC technology adoption indicated age, education, access to training and extension services, yield, own seed production and government subsidies as predictors which were positively correlated with a pseudo R-squared value of 80.64 per cent. The receiver operating characteristic (ROC) curve analysis revealed high predictive accuracy area under curve (AUC = 0.9588), underscoring the model's effectiveness in distinguishing between adopters and non-adopters. The most significant barrier was high mortality of planting material followed by lack of storage and warehousing facilities. The most significant opportunities for adopting ARC technology were farmer-centered decentralized seed production followed by uniformity of potato seed production. Hence, to enhance ARC technology adoption among farmers, particularly in regions characterized by traditional potato cultivation, targeted interventions, such as improved training and financial support are to be taken on priority.

Keywords : ARC technology, Potato seed tuber, Adopters, Marginal effects, Seed production

POTATO (*Solanum tuberosum* L.) ranks as a staple food crop worldwide and is often referred to as the king of vegetables (Devi and Venkataramana, 2024). It plays a crucial role in ensuring food security, especially in countries like India (Kumar & Sreenivasmurthy, 2022 and Kumari & Maria, 2024). However, sustainable potato production is largely contingent upon the availability of high-quality seed tubers, which account for a significant portion of production costs and influence yield potential (Kuriachen *et al.,* 2020). In India, seed potato production has conventionally been concentrated in Punjab, where skilled and entrepreneurial growers have established a stronghold on the domestic seed market (Buckseth *et al.,* 2022 and Ali *et al.,* 2018). India's potato-growing regions can be broadly divided into the southern hills, the plateau region, the northern hills, the northern plains and the eastern hills. The long-day *kharif* season is the growing season in the northern hills.

In Karnataka, potato is being grown mainly in Hassan, Kolar, Chikkaballapura, Belagavi, Dharwad and Chikkmagaluru districts. Over the past few-years, the area under potato cultivation in the state has reduced drastically due to the outbreak of diseases and low returns and hence, farmers are switching to other crops. For instance, the area under potato production in the Hassan district of Karnataka drastically reduced from 60,000 hectares to 7371 hectares in 2022 over the past 10 years (Anonymous, 2023). Productivity remained low, averaging 9.94 tons per hectare in Karnataka, compared to the national average of 25.79 tons per hectare in 2022 (Anonymous, 2023a). Poor-quality seed is considered as one of the primary reasons for this low productivity (Mohanty *et al.,* 2020). The growers of potato in Karnataka primary depend for seed supplied from Punjab located roughly 2500 kilometers from Karnataka (Mohanty *et al.,* 2020). This distance has led to substantial transportation costs and significant logistical challenges in moving large quantities of seed every year. Though there are improved varieties of potato for cultivation, they rarely reach farmers in Karnataka due to limited access. Another limitation with the existing seed production system, is that it takes at least six seasons to multiply a new variety and seed producers in Punjab understandably are hesitant to assume the risks of growing newer varieties (Ashu *et al.,* 2018 and Devaux *et al.,* 2021). Exploitation by local seed traders in terms of quality, price and quantity of seeds is another common problem faced by farmers cultivating potato. Traders often sell seeds in 50 kg bags that are in many cases, under weight and seed prices remained high and unpredictable, placing additional financial strain on farmers. This situation has created an urgent need to revive the potato seed production by developing an alternative seed system that could provide farmers with high quality seeds at affordable prices. In response to this need and to strengthen the potato seed supply chain in Karnataka, University of Horticultural Sciences, Bagalkote (UHS-B), the Department of Horticulture (DoH), Government of Karnataka, the International Potato Center (CIP), Gesellschaftfür Internationale Zusammenarbeit (GIZ), private nurseries and farmers in Hassan have taken up the promotion of Apical Rooted Cutting (ARC) technology to enable smallholder farmers to produce seeds locally (Moolimane, 2023 and Ravindranath *et al.,* 2020).

