FACTORS LIMITING ADOPTION OF TECHNOLOGIES BY FARMERS IN CATABOLA MUNICIPALITY, ANGOLA*

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The objective of the paper is to define the factors influencing the adoption of animal traction and/or mechanical-power technology in the conditions of Catabola municipality where hand-tool technology is being used on 99.7% of the area cultivated by small farmers. Primary data collection was conducted in the period July–August 2011; semi-structured questionnaires and focus group discussions were the most frequent methods used. In total, 151 small-scale farmers from 9 villages participated in the survey. Ten factors influencing the dependent variable – *level of technology used by farmers in combination with hiring of labour* – were defined. The factors were statistically analyzed by ANOVA. The area of cultivated land and the educational level of both parents and children were found to be the factors limiting the process of animal traction or mechanical power adoption by small farmers in the Catabola municipality. In addition, a relatively high rate of child labour was observed. With the exclusion of childless families, 62.7% of small farmer families regularly use children aged 0–14 years for field operations. The results confirm that the factor of hiring extra labour is irrelevant in determining the development in technology use by small farmers in the Catabola municipality.

human power; hired and child labour; hand-tool technology; animal traction

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INTRODUCTION

Smallholder farm production could be transformed from subsistence to market oriented if higher levels of technology were used, in view of the statement by Crossley (1983) that farming carried out with a hand tool technology seldom exceeds subsistence levels, and of Sims, Kienzle (2006) that a typical farming family using only hand tools cultivates on average 1.5 ha, which rises to 4 ha if draught animal power is available, and to over 8 ha if tractor power is accessible.

Studies of technologies based on power sources used by farmers are rare; nevertheless, the majority of cropping areas in developing countries is cultivated with the use of human muscle power. According to Sims, Kienzle (2006), in Sub-Saharan Africa human muscle power represents about 65% of the power used for land preparation. Furthermore, after the biomass, human and animal power are the most important energy sources for these populations; on a global scale, human and animal power are the largest single contributors to renewable energy sources (Fuller, Aye, 2012). According to Fuller, Aye (2012), the omission of studies can have several possible explanations: human and animal-powered technologies are not fashionable, they lack big company support, there has been a decline in their use in industrialized countries, and perhaps their reputation has been blemished by misconceptions about appropriate technology. In Angola, hand-tool technology is used at 71% of area at a national level (Ministry of Agriculture, 2009) in comparison with 98.7% at the level of Bié province (according to MINADER - Regional Ministry of agriculture - report from 2009).

The aim of this study is to define which factors are influencing the process of adoption of more sophisticated technologies than the hand-tool one used

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Table 1. Factors influencing farmers' typology based on technology used on field in combination with hiring extra labour in the Catabola municipality

No.	Factor	Unit	Definition	Source
1	total cultivated area	ha	size of land[1] cultivated by a farmer family	Coelli, Batesse (1996), extension workers
2	area cultivated per farmer family members	ha per person	share of total area per each member of a farmer family	extension workers
3	annual income	.000 of AOA	total annual income of a farmer family	extension workers
4	power of farmer family	kW	total power of farmer family members working on field	extension workers
5	share of family members working on field	%	share of farmer family members working on field, including children	extension workers
6	share of children aged 0–14 working on field	%	share of children aged 0–14 (both males and females) working on field[2]	extension workers
7	share of children aged 0–17 working on field	%	share of children aged 0–17 (both males and females) working on field[2]	extension workers
8	annual labour-days of hired workers	days per year	number of extra workers multiplied by the number of days they spend on the field of a farmer per year[3]	extension workers
9	education level of farmer family – parents		proxy variable defining education level of the head of farmer family and his wife[4]	Coelli, Batesse (1996)
10	highest education level reached by children of farmer family		proxy variable specifying only the highest education level achieved among the children of farmer family[5]	Coelli, Batesse (1996), extension workers

[1]Lands are either *lavra* (larger, more distant rain-fed fields used predominantly for maize, cassava, and beans cultivation) or *naca* (predominantly small wetland fields along rivers and drainage systems used for cultivation of vegetables, bananas, and sugar cane)

