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Luca Crudeli, Susanna Mancinelli, Massimiliano Mazzanti, Raul Pitoro

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Beyond Individualistic Behaviour: Social Norms and Innovation Adoption in Rural Mozambique

Luca Crudeli (Marine Market Systems) Susanna Mancinelli (University of Ferrara, SEEDS) Massimiliano Mazzanti (University of Ferrara, SEEDS) Raul Pitoro (Feed the Future Inova Mozambique)

Abstract

Development efforts to lift smallholder farmers out of poverty are often focused on promoting the adoption of new technologies that can improve yields, such as improved seeds, fertilizer, and chemicals. Two sets of drivers / obstacles must be considered when addressing innovation adoptions: economic and cultural and behavioural drivers. This paper focuses on both sets of drivers with special consideration of the second set, which is often overlooked during intervention design and execution. Using a dataset of observations from 300 smallholder farmers from rural Mozambique, this paper investigates the cultural and behavioural aspects that may facilitate or hinder the adoption of new farming technologies. The prevailing social norms that shape the behaviour of an ideal "good farmer" as defined by each of the investigated communities are explored, examining how these characteristics hinder or accelerate the diffusion of technological innovation. What emerges from the analysis is a social norm of good farmer extremely concerned about others. Moreover, this collectivistic image does not prevent a positive social perception of achieving above average farming results. The empirical analysis investigates the main drivers of Mozambican farmers' innovation adoption, especially in the case of the most radical innovations, with particular attention given to analysing whether the collectivistic good farmer identity constitutes an obstacle to innovation. The results of various econometric analyse on intensity and adoption of innovations show that education, information, training and income level are structural drivers of radical innovation adoption and its intensity. Moreover, not only does the prosocial idea of good farmer not prevent farmers from undertaking innovative solutions but also has a significant impact on the adoption of the most radical solutions.

Keywords: social norms, stigma, networking, good farmer, radical innovations, innovation intensity, rural Africa

1. Introduction

Development efforts to lift smallholder farmers out of poverty are often focused on promoting the adoption of new technologies and knowledge which support economic and human development. Nevertheless, seemingly profitable innovations are not adopted by producers as expected. In recent years, to better understand the causes of this underinvestment, a relevant stream of the economic literature has focused on the microanalysis of adoption behaviour in different situations and for different kinds of technology[1]. In the African context researchers are especially concerned about the dynamics of technology adoption in agriculture, given the importance that the sector has for overall economic growth and, specifically, for poverty reduction. The types of innovations treated in these studies are primarily the adoption of high-yield seed varieties and fertilizer and crop-protection chemicals by poor smallholder farmers. Studies pay particular attention to what this paper defines as more *radical innovations*, especially the use of fertilizer, which is considered a key input to improve African yields (Morris et al., 2007). The adoption of these innovations faces two sets of constraints. First, new technologies may expose farmers to increased risk levels since they are usually expensive and unknown and often require additional labour. Second, adoption of new technologies may often be hindered by the stickiness of cultural and behavioural norms in rural communities, where community safety networks and sanctions for defection may play important roles.

This paper joins a consolidated body of work by considering both the economic and the cultural and behavioural norms that drive or hinder the adoption of simple (i.e., improved seed varieties) and more radical innovations, such as pesticides, herbicides, and fertilizers. More specifically, the investigation assesses Mozambican farmers behaviour through a survey that collected 300 observations in November 2019.

In addition to other issues that have been already widely investigated in the economic literature, the analyses especially focus on the role of social norms in that context and on their possible impact on farmers' decisions to adopt technological innovations. More specifically, the work refers to the importance that the social norm of being a 'good farmer' has received in the literature[2]. Adherence to that norm is considered one of the main drivers of farmers' behaviours and choices, which include innovation adoptions. The most widespread concept of being a good farmer is connected to a productivism model, according to which maximizing farming production is the ruling social signal among farmers in developed countries. To the best of our knowledge, the social norm of being a good farmer in the African context remains pretty overlooked, despite the relevance of the agricultural sector. Different from developed countries, in African rural communities, many contracts are informal (including loans and insurance). Accordingly, different lenses are needed to investigate the prevailing social signals attached to the good farmer identity. More specifically, in our investigation of Mozambican farmers, besides typical concerns about the farming results, we consider the relevance of the family and the community and the attitude to take care of others. The survey shows that the productivity concept of good farmers is also widespread among the farmers of our sample, but even more farmers share a community-oriented approach as the main characteristic that identifies good farmers.