Apical Rooted Cutting (ARC) technology is a method of vegetative propagation where tissue culture plantlets are used to produce rooted transplants in a polyhouse, enabling the rapid multiplication of seed potatoes (Kariuki, 2022; The International Potato Center, 2021 and Mohanty *et al.,* 2020). Instead of allowing the tissue culture plantlets to mature directly into mini-tubers, cuttings are taken from them. These cuttings, once rooted, are then transplanted into either a temporary net house or an open field to grow new mini-tubers. By leveraging this rapid propagation technique, a substantial number of seedlings can be produced within 12-14 weeks (Mohanty *et al.,* 2020 and Miklos, 2021). Mother plants are grown for approximately three to four weeks before the first set of cuttings is transferred to the field. Newly formed shoots are then placed in plugs to continue transplant production, sustaining commercial output over two to four months (The International Potato Center, 2021; Vanderzaag *et al.,* 2021 and Kadian *et al.,* 2010).

Given the limitations of traditional potato seed tuber systems Karnataka and the need for a sustainable alternative, adoption and suitability of ARC technology for rapid multiplication of seed tubers with the intention to provide quality potato seed at affordable prices for small and marginal farmers is implemented in Hassan district of Karnataka. However, adoption of technology depends on various factors related to the socio-economic backgrounds of farmers (Tanuja *et al.,* 2019). To explore the factors of ARC adoption, the present study, therefore, aims to identify and analyse the factors influencing adoption and barriers to adoption. The findings will help to develop effective approaches that promote ARC technology enabling farmers to overcome the barriers posed by traditional seed systems and offer insights for evidence-based policy decisions for strengthening potato value chain in Karnataka.

METHODOLOGY

Data Collection

A purposive multistage sampling was applied to determine the study area, while random sampling was used to select farmer respondents. Hassan district was

TABLE 1
Selection of sample villages and sample respondents in the study area

District	Taluks	Villages	Sample size (n=80) ARC farmers (n=40)	Traditional farmers(n=40)
Hassan	Hassan	Tejur	15	06
		Somanahalli	06	07
		Hachagowdanahalli	05	10
		Aladahalli	05	07
		B. Byrapura	04	05
	Arasikere	Aadhihalli	05	05
Total	2 Taluks	6 Villages	40	40

purposefully chosen for the study as ARC technology has been implemented and adopted by potato farmers and in the next level, within Hassan district two taluks namely Arasikere and Hassan which had high area under ARC potato cultivation. Following this, based on high rates of ARC technology adoption the specific villages chosen were Tejur, Somanahalli, Hachagowdanahalli, Aladahalli and B. Byrapura in Hassan taluk and Aadhihalli in Arasikere taluk (Table 1). Within these villages, farmers were selected-randomly and from the selected farmers, data using a structured, pre-tested questionnaire. Data regarding socio economic background of the sample respondents such as age, education, family size, land holding, farming experience and factors determining the adoption of ARC technology of potato seed cultivation, data pertaining to the various constrains and opportunities associated with adoption of ARC technology of potato seed cultivation were collected from the selected farmers. In total, 80 farmers were selected for the study, with 40 using ARC technology and 40 practicing traditional method.

Analytical Framework

Logistic Regression

The information gathered pertaining to the factors determining adoption of apical rooted cuttings technology by the sample farmers was assessed by applying a typical logistic regression. Logistic regression is useful for the kind of situation where the prediction of the presence or absence of an outcome based on values of a set of explanatory variables. The logit model employed was of the form;

$$Logit\ P_i = ln\left\{\frac{P_i}{1-P_i}\right\} = \alpha + \sum_{k=1}^{M} \beta_k X_{ki} + e$$

Where, k = 1, 2... M.

Where $ln\left\{\frac{P_i}{1-P_i}\right\}$ = logit for assessing the probability of evaluating the likelihood of adoption or non-adoption of ARC technology. This can be estimated as a linear function of independent variables (X_{ki}).

P_i = The probability of adoption of ARC technology

$1-P_i$ = The probability of non-adoption of ARC technology

βk = Logit parameters for the independent variables

M = number if independent variables

α = constant

e = Residual disturbance term

In the model, the dependent variable (dichotomous) took the values 0 or 1, where 0 represents non-adoption of ARC technology and 1 denotes adoption of ARC technology method. The odds ratio, calculated as the likelihood divided by the probability of an event not occurring [probability / (1 - probability)], is a critical metric in comparing the relative influence of different variables on the desired outcome. Odds ratios offered insights into the extent to which specific variables, relative to others were associated with the outcome of interest.