[2]Families without children (not yet born or already out of the farmer house) were excluded. Thus, data of 118 and 127 families (out of total 151) in the case of factors 6 and 7 respectively were applied

[3]The variable was used only for the comparison of the farmer groups HTH (= farmers using only hand-tool technology and hired labour) and AM (= farmers using animal draught/mechanical power technology with/without a record of hiring extra labour); comparison with the HT farmer group (= farmers using exclusively hand-tool technology and the power of the farmer family members) is irrelevant as the farmers of the HT groups use only power of the farmer family members

[4]The scale 1–15 has been broken into levels according to the Angolan education system: 1st–4th class, 5–6th class, 7–9th class, 10–12th class (where 12th class is the graduation year of high school). The scale starts with the most frequent illiteracy of both parents (and widow/widower). The highest level (15) corresponds to the 10–12th class of one of the parents and the 7–9th class of the other one. There was no higher education level achieved by the farmers. In the case of widows and widowers, only levels 1–5 of the scale were used

[5]The scale ranges from level 1 to level 6, where level 1 corresponds to illiteracy of all children, level 2 to 6 is divided into levels according to the Angolan education system: 1st–4th class, 5–6th class, 7–9th class, 10–12th class, university

(1 USD equals about 105.8 AOA – March 2015; Banco Nacional de Angola)

for field operations by small farmers in the Catabola municipality in Angola.

MATERIAL AND METHODS

Data collection

Primary data collection was conducted in the Catabola municipality, one of the nine municipalities in the Bié province with a population of 182,429 inhabitants (according to MINADER report from 2011), mainly of Umbundu ethnicity. A majority of farmers in the municipality can be considered small-scale or subsistence farmers. The data were collected in the period July–August 2011. Semi-structured questionnaires and focus group discussions were the most frequent methods used for data collection. The survey was conducted in the Portuguese language, although questionnaires used in the villages were translated into the Umbundu language. The survey was conducted with help of the EDA (Station for agricultural development) Catabola technicians. The survey among small-

Table 2. Typological classification of small farmers in Catabola municipality

Village	HT farmers		HTH farmers		AM farmers		Farmers total	
	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*
Liunde	84.2	16	5.3	1	10.5	2	12.7	19
Sashonde	75.0	15	0.0	0	25.0	5	13.2	20
Cavinda	50.0	4	37.5	3	12.5	1	5.4	8
Canjoio	100.0	15	0.0	0	0.0	0	9.9	15
EmbalaGonde	34.8	8	65.2	15	0.0	0	15.2	23
Bimbi	30.0	6	55.0	11	15.0	3	13.2	20
BairroSantinho	35.0	7	55.0	11	10.0	2	13.2	20
Dembi-1	90.9	10	9.1	1	0.0	0	7.3	11
Ongué	46.7	7	53.3	8	0.0	0	9.9	15
Farmers total	58.3	88	33.1	50	8.6	13	100	151

HT = farmers using exclusively hand-tool technology and the power of the farmer family members (no extra labour hire), HTH = farmers using only hand-tool technology and hired labour, AM = farmers using animal draught/mechanical power technology with/without a record of hiring extra labour

scale farmers was carried out in the villages Liunde, Sashonde, Cavinda, Canjoio, EmbalaGonde, Bimbi, BairroSantinho, Dembi-1, and Ongué. The village sorting was based on the currently prevailing technology used and labour hiring. In total, 151 small-scale farmers participated in the survey. The farmers were sampled through the convenience sampling technique.

Data analysis

The basic research output for further analysis is a typological classification of small farmers into categories based on technology use in combination with hiring extra labour: farmers using only hand-tool technology with no record of extra labour hire – farmers using the power of the farmer family members only (HT farmers), farmers using only hand-tool technology with the employment of hired labour (HTH farmers), and farmers using animal draught and/or mechanical power technology with/without some/any record of hiring extra labour (AM farmers). Further division of AM farmers was found to be disadvantageous as the sample of AM farmers in comparison with HT and HTH farmers was considerably smaller. The key assumption for the typological classification is that HTH farmers are supposed to be transitional farmers, moving on to apply innovation in the form of draught-animal or mechanical-power technology.