[1] See Foster and Rosenzweig (2010) and the literature review reported therein.

[2] Gray (1998), Silvasti (2003), Burton (2004), Stock (2007), Haggerty et al. (2009), Sutherland and Darnhofer (2012)

We investigate the impact of this social norm on the choices regarding (radical) innovation adoption. Our research question is whether a non-individualistic profit maximizing approach may constitute an obstacle to productivity improving decisions. The question is of crucial importance in economies that transition towards higher development. Mozambique is 181/189 in the Human development Index ranking (UNDP, 2020), with a human development performance which is better than that of mere GDP per capita, especially due to gender dimensions of wellbeing.

From the results of our econometric analysis on both innovation intensity and radical innovation adoption, what emerges is that, consistent with the existing results in the social sciences literature, farmers' innovative choices are positively correlated with some socioeconomic factors - such as income and literacy - and the information and learning process as well. More interestingly, regarding the main purpose of this research on farmers' social norms, not only does the communitarian identity of good farmers not hamper farmers' choices regarding this activity but also has a significant impact on the adoption of the most radical innovations.

The remainder of this paper is structured as follows: Section 2 identifies the social norm of good farmer for the community of farmers in our sample. Section 3 presents the dataset and some descriptive statistics. Section 4 presents the econometric analysis and results. Section 5 concludes the paper.

2. Reconstructing the good farmer social norm in Mozambique

2.1 The importance of the good farmer

The relevance of the existence of a social norm for being a 'good farmer' in agricultural practices has been widely emphasized. The fundamental argument is that adhering to shared farming and cultural norms helps farmers gain some form of social standing in their communities. As farming communities are often tightly knit, these social norms often contribute to the preservation of farming traditions, which in advanced agricultural economies, is an added value that contributes to the diversity of local agricultural production. However, these social norms may also have a negative impact on the speed of innovation and technological change to spread amongst farming communities[3].

Since this research has been applied mostly in developed market based economies, the most widely spread good farmer concepts in the literature are almost exclusively characterized by predominantly entrepreneurial and individualistic traits, which prioritize maximizing production over community sharing and safety nets. Consistent with this productivity-oriented model, several studies[4] have identified two main factors that in farmers' minds contribute to the definition of a good farmer: (i) crop yield per acre/hectare and (ii) the physical appearance or attractiveness of the crop and/or of the livestock the farmer grows. These studies show that in developed countries,

[3] However, as highlighted by Sutherland and Darnhofer (2012) in their empirical research on organic and conventional farmers in England, the concept of the good farmer cannot be considered a static conviction; conversely, it is subject to change both among different cultures and across different periods.

[4] Gray (1998) for Scottish farmers, Silvasti (2003) for Finnish farmers, Burton (2004) and Burton et al. (2008) for UK farmers, Stock (2007) for US farmers, and Haggerty et al. (2009) and Hunt (2010) for New Zealand farmers.

farmers' adherence to the social norm of being a good farmer causes utility mainly from the social status associated with more productive results in terms of both quantity and quality.
To the best of our knowledge, this approach has never been utilized to investigate poor rural farming communities in Sub-Saharan Africa, where the cultural backgrounds in which social norms emerge are significantly different than those in other developed market contexts. The social characteristics and dynamics in which African smallholder farmers operate are substantially different from those faced by farmers in Western economies, where the bulk of the good farmer literature is concentrated. The differences are evident both in sociocultural and socioeconomic aspects. On the cultural level, while modern Western cultures are grounded on the idea that individualism and entrepreneurship are the engines of prosperity, in rural sub-Saharan African societies, the well-being of an individual is achieved by creating and contributing to a community, an ethical approach that the literature has called *African communalism*[5]. From an economic standpoint, when markets are thin and services are unavailable, as in the case of sub-Saharan Africa, drawing from community networks may be the only viable method for any enterprise. For example, in situations in which insurance and financial markets are largely absent, social networks can constitute the only or prevailing source of insurance and credit available to farmers. Many loans occur between neighbours and relatives. This kind of informal insurance can only rely on the propensity of the wealthiest farmers to take care of those who are less fortunate (Banerjee and Duflo, 2007)[6].
Given the importance that has been assigned to the role of the good farmer identity in leading farmers' behaviour and choices, we believe that a deeper investigation of this issue is needed to better understand the attitudes of African farmers towards some fundamental choices, such as investments in innovations.