The explanatory variables specified in the model were age (years), educational status (years of schooling), family size (number of persons in family), farm size (acres), farming experience (years), cost of cultivation (Rs/acre), yield (quintals/acre), awareness programmes, trainings attended and extension services (dummy), own seed production (dummy) and subsidy from government (dummy). The data was tabulated, coded and analysed using STATA statistical computer programme.

Then marginal effects of the explanatory variables at the mean could be obtained by:

Marginal effect of $X_i = \frac{dy}{dXi} * \frac{\overline{Xi}}{\bar{Y}}$ (or) $b_i * \frac{\overline{Xi}}{\bar{Y}}$

Where,

B = Parameter estimate (partial elasticity associated with each independent variable)

X = Mean of independent variable

Y = Mean of dependent variable

Garrett's Ranking Technique

Garrett's ranking technique was used to rank the constraints faced by the farmers who adopted ARC method of potato production and traditional method. Each of the sample farmer was asked to rank the given constrains and opportunities. The ranks one meant most important factor and rank last meant least important factor. In the next stage, rank assigned to each factor by each individual was converted into per cent position using the following formula:

$$\text{Per cent positon} = \frac{100 \text{ x } (Rij - 0.50)}{Nj}$$

Where,

R_{ij} = rank given for i^{th} factor by j^{th} individual

N_j = number of factors ranked by j^{th} individual

Once the per cent positions were found, the per cent position of each rank was converted to scores by referring to table given by Garrett and Woodsworth (1969). The scores for each factor were then summed over the number of sample farmers who ranked that factor. The total scores were arrived at for each of the reasons and mean scores were calculated by dividing the total score by the number of respondents, who gave ranks.

RESULTS AND DISCUSSION

The socio-economic characteristics of the sample respondents were presented in Table 2. The distribution of sample farmers according to age categorized as young age (up to 35 years), middle-aged (36-50 years), and old (above 50 years) indicated that the largest proportion of farmers belongs to the middle-aged group (72.50 %), followed by 20 per cent in the young age group. This indicated that young and middle-aged farmers dominated the ARC method of potato cultivation. Conversely, the traditional method has a more even distribution with a majority still were in the middle-aged group (52.50 %) and old farmers were 40 per cent compared to the ARC method. The average age of farmers using the ARC method was found to be 39.25 years while it was 46.53 years in traditional method.

The educational status of the sample farmers indicated that 35 per cent of the farmers were found to have PUC level of education, while it was found to be 12 per cent in case of traditional method. Among the ARC farmers, 25 per cent of the farmers were found to have secondary level of education, while it was found to be 20 per cent in case of traditional method. A slightly higher percentage of ARC farmers (15 %) had primary level of education while it was 32 per cent farmers in traditional method. While 15 per cent of ARC farmers held a degree and only six per cent of traditional farmers had attained this level of education. Among the producers using the ARC method, 15 per cent belonged to small families (<= 4 members), while a slightly higher 20 per cent in the traditional method group fell into this category. The majority of producers in both groups were from medium-sized families (5-7 members).

TABLE 2

Socio-economic characteristics of sample respondents cultivating potato

Particulars	ARC method (n=40)	Traditional method (n=40)
Age group		
Young age (Up to 35)	8 (20.00)	3 (7.50)
Middle Age (36-50)	29 (72.50)	21 (52.50)
Old Age (Above 50)	3 (7.50)	16 (40.00)
Average age	39	47
Education level		
Illiterate	4 (10.00)	7 (30.00)
Primary	6 (15.00)	11 (32.00)
Secondary	10 (25.00)	10 (20.00)
PUC	14 (35.00)	8 (12.00)
Degree	6 (15.00)	4 (6.00)
Family size		
Small ((d" 4 members)	6 (15.00)	8 (20.00)
Medium (5-7 members)	23 (57.50)	25 (62.50)
Large (> 7 members)	11 (27.50)	7 (17.50)
Average family size	6	5
Distribution of respondents based on land holdings		
Marginal (<2.47 acres)	1 (2.50)	3 (7.50)
Small (2.47-4.94 acres)	20 (50.00)	23 (57.50)
Medium (4.94-9.88 acres)	16 (40.00)	13 (32.50)
Large (> 9.88 acres)	3 (7.50)	1 (2.50)
Distribution of respondents based on irrigated land and dryland		
Irrigated land (acre)	135.50 (70.17)	120.10 (67.43)
Dry land (acre)	57.60 (29.83)	58 (32.57)
Total land (acre)	193.10 (100)	178.10 (100)
Average size of holding (acre)	5.04	4.58
Average area under potato cultivation	2.87	2.43
Experience in farming		
<15 years	1 (2.50)	2 (5.00)
15-25 years	12 (30.00)	9 (22.50)
26-35 years	21 (52.50)	27 (67.50)
≥ 36 years	6 (15)	2 (5.00)
Average Farming Experience	29	26

