

# Impact of migration on agricultural productivity in rural Mali.

## Abstract:

The paper employs a national survey data of agricultural production in rural Mali. The study aimed at estimating the effect of migration on the technical efficiency of agricultural households. Therefore, a theoretical model was developed to investigate the fact, which showed that the more the migrants deliver insurance, the less incentive their behind families have to work. A production function-using cross sectional data with household-specific fixed effects was ran to test this assumption. Probability of being financially supported by migrants is found to significantly contribute to technical inefficiency. This result should help decision makers especially agricultural policy makers formulate more efficient development strategies in agricultural production sector.

Key words: migration, agricultural productivity, theoretical model, rural Mali.

## Introduction:

Migration's impact on agricultural productivity has been a subject that catches researchers' attention in the entire world particularly in the developing countries. The decision of migration of any individual implicates several push factors that force migrant out of rural areas and pull factors that attract migrants to urban centres.

The earlier studies conducted by [1] and [2] describing rural-urban migration proved that anticipated wage differential is as or has been the main cause of migration from rural to urban. It implies that people will continue migrating from rural to urban centres until the wages in the rural area become equal to the wage in urban area. Therefore, the labour migration from rural area to urban area will involve the decreasing of agricultural workers, which can probably affect the production in the agricultural sector. Which corroborate with the result of [3], who argued that as economies continue to develop, the percentage of agricultural workers declines.

Agricultural sector is fragile from the viewpoint of rainfall dependent and price instability. Producers will be consequently affected if there is deterioration in the price of their production. Moreover, the farming industry offers seasonal employment, so it does not

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33 | provide suitable revenue to sustain the household over an entire year. Therefore, there is a  
34 | need for the family household to look for an extra revenue to support the household.

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35 | Sources of data This should be properly quoted and taken to reference IF THIS IS  
36 | UNDER METHODOLOGY. THEN MAKE SURE THE METHODS YOU USE IS  
37 | SPECIFIC AND FINDING USE TO BACK UP YOUR WORK SHOULD BE UNDER  
38 | RESULTS AND DISCUSSION

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39 | The data for this chapter was obtained from Enquête Agricole de Conjoncture Intégrée  
40 | (EACI) done by the Cellule de planification et de Statistiques et le secteur du  
41 | Développement Rural (CPS/SDR) in collaboration with the national institute of statistics  
42 | and other services from rural development. In this survey, agricultural exploitation was  
43 | defined as an economic entity of agricultural production including all the animals in it and  
44 | all the land that belong, which is wholly in employment or in part and that, directed by the  
45 | head of household. It is exploited by a household or a group of households independently  
46 | associated regardless of title of possession, legal status, size and location of the  
47 | exploitation.

48 | EACI obtained its sample through stratified sampling of two stage with a sample of 2,515  
49 | exploitations sharing between 503 enumerations sections. Each section involved 750  
50 | persons in rural area and 1100 persons in urban area. At the first stage, exploitations are  
51 | drawn with the same probability to the level of each stratum, which corresponds to the  
52 | cercle or department. Cercle/department contains one to three sub-strata based on natural  
53 | regions. At the second stage, two to five exploitations were drawn within the sample  
54 | enumeration sections after counting all the exploitations. The survey covered the whole  
55 | country and it was conducted in all regions apart from Kidal region and Bamako the  
56 | capital. The survey covered both rural and urban areas. The objectives of this survey  
57 | included collecting data on the rural sector, the establishment of significant information on  
58 | the economics characteristics of farms, research of agricultural population statistics and  
59 | various factors of production (CPS/SDR, 2014/2015). Based on these objectives the data  
60 | collected included the following:

61 | The characteristics of farm members (sex, age, education level, economic activities,  
62 | marital status etc.), the characteristics of plots and factors of production (area of land,  
63 | mode of cultivation, seed, fertilizer and pesticide type, labour use), stocks status and off-  
64 | farm income generating activities. EACI has incorporated, since the general census of

65 agriculture in 2004, a new module on vulnerability, which contains several sections  
 66 including one related to farm migration. An emigrant was defined by the survey as an  
 67 individual who has been living outside his/her origin department for at least six months.  
 68 This module was usually surveyed before the beginning of the crop season or the rainy  
 69 season while the production was measured at the end of the season. The effect of  
 70 agricultural production in current year on the decision to migrate was then controlled.

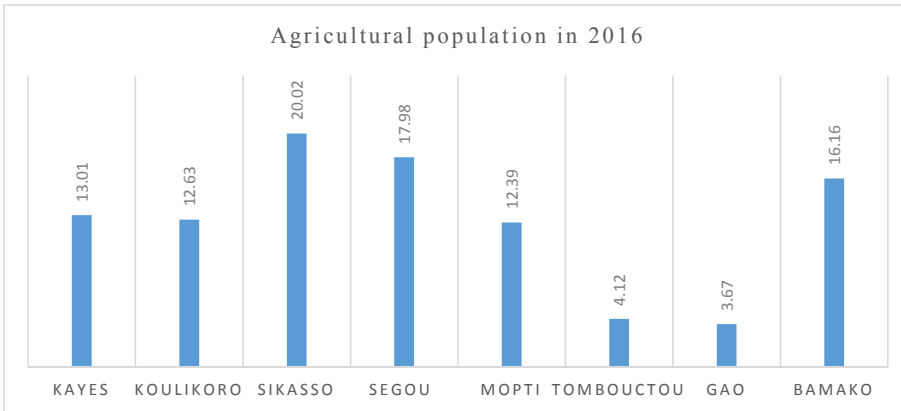
71 This section provides information on the destination of the migrants, the reason of  
 72 migration, and the remittances during the last twelve months (description, amount if it is  
 73 money, level, and their share of food consumption). For 2014/2015, crop year had a  
 74 complete data and hence was used in this research. After cleaning data, the exploitations  
 75 with all the information available for the modules were gathered. The survey contains 2  
 76 331 exploitations over 474 enumerations sections.

77 Table 1: The distribution of the sample by region

Region	Number of ES		Number of exploitations		Rate of reply
	number	%			
Kayes	90	19.0	444	19.0	98.7
Koulikoro	72	15.2	359	15.4	99.7
Sikasso	81	17.1	400	17.2	98.8
Segou	80	16.9	394	16.9	98.5
Mopti	99	20.9	487	20.9	98.4
Tombouctou	32	6.8	151	6.5	94.4
Gao	20	4.2	96	4.1	96.0
Total	474	100.0	2331	100.0	98.4

78 With a very neglect rate of non-reply during the survey, the Malian agricultural population  
 79 in 2016 was about 14 408 458 individuals. From the figure 1 the distribution of  
 80 agricultural population by region except Kidal due to the insecurity, showed that more  
 81 than one-fifth of the agricultural workers are living in the region of Sikasso (20.02 %).  
 82 This was followed by the region of Ségou with 17.98% of the agricultural population. The  
 83 region of Gao reported the lowest rate of agricultural population in Mali.