2.2. The good farmer identity in our sample

The investigation is based on a sample of 300 farmers in two rural areas Mozambique provinces of Nampula and Manica. These two areas were selected due to the significant climatic and socio-economic difference that characterize them. Bordering with Zimbawe, Manica's agriculture is influenced by three major topographical features, the western mountain range, a central plateau and a series of three river valleys, the Pungwe, Save and Zambezi and their tributaries. Tobacco and cotton are important cash crops in the province, the former with outgrower schemes augmenting production from large privately owned estates. The foodcrop sub-sector is based on small hand cultivated family farms growing maize, sorghum and millet during a main season which extends from October to April. A small second season, accounting for some 6 percent of the provincial harvest, is noted. As opposed to Manica, the province of Nampula is drier and less fertile, particularly along the coastline with the Indian Ocean.

[5] The philosopher Polycarp Ikuenobe argues that, "African communalism does not necessarily see a conflict between individuals and community; they are mutually supportive, and people are required to have the moral attitude of contributing to the community for their own well-being. This attitude creates the priority of duty, which is for the fundamental goal of creating a community, in order to provide the material conditions for actualizing individuals' substantive rights and well-being" (Ikuenobe, 2018).
[6] In a study on poverty, the authors report that, in Mozambique, everybody who is considered rich has to bear the social responsibility for sharing and to give sufficient support to the community (Jones and Tvedten, 2019).

Accordingly, in the interviews, besides the standard and widespread concept of a good farmer as one who obtains the best farming results in her/his community, we also proposed an image of a good farmer who supports the other farmers in her/his community and, to a stronger degree, even at the cost of her/his own productive results. Table 1 below reports some results related to section D[7].

Table 1: The good farmer perception in Mozambique rural communities

		Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
Questions from the questionnaire		%	%	%	%
D21	Whenever my friends or family are having a hard time, I support them, even at the cost of my farming results.	75	19	4	2
D22	A good farmer should take care of the other farmers (even if they are not friends or family) in his/her community	72	18	5	5
D23	A good farmer should support the other farmers in his/her community (even if they are not friends or family) whenever they are having hard times, even at the cost of his/her farming results	63	23	8	6
D24	A good farmer should always be amongst the ones that get the best farming results in the community	53	26	10	11
D25	A good farmer should always prioritize her/his own farming result, even if this means s/he is not able to help other farmers in the community (that are not friends and family)	11	15	30	43
D26	A good farmer should always prioritize her/his own farming result, even if this means s/he is not able to help other farmers in the community (even if they are friends or family)	8	10	26	56

The first noteworthy result is the relevance that the strong majority (94%) of responders give to the behaviour of supporting friends and family, even at the cost of their own farming results.
The standard individualistic concept of the good farmer identity is also very widespread in the rural communities of our study: 78% of the interviewed farmers agree (strongly or somewhat) that good farmers should be among the ones who obtain the best farming results. More interestingly, an even greater percentage of responders agrees on a more collectivist vision of good farmers: 90% of responders agree (strongly or somewhat) that a good farmer should be one who takes care of the other farmers, and 86% agree (strongly or somewhat) that the good farmer should support the other farmers in the community, even at the cost of her/his farming results.

[7] See section D of the questionnaire. The full questionnaire is attached as a complement file.

However, only a part of farmers agree on a strong individualistic figure of good farmers: 26% of the responders consider that the prevailing social norm for a good farmer is one who prioritizes her/his farming results even at the cost of not taking care of other farmers (who are not friends or family). Only 18% believe that a good farmer should prioritize her/his farming results, even at the cost of not taking care of other farmers (even if they are friends or family).[8]

A question that arises and deserves deeper investigation is whether the shared prosocial image of good farmers in Mozambican rural communities may hamper the adoption of entrepreneurial decisions that drive highly productive results. In other words, we have to consider whether the prosocial emphasis of the good farmer identity can generate negative feelings of stigma and suspicion regarding those who achieve highly productive results, which can be considered signals of individualistic behaviour.

For this purpose, the survey includes some questions regarding reactions to "good farming results" (better than average). Four possible scenarios have been considered: (i) approval (happy for him/her); (ii) approval and emulation (consider him/her to be an example to follow); (iii) envy, not necessarily in a negative meaning (envious of his/her results but let her/him continue to have success); and (iv) feeling of envy that would involve active boycotting behaviour (envious of his/her results and try to make it more difficult for them to continue).