Note : Figures in the parenthesis indicates percentages to total sample

Among, the farmers using ARC method of potato cultivation, 50 per cent were small landholder farmers (2.47 to 4.94 acres of land) while among traditional method, 57.50 per cent small landholder farmers. The per centage of large landholder farmers (>9.88 acres), using was only 7.50 per cent. The ARC method cultivators had a significantly higher percentage of their total land as irrigated land (70.17 %) compared to the traditional method cultivators (67.43 %). Farmers using the ARC method tended to possess larger and more irrigated landholdings and cultivated potatoes over a greater area compared to those employing the traditional method. The average size of landholdings was found to be in ARC method of farmers 5.04 acres per holding and the traditional method was found 4.58 acres. The average area under potato cultivation, the ARC farmers was found 2.87 acres, while the traditional method was 2.56 acres. Majority of ARC farmers (52.50%) had farming experience of 26-35 years while 15.00 per cent had 36 or more years of experience. The average farming experience of the sample farmers using ARC method was found to be 28.89 years and that for traditional method it was 26.32 years.

Factors Influencing the Adoption and Non-Adoption of ARC Technology for Potato Production

The results of a logistic regression model co-efficients that influence the adoption of apical rooted cuttings (ARC) technology among the sample farmers is presented in Table 3. Adopters and non-adopters of ARC technology was considered as dependent variable and was regressed on the independent variables age, education, family size, farm size, access to training and extension services, cost of cultivation, yield, own seed production and subsidy from the government.

It was assumed that younger farmers would be less risk-averse and more daring than experienced ones (Knowler and Bradshaw, 2007). Therefore, it was

TABLE 3

Estimates of logit model on determinants of adoption of apical rooted cuttings technology potato seed production in Hassan, Karnataka

Variables	Parameters	Coefficients	Odds ratio	P>z
Age (years)	β1	-0.4978 **	0.608	0.049
Education (No. of schooling years)	β2	0.4871 *	1.628	0.095
Family Size (No. of persons in family)	β3	0.8398	2.316	0.256
Farm size (No. of acres)	β4	0.1782	1.195	0.528
Farming Experience (No. of years)	β5	0.2567	1.293	0.145
Training and extension services (Yes=1. No=0)	β6	4.1510 **	63.500	0.017
Cost of Cultivation(Rs/acre)	β7	-0.00043 ***	1.000	0.007
Yield (Quintal/acre)	β8	0.5214 **	1.684	0.042
Own seed production(Yes=1. No=0)	β9	2.7191 *	15.167	0.064
Subsidy from government(Yes=1. No=0)	β10	3.6584 **	38.803	0.027
Constant		9.2832	10756.540	
Number of observation	80			
LR chi2 (7)	89.43			
Prob> chi2	0.0000			
Pseudo R2	80.64			
Log likelihood	-10.73			

Note : ***,** and* indicates significant at one per cent, five per cent and ten per cent probability level, respectively anticipated that age would ARC adoption. Education level was treated as a continuous variable in the analysis. It was hypothesized that farmers with higher levels of education, higher farm size, access to training and extension services, farmers using own seed, subsidy for adoption would show greater inclination for adoption of ARC technology.