84 Figure 1: Agricultural population by region except Kidal.



85 *Source: Author's field research*

86 Table 2: Repartition of the agricultural population by status of residence and by region

Region	Present residents		Absent residents		Total number
	Number	%	Number	%	
Kayes	1 808 656	96.5	65 969	3.5	1 874 625
Koulikoro	1 812 764	99.6	7 950	0.4	1 820 714
Sikasso	2 840 592	98.4	45 092	1.6	2 885 683
Segou	2 559 074	98.8	31 555	1.2	2 590 629
Mopti	1 676 638	93.9	108 726	6.1	1 785 364
Tombouctou	570 214	96.0	23 709	4.0	593 923
Gao	526 919	99.6	2 024	0.4	528 942
Kidal	-	-	-	-	-
Bamako	2 255 866	96.9	73 222	3.1	2 329 088
Total	474	100.0	2331	100.0	98.4

87 *Source: Author's field research*

88 Table 3: Agricultural population by bracket age and by status of residence

Bracket age	Present residents		Absent residents		Total
	Number	%	Number	%	
0 to 14 years	6 449 928	97.8	145 076	2.2	6 595 004
15 to 29 years	3 653 106	97.0	113 771	3.0	3 766 877
30 to 59 years	3 256 352	97.3	88 900	2.7	3 345 252

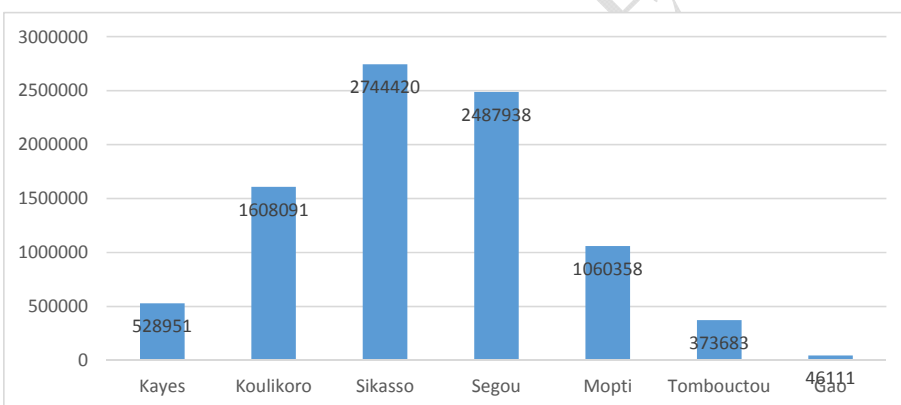
60 years and more	690 824	98.5	10 500	1.5	701 325
Total	14 050 201	97.5	358 247	2.5	14 408 458

89 *Source: Author's field research*

90 *Some descriptive statistics on the agricultural sector and migration:*

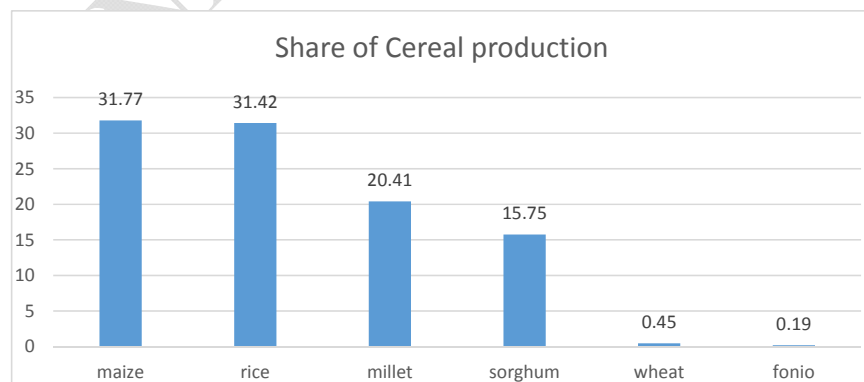
91 The 2014/2015 crop year recorded an estimated of 8,849,551 tons of cereals production  
 92 (rain season and dry season crop). In this quantity produced are including 2,811,385 tons  
 93 of maize, 2,780,905 tons of rice, 1,806,559 tons of millet, 1,393,826 tons of sorghum,  
 94 40,137 tons of wheat and 16,740 tons of fonio. The quantity of cereals produced varies  
 95 largely from region to another region in Mali. Sikasso first comes and follow by Segou. In  
 96 terms of cereals production the regions of Gao and Kayes produce less cereals compare to  
 97 other regions.

98 Figure 2: Cereals production per region (2014/2015 rainy season)



99 *Source: Author's field research*

Figure 3: Share of cereals production by crop 2014/2015



100 *Source: Author's field research*

101 Malian's agriculture remains dominated by the traditional subsistence sector. In fact,  
102 farms are generally small in terms of size. The average area cultivated wasis about an  
103 hectare (ha) per farm. Three over ten farms (28.3%) have less than two hectares of  
104 cultivated area while only three over twenty (14.6%) cultivate more than 10 hectares.

105 Agricultural mechanisation in Mali is quite widespread. The expansion of mechanisation  
106 is more linked to the possession of equipment such as plough availability from seven over  
107 ten farms. Animals like donkeys, camels, horses, sheep and goats are used as milking  
108 animals in some places in the country.

109 An agricultural worker is a member of the farm who is six years old or older, involving in  
110 the agricultural activities i.e. participating in at least one of the following activities: soil  
111 preparation, seeding or transplanting, weeding, spreading, crop treatment, harvesting and  
112 transportation. Across the whole country, farms have nine people as average of member of  
113 the household. This number is significant higher in exploitation lead by man than to the  
114 one head by woman. On gender basis, the data showed that females were engaged in  
115 farming as the males. This shows showed that women's involvement in agricultural  
116 activities is high in the county.

117 In addition to these farm assets, exploitations may use the service of others to help  
118 perform with certain stages of farming activity for cash or in kind compensation. This is  
119 what is chosen by the agricultural labour as defined by the EACI. It can be temporary or  
120 permanent. In 2016, four of every then farms used temporary labour while only one over  
121 ten used permanent labour.

122 Migration in the EACI survey, this phenomenon was measured by asking farmers if they  
123 have one or more family members living and working outside their community of origin.

124 From their responses, the list of emigrants was were then established and information is  
125 was provided on each respondent.

### 126 **Technique of production and migration**

127 Table 4 displays a correlation analysis between the participation in migration and the  
128 ownership of certain agricultural equipment. The proportion of exploitation (household)  
129 with a hoe, a plough, and a cart is higher in the exploitations involved in migration than  
130 farming households without migrant. Thus, it is about 5.6% concerning household with  
131 internal migrant, 8.3% in household with international migrant and 4.3% in household

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132 | without migrant. It **is** the same for the proportion of household owing a hoe plus cart and  
 133 | oxen this is also relatively higher in household involved in migration than those without  
 134 | migrant (23.2% for household with internal migrant, 27.9% for household with  
 135 | international migrant and 19.5% for household without migrant). . In addition, farmers  
 136 | owing only a hoe, an ox of tillage and a plough are higher than exploitation not involved  
 137 | in migration. In fact, the proportion of household with multiple equipment **is** higher  
 138 | among those participating in the migration than those who do not participate. However,  
 139 | looking well at the situation, the observed difference **is** not generally significant,  
 140 | specifically with respect to the possession of complete a hoe plus plough and seeder. Less  
 141 | than 5% of exploitations of the whole country owing the complete combination of  
 142 | equipment. These results showed that except a relative mechanization of exploitation  
 143 | production, the equipment **is** still incomplete for most of the majority of the exploitation  
 144 | according to their participation in migration (their migratory status).

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145 | Average expenditures of hired labour **waswere** almost twice high in exploitation with  
 146 | member(s) participating in international migration than other group of farmers. From  
 147 | Table 4, farmers with international migrant had an average hired labour expenditure of  
 148 | 52,343 Francs CFA 29,316 Francs CFA for household involved in internal migration and  
 149 | 23,626 Francs CFA for household who do not participating in migration. Therefore, the  
 150 | observed differences **are** considerably high. However, in terms of exploitation usage of  
 151 | fertilizer those involved in international migration spend less on fertilizer. Among the  
 152 | inputs, **is** the expenditure on fertilizer was higher than the other inputs regardless of the  
 153 | migratory status of the exploitation.

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154 | The average cultivated areas and the number of plots are larger for the household  
 155 | participating in migration. In addition to this, improved seeds usage was more prevalent  
 156 | within the exploitations groups with internal migrant while it **is** roughly equal among  
 157 | those with no-migrant households and those participating in international migration.

