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*Full Length Research Paper*

# Socio-economic determinants of the adoption of budded planting materials in rubber smallholdings of the South West region, Cameroon

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**The rubber tree, *Hevea brasiliensis* (Willd. ex Adr. Juss.) Muell. Arg. constitutes one of the main cash crops in Cameroon. The use of budded planting materials is being generalized in rubber smallholdings though the extent of its adoption remains quite variable. In this paper, a logit model was used to study the factors which determine the decision-making behaviour of farmers in the adoption of budded planting materials in the South West region of Cameroon. Survey results showed that the strongest predictor of the farmer's intention to adopt budded planting materials was membership to a rubber farmers' organization (odds ratio = 112; 95% confidence interval: 8.8685 to 1414.44). Mastery of the budding process and access to budwood were also factors which facilitated the appropriation of this innovation by farmers and that fostered its adoption in Cameroon.**

**Key words:** Budded planting materials, adoption, *Hevea brasiliensis*, decision-making, Cameroon.

## INTRODUCTION

The access to high latex yield planting materials by smallholders is one of the most important constraints faced by rubber farmers in Cameroon (Chambon, 2002; Fèvre, 2002; Michels, 2001). Seedlings are not recommended for smallholdings because of problems associated with relatively low yield, Brown Bast and variable growth (MRB, 2003) and the generally rough nature of the bark that does not ease eventual tapping. The use of budded planting materials (clones) may result in a three-fold increase of production compared to a plantation of seedlings (Compagnon, 1986). However, the high cost of the budded planting materials in polythene bags sometimes proposed by some suppliers (€ 0.686) also constitutes a hindrance to the development of clonal rubber plantations.

Household farm lands are limited in the area of study. These farmers usually have less than 2 ha of land (Besong et al., 1992, 1993). Crop intensification by the use of improved planting materials proves to be essential.

Budded planting materials were mainly diffused in rubber smallholdings in Cameroon within the framework of a programme called the National Fund for Rural Development (FONADER) between 1978 and 1992. This programme consisted of a loan given by the State to smallholders in terms of budded planting materials and other inputs necessary for the establishment of clonal rubber plantations. The eventual disengagement of the State and the structural adjustment programmes following the advent of the economic crisis of the 1990s, led to the end of this assistance to the rural sector (Michels, 2005).

This study thus aims to highlight the factors influencing the use of budded planting materials by smallholders and to analyse their perceptions about this venture in the South West region. This work was realised following an on-farm experiment and demonstrations on the production of budded planting materials by two rubber smallholders' pilot groups in the villages of Bombe and Mundame launched in 2004. Under given conditions, smallholders could produce their own budded planting materials from a smallholder-owned and managed

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bud-wood garden (Schueller et al., 1997). The main objective pursued was the promotion and appropriation of budding techniques with direct access to budwood from a collective budwood garden created by the Latex Plants Programme of the Institute of Agricultural Research for Development (IRAD), Cameroon.

## MATERIALS AND METHODS

### The study area

The South West region of Cameroon is part of the coastal humid forest agro-ecological zone (Akinwumi et al., 2000), with a mono-modal rainfall pattern favourable to agricultural activities (Dongmo et al., 2005). The region is divided into four major zones: Kumba, the volcanic zone, sand zone and Mamfe. This region has a gradient of population pressure, which is the highest in the lower volcanic area (67 persons $km^{-2}$) and lowest in the Mamfe area (18 persons $km^{-2}$). Farmers of this area practise slash and burn agriculture with a minimum tillage and grow crops on either mounds or flat seed beds (Almy et al., 1991). This form of land use impoverishes the soil and with the problem of land scarcity, has a negative consequence on the rising population and pressure on land is felt everywhere. The agro-industrial plantations occupy more than half (60%) of suitable lands of this area (Konings, 1993).

### Data collection

Field survey was conducted using a survey research design. Data were collected through a questionnaire design technique (semi-structured interviews) from 42 rubber smallholdings, among which 15 took part in the on-farm experiment and demonstrations on the production of budded planting materials. The questionnaires were pre-tested with 10 farmers and then revised to incorporate farmers' suggestions and the perceptions they had on this innovation.