Assuming that the changes in the other variables remained constant, the odds ratio illustrated the impact of changes in each independent variable on the chance of adoption or non-adoption of ARC technology. From the table it is shown that out of 10 independent variables considered for the study, seven were statistically significant. The most significant variable was the cost of cultivation with a negative β value of -0.00043 at 1 per cent level of significance (p = 0.007) with odds ratio of 1.000 suggesting that cost of cultivation had negative impact on adoption and higher costs reduced the likelihood of technology adoption. The other important factor influencing adoption was access to training and extension services with β coefficient 4.151 and was statistically significant at the 5 per cent level (p = 0.017) and odds ratio of 63.500. This showed that farmers who received such extension services were considerably more likely to adopt ARC technology. This finding emphasizes the need for extension and training service for adoption of technology.

Among the demographic factors, age was statistically significant at five per cent (p = 0.095) and showed a negative association (β = -0.4978) with technology adoption with odds ratio of 0.608, implying that older farmers were less likely to adopt ARC technology. Higher levels of education are often associated with increased participation in cooperatives decision making due to the presumed correlation between education and knowledge (Chopra *et al.,* 2024 and Gyau *et al.,* 2016). In the present study, education, measured in years of schooling, had a positive effect on adoption, with a coefficient of 0.4871 with odds ratio of 1.628, though it was significant at the 10 per cent level (p = 0.095), suggesting that more educated farmers were more inclined towards adoption of new technology. Family size, farm size and farming experience were not statistically significant and thus showed no strong association with the adoption of ARC technology.

Yield per acre positively influenced adoption (β = 0.5214) with an odds ratio of 1.684 which was significance at the 5 per cent level (p = 0.042), indicating that higher yields encouraged farmers to adopt ARC technology. The own seed production had a positive coefficient (β = 2.7191) and with an odds ratio of 15.167, reaching a 10 per cent significance level (p = 0.064), which suggested that farmers

Table 4

Marginal effects on determinants of adoption of ARC technology Hassan, Karnataka

Variables	Parameters	Marginal effects (dy/dx)	S E	z	P>z
Age (years)	β1	-0.0203 **	0.009	-2.260	0.024
Education (No. of schooling years)	β2	0.0198 **	0.010	1.970	0.049
Family Size (No. of persons in family)	β3	0.0342	0.029	1.200	0.231
Farm size (No. of acres)	β4	0.0072	0.011	0.630	0.526
Farming Experience (No. of years)	β5	0.0104	0.007	1.560	0.119
Training and extension services (Yes=1. No=0)	β6	0.1693 ***	0.050	3.370	0.001
Cost of Cultivation (Rs/acre)	β7	-0.00002 ***	0.000	-4.710	0.000
Yield (quintal/acre)	β8	0.0212 **	0.009	2.490	0.013
Own seed production (Yes=1. No=0)	β9	0.1109 **	0.048	2.300	0.021
Subsidy from government (Yes=1. No=0)	β10	0.1492 ***	0.051	2.920	0.003

Note : *** and **indicates significant at one percent and five percent probability level, respectively; SE- Standard error producing their own seeds showed a moderate tendency towards ARC technology adoption.

Similarly, government subsidies played a significant role (β = 3.6584, p = 0.027) with an odds ratio of 38.803, as farmers receiving subsidies were more likely to adopt the technology. The finding emphasized the need for subsides in the initial phases for adoption of the technology. The model achieved a pseudo R-squared value of 80.64 per cent with a statistically significant chi-square test ($p < 0.01$), indicating that the factors included in the model collectively provided a good fit for explaining the factors influencing the adoption of ARC technology. These findings are in similar line with the study conducted by Moolimane (2023); Eliya *et al.* (2019) and Mohamed *et al.* (2018) which revealed that age, education and extension services significantly influence of improved technology. Upadhyay *et al.* (2020) found that training and seed source were the major significant factors affecting the adoption of improved potato varieties.

Marginal Effects on Determinants of Adoption of Apical Rooted Cuttings Technology

Marginal effects are a way of presenting results as differences in probabilities, which is more informative than odds ratios and relative risks. To know the extent of changes in the household decision to adopt ARC technology, marginal effects have been estimated and have been presented in Table 4. The marginal effect farmers age was -0.0203 and was statistically significant at the five per cent level which indicated that farmers age negatively impacted adoption with older individuals less likely to adopt and young farmers tend to adopt ARC method of potato seed cultivation. Education positively influenced adoption, as an additional year of schooling increased the likelihood of adoption by 0.0198 and was significant at the 5 per cent level. Training and extension services had a strong positive influence on adoption with a marginal effect of 0.1693 which was significant at the 1 per cent level, indicating the importance of support services. Cost of cultivation showed a significant but negative marginal effect of -0.00002, implying that higher cultivation costs discouraged adoption. Yield was positively associated with adoption with a marginal effect of 0.02127 which was significant at the 5 per cent suggesting that higher productivity promoted adoption. Likewise, the practice of own seed production positively impacted adoption with a significant marginal effect of 0.1109. Government subsidies also had a substantial positive impact on adoption with a marginal effect of 0.1492 and was significant at the 1 per cent level. Family size, farm size and farming experience however were not significant.