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158 | Table 4 : Cross tabulation of agricultural equipment by migration status

Characteristics	Household with internal migrant	Household with international migrant	Household without migrant
	% of exploitation using equipment		
Cart	22.6	38.8	24.9

Ox of tillage	68.7	69.0	59.7
Plough	74.2	81.4	66.9
Seeder	20.3	24.8	25.6
Hoes	17.9	28.5	16.7

Combined equipment

Hoe + plough + cart	5.6	8.3	4.3
Hoe + plough + seeder	8.2	11.4	10.9
Hoe + plough + ox	23.2	27.9	19.5

Area

Average cultivated area	6.7	6.9	5.1
Average number of plot by exploitation	6.7	6.8	4.2
Plot with improved seed	21.9	15.0	16.1
Plot with fertilizers	26.0	19.3	24.8

Average expenditures

Hired labour	29,316	52,343	23,626
Fertilizers	80 607	128 668	86 691

159 *Source: Author's field research*

160 In the country as a whole, average production varies between 1,900 tons for maize and  
161 3,259 tons for rice. However, the major staple crops in the country are rice, millet,  
162 sorghum and maize while cotton is the only cash crop. Except for cotton, the average  
163 production of the staple crops was higher for farming households participating in  
164 migration. On the other hand, yields per hectare are lower for farmers with a member  
165 involved in migration, especially international migration. These results suggested that  
166 production is higher because farmers exploits larger areas, which is in line with the Malian  
167 family farming based on agricultural extension. The availability of equipment and the use  
168 of new farming practices do not favour an increase in agricultural yields. [4] showedn that  
169 several factors may explain this situation. In fact, the soils of the plots exploited by  
170 migrant families may be of a lower quality than those of non-migrants, which could be the  
171 cause of the departure to the migration of certain members of the household. In addition,  
172 the activities and types of crops chosen may be different depending on the migratory

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173 status. Moreover, the misuse of newly acquired equipment by exploitation participating in  
 174 migration may result in lower yields. Finally, the imperfections of the labour and capital  
 175 markets **can** lead to a difference in the opportunity costs of the factors of production  
 176 according to the migratory status. [5] has also made similar arguments on the relationship  
 177 between migration and yield. The explanation **is** that, the existence of a behaviour of  
 178 collection of rent (rent - seeking behaviours) made possible by migrant remittances that  
 179 make it less imperative to balance production and food needs. The technical inefficiency  
 180 of household participating in the migration, i.e. their inability to reach the highest possible  
 181 level of production with a certain amount of factor, can be explained by this "opportunistic  
 182 behaviour[6].

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183 Table 5 : Production and average yield of the crops by migration status

Characteristics	Household with internal migrant	Household with international migrant	Household without migrant
Average yield (kg/hectare)			
Rice	2 398,6	1 908,4	2 051,5
Millet	814,8	715,0	804,2
Maize	1 678,3	1 423,5	1 615,6
Sorghum	934,0	890,6	956,6
Cotton	1 061,6	1 077,9	1 052,4
Average yield (kg)			
Rice	3 108.9	6 833.1	3 028.3
Millet	2 962.1	2 734.9	2 598.8
Maize	1 605.9	1 993.4	1 975.4
Sorghum	2 430.2	2 220.2	2 167.1
Cotton	2 126.8	3 159.0	3 189.8

184 *Source: Author's field research*

## 185 **Data analysis**

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### 186 Theoretical model

187 According to [5], migration of a family member and its financial after-effects meet two  
 188 essential purposes: firstly, the migration might contribute to ease the constraint of credit

189 and risk constraints faced by rural household and facilitate technological change through  
190 remittances [5, 6]. Finally, migration can be seen as part of a diversification strategy,  
191 aimed at protecting households from production failure or income risk in agricultural  
192 sector. Therefore, migration as a strategy means that remittances from migrant labours  
193 respond to shocks affecting the recipient families in origin countries [8]. In some cases,  
194 moral hazard is probable to appear as shocks like climatic issue, which are not directly  
195 observable by the migrants in his own place. This situation can be analysed in a consistent  
196 theoretical framework used by [5].

197 Assume that, given the production technology and the state of nature, the agricultural  
198 household can produce either  $Y_h$  with probability  $p(le)$  of  $Y_l$  with probability  $1 - p(le)$ .

199 Where,  $l$  designs the amount of labour input and  $e$  is the average level of effort applied to  
200 these units of labour ( $le$  is labour in efficiency units). Therefore,  $p' > 0$  and  $p'' < 0$ .

201 The probable production level is then given as

$$202 \quad E(Y) = p(le)Y_h + [1 - p(le)]Y_l$$

203 (1)

204 In such net income of the farm production is given by:

$$205 \quad \Pi = Y - x \quad (2)$$

206 In this second equation  $x$  represents the amount of material other than labour. Output and  
207 input prices have been normalised to one, since we are going to use only cross-sectional  
208 data in the empirical application.

209 Considering that  $v(le)$  is the non-use of labour for the household, with  
210  $v(0) = 0$ ,  $v' > 0$  and  $v'' > 0$ .

211 Under the assumption of risk neutrality, expected utility when the household works  $le$  in  
212 efficiency units follows as:

$$213 \quad EU = E(C) - v(le) \quad (3)$$

214  $C$ , is the agricultural household's level of consumption.

215 The expected utility of the household is maximised subject to the following cash-revenue  
216 and time constraints:

$$217 \quad C = \Pi + R + \bar{Y} \quad (4)$$

$$218 \quad 1 - l = \text{loisir} \quad (5)$$

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219 Where,  $R$  is the remittances from internal and international migrants,  $\bar{Y}$  is exogenous  
220 income like pension, rental income, and  $l$  is the total (normalised) time endowment.  
221 However, assume that the levels of output are as follow:

$$222 \begin{cases} Y_h > Y_l \\ \Pi_h + \bar{Y} \geq \bar{C} \\ \Pi_l + \bar{Y} < \bar{C} \end{cases}$$

223 Where  $\Pi_h (\Pi_l)$  denotes net income from farm production when output level is  $Y_h (Y_l)$ ,  
224 and  $\bar{C}$  can be interpreted as the level of consumption such as the basic needs are satisfied.  
225 Assume that, remittances be part of an implicit contract between migrants and their  
226 recipient origin families (exploitations), it is an informal arrangement, which rest on a  
227 sense of distributive justice. Concerning the justice involves that the migrants have the  
228 duty to satisfy the basic needs of their families whenever they are not able to do it  
229 themselves (i.e whenever  $C$  fails below  $\bar{C}$ ).

230 In particular, a clause in the contract binds the migrants to send funds (or consumer goods)  
231 each time their families cannot establish entitlement over an adequate amount of food  
232 through purchase or through food production. Such a transfer of general purchasing power  
233 from the migrants to their families may be viewed as an informal tax aimed at re-  
234 allocating incomes between the modern capitalist sector, located either in Mali or abroad,  
235 and the subsistence farming sector. This family solidarity serves as a substitute for the  
236 welfare state of industrialised societies and, by guaranteeing subsistence, provides what  
237 may be called a poverty insurance. The implementation of distributive justice as described  
238 above is not Pareto efficient, however, if we assume that the household's effort level is  
239 unobservable by the migrant. Imperfect monitoring of effort implies that the migrant  
240 cannot ascertain whether low yields in his family's fields are due to his relatives' idleness  
241 or to unfavourable weather conditions (or any other unfavourable state of nature). It may  
242 thus induce the household to shirk and to rely on the migrant for her subsistence.