The interviewed farmers were selected on the basis of the following criteria: (1) They must have participated in the on-farm experiment and demonstrations on the production of budded planting material and had established at least a plot of rubber trees after 2004 (date of the experimentation process), which supposes that the farmer had received training on budding process; (2) The farmer possessed an immature rubber plantation established between 2001 and 2007. This second condition implied that the farmer did not necessarily have access to budwood issued from one of the collective budwood nurseries established within the framework of the experiment.

The questions asked were based on reasons for the adoption or non-adoption of budded planting materials, the origin of their planting materials and the budwood used if they were producing their own planting materials. Some socio-economic data were also collected from farmers.

### Analytical model

A logit model (Maddala, 1 983) was used to evaluate farmers' decision to adopt the budded planting materials. The most used model which better explains the diffusion process is the logistic function (Adéoti et al., 2002; CIMMYT, 1993). The conceptual model is given as:

$$E(Yi) = P(Yi) = \left(e^{\alpha+\beta x_i}\right) / \left(1 + e^{\alpha+\beta x_i}\right)$$

Where $P(Y_i)$ is the probability (P) that an individual (i) adopts the budded planting materials, $P(Y_i)$ takes on the value 1 for the $i^{th}$ farmer who adopted budded planting materials and if no adoption occurred the value 0 was used. $Y_i$ is the dependent variable (adoption of budded planting materials), α the constant, β the vector of the parameters to be estimated, e the exponential function and $X_i$ a vector of explanatory variables corresponding to $i^{th}$ observation.

In order to model the probability of adopting budded planting materials, the following were introduced: (i) dichotomous explanatory variables such as the type of planting materials used by the farmer (budded or not), the sex (man or woman), membership to a rubber farmers' association; (ii) polytomous variables such as the farmers' level of education (battery of dummy variables like none, primary, secondary school and above) and, (iii) quantitative variable such as the age of the farmer.

The logit model was estimated by a maximum of likelihood method using XLStat 2008®.

## RESULTS AND DISCUSSION

### Profile of rubber household farm heads

In Cameroon, rubber just like all perennial crops is rarely practised by women. Majority of rubber household farm heads (90%) were men while only 10% were women (Table 1). The few women respondents were widows who had become family heads following the deaths of their spouses). This unequal distribution of gender in the rubber smallholdings production was due to the traditional models of land acquisition. In general, the women had access to land through their husbands (Almy et al., 1991). Perennial crops are symbols indicating land ownership and their introduction within farms was up to men who are the land owners of the family. With regards to the adoption of budded planting materials, 79% of men adopted the proposed innovation, against 75% of the women. There was no difference between the groups compared (odds ratio = 1.25; 95% confidence interval: 0.11 to 13.69). The results obtained did not corroborate those found by Endeley and Tebeto (1996), who revealed significant gender-related differences in farmer's attitudes towards adoption of improved agricultural practices in Cameroon. This result should nonetheless be considered with caution due to the poor representation of women in our sample.

The age of respondents was between 27 and 74 years. Two age groups were considered with 40% of farmers being less than 45 years old and the remaining 60% were more than 45 years old. With respect to adoption of the budded planting materials, 88% of farmers aged less than 45 years old adopted the innovation as against 71% of farmers aged more than 45 years old. The probability of adoption of the budded planting materials was the same for the two age groups (odds ratio = 2.92; 95% confidence interval: 0.5252 to 16.1973). This implied independence between the age groups considered. Although younger farmers are said to have greater flexibility in dealing with risks (Akinola and Young, 1985; Bodiguel, 1975), recent studies have reported negative impacts of age on the adoption of modern technologies or

**Table 1.** Surveyed farmers' profiles Values represent the number of farmers who adopted or not the budded planting materials and those in parentheses are the percentages for each variable.