Consequently, ten factors that might influence the dependent variable – *level of technology used by farmers in combination with hiring of labour* – were defined. All factors, except for a few specific ones, take into consideration all farmer family members, not simply the head of the family. The factors, including their sources, are described in Table 1. Some of the factors defined before the primary data collection could not be applied as their validity was low. For example, the factor labour-days was defined by the respondents as 'the family members working on field are working there every day'. Other useful variable, access to credits, was not included as the access to credits for Catabola municipality farmers was yet at the very beginning in the form of a governmental programme and the respondent farmers did not have the possibility to use them yet. The data were analyzed using MS Excel (MS Office 2010) for basic calculations and simple descriptive statistics as well as for the calculation of the analysis of variance (ANOVA) and the correlation coefficients of the ten selected variables.

RESULTS

In the municipality, use of hand-tool technology prevails. The mean power (regularly used) of farmer families is 0.168 kW, with installed power of 0.080 kW/ha. Animal traction is partially used by 6.6% of small farmers for specific tasks.Tractors are rarely used, usually for the first tillage of the virgin/long-abandoned land. Hired labour is used by 59.0% of small farmers, with an average of 20 labour-days per year. The typological division of farmers is defined in Table 2.

The main limitations of the survey stem from poor literacy level of the farmers which complicates the estimation of the area they cultivate. Generally, there could be some data loss in the process of translation from Portuguese to Umbundu and back.

The ANOVA showed statistically significant differences between the three farmer groups in six out of the ten variables tested (Table 3). Correlation coefficients proved a strong dependence (higher than 0.7) in five tested factors. Summarized sample means and standard deviations of variables are presented in Table 4.

Table 3. ANOVA statistics for farmers in nine villages of Catabola municipality divided according to the farmers' typology

Variable	1	2	3	4	5	6	7	8[a]	9	10
HT vs HTH										
F	0.572	1.189	0.000	1.081	**9.909**	**7.301**	**11.473**	–	0.026	0.703
P	0.462	0.294	0.984	0.316	**0.007**	**0.019**	**0.005**	–	0.873	0.416
F crit.	4.600	4.600	4.600	4.600	**4.600**	**4.747**	**4.747**	–	4.600	4.600
R	+0.676	+0.394	+0.399	–0.651	–0.086	**–0.706**	–0.636	–	+0.362	**–0.710**
HTH vs AM										
F	**6.373**	1.964	1.716	1.093	1.610	0.444	0.252	0.589	4.742	2.809
P	**0.030**	0.191	0.219	0.321	0.233	0.527	0.631	0.461	0.054	0.125
F crit.	**4.965**	4.965	4.965	4.965	4.965	5.591	5.595	4.965	4.965	4.965
R	–0.246	–0.219	**+0.73**	–0.030	+0.122	+0.299	+0.154	**+0.963**	+0.266	+0.289
HT vs AM										
F	**10.189**	4.264	2.153	0.113	0.459	0.862	**6.348**	–	**6.049**	**9.629**
P	**0.008**	0.061	0.168	0.743	0.511	0.373	**0.029**	–	**0.030**	**0.009**
F crit.	**4.747**	4.747	4.747	4.747	4.747	4.844	**4.844**	–	**4.747**	**4.747**
R	–0.193	+0.117	+0.492	–0.013	**–0.746**	–0.395	–0.201	–	–0.121	–0.274

1 = total cultivated area, 2 = area cultivated per farmer family members, 3 = annual income, 4 = power of farmer family, 5 = share of family members working on field, 6 = share of children aged 0–14 working on field, 7 = share of children aged 0–17 working on field, 8 = annual labour-days of hired workers, 9 = education level of a farmer family – parents, 10 = highest education level reached by children of a farmer family, HT = farmers using exclusively hand-tool technology and the power of the farmer family members (no extra labour hire), HTH = farmers using only hand-tool technology and hired labour, AM = farmers using animal draught/mechanical power technology with/without a record of hiring extra labour

[a] The variable 'annual labour-days of hired workers' was used only for the comparison of the farmer groups and AM; comparison with the HT farmer group is irrelevant as the farmers of the HT groups use only power of the farmer family members

The AM farmers differ statistically significantly from the two other groups in variable (1) *Total cultivated area*. The average cultivated area makes 2.42 ha in HT farmers, 3.14 ha in HTH farmers, while it is 5.69 ha in AM farmers.