We have framed the questions regarding reactions to "high farming results" both in terms of how responders react to others' high farming results and responders' beliefs about others' reactions to their own high farming results[9]. This question framing is often used in the psychological and behavioural economic literature (Johansson-Stenman and Martinsson, 2006). According to studies, individuals perceive utility from their good *self-image*, which typically positively depends on some characteristics that are socially considered positive (such as altruism) and negatively depends on some other characteristics that are socially considered negative (such as anger). Moreover, to have a good self-image, it is not only relevant that an individual perceives herself as positive and not negative but also that the individual perceives herself as more positive and less negative than others. From this perspective, for the questions concerning perceived negative characteristics, self-reported concerns might be biased downwards, and others' reported concerns might be biased upwards. The opposite might be true for perceived positive characteristics.

Our goal is to detect the widespread perception of socially approved feelings towards farmers' highly productive results. In table 2, following Johansson-Stenman and Martinsson (2006), we weighted the responses through a cardinal index that gives different values (4, 3, 2, and 1) to the different levels of judgement (strongly agree; somewhat agree; somewhat disagree; strongly disagree), which allows for simplifying comparisons[10].

[8] In more individualistic cultures, the concept that a good hard worker is one who sacrifices to achieve economic returns, even at the cost her/his own family wellbeing, is somewhat widespread.

[9] See section E in the questionnaire.

[10] We are aware that the weights attributed to the different levels of judgement are arbitrary, but we used them to make the comparisons easier.

Table 2: Perceptions and judgements - indexes

Imagine that your farming results are better than those of the other farmers in your community	
	INDEX
E11: They are happy for me	1.79
E12: They consider me as an example to follow in order to improve their farming work	2.35
E13: they are envious of my results but let me continue to success	2.68
E14: they are envious of my results and try to make it more difficult for me to continue to success	2.65
Imagine that the farming results of some other farmer in your community are better than yours	
E21: you are happy for him/her	2.64
E22: you consider him/her as an example to follow in order to improve your farming work	3.32
E23: you are envious of her/his results but let her/him continue to success	2.33
E24: you are envious of her/his results and try to make it more difficult for her/him to continue to success	1.30

The data presented in table 2 show that a difference in the perception about one's own judgements and others' judgements exists, which is particularly evident for feelings of approval and emulation ("happy for him/her" and "consider him/her as an example to follow") and for feelings of envy that would involve active boycotting behaviour ("envious of his her results and try to make it more difficult to continue"). In the first two cases, there is an overestimation of one's own reaction with respect to the others, and in the last case there is an underestimation.
From the above, we can infer that the dominant perception of the farmers in our sample is that the reaction to high farming results should be approval, emulation and, eventually, harmless envy.

Ultimately, what emerges is that the collectivistic social norm of a good farmer who is highly concerned about others is not inconsistent with a positive social perception of achieving high farming results.

According to a stream of the economic literature (Gorodnichenko and Roland, 2011), individualistic and collectivistic cultures have different implications in terms of economic growth since they drive entrepreneurs' choices towards innovation differently. More specifically, individualism results in higher innovation.
Given the results of the responders of our sample, we are interested in analysing whether the collectivist social norm of good farmers that characterizes the Mozambican farming context influences farmers' innovative investments. More specifically, we investigate whether the prosocial Mozambican good farmer social norm constitutes an obstacle for innovation.

3. Empirical framework

3.1 The survey: construction of the work in rural Mozambique

The survey questionnaire was finally administered after a period of internal pre-tests and training of enumerators[11] from October 30th to November 13th, 2019. We conducted field work data collection in the provinces of Manica and Nampula, targeting a representative sample of 300 farmers in the two provinces. Before the field work started, nine enumerators/interns were identified, selected and trained to conduct the field work, use tables, and understand the questionnaire and the field work. A structured questionnaire seeking to interview 300 farmers in Manica (150) and Nampula (150) was implemented using tablets to collect, clean and store the data in a central database.

In collaboration with the public (SDAE) extension supervisors and local leaders in each district, we collected lists of farmers in Posto Administrativos and localities to be used for sample selection. The number of farmers in the lists for each locality was used to calculate the proportion of farmers to interview in that locality with the goal of interviewing 50 farmers in each district. In most cases, random selection by computer was used after listing the farmers present in the respective meetings organized by SDAE supervisors. A minimum of 8 and a maximum of 20 interviews were performed per day depending on the distances between villages and delays reaching the interviewees' locations. At the end of the day, the interviews were checked for errors, corrected and sent to the central database. Unrepaired errors were reported in daily reports shared with the MEL manager. The enumerators were encouraged to draft a short report of their insights, observations and lessons learned after concluding the interviews in each district. In 12 days, a team composed of nine enumerators/interns (six male and three female), one manager, two supervisors, one ops technician, six SDAE guides and two drivers interviewed 300 farmers (105 female and 195 male) in 36 localities and 18 Postos Adminsitrativos in six districts of Manica (Gondola, Sussundenga and Manica) and Nampula (Mecuburi, Monapo and Ribaue), travelling approximately 3300 km.