| Variables | Type | Adoption | | Non-adoption | | Total |
|---|---|---|---|---|---|---|
| Sex | Male | 30 | (79%) | 8 | (21%) | 38 |
| | Female | 3 | (75%) | 1 | (25%) | 4 |
| | Total | 33 | | 9 | | |
| Age | Less than 45 years | 15 | (88%) | 2 | (12%) | 17 |
| | 45 years and above | 18 | (72%) | 7 | (28%) | 25 |
| | Total | 33 | | 9 | | |
| Level of education | None and Primary | 23 | (82%) | 5 | (18%) | 28 |
| | ≥ Secondary school | 10 | (71%) | 4 | (29%) | 14 |
| | Total | 33 | | 9 | | |
| Membership to a rubber farmers' associations | Yes | 32 | (94%) | 2 | (6%) | 34 |
| | No | 1 | (13%) | 7 | (88%) | 8 |
| | Total | 33 | | 9 | | |
| Social class | Well-off | 15 | (88%) | 2 | (12%) | 17 |
| | Poor | 18 | (72%) | 7 | (28%) | 25 |
| | Total | 33 | | 9 | | |

practices (Adesoji et al., 2006; Ajayi, 1995; Nkonya et al., 1997; Rajasekharan and Veeraputhran, 2002).

From Table 1, about 67% of the respondents had received no formal education or were just primary school leavers, while the rest (33%) had been at least to secondary school. Most of the farmers who had no formal education or just finished primary school (82%) adopted budded planting materials as against 71% of farmers with at least secondary education. No significant differences were found between the two classes considered (odds ratio = 1.84; 95% confidence interval: 0.41 to 8.33). Although education augments one's ability to receive, decode and understand information relevant to making innovative decision (Wozniak, 1984), these results do not seem to confirm this. This is probably because rubber farmers in the South West region work in the same socio-political and cultural environment and as such their practices and production strategies differ very little.

The surveyed farmers in their majority (81%) were members of a rubber farmers' organization. With regards to adoption of budded planting materials, 94% of farmers belonging to a rubber farmers' organization adopted the innovation as against 13% of the farmers not belonging to these organizations. Farmers belonging to rubber farmers' organizations were most likely to adopt budded planting materials (odds ratio = 112; 95% confidence interval: 8.87 to 1414.44).

The social class of the farmer was also a determinant factor for access to improved planting materials. Most of the farmers (60%) could be considered as poor (peasant farmers) as against 40% of well-off farmers (civil servants, employees of private companies, etc.). Most of the well-off farmers (88%) adopted the budded planting materials as against 72% of poor farmers. The chances of adoption of budded planting materials were the same for the two social classes (odds ratio = 2.92; 95% confidence interval: 0.53 to 16.2), this supposes independence between the social classes considered. The better-off the farmer, the greater would be his/her capacity to purchase budded planting materials. However, the capacity of poor farmers to produce their planting materials themselves increases their chances of adoption of the said planting materials.

## Farmers' perceptions on budded planting materials

From this study an inventory of some of the criteria influencing the decision-making behaviour of farmers in adoption of budded planting materials was made as follows: (i). All the interviewed farmers have sufficient knowledge on rubber production; (ii). They know most of the clones planted in their farms and (iii). They have a narrow idea on the exploitation systems and on the production performances of these clones.

Many reasons were given by farmers on the choice of planting materials (budded or not). For 88% of interviewed farmers who chose to adopt the budded planting materials, their choice was motivated either by the personnel of the competent research institute

**Table 2.** Regression results for the determinants of adopting budded planting material of rubber in the south west region of Cameroon.

| Source | Value | Standard deviation | Wald'sKhi² | Pr > Khi² | 95% conf. interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Constant | -4.498 | 2.363 | 3.624 | 0.057 | -9.128 | 0.133 |
| sex | 2.927 | 2.048 | 2.043 | 0.153 | -1.087 | 6.940 |
| Level of education | -1.039 | 0.909 | 1.305 | 0.253 | -2.821 | 0.743 |
| Membership to rubber farmers' associations | 6.042 | 1.968 | 9.429 | 0.002 | 2.185 | 9.898 |
| Social class | 1.354 | 1.768 | 0.586 | 0.444 | -2.111 | 4.818 |
| Age | 0.738 | 1.436 | 0.264 | 0.607 | -2.076 | 3.553 |