The differences between the groups of AM farmers and HT farmers are statistically significant also in the following variables: (9) *Education level of farmer family – parents* and (10) *Highest education level reached by children of farmer family*. The higher form of farming (AM) was (partially) achieved and/or stimulated by higher education of both parents and children. In both variables, data show a closer similarity between HT and HTH farmers (in both groups more than 50% of farmer-parents are illiterate) than between HTH and AM farmers. Nevertheless, from the determined coefficient of correlation there is an evident strongly decreasing dependence in variable (10) between HT and HTH farmers. The mean of the highest education level reached by children varies from the 5–6th class of HT and HTH farmers to 10–12th class of AM farmers.

The difference between the groups of farmers using only hand-tool technology (HT and HTH farmers) is statistically significant in the following variables: (5) *Share of family members working on field*, (6) *Share of children aged 0–14 working on field*, and (7) *Share of children aged 0–17 working on field*. In variable (6), there is a strongly decreasing dependence of the HT and HTH farmers, as is evident from the determined coefficient of correlation. HTH farmers involve their own family members to the field operations more than HT farmers (77.9% and 67.0%, respectively). Interestingly, for both HT and HTH farmers, the share of cultivated land per one family member regularly working on the fields is 0.96 ha. Although there is no strong dependence between HT and HTH farmers in regard to factor (5), interestingly, there is a strongly decreasing dependence between HT and AM farmers, as is evident from the determined coefficient of correlation.

Regarding child labour, on average 33.6% of HT farmers' children aged 0–14 are involved in field operations, in comparison with a 48.0% involvement of children aged 0–14 by HTH farmers and 38.5% by AM farmers. In the age category 0–17, HT farmers involve slightly more children – 37.9%, HTH as many as 54.7%. Nevertheless, in this age category, AM farmers differ significantly from HT farmers as well with a 55.6% involvement of children in the age category 0–17.

The basic output of the research is the rejection of the key assumption that HTH farmers are supposed to be a transitional farmers group, moving towards the application of innovation in the form of draught-animal or mechanical-power technology. The HTH farmers are similar to the HT group. In addition, the results of correlations defined in Table 3 prove a strongly increasing dependence of HTH and AM farmers in variables (3) *Annual income* and (8) *Annual labour-days of hired labour*, as is evident from the coefficients of correlation. These results confirm that the factor of hiring extra labour is irrelevant in determining the development in technology use by small farmers in the Catabola municipality.

DISCUSSION

Hand-tool technology is employed on 99.7% of the cultivated land of small farmers in the municipality (compared to 98.7% at the provincial level (according to MINADER report from 2010) and 71.0% at the national level (Ministry of Agriculture, 2009)), compared to only 65.0% determined by Sims, Kienzle (2006) for Sub-Saharan Africa. Partial animal traction use for specific tasks is in accordance with the results of Delgado-Matas, Pukkala (2014). The adoption of technologies more sophisticated than the hand-tool is significantly influenced by the education level of all farmer family members and the area of cultivated land. Similar results were obtained by Coelli, Batesse (1996) who identified age, education level, and farm size as factors influencing the technical inefficiency of small farmers in India.