Table 3: Number of Posto Administstrativos and localities covered

Province	Number of P. Admin.	Localities
Nampula	6	11
Manica	12	25
Total	18	36

Out of the 300 farmers interviewed, 105 were women, corresponding to 35% of the sample. A significant number of women were interviewed in Manica, where the participation of men in agricultural and community meetings related to agricultural issues is low, presumably because of the higher engagement of men in mining and other nonfarm activities.

Table 4: Number of interviewed farmers per District and gender

Province	District	Number of farmers

[11] We conducted training sessions for enumerators and in field survey tests (pilot study) in early October 2019 both in Nampula and Chimoio provinces.

		Male	Female	Total
Nampula	Mecuburi	39	11	50
	Monapo	40	10	50
	Ribaue	37	13	50
Manica	Gondola	28	22	50
	Sussundenga	21	29	50
	Manica	30	20	50
Total		195	105	300

Five enumerators were assigned to Nampula, and the other four were assigned to Manica. In Nampula, all the enumerators performed the same number of interviews; while in Manica, the number of interviews performed by the enumerators depended on the capacity and proximity of the farmers to be interviewed.

3.2 Descriptive statistics: key variables

The main source of information regarding the dependent variable 'innovation adoption' by farmers is a question on the *use of improved inputs/technologies in the past 2 seasons (2017/2018 and 2018/2019*). Table 5 reports the relative shares. The share of farmers who state they have not adopted innovations (non-innovators) is 79 out of 300, which makes it necessary to treat the 'zeros' in empirical applications.

Table 5: Innovation categories

Innovation type		Did you use any of the following inputs in the current and last crop season (2017/2018 and 2018/2019)?
		% of yes
Hybrid Seeds		44.3
OPV		42.3
Improved Seeds		57.6
Improved Seedlings		30.3
Chemical fertilizer	Radical innovation	32.0
Pesticides		38.6
Herbicides		15.0

If we focus on radical types of innovations and group the three last rows, we note that the distribution is as follows (table 6). Logit analysis is then performed on the 4 variables below.

Table 6: Radical Innovation adoptions

	%	acronym
Adoption of all three radical innovations	10.67	RAD3
Adoption of at least one radical innovations	45.67	Rad3
Adoption of two radical innovations (pesticides, herbicides)	13.00	RAD2
Adoption of at least one of the two radical innovations (pesticides, herbicides)	40.67	Rad2

Figure 1 presents the intensity and distribution of innovations on a count basis. The intensity follows a typical shape when different innovations by adopters are counted (Ghisetti et al., 2015).