(Institute of Agricultural Research for Development, IRAD) or by the local representatives of a nearby agro-industrial firm (Cameroon Development Corporation, CDC) who sensitized them on the high production potentials of budded planting materials. Furthermore, all surveyed farmers who were members of a rubber farmers' association (with access to a budwood nursery and budding know-how), had a second motivation which was the low production cost of budded planting materials. Most farmers who produced their budded planting materials considered the production costs to be minimal because they incurred very little external inputs. Earlier works undertaken at the Sembawa research station (Indonesia) revealed that production costs were much lower for plants produced by farmers than for those produced on-station (Rosyid et al., 1996), probably because farmers producing their own planting materials rarely estimate the time they spent in their production.

As for the non-adoption of the budded planting materials, surveyed farmers mentioned three major constraints: (i). the high cost of the budded planting materials (83%), (ii). ignorance on the budding process (62%) and (iii). lack of budded planting materials due to absence of private producers (14%). Indeed, the agro-industries seemed to sell only the surplus of their planting programmes and sometimes the least vigorous plants.

## Intensification level

From the data collected during this study, an intensification typology for rubber smallholdings according to the type of planting materials used was equally built. Three types of plantations were retained, notably (i). Intensified, that is entirely made up of budded planting materials, (ii). Less intensified or made up of a mixture of budded planting materials and seedlings, and (iii). Non-intensified or entirely made up of seedlings.

In most studies, adoption was categorised as dichotomous and such analysis will not indicate the extent of adoption. In practice, a technology may be adopted fully or partially by farmers (Rajasekharan and Veeraputhran, 2002). In the framework of this study, the level of intensification of rubber smallholdings could be considered as higher as the majority of surveyed farmers (71%) possessed intensified plantations, as against 17% with less intensified plantations and only 12% with non-intensified plantations. This high intensification of rubber plantations, with regards to the budded planting materials and for the study period considered, was due to the on-farm experiment and demonstrations. This experiment-tation session trained rubber smallholders on budding process and enabled the creation of two collective budwood gardens, thus giving the farmers the possibility to produce their own planting materials.

## Econometric model

Table 2 presents the results of the estimation of the logit model on a sample of 42 rubber smallholdings of the South West region of Cameroon. The chosen model was statistically valid ($R^2 = 0.6$). Nonetheless, for demand models in cross section, $R^2$ values are generally weak because structural variables (taste, behaviour, etc.) which bring about modifications in the consumer's choice are not taken into consideration during the survey (Adesina, 1995). This high coefficient of determination shows the existence of a good correlation between the adoption of budded planting materials and the explanatory variables associated with this study. Analysis of the collected data showed that one main variable, notably membership to a farmers' organization possessing a collective rubber budwood garden, significantly influenced the adoption of budded planting materials ($P \leq 5\%$). Membership to a rubber farmers' organization equally implied that the farmer had been trained on the budding process and had access to budwood. Of course, increased access to the budwood and a better mastery of the budding process were elements which seemed to guarantee the adoption of budded planting materials by these farmers. However, these two variables could not be integrated in the logit model estimated by a maximum of likelihood method due to reasons of colinearity.

## Conclusion

The use of budded planting materials was increasingly extended in the present dynamics of rubber farming in

the South West region of Cameroon. This study identified some socio-economic factors influencing adoption of budded planting materials in rubber smallholdings of this region. Understanding the rationale and decision criteria of farmers in determining the choices of planting materials is essential in the design of diffusion policies of budded planting materials in smallholdings. Membership to rubber farmers' associations was the dominant variable which influenced the adoption of budded planting materials. Training farmers on the budding process and their access to budwood facilitated their appropriation of budded planting materials and this guaranteed the traceability of planted clones. However, most farmers still lacked access to budwood and also lacked the technical know-how to bud, hence continue to use, either partly or totally, seedlings in their present plantations. In order to boost rubber production in the South West region of Cameroon and other rural areas, it therefore appeared important to promote the creation of rubber farmers' associations, train farmers in budding processes and to create collective budwood gardens.

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