Farmers using more sophisticated technologies have larger holdings than farmers using only hand-tool technology, contrary to the results of de Toro, Nhantumbo (1999) showing that ownership of animal traction does not seem to have a big impact on increasing the area cultivated. The average cultivated area is 2.42 and 5.69 ha in the case of HT and AM farmers, respectively, contrary to the data of the Ministry of Agriculture (2009), that the average area cultivated by a farmer family in Angola is 1.56 ha, as well as contrary to the data of de Toro, Nhantumbo (1999) from Mozambique where the mean area cultivated by farmers using animal traction is 3.0 ha. Regarding land area, there is an exception in Bairro Santinho village where the average land area of farmers using only hand-tool technology is higher than that of farmers using animal traction. The difference can be explained by the short time period from the start of draught animals ownership (less than two years), thus it is to be supposed that the owners will increase their land area in future. The relatively large areas cultivated by small farmers could be explained by planting larger areas than necessary in order to ensure a sufficient amount of food and to reduce uncertainty (Hildebrand et al., 2003). Farmers in the Catabola municipality could gain permission to use more hectares of bushy virgin land (or land cultivated decades ago) as the population density is low and majority of the non-cultivated areas is without any significant potential for extracting natural resources. These findings, in combination with prevailing use of the hand-tool technology, are in line with the results of Boserup (2005) that farmers intensify their production only when land becomes limited due to population pressure, and even then they continue to use techniques adapted to more extensive systems as long as possible, until forced by starvation to adopt or invent labour-saving technologies such as ploughs. However, the most profitable crops (garlic, potatoes, and cabbage) can grow well on sites that are among the least abundant in the region, which could create conflicts related to the ownership of these sites (Delgado-Matas, Pukkala, 2014).

The lower education level of HT and HTH farmers' children results from decreased school attendance as well as frequent recruitment of children to do farm tasks, in accordance with Delgado-Matas, Pukkala (2014). A low level of education could impede adequate awareness of animal draught farming which may result in a conservative approach to the use or adoption of draught animals for farming, in conformity with findings of Bawa, Bolorunduro (2008), Abubakar, Ahmad (2010) or regarding new agricultural technology adoption, in line with the results of Feder et al. (1981), Mittal, Kumar (2000), Fuller, Aye (2012), and Awais, Khan (2014).

Interestingly, for both HT and HTH farmers, the share of cultivated land per one family member regularly working on the fields is 0.96 ha. With the addition of the key difference between the two groups in hiring extra labour, HT farmers could be defined as farmers employing labour in the field operations in a more effective way. This conclusion may be associated with a common method of hired labour payment in the Catabola municipality – reciprocal help on the fields of the hired persons/farmers. This is consistent with the results of Jul-Larsen, Bertelsen (2011) that most of the farmer households in Angola have hired extra labour as well as have reciprocally worked for other households in the village, even though the frequency of working for others mostly prevails among the poorer households.

Child labour incidence increases as the age of the child increases, in line with findings of Cockburn (1999), Grootaert, Patrinos (1999), and Badmus (2011). The relatively low rate of child labour among HT farmers in variables (6) and (7) might be explained by the argumentation of Baland, Robinson (2000) that child labour is a device for transferring resources from the future into present; and as poor families have no reason to expect any change in their future income, they have no motivation to involve the children in field operations. This

Table 4. Summary statistics for farmers in nine villages of Catabola municipality - part 1