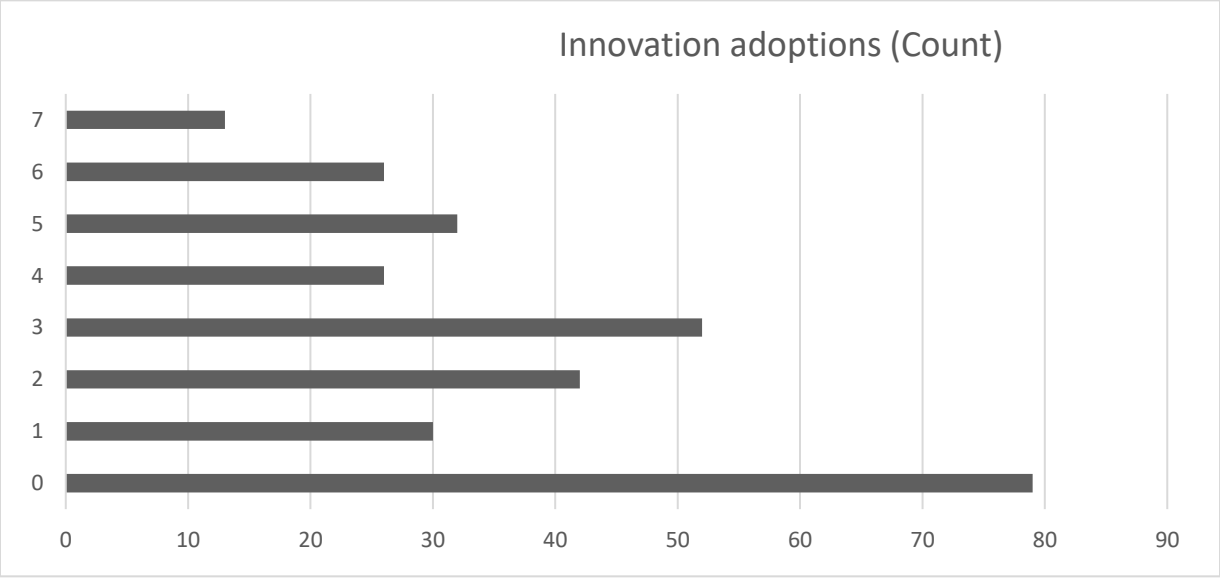

Figure 1 - Counting Innovation adoptions

Examining innovation adoptions in terms of intensity, overdispersion might be present, and a negative binomial model would be appropriate in this case. In this case, the mean is 2.60 and the standard deviation is 2.18.

We report some information on the key independent variables. Other descriptions are available upon request. Data on the input-related information and learning received and on farmers' saving and borrowing behaviours are elicited through the questions reported in table 7.

Table 7: information and learning received; saving and borrowing

Has your household ever received any information on how to use input or technologies (including training)?	Yes 61%
Are you currently receiving learning about how to use input or technologies?	Yes 43.3%
Have you saved money over the past 2 years?	Yes 48.5%
Have you borrowed money over the past 2 years?	Yes 43.7%

4. Empirical analysis on innovation adoption

4.1. Econometric methods

Various methods are used, consistent with the typology of data regarding innovation adoption. As the survey elicits data on innovation adoption through 7 categories that cover incremental and radical innovations (fertilizers, chemicals, and pesticides are the more radical options in the context), it is possible to test our research hypotheses first by constructing indexes of innovation intensity (range 0-7) and second by conducting logit analysis on the radicalness of innovation. In the former case, econometric methods, such as Poisson-based estimators and eventually negative binomial estimators, are used to address count data; given the usual share of '0's, zero-inflated specifications are tested[12] (Cameron and Trivedi, 1998, 2013)[13]. Table A1 in the appendix shows that the correlations among covariates are somewhat low, a framing condition which mitigates multicollinearity.

The next sections explore both the intensity and radicalness of innovation adoption. First, the intensity of innovation is examined: the analysis conveys insights into general innovation behaviour by 'counting' the number of innovations. As is often the case with this type of perspective, the picture is pretty heterogeneous with a relevant share of nonadopters. Second, the investigation moves to more specific radical innovations, a subset of the entire spectrum.

The set of covariates is represented by socio-economic factors, training and learning[14], and information associated with sections E and D.

Table A1 in the appendix shows that the correlations among covariates are somewhat low, which mitigates multicollinearity problems. We opt for a comprehensive but parsimonious set of covariates that ensure regression robustness without generating flaws through the introduction of an excessive series of information.

4.2 Intensity of innovation adoption: drivers and barriers

This section first addresses innovation adoption, pointing to the analysis of intensity, namely, the number of innovations adopted by farmers. Taking table 5 and figure 1 as references, the count-based dependent variable is ranging from 0 to 7, with a mean of 2.60 and a standard deviation of 2.18.

[12] The share of noninnovators is also considered in the logit situation by checking two-step models that seek to first explain the simple 'innovate/do not innovate' decision and then to explain the decision to radically innovate.

[13] For applications in the economic geography and environmental innovation realms, see Coll-Martinez and Arauzo-Carod (2017) and Ghisetti et al. (2015), who used count models for innovation adoption and intensity.

[14] Some descriptive statistics are given in the appendix (Table A2) and Table 7.

Count-based data lay within the realm of categorical discrete variables that have several applications in social sciences. When count data are present, instead of binary or multivariate discrete factors that are managed by logit and probit models, the set of econometric models includes Poisson models (PMs), negative binomial models (NBMs), zero-inflated Poisson models (ZIPs) and zero-inflated NBMs (ZINBs)[15]. While the PM is the starting point, overdispersion, namely, the variance being larger than the mean, and the inflation of '0' terms, can create the necessity to use other models. Tests are available to compare statistical performances across models, such as the AIC and BIC[16] and the Vuong test[17] (Coll-Martinez and Arauzo-Carod 2017). The outcomes commented on below consider the various test procedures to produce a final set of sound deliverables.