243 Following [9], an effective way to prevent the occurrence of moral hazard is to use  
244 punishment strategies. The migrant may in fact, threaten his family to break the  
245 contractual arrangement by suspending remittances. Since the loss of the migrant's  
246 financial support is very costly in intertemporal utility terms, the family has a strong  
247 incentive not to shirk. This implies, however, that the migrant is able to check his family's

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248 work performance. A comparison of family output with that of others can serve as an  
249 indicator of effort. Such a scheme **is** often referred to as "yardstick competition" in  
250 industrial or labour economics [10],[11]). Though compensation schemes based on  
251 relative performance may provide an efficient mechanism for monitoring productivity,  
252 collusive manipulation by participating firms or workers **is** often an important limitation  
253 of yardstick competition [10]. In the particular case of the Kayes area, some scope for  
254 collusion is undeniably present. Agricultural households may for example collude in order  
255 to send false signals to the migrants. Acts of collusion, such as the announcement of  
256 fictitious natural disasters, were actually observed in the area. Moreover, peer pressure  
257 could make family output an unreliable signal, for "zealous" families (i.e. those that do not  
258 take advantage of their informational rent) could well be constrained by others to reduce  
259 their labour effort. Ex- ante financial support **is**, according to [9], another way to prevent  
260 opportunistic behaviour. In the case of the Kayes area, survey data suggest that even if the  
261 bulk of remittances **occuroccurred** after the harvest has been realised, the migrants  
262 supply some liquid assets prior to the crop season so that their families may have access to  
263 key factors of production.

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264 So far, our theoretical discussion has not taken into account the presence of another  
265 informational asymmetry, which would this time be beneficial to the migrant. Indeed, the  
266 migrant freely decides whether he sends funds or not. If he decides not to, his family  
267 cannot ascertain whether this decision is due to temporary money troubles or to his  
268 intentional derogation of the contract. Various elements, among which directly moral  
269 motivations or migrants' concern about other persons' opinions of them, induce us to  
270 believe that the migrants do not take advantage of this informational asymmetry and that  
271 the implicit agreement to assist others is enforced by social pressure. Yet, the possible  
272 occurrence of money troubles is introduced in the model since it alters the reliability of the  
273 poverty insurance mechanism. Let  $\Psi$  the probability that the migrant financially supports  
274 the family be:

$$275 \quad \Psi = h\left(\frac{N_m}{N}\right)$$

276 (6)

277  $\Psi$  is assumed to be positively correlated with the number of family emigrants  $N_m$   
278 divided by the number of family members residing in the country of origin  $N$ . The higher

279 the ratio, the smaller the number of individuals being financially supported by each  
 280 migrant and the more the insurance mechanism.

281 *Insurance mechanism reliability and level of effort:*

282 The presence of a relationship contractual between emigrants and their families of origin  
 283 imply that when families suffering a shortfall in income receive an amount of remittances

284  $R$  in such a way that  $R \geq \bar{C} - \Pi - \bar{Y}$  with probability  $\Psi$  and  $R < \bar{C} - \Pi - \bar{Y}$  with  $(1 - \Psi)$ .

285 For simplifying the model, we can assume that the migrants send either an amount strictly

286 equals to the deficit of consumption ( $R = \bar{C} - \Pi - \bar{Y}$ ) with probability  $\Psi$  or no remittances

287 at all ( $R = 0$ ) with probability  $(1 - \Psi)$ , whenever,  $Y = Y_l$

288 Under these assumptions, the expected value of remittances is written as follow:

$$289 \quad E(R) = \Psi[1 - p(le)](\bar{C} - \Pi_l - \bar{Y}) \quad (7)$$

290 The optimisation facing each household is to choose a level of labour effort that  
 291 maximises expected utility, where expected utility is given by:

$$292 \quad EU = E(\Pi) + E(R) + \bar{Y} - v(le) \quad (8)$$

$$293 \quad \Leftrightarrow EU = (1 - \Psi)(\Pi_l + \bar{Y}) + \Psi\bar{C} + p(le)[(\Pi_h - \Pi_l) + \Psi(\Pi_l + \bar{Y} - \bar{C})] - v(le)$$

294 This first-order condition is

$$295 \quad \frac{v'(le)}{p'(le)} = (\Pi_h - \Pi_l) + \Psi(\Pi_l + \bar{Y} - \bar{C}) \quad (9)$$

296 Starting from equation (9), the effect of increasing  $\Psi$  on optimal  $le$  can be derived from  
 297 differentiating the first-order condition. The resulting expression is as follow:

298

$$299 \quad \left[ \frac{v''(le)p'(le) - v'(le)p''(le)}{[p'(le)]^2} \right] dle = d\Delta\Pi + (\Pi_l + \bar{Y} - \bar{C})d\Psi + \Psi d\Pi_l + \Psi d\bar{Y} - \Psi d\bar{C}$$

300 (10)

$$301 \quad \quad \quad (+) \quad \quad (-) \quad \quad (+) \quad (+) \quad (-)$$

302 Where  $\Delta\Pi = \Pi_h - \Pi_l$

303 Summary of the result of the comparative experiments on the level of effort derived from  
 304 the model is:

$$le^* = le^* (\Delta\Pi, -\Psi, +\Pi_l, +\bar{Y}, -\bar{C})$$

306 (11)

307 The model predicts a negative relationship between the  $\Psi$ , which is an indicator of the  
 308 reliability of the insurance mechanism, and the labour in efficiency units in a context of  
 309 informational asymmetry. This prediction cannot be directly tested due to lack of data.  
 310 Formally it is possible to show the presence of a negative relationship between the degree  
 311 of reliability of insurance mechanism and technical efficiency of the exploitation in the  
 312 case where the hypothesis moral hazard is pertinent.

313 From the literature, technical efficiency is defined as follows:

$$314 TE = \frac{\text{realised output}}{\text{Maximum output}}$$

315 The maximum output in the model above  $Y_h$  corresponds to a level of effort  $\bar{le}$ , such that  
 316  $p(\bar{le}) = 1$ . Technical efficiency may then be written as:

$$317 TE = \frac{E(Y)}{Y_h} = \frac{p(le)(Y_h - Y_l) + Y_l}{Y_h} \quad (12)$$

318 It follows that:

$$319 TE'(le) = \frac{p'(le)(Y_h - Y_l)}{Y_h} > 0 \quad (13)$$

320 The key prediction of the model thus becomes the more reliable the income-smoothing  
 321 mechanism, the higher the incentive to shirk, the lower the technical efficiency.

322 Extension of the model: aversion of the risk hypothesis

323 The hypothesis of the neutrality towards the risk can be modified by the specification of the  
 324 expected utility of the exploitation as follow:

$$325 EU = \log(C) - v(le)$$

326 (3bis)

327 So it becomes possible to show that:

$$328 EU = p(le) \cdot \{\log(\Pi_h + \bar{Y}) - \log(\Pi_l + \bar{Y}) + \Psi [\log(\Pi_l + \bar{Y}) - \log \bar{C}]\} + \Psi \log \bar{C} \\ + (1 - \Psi) \log(\Pi_l + \bar{Y}) - v(le) \quad (8bis)$$

329 Which gives the first order condition

$$330 \quad \frac{v'(le)}{p'(le)} = \log(\Pi_h + \bar{Y}) + \Psi[\log(\Pi_l + \bar{Y}) - \log \bar{C}] \quad (9bis)$$

331 | This last equation shows that the prediction of the model does not change nothing if we  
 332 introduce the aversion hypothesis towards risk. Nous found a negative relationship  
 333 between  $le$  and  $\Psi$  in estimating the total difference of the expression (9bis). I search, in the  
 334 following, to size the opportunist behaviour of the exploitations by analysing the technical  
 335 efficiency. I propose frontier estimation of the production function using the fixed effects  
 336 method to show that the offered guarantee linking the migrants to their origin exploitations  
 337 are a determinant factor of the inefficiency.