Variable – village	HT		HTH		AM		variable – village	HT		HTH		AM	
	SM	SD	SM	SD	SM	SD		SM	SD	SM	SD	SM	SD
(1) Area total per farmer family (ha)							(2) Area total per farmer family members (ha per person)						
Liunde	1.50	0.43	3.00	0.00	4.75	3.25	Liunde	0.43	0.26	1.00	0.00	1.19	0.81
Sashonde	2.24	0.73			7.40	5.24	Sashonde	0.38	0.15			1.27	0.69
Cavinda	1.89	0.74	1.69	0.47	10.0	0.00	Cavinda	0.88	0.70	0.42	0.19	5.00	0.00
Canjoio	1.79	0.49					Canjoio	0.35	0.16				
Embala Gonde	3.28	1.09	3.33	1.77			Embala Gonde	1.06	0.60	0.69	0.67		
Bimbi	2.12	0.55	2.35	0.68	3.15	0.08	Bimbi	0.51	0.23	0.77	0.54	1.13	0.31
Bairro Santinho	5.01	2.00	4.48	1.82	4.02	0.00	Bairro Santinho	0.87	0.50	0.78	0.38	0.74	0.06
Dembi-1	3.16	1.14	4.05	0.00			Dembi-1	0.82	0.42	2.03	0.00		
Ongué	2.22	0.65	2.00	0.77			Ongué	0.71	0.40	0.53	0.27		
(3) Income (thousands of Angolan kwanza							(4) Power total per family (kW)						
Liunde	29.0	18.9	85.0	0.0	37.5	2.5	Liunde	131	75	153	0	175	18
Sashonde	23.3	13.7			94.4	28.0	Sashonde	168	76			197	88
Cavinda	21.5	6.3	41.7	6.2	105.0	0.0	Cavinda	126	69	190	62	59	0
Canjoio	124.3	147.7					Canjoio	229	83				
Embala Gonde	80.0	30.3	64.3	24.9			Embala Gonde	126	66	202	65		
Bimbi	145.0	84.4	140.0	121.1	423.3	265.4	Bimbi	130	58	187	115	150	49
Bairro Santinho	30.9	12.1	59.6	28.9	52.5	2.5	Bairro Santinho	183	80	200	66	134	27
Dembi-1	15.7	1.1	15.0	0.0			Dembi-1	137	67	97	0		
Ongué	71.7	25.9	22.8	5.8			Ongué	126	22	161	48		
(5) Share of family members working on field out of farmer family members total (%)							(6) Share of children aged 0–14 working on field out of children total per farmer family (%)						
Liunde	62.8	25.0	100.0	0.0	87.5	12.5	Liunde	24.8	31.1			50.0	50.0
Sashonde	53.3	20.0			73.4	27.6	Sashonde	25.6	33.1			0.0	0.0
Cavinda	75.8	25.6	89.0	15.6	50.0	0.0	Cavinda	12.5	12.5	100	0.0		
Canjoio	84.9	17.9					Canjoio	69.1	32.4				
Embala Gonde	69.4	25.8	70.0	20.6			Embala Gonde	25.0	38.2	38.0	36.0		
Bimbi	56.2	21.4	88.2	17.5	100.0	0.0	Bimbi	13.0	16.6	64.0	37.1	100	0.0
Bairro Santinho	57.9	21.5	70.0	20.8	53.5	13.5	Bairro Santinho	28.6	34.2	48.7	27.8	25.0	25.0
Dembi-1	70.0	30.4	100.0	0.0			Dembi-1	32.7	43.7				
Ongué	74.6	25.0	80.0	23.1			Ongué	30.0	40.0	43.4	38.9		
(7) Share of children aged 0–17 working on field out of children total per farmer family (%)							(8) Labour-days of hired workers (days per year)						
Liunde	30.1	35.7			100.0	0.0	Liunde	0	0	32	0	25	25
Sashonde	26.4	32.0			25.0	25.0	Sashonde	0	0			0	0
Cavinda	20.0	20.0	66.7	47.1			Cavinda	0	0	274	155	675	0
Canjoio	73.2	29.5					Canjoio	0	0				
Embala Gonde	25.0	38.2	49.6	31.5			Embala Gonde	0	0	21	46		
Bimbi	22.7	18.7	74.4	34.4	50.0	50.0	Bimbi	0	0	35	34	57	42
Bairro Santinho	31.0	35.0	48.6	27.8	100.0	0.0	Bairro Santinho	0	0	91	164	30	10
Dembi-1	32.7	43.7					Dembi-1	0	0	10	0		
Ongué	33.3	42.2	60.7	42.0			Ongué	0	0	18	15		

Table 4. Summary statistics for farmers in nine villages of Catabola municipality - part 2