Statistical tests here favour zero-inflated models, such as the ZIP. Nevertheless, we briefly first comment on the economic outcomes derived from the PM and NBM as well[18]. Summing up, saving and information/training are positively correlated with the intensity of innovation. The relevance of income is lower. In addition to saving and information/training, the introduction of information elements from sections D and E of the questionnaire shows that farmers agree with the statements (in section D on the good farmer vision) '*Whenever my friends or family are having a hard time, I support them, even at the cost of my farming results*' and quite oppositely '*A good farmer should always prioritize her/his own farming result, even if this means s/he is not able to help other farmers in the community (who are not friends and family)*'. A complementary set of motivations behind innovative behaviour within the community exist.
Regarding section E on the perceptions of farmers' 'high farming results', the outcomes show that farmers who declare approval and emulation tend to show greater innovation intensity, while farmers who have feelings of envy that involve active boycotting behaviour have lower innovation intensity. Overall, prosocial and pro-community behaviours tend to be positively correlated with stronger innovation intensity[19].
Considering models that account for the fact that '0' represents a significant part of the 'innovation replies', the Zero-Inflated Poisson (ZIP) and Zero-Inflated Negative Binomial (ZINB), are options. Table 8 shows that, according to the Vuong test, the ZIP should be preferred[20]. The evidence confirms saving and information/training are drivers of innovation; furthermore, the intensity of innovation is mainly supported by education and income for the nonzero observations.

[15] The commented results of the PM and NBM are available upon request since we focus our attention on zero-inflated models. Evidence is coherent across models.
[16] In general, "smaller is better": given two models, the one with the smaller AIC fits the data better than the one with the larger AIC. As with the AIC, a smaller BIC indicates a better-fitting model.
[17] Technically speaking, the test presents 'ZIP versus Poisson' figures. This test statistic has a standard normal distribution with large positive values favouring the ZIP model and large negative values favouring the Poisson model.
[18] The likelihood ratio tests show an overall significance of the regressions with chi-squared figures larger than 100 (7 d.o.f.) and also very significant pseudo R^2s. Though the standard deviation of the count innovation variable is not very large and the AIC and BIC have values that marginally favour the PM, the likelihood ratio test that addresses overdispersion presents chi-squared figures that reject the null hypothesis of 'equivalence of PM and NBM' (absence of overdispersion).
[19] The results of the PM and NBM are available upon request.
[20] The z statistics are larger than 5 in all specifications.

Table 8: Innovation Intensity

Estimation method	Zero inflated Poisson
Dependent variable	INNOVATION INTENSITY (COUNTINNO)
AGE	0.0038 [1.34]
GENDER	-0.0084 [0.10]
LITERACY	0.218* [2.45]
HIGHINCOME	0.284** [2.93]
INFLATE REGRESSION (LOGIT)	
PROVINCE	-1.519*** [-3.72]
SAVING	-1.260*** [-2.93]
INFOTRAINING	-1.994*** [-5.050]
N. Obs.	300
Nonzero observations	221
LR chi2 (4)	18.24
Vuong test ZIP vs Poisson	Z = 5.86 (Pr > z 0.0000)

*** significant at the 0.1% level, ** significant at the 1% level, and * significant at the 5% level. The t statistics are in brackets. The constants are not shown in the regressions tables. The inflate regression determines whether the count is zero. Omitting Inflate would be equivalent to fitting the model with a Poisson regression. The Vuong test statistic has a standard normal distribution with large positive values favouring the ZIP model and large negative values favouring the Poisson model.

After introducing covariates based on the information related to the statements in sections D-E , the ZIP models show that agreement with the following statements is positively correlated in the multivariate econometric setting. Different versions of the E-D related covariates are constructed, based upon the likert scale, as sensitivity test. Table 9 shows a summary of main results. The detailed regressions are then shown in tables 10 and 11[21].

Table 9: Innovation intensity correlations with key farmer's statements

Section D (positive correlations with innovation intensity)		'versions' of the covariate based on the likert scale
D21	Whenever my friends or family are having a hard time, I support them, even at the cost of my farming results.	Both for 'strongly agree' and ' strongly or somewhat agree' dummies
D23	A good farmer should support the other farmers in his/her community (even if they are not friends or family) whenever they are having hard times, even at the cost of his/her farming results.	Only for the 'strongly or somewhat agree' dummy
D25	A good farmer should always prioritize her/his own farming results, even if this means s/he is not able to help other farmers in the community (**that are not friends and family**).	Both for 'strongly agree' and ' strongly

[21] The three covariates of the 'Inflate regression' do represent logit coefficients for the variables predicting excess zeros (see https://stats.idre.ucla.edu/stata/dae/zero-inflated-poisson-regression/).