### 338 **The econometric model:**

339 Here is the function of the production technology on each plot

$$340 \quad g(X_{ih}, W_i, G_{ih}, \mu_h, \theta_{ih}), \quad (14.a)$$

341 Where  $i$  is the index plots of land and  $h$  is the index of the household  
 342 ( $i = 1, \dots, p$ ,  $h = 1, \dots, H$ );  $X_{ih}$  represents a vector of physical inputs on plot  $i$ ,  
 343  $W_i$  represents a vector of observable plot characteristics,  $G_{ih}$  stands for a vector of  
 344 characteristics of the individual who controls the plot;  $\mu_h$  represents a disturbance term  
 345 that recapitulates the effects of unobserved plot quality variables and plot-specific  
 346 production shocks.

$$347 \quad \text{Considering that } g(X_{ih}, W_i, G_{ih}, \mu_h, \theta_{ih}) = g(X_{ih}, W_i, G_{ih}) \exp(\mu_h + \theta_{ih})$$

348 In fact, the logarithms are taken on both sides, the production function is specified as:

$$349 \quad \ln Y_{ih} = \ln g(X_{ih}, W_i, G_{ih}) + \mu_h + \theta_{ih} \quad (14.b)$$

350 According to Greene (2012), the term  $\mu_h$  can be considered as a fixed effect where it  
 351 represents a specific constant to each exploitation. It is the estimator *within*, the statistics  
 352 properties have been clarified by a relative study on panel data [12]. On the other hand, a  
 353 random effect where, it is included in the residual where the distribution is not explicit  
 354 specified. The generalised least squares GLS, which brings unbiased estimators and  
 355 convergent can be used to estimate the model.

356 While it is possible to argue for one or the other model, unobserved heterogeneity and  
 357 embodied in the error component  $\mu_h$  are the key problem with the random effects

358 approach, therefore, may be correlated with observed inputs. The traditional technique to  
359 deal with this problem is to exploit a fixed effects procedure, i.e. to remove the household-  
360 specific effect  $\mu_h$  by transforming the data into deviations from household means [13]. In  
361 that case, sufficient conditions for the OLS estimates from the transformed variables to be  
362 unbiased and consistent is that the elements  $X$  and  $W$  are uncorrelated with the classical  
363 disturbance term  $\theta$ .

364 [14] proposed a test for orthogonality of the random effects and the regressors. It is based  
365 on the thought that under the hypothesis of no correlation. The random effects and the  
366 fixed effects estimates should not differ systematically. The basic idea of the test is that,  
367 under the hypothesis of independence, the estimators within and Generalized Least  
368 Squares are not significantly different.

369 Two main limits are observed for this method. First, the regressors' specific to every  
370 exploitation and invariants according to the plots of land, are excluded by the within  
371 transformation, which consists in expressing variables according to their gap to the  
372 individual mean. Finally, the efficiency and the convergence of the within estimators are  
373 bound to the acceptance of the hypothesis of exogeneity of the independent variables with  
374 the term of classic error.

375 The use of the method of fixed effects is legal because the specification of the model does  
376 not contain invariant regressors according to the plots of land. However, without  
377 instruments, it was not possible to correct the estimated coefficients of biases introduced  
378 by a possible correlation between the explanatory and  $\theta$  variables. After the estimation  
379 of equation 14b, we test the hypothesis of a negative relationship between the reliability of  
380 the insurance mechanism ( $\psi$  in the theoretical model) and the technical efficiency (not  
381 observed) of the holdings, measured by  $\mu_h$ . It will be a matter of simply regressing  $\mu_h$  on a  
382 set of variables representing the characteristics of the exploitation with a proxy of  $\psi$ .

383 Specification of the model:

384 Before estimating the model, we have to choose the specific functional form  
385  $g(X_{ih}, W_i, G_{ih})$ . For that, we assume that the process of the production on a plot  $i$  from an  
386 exploitation  $h$  determined by Cobb-Douglas production function. In this case, we  
387 estimate:

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388  $\ln y_{ih} = \alpha + \beta_x \ln X_{ih} + \beta_k W_i + \beta_N G_{ih} + \mu_h$  (15)

389 Where,

390  $y_{ih}$ , represents the yield on plot  $i$  from an exploitation  $h$  ;

391  $X_{ih}$ , denotes the vector of traditional factors of agricultural production (area, labour, and  
392 capital);

393  $W_i$ , is the vector of the plot characteristics (include the characteristics of the responsible of  
394 the plot himself "sex, age, education);

395  $G_{ih}$ , is the representing certain variables exogenous uncontrollable by the farmers (like  
396 precipitation and regions' fixe effects);

397 The specification has an advantage to be simple and provide the estimators without bias.

398 The estimation of this function gives a measure of technical efficiency that is regressed  
399 using certain characteristics of the exploitation and the locality of residence.

400  $\hat{\mu}_h = \beta_a + \beta_k Z_h + \varepsilon$

401 Where,  $Z_h$  is a vector of the characteristics of the exploitation like participation in  
402 migration, le sex, education level, and ethnic of the head of exploitation, the proportion of  
403 plot with improved seed and the variables of localisation as region of residence.

404 Dependent variables:

405 The dependent variable for the first model is logarithm of the yield on each plot. The  
406 agricultural survey of economic conditions makes it possible to obtain the yield of all the  
407 crops on all the plots of the sample from the survey on the yield squares (carré de  
408 rendement) on 1/3 of the plot and the farmer declarations on the others. The regression on  
409 the production of the different plots of the holding provides a measure of technical  
410 efficiency, which is the dependent variables for the second model.

411 Explanatory variables:

412 The explanatory variables used in the regression are:

413 Area: The Malian's agriculture remains extensive. The increase of agricultural output  
414 remains linked to the expansion of the cultivated areas. All the plots of land of the  
415 exploitations samples are measured during the first move of the survey. When several

416 speculations are cultivated on the same plot of land, is made an evaluation of the  
417 proportion occupied by each of them;

418 The variables of input: the work is measured by the number of the agricultural assets  
419 (active persons) having worked on the plot. When family cannot handle all the work, the  
420 exploitations can turn to hired labour in certain periods of the cultural calendar, the use of  
421 this outside work is taken into account through the cost made for this service. Fertilizers  
422 and improved seeds are taken into account through the introduction of dummy variables,  
423 take value 1 if the input is used on the plot and 0 otherwise;

424 The characteristics of the plot: the quality of the soil is measured by dummy variables that  
425 reflect its use or not during the previous season and its weeding for the current season;

426 Farming techniques such as the use of complete equipment, the practice of monoculture or  
427 the type of cereals grown are introduced in the regression. The method of exploitation of  
428 the plot (collective or individual) is also integrated into the model;

429 The individual characteristics of the person responsible for the plot are taken into account  
430 through sex and schooling.

431 For the technical efficiency regression, the explanatory variables are:

432 The reliability of the insurance mechanism is measured by the ration of migration,  
433 calculated by the number of migrants over the number of members of the exploitation.

434 This ration is calculated separately for each type of migration to distinguish their effects.

435 To show the existence of moral hazard, the coefficient associated with each ration must  
436 have negative sign.

437 Characteristics of the household head: the household head is the main decision maker at  
438 the production unit level. Its ability to make good decisions and ensure better execution is  
439 important for the proper running of the exploitation. Despite the theoretical and even  
440 empirical controversy surrounding the role of education on agricultural productivity, we  
441 expect that it will have a positive impact in the sense that it is important to us to strengthen  
442 its capacity to absorb new farming practices. In a society, still marked by cultural  
443 heaviness, it is thought that men are better equipped to master a unit of production and  
444 consumption. Therefore, a negative sign of the sex variable of the farm manager is  
445 expected, which takes the value of one if woman and zero if not. The manager's ethnicity  
446 is also integrated into the model;

447 Other variables such as the proportion of plots grown with improved seeds and locality  
448 characteristics across the region of residence introduced in the model.