Receiver Operating Characteristic (ROC) Curve Analysis for Adoption of ARC Technology

The ROC analysis provided the model's accuracy and effectiveness in differentiating between adopters and non-adopters. The ROC curve was derived from the performance of the model over 80 observations. The analysis shows the model's ability to correctly classify individuals based on various thresholds, where Area Under the Curve (AUC) close to 1 signifies high performance. It can be observed from the Fig. 1 that the AUC value was 0.9588, indicating that the model has a near-perfect ability to correctly classify adopters (positive cases) and non-adopters (negative cases). The standard error of 0.0094 indicated a precise estimate of the AUC, while the 95 per cent confidence interval further confirmed the robustness and reliability of the model's predictive power. The analysis was crucial for understanding how well the model distinguished individuals who are likely to adopt ARC technology and those who are not, making it an effective tool for further research or policy implementation.

Barriers for Adoption of ARC Technology

Farmers adopting the ARC method of potato cultivation were surveyed to gather information on the constraints faced by them for technology adoption. These constraints were ranked according to the farmers' preferences with the rankings converted into numerical scores (Table 5). The problems have been listed based on their Garrett scores and ranks, where a higher score indicated a more severe constraint. The most significant constraint was lack of inadequate

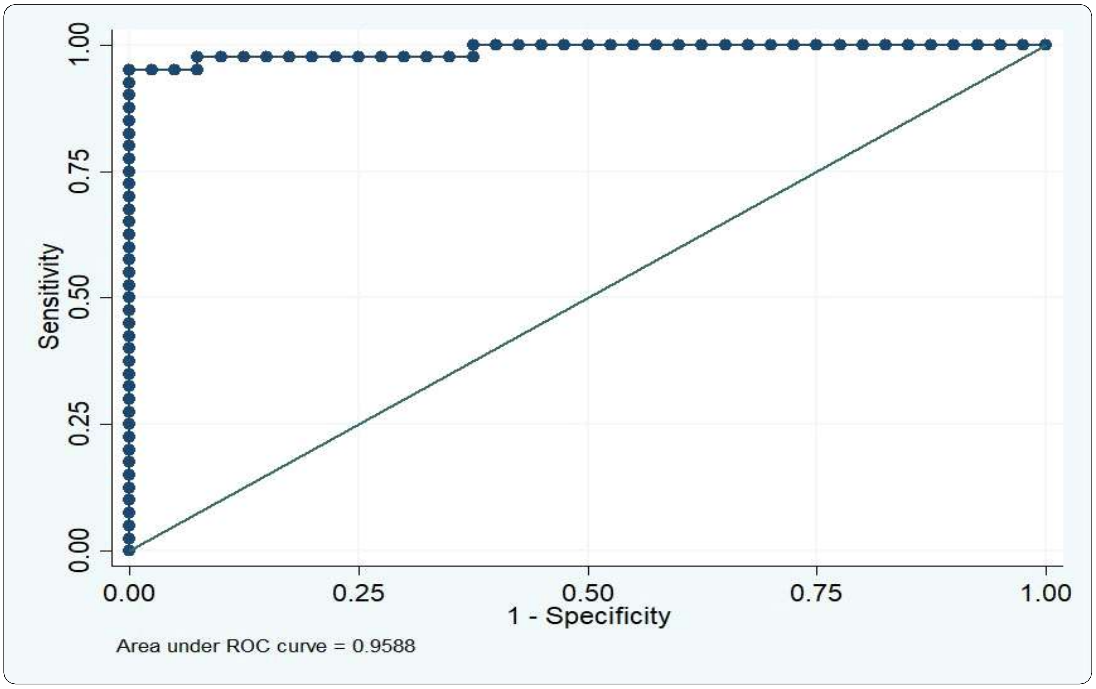

Fig. 1 : Receiver Operating Characteristic curve for adoption of ARC technology

Table 5

Barriers faced by farmers in adoption of ARC technology

(n=40)