(9) Education level of parents							(10) Highest education level reached by children of a farmer family						
Liunde	5.0	3.1	7.0	0.0	5.5	2.5	Liunde	3.0	1.4	4.0	0.0	5.0	0.0
Sashonde	2.3	2.0			3.6	0.5	Sashonde	3.7	1.2			5.2	2.3
Cavinda	1.8	0.4	1.7	0.5	14.0	0.0	Cavinda	2.5	1.5	4.7	0.5	7.0	0.0
Canjoio	5.7	3.2					Canjoio	4.7	1.4				
Embala Gonde	2.8	2.3	3.9	2.6			Embala Gonde	2.8	1.3	4.1	1.5		
Bimbi	5.5	3.1	4.7	3.0	7.3	0.9	Bimbi	3.5	1.5	4.4	1.8	3.3	1.7
Bairro Santinho	3.7	2.1	4.2	2.4	6.0	2.0	Bairro Santinho	3.1	1.0	3.6	1.1	4.0	0.0
Dembi-1	1.0	0.0	1.0	0.0			Dembi-1	3.0	1.3	1.0	0.0		
Ongué	4.6	2.0	1.5	1.0			Ongué	3.0	1.2	3.8	1.5		

SM = sample mean, SD = standard deviation, HT = farmers using exclusively hand-tool technology and the power of the farmer family members (no extra labour hire), HTH = farmers using only hand-tool technology and hired labour, AM = farmers using animal draught/mechanical power technology with/without a record of hiring extra labour

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may be a possible explanation for the different means determined for AM farmers in variables (6) and (7) as well. As AM farmers tend to expect change in future incomes, all of them involve children in the age category 15–17. On the other hand, in the age category 0–14, use of child labour by AM farmers is significantly lower, probably caused by the higher education level of farmers-parents. Contrary to these explanations, the results of Badmus (2011) from Nigeria indicate that households headed by an illiterate person have the highest incidence of child labour.

Hiring extra workers could be considered a factor needed to increase the working power of the family which is ineffectively used. However, Delgado-Matas, Pukala (2014) define labour needs as a major constraint in the Umbundu system that is strongly dependent on the availability of women labour.

Regarding the statistical significance of the selected variables, all the factors based on the methodology of Coelli, Batesse (1996) are statistically significant; while those specified only by the local agriculture extension workers are statistically significant only in some cases. This finding might indicate insufficient knowledge of the extension workers related to the circumstances of technology use by the small farmers and in a more general way, the specific factors influencing agricultural development in the municipality.

Another important finding reflects the relatively high engagement of child labour in field operations. With the exclusion of childless families, 62.7% of small farmer families regularly use children aged 0–14 for operations on fields (67.7% families in the age category of 0–17). The significantly high rate of child labour employment found in the research is consistent with the findings of Dwibedi, Chaudhuti (2014) that child labour is used in backward agriculture where primitive techniques of cultivation are applied. From a gender point of view, the share of girls in both age categories (0–14 and 0–17) is 45%, similarly to data of the ILO (2002) and Badmus (2011). The lowest age of children working on field found in the survey is 5 years. The high involvement of children in field operations might indicate either lack of adults staying on farms caused by migration to urban areas (usually of men) and the persisting consequences of civil war or traditionally high rates of child participation in field work. Both of these possibilities are in conformity with the findings of Delgado-Matas, Pukkala (2014). A compatible explanation might be the high illiteracy rate of the farmers in the Catabola municipality, in accordance with the findings of Psacharopoulos, Arriagada (1989) that the level of education negatively affects the likelihood of child work.

CONCLUSION

The process of adoption of more sophisticated technologies than the hand-tool one used for field operations by small farmers in the Catabola municipality in Angola is influenced by the area of cultivated land and the education level of farmer family members – both children and parents.

The government of the Bié province and the administration of Catabola municipality should facilitate the bureaucratic process of land acquisition and support both formal and informal education of farmers and their children. Special regard should be put on skills in animal traction and mechanization (small mechanization preferably) use in farm operations. As the study does not include any variables which might be important in the adoption process of animal traction/mechanical power, such as access to credit or labour-days, there is potential for a more refined analysis, if such data were available. A deeper analysis from the gender point of view needs to be provided as well.

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