## 449 **Results and discussions**

450 This section presents the results on the impact of migration influence on agricultural  
451 **productivity** in fact, on the **productivity** of growing crops in Mali. Primarily, the study  
452 supposed to estimate the impact of each type of migration (internal and external),  
453 unfortunately the secondary data used from national survey was cross sectional data so the  
454 international migrants were not enough to make our regression.

455 *Descriptive statistics of the variables used in the model:*

456 Table 1 reveals the descriptive statistics of the variables used in the present study. The  
457 data employed in the estimation includes 37175 individuals sharing between 2331 farm  
458 households (13.82 individuals' in average per household with a standard deviation of  
459 9.06) through the nine regions of Mali except Kidal because of the insecurity of this  
460 region. This data **is** a representative survey of 2331 households statistically distributed in  
461 the country. Children represented 33.99 % aged less or equal to 14 years old of the  
462 sampled individuals and the work-force age going from 15 to 65 years old accounted for  
463 60.28 %, while the retired or the elders above 65 years represented 5.80 %. Males  
464 represent 53.0 % of the sampled individuals of the whole sample and the remaining 47.0%  
465 were females. The educational level from the sample showed that 72.38% had no formal  
466 educational, 17.47% had primary while only 9.46% had education up to secondary or  
467 professional educational level. For the university level, the percentage **is** very low in the  
468 agricultural production sector.

469 The Malian farming remains dominated by the traditional practice (see the table 1), it **is** up  
470 to now family production scale with small cultivated area. In the survey, they used GPS to  
471 measure the cultivated area and the yield square to measure the output of the crop  
472 production. More than 51% of the farmers do not use the manure or fertilizer and the  
473 mode of cropping by the majority (91.45%) was mostly pure cultivation (one plot one  
474 crop), a system known as mono-cropping. On average, the production in kg **is** 113.59 for  
475 the entire staple crop together (millet, sorghum, rice and maize) with a standard deviation  
476 of 206.81. It **can said** that there **is** a high variability of the cultivated area of crop in the  
477 agricultural production in Mali. The average cultivated area averages 6.85 hectare with

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478 | standard deviation of 20.61, which simply show that there **is** a big difference between the  
 479 | sizes cultivated.

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480 | The proportion of young population in the population in Mali **is** very considerable, and  
 481 | this is evident in the sampled population. The average age **is** about 29.32 years old with  
 482 | 21.64 as standard deviation. This situation is associated with our variable of interest,  
 483 | migration, which **is** very widespread in the Sahel especially in Mali our study area. Indeed,  
 484 | the phenomena of migration in Mali **is** the consequence of unemployment and the difficult  
 485 | economics conditions of the country, which push the population to emigrate. Regarding to  
 486 | our sampled population, there is an average emigrant of 0.40 by household.

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487 | Table 6 : Descriptive statistics of the variables used in the models

Variable	Number	Mean	Std. Dev.
Production (in Kg)	8477	113.59	206.81
Area (in hectare)	8477	6.85	20.61
Number of migrant by household	8477	0.40	1.16
Average age	8477	29.32	21.64
Household size	8477	13.82	9.06

Variables	Modality	Number	Frequency
Age of the household member	Children (<=14 years)	2876	33.93
	Working age (15-65 years)	5110	60.28
	Vieux (>65 years)	491	5.79
Sex of the household member	Male	4493	53
	Female	3984	47
Level of education of the household member	Non educated	6136	72.38
	Primary school	1481	17.47
	Secondary & professional	802	9.46
	University level	58	0.68
Mode of plot's ploughing	No ploughing	719	8.48
	Manual	961	11.34
	plough	464	54.74
	Manual et plough	1957	23.09

	Mechanic	159	1.88
	Manual et mechanic	26	0.31
	plough et mechanic	15	0.18
	None	4346	51.27
Use of manure and fertilizer	Manure or fertilizer	318	37.51
	Manure and fertilizer	951	11.22
Mode of cropping	Pure	7752	91.45
	Association of crops	725	8.55

488 *Source: Author's field research*

### 489 **Estimates of production function**

490 The econometric results is presented in Ttable 6. A multiple regression was estimated for  
491 the main staple crops in the country (millet, sorghum, rice, maize and bean) jointly and  
492 separately. It gives the elasticities of production in relation to the different factors used  
493 such as input (fertilizer and manure). The Adjusted R square shows that 62.5% of the  
494 variability of the plot production is explained by the explanatory variables used in the  
495 model. Seed is an important factor that influences the yield in terms of quantity and in  
496 terms of the quality of the seed used for the production. From the results, it was observed  
497 that the quantity of seed is positively significant in explaining the output of farmers. The  
498 use of improved seed other than local seeds for the first year was statistically significant  
499 but negative in explaining the yield of farmers. However, improved seed for the third year  
500 had a positive sign and significant. The area coefficient is positive and significant at 10%;  
501 this situation indicates that the marginal yield of the area is not zero. First, this result is  
502 coherent with the theory and it confirms the extensive nature of agriculture in Mali. The  
503 results showed that the number of agricultural workers (family labour and hired labour)  
504 significantly influence the production on the plots. Therefore, it can be argued that the  
505 coefficient associated with the logarithm of the number of both workers on the plot are  
506 significant. This suggesteds that the constant of the production function varies according  
507 to the number of agricultural assets. This circumstance indicates that the potential of these  
508 factors of production are still to be exploited. Consequently, it confirms the hypothesis  
509 that, there is a surplus of workers in farms production in developing countries, which  
510 reinforced Lewis' model done in 1954: "labour can move from the traditional sector to the  
511 modern sector without loss of production in the traditional sector" [15]. In this case, the

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512 departure of one or more members in migration should not negatively influence  
513 agricultural work because, as [16] argued, migration takes workers but not work, hence,  
514 "the effort of those who remain adjusts". Once the use of the hired labour is positive and  
515 significantly different from zero, it indicate that farms could compensate for the departure  
516 of agricultural assets by using additional labour. The mechanization of the production  
517 system can also help reduce the need for agricultural assets. The use of fertilizers and  
518 manure have a positive influence on the level of production. Production is higher for  
519 newly developed plots according to the farmers. Probably because these plots are more  
520 fertile. As expected, pure cultivation (a single crop on the plot) favours increased  
521 production compared to the crop association. Production is higher in a plot managed by a  
522 man compare to a plot managed by a woman. This situation is in line with several studies  
523 done on measuring men and women's agricultural output [17].

524 Regarding the labour force, the working population is not significant, however, the  
525 category elder's population **is** statistically significant at 10% and affects negatively the  
526 production. This situation can be explained as the fact that the elder's population do not  
527 have the work force to work decently in the farm. In terms of gender issue, the result  
528 showed that the plot controlled by women are less productive than the one controlled by  
529 men, which is similar with the results found by **Udry et al (1995)**. Citation not consistent  
530 with others. Explaining this outcome, women in rural area in Mali mostly use most of their  
531 time working for men instead of working for themselves and also, this can due to the  
532 limited resources by rural women. In fact, referring to the Food and Agriculture  
533 Organization of the United Nations (FAO), in underdeveloped nations, rural women act as  
534 a keystone of family agriculture that is small-scale production and daily household  
535 subsistence.

536 Migration variable **is** statistically significant and held a negative sign that means **it has a**  
537 negative impact on the output of the several crops used in the model. Our finding is related  
538 to the results of [18]; [19]. Migration plays important role in time of food shortage in the  
539 rural area in Mali [20]. Especially through the remittances send by migrants to their  
540 respective family members behind. Migration contributes also to diversify the sources of  
541 earnings, which allows the household to overcome the weaknesses of market in the rural  
542 area and also restraints of credit and insurance.