Particulars	Garret's Mean Score	Rank
Inadequate storage and warehousing facilities	92.27	I
High mortality of planting material	84.14	II
Scarcity of labour in peak season	63.67	III
Non availability of planting material	54.73	IV
Inadequate transport facilities	53.19	V
High cost of planting material	50.44	VI
Susceptible to disease and pests	22.34	VII
Low selling price for ARC potato in the market	17.09	VIII
Inadequate access to technical information	13.46	IX

storage and warehousing facilities with the highest Garrett mean score of 92.27, indicating that this constraint had been a substantial limitation for farmers. High mortality of planting material was ranked second with a mean score of 84.14, underscoring that farmers faced critical challenges in safely storing and preserving their planting materials for next season. Scarcity of labour during peak seasons was ranked third (mean score 63.67), reflecting that labour shortages had been another pressing issue impacting adoption of ARC. Non-availability of planting material, inadequacy of transport facilities and high cost of planting material with a mean score of 54.73, 53.19 and 50.44 were ranked fourth, fifth and sixth, respectively. Accessibility to planting resources, inadequacy of transport facilities especially

TABLE 6

Drivers for adoption of ARC technology

(n=40)

Particulars	Garret's Mean Score	Rank
Farmer-centered decentralized seed production	86.96	I
ARC technology improve the uniformity of potato seed production	82.37	II
ARC technology boosted potato seed production	81.08	III
Subsidy from the government for the ARC plants	69.30	IV
ARC technology's cost savings as compared to traditional method	61.38	V
Increased seed multiplication rate	52.26	VI
Potato used for dual purpose	45.13	VII
Pest and disease control	35.36	VIII
Linking actors in the seed production supply chain	22.23	IX
Mutual seed tuber exchange between farmers	10.60	X
Improved technology and information transfer	5.78	XI

for farmers in remote areas who relied on efficient logistics for ARC adoption and high cost indicated were perceived as impediments for technology adoption. Inadequate access to technical information (mean score 13.46) was identified as another pressing issue and hence demonstrated a need for better dissemination of knowledge related to ARC potato cultivation.

Drivers for Adoption of ARC Technology

The opinions of the respondents' gathered on the drivers for ARC technology adoption were ranked by preferences and then converted into numerical scores (Table 6). The highest-ranked opportunity was farmer-centered decentralized seed production with a Garrett mean score of 86.96. This suggested that respondents highly value localized seed production tailored to meet farmers' specific needs. Improvement in the uniformity of potato seed production with a mean score of 82.37 was ranked second which indicated that the ARC method was perceived to enhance consistency in seed quality, a critical aspect for successful seed tubers production. Potential for an overall boost in potato seed production with a mean score of 81.08 ranked third highlighted the recognition of ARC technology to increase yields significantly.

Subsidies for ARC seedlings were also considered essential by sample farmers which ranked fourth with a mean score of 69.30. Kumar and Joshi (2018) have examined the relationship between agricultural subsidies and productivity and have argued that subsidies have played a crucial role in increasing crop yields and food security. Hence, financial support in the form of subsidies are considered critical in promotion and adoption of the technology.

The findings of the study on factors influencing adoption of ARC technology for potato cultivation revealed strong correlations between education, yield, own seed production and subsidies from government. Marginal effects further clarified these relationships, demonstrating that each additional year of schooling and the receipt of government subsidies substantially boosted the probability of adopting ARC technology. Hence, to address the critical problem of timely, locally available quality seed and for its sustainable production, awareness, trainings and government support are essential for ARC technology adoption. High mortality of planting materials and inadequate storage facilities are considered as barriers for adoption while farmer centred de-centralized quality seed production were the drivers for adoption. While challenges exist, the favourable perception of ARC technology's benefits suggests a promising future for its adoption among younger, educated farmers. Hence, policies should be designed to address the challenges thereby facilitating the broader adoption of innovative agricultural practices like ARC technology in potato cultivation.

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