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545 Table 7 : Jointly modelling of the production function of the growing staple crops in Mali

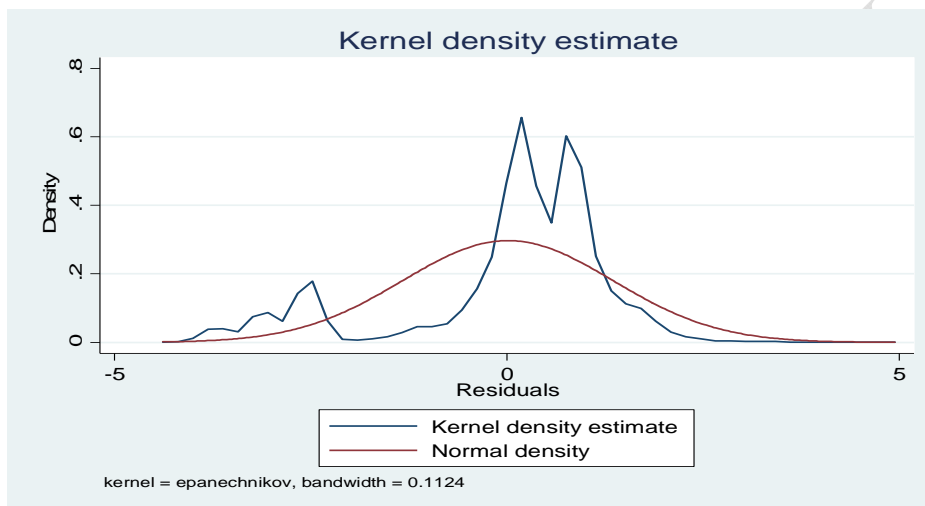
<b>Log (production)</b>	<b>Coefficient</b>	<b>S. Error</b>	<b>t</b>	<b>P&gt;t</b>	<b>[95% Conf. Interval]</b>	
<b>Constant</b>	3.61***	0.05	68.33	0.00	3.51	3.71
<b>Seed [Ref. Local seed]</b>						
Improved seed for first year	-0.36***	0.07	-5.23	0.00	-0.50	-0.23
Improved seed for 2 <sup>d</sup> year	0.12	0.10	1.26	0.207	-0.07	0.31
Improved seed for third year	0.32***	0.11	2.98	0.003	0.11	0.53
Improved seed unknown year	-0.17**	0.07	-2.53	0.011	-0.31	-0.04
<b>Quantity of seed used/plot</b>	0.02**	0.01	2.23	0.026	0.00	0.04
<b>Log (Area)</b>	0.02*	0.01	1.70	0.09	0.00	0.05
<b>Log (Hired labour)</b>	0.03**	0.01	2.69	0.01	0.01	0.06
<b>Log (Family labour)</b>	0.10***	0.02	4.77	0.00	0.06	0.15
<b>Input [Ref. No use of manure and fertilizer]</b>						
Manure or Fertilizer	0.58***	0.03	18.44	0.00	0.52	0.64
Manure and Fertilizer	0.77***	0.05	16.81	0.00	0.68	0.86
<b>Mode of Cropping [Ref. Monoculture]</b>						
Association de cultures	-0.21***	0.06	-3.49	0.00	-0.33	-0.09
<b>Level of schooling [Ref. Non educated]</b>						
Primary school	0.14***	0.04	3.77	0.00	0.07	0.21
Secondary& professional	0.13***	0.05	2.87	0.00	0.04	0.22
University level	0.23	0.18	1.30	0.19	-0.12	0.58
<b>Age [Ref. (&lt;=14 years)]</b>						
Working age (15-65 years)	-0.04	0.03	-1.41	0.16	-0.10	0.02
Elders (>65 years)	-0.12*	0.06	-1.35	0.06	-0.19	0.006
<b>Sex [Ref. Male]</b>						

Female	-0.04	0.03	-1.42	0.15	-0.10	0.02
Migration (0=No, 1=Yes)	-0.10*	0.04	-2.43	0.02	-0.18	-0.01

546 \*\*\*p<0.001 indicates significance at 1%, \*\*p<0.05 indicates significance at 5%, \*p<0.01  
547 indicates significance at 10%.

548 *Source: author's field research*

549 Figure 4 : Sharing of fixed effects



550 *Source: Author's field research*

551 Once technical efficiency's estimation of agricultural unit **is** available. We are now  
552 checking whether it **is** a decreasing function of the reliability of the insurance mechanism.  
553 Therefore, we estimated an equation of the predicted value of the fixed effect as a function  
554 of a vector of observable characteristics of the operation and the insurance mechanism  
555 measured by  $\Psi$ . Due to the aspect of data (cross sectional), we ran only one model with  
556 internal migration (rural to urban migration) because the data did not contain much  
557 exploitations involved in international migration. The results of technical efficiency  
558 regressions are presented in table 8 (see appendix). The coefficient associated with the rate  
559 of migration **is** significant and held a negative sign. This means that the null hypothesis of  
560 moral hazard **is** not rejected. The presence of opportunistic behaviour might well be  
561 facilitated by the existence of an implicit contract between migrants and their families  
562 behind.

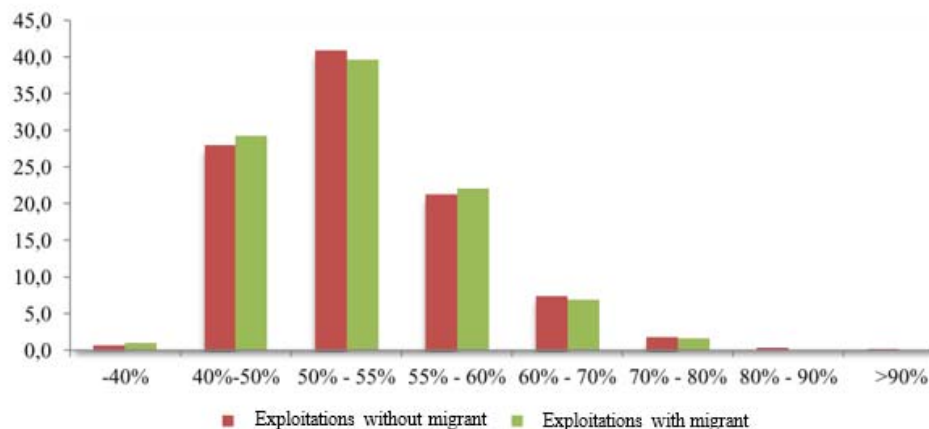
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563 Figure 5 : Distribution of the exploitations according to the technical efficiency by  
 564 migration status



565 Source: author's field research

566 Production function ran separately for each crop:

567 The regression ran separately, the results changed from one crop to another crop. Our  
 568 interested variable that **is** migration has an impact at 10% only on the yield of maize. That  
 569 effect **is** statistically significant and negative, which **is** beyond our expectation. Maize and  
 570 groundnut production demand labour intensive for its practices. The labour both hired  
 571 labour and family labour are statistically significant and positive for these crops. The  
 572 variable area **is** significant and positive for maize and groundnut cultivation, this situation  
 573 is understandable because Malian agricultural **is** based on extensive agriculture. The input  
 574 fertilizer and manure and the labour both hired labour and family labour are statistically  
 575 significant and positive for the crops (millet, sorghum, maize and peanut). Association of  
 576 crops **is** negative for the maize crop such as more number of plants in one acre and also  
 577 due to less sunlight can make difficult crop to grow effortlessly or easily.

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578 Table 8: Production function ran for each crop separately

Variables	Millet	Sorghum	Rice	Maize	Peanut
<b>Log (production)</b>	Coef/SE.	Coef/SE.	Coef/SE.	Coef/SE.	Coef/SE.
	3.96***/0.		4.40***/0.	3.09***/0.	3.25***/0.
Constant	13	3.80/0.15	07	12	11
<b>Log (Area)</b>	0.03/0.04	-0.05/0.04	-0.01/0.01	0.07*/0.04	0.09**/0.0

					4
	0.12***/0.				0.17***/0.
<b>Log (Hired labour)</b>	04	0.03/0.04	0.00/0.02	0.05*/0.03	03
	0.12**/0.0			0.14***/0.	0.11**/0.0
<b>Log (Family labour)</b>	6	0.06/0.06	-0.03/0.03	05	5
<b>Input [Ref. No use of manure and fertilizer]</b>					
Manure or Fertilizer	0.21***/0.	0.65***/0.		1.36***/0.	0.56***/0.
	07	08	0.04/0.05	09	07
Manure and Fertilizer	0.76***/0.	0.92***/0.		1.38***/0.	0.36**/0.1
	10	13	0.04/0.07	10	7
<b>Mode of Cropping [Ref. Monoculture]</b>					
Association of cultures	0.13/0.11	-0.26/0.14	-0.05/0.09	-0.54***/0.16	0.20/0.16
<b>Level of schooling [Ref. Non educated]</b>					
		0.30***/0.0			0.42***/0.0
Primary school	0.06/0.08	9	0.01/0.04	0.08/0.07	8
Secondary & professional	0.29***/0.0				0.41***/0.0
	9	0.18/0.13	0.08/0.09	-0.09/0.10	9
					0.81***/0.1
University level	-0.05/0.74	0.24/0.22	-0.08/0.05	0.26/0.25	3
<b>Age [Ref. (&lt;=14 years)]</b>					
Working age (15-65 years)	0.19***/0.07	0.19**/0.08	0.05/0.05	0.04/0.07	-0.04/0.07
Elders (>65 years)	0.49***/0.16	0.31**/0.15	0.18/0.07	-0.05/0.15	0.21/0.26
<b>Sex [Ref. Male]</b>					
Female	0.10***/0.06	-0.07/0.08	-0.10**/0.05	-0.06/0.06	0.08/0.07
Migration (0=No, 1=Yes)	-0.29/0.23	-0.23/0.18	0.05/0.06	-0.11*/0.06	-0.07/0.05
Number of observation	1917	1538	1019	1340	1493

579 Standard error after /. Source: author's field research

580 **Conclusion**

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581 The principal component of this objective was to highlight the existence of a moral hazard  
582 phenomenon that would be the cause of poor agricultural output obtained by exploitations  
583 with at least one member living outside their locality. A remark, most of the researches  
584 have been focused on the international migration, but the present study mostly focused on  
585 the impact of internal migration on agricultural productivity. Because more than 95% of  
586 the whole migrants move inside the country. The theoretical model used in this research,  
587 proposed by [5], shows that the farmers exercise lower average level of effort in doing  
588 farm activities once they are insured by receiving transfer from migrants. The forecast of  
589 the theoretical model was tested using the estimation by the fixed effects method of a  
590 production frontier. The indicator of the reliability of the insurance mechanism, measured  
591 by the ration of migration (ration of migration is to the number of migrants over the size of  
592 the exploitation) seems determine the technical inefficiency of agricultural exploitations.  
593 [5] obtained this conclusion with regard to the Kayes region (international migration).  
594 Although some previous studies conducted regional analysis, this present study was  
595 estimated based on national impact and have also concentrated on the impact of internal  
596 migration which is the most dominant migration type in Mali.

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#### 597 **References:**

- 598 [1] M. P. Todaro, "American Economic Association A Model of Labor Migration and  
599 Urban . Unemployment in Less Developed Countries," *Am. Econ. Assoc.*, vol. 59,  
600 no. 1, pp. 138–148, 1969.
- 601 [2] J. R. Harris and M. P. Todaro, "Migration, unemployment and development: a two-  
602 sector analysis," *Am. Econ. Rev.*, vol. 60, no. 1, pp. 126–142, 1970.
- 603 [3] M. McCatty, "The Process of Rural-Urban Migration in Developing Countries,"  
604 2004.
- 605 [4] C. Udry, "Gender, Agricultural production and the theory," *Dep. Econ. Northwest.*  
606 *Univ.*, 1995.
- 607 [5] F. Gubert, "Migration , Remittances and Moral Hazard . Evidence from the Kayes  
608 Area ( Western Mali )," *Cent. d'études Rech. sur le Dev. Int.*, pp. 1–30, 2000.
- 609 [6] P. L. Delville, "Migrations internationales , restructurations agraires et dynamiques  
610 associatives en pays soninké et haalpulaar ( 1975-1990 ), essai d ' anthropologie du  
611 changement social et du développement," 2014.
- 612 [7] P. Collier and D. Lal, "Why poor people get rich: Kenya 1960-1979," *World Dev.*,

- 613 vol. 12, no. 10, pp. 1007–1018, 1984.
- 614 [8] O. Stark, “The migration of labour,” *J. Labor Econ.*, vol. 9, no. 3, 1991.
- 615 [9] M. Fafchamps, “Solidarity Networks in Preindustrial Societies: Rational Peasants  
616 with a Moral Economy,” *Econ. Dev. Cult. Change*, vol. 41, no. 1, pp. 147–174,  
617 1992.
- 618 [10] Andrei Shleifer, “A theory of Yardstick Competition,” *Rand Journal of Economics*,  
619 vol. 16, no. 3. pp. 319–327, 1985.
- 620 [11] E. P. Lazear and S. Rosen, “Rank-Order Tournaments as Optimum Labor  
621 Contracts,” *J. Polit. Econ.*, vol. 89, no. 5, pp. 841–864, 1981.
- 622 [12] Y. Mundlak, “On the Pooling of Time Series and Cross Section Data,” vol. 46, no.  
623 1, pp. 69–85, 1978.
- 624 [13] J. A. Hausman and W. E. Taylor, “Panel Data and Unobservable Individual  
625 Effects,” vol. 49, no. 6, pp. 1377–1398, 1981.
- 626 [14] J. A. Hausman, “Specification Tests in Econometrics,” *Econom. Soc.*, vol. 46, no. 6,  
627 pp. 1251–1271, 1978.
- 628 [15] W. A. Lewis, “Economic Development with Unlimited Supplies of Labour,”  
629 *Labour*, pp. 139–191, 1954.
- 630 [16] A. K. Sen, “Labour Allocation in a Cooperative Enterprise,” *Rev. Econ. Stud.*, vol.  
631 33, no. 4, pp. 361–371, 1966.
- 632 [17] A. R. Quisumbing, R. M.-D. Raney, T. L. Raney, A. Croppenstedt, J. A. Behrman,  
633 and A. Peterman, *If Women Hold Up Half the Sky, How Much of the World’s Food*  
634 *Do They Produce? (in Gender in Agriculture, closing the knowledge)*. 2014.
- 635 [18] P. Zahonogo, “Migration and Agricultural Production in Burkina Faso,” *African J.*  
636 *Agric. Res.*, vol. 6, no. 7, pp. 1844–1852, 2011.
- 637 [19] M. Imran, K. Bakhsh, and S. Hassan, “Rural to urban migration and crop  
638 productivity: evidence from Pakistani Punjab,” *ResearchGate*, vol. 29, no. 1, pp.  
639 17–19, 2016.
- 640 [20] S. E. Findley, “Does Drought Increase Migration? A Study of Migration from  
641 Rural Mali during the 1983- 1985 Drought,” *Int. Migr. Rev.*, vol. 28, no. 3, pp. 539–  
642 553, 1994.