		or somewhat agree' dummies
D26	A good farmer should always prioritize her/his own farming results, even if this means s/he is not able to help other farmers in the community (**even if they are friends or family**).	Both for 'strongly agree' and ' strongly or somewhat agree' dummies
Section E (positive correlations with innovation intensity)		
E12	They consider me as an example.	Both for 'strongly agree' and ' strongly or somewhat agree' dummies
E21	I am happy for him/her.	Only for the 'strongly or somewhat agree' dummy

The core factors (literacy and income in the core part of the specification) are significant and positive. The evidence on good farmer visions shows that agreement with the statements "*A good farmer should support the other farmers in his/her community (even if they are not friends or family) whenever they are having hard times, even at the cost of his/her farming results*" and "*A good farmer should always prioritize her/his own farming result, even if this means s/he is not able to help other farmers in the community (even if they are friends or family)*" are both positively related to the 'intensity' of innovation.
Overall, it is confirmed that both altruistic and individualistic behavioural motivations can be behind innovative choices.

Table 10: Intensity of Innovation (with related variables from sections E and D)

Estimation	Zero inflated Poisson					
Dependent variable	COUNTINNO					
	[1]	[2]	[3]	[4]	[5]	[6]
AGE	0.003	0.003	0.003	0.003	0.004	0.003
	[1.34]	[1.31]	[1.29]	[1.40]	[1.74]	[1.30]
GENDER	-0.024	-0.007	0.0432	0.035	0.020	-0.005
	[-0.24]	[-0.09]	[0.54]	[0.45]	[0.27]	[-0.07]
LITERACY	0.213*	-0.206*	0.228**	0.206*	0.205*	0.199*
	[2.48]	[2.36]	[2.74]	[2.47]	[2.50]	[2.30]
HIGHINCOME	0.256**	0.268**	0.298***	0.276***	0.270**	0.259**
	[2.75]	[0.012]	[3.37]	[3.10]	[3.12]	[2.86]
D21	0.173					
	[1.62]					
D23		0.097				
		[1.16]				
D25			0.418***			
			[5.23]			
D26				0.373***		
				[4.00]		
E12					0.215**	
					[2.87]	
E21						0.150*
						[2.02]
INFLATE REGRESSION						
INFOTRAINING	-2.00***	-1.99***	-2.03***	-1.97***	-1.97***	-2.02***
	[-4.91]	[-4.96]	[-4.93]	[-5.03]	[-5.00]	[-4.95]
PROVINCE	-1.51***	-1.49***	-1.49***	-1.45***	-1.97***	-2.00***
	[-3.54]	[-3.56]	[-3.54]	[-3.57]	[-3.62]	[-3.55]
SAVING	-1.23***	-1.26***	-1.28***	-1.27***	-1.26***	-1.26***
	[-3.06]	[-3.16]	[-3.15]	[-3.21]	[-3.16]	[-3.12]
N. Obs.	300	300	300	300	300	300
Wald chi2 (5)	21.27	19.57	34.52	27.26	25.32	22.13
Vuong test ZIP vs Poisson	5.63	5.79	5.73	5.93	5.84	5.73

*** significant at the 0.1% level, ** significant at the 1% level, and * significant at the 5% level. The t statistics are in brackets. The constants are not shown in the regressions tables. Nonzero observations = 221. The E and D variables refer to 'strongly agree' answers. Other results for dummies E and D are available on request.

Table 11: Intensity of Innovation (with related variables from sections E and D - additional analysis)

Estimation	Zero inflated Poisson					
Dependent variable	COUNTINNO					
	[1]	[2]	[3]	[4]	[5]	[6]
AGE	0.0037	0.0034	0.0036	0.0036	0.0034	0.0038
	[1.40]	[1.31]	[1.38]	[1.41]	[1.25]	[1.41]
GENDER	0.001	-0.0155	0.035	0.0181	0.004	0.008
	[0.002]	[-0.19]	[0.44]	[0.23]	[0.06]	[0.10]
LITERACY	0.193*	0.200*	0.275**	0.230**	0.205*	0.215*
	[2.26]	[2.36]	[3.28]	[2.75]	[2.42]	[2.49]
HIGHINCOME	0.263**	0.259**	0.302***	0.284***	0.251**	0.282**
	[2.91]	[2.91]	[3.54]	[3.26]	[2.70]	[3.11]
D21	0.440**					
	[2.59]					
D23		0.277*				
		[2.33]				
D25			0.279***			
			[3.73]			
D26				0.209*		
				[2.41]		
E12					0.169	
					[1.87]	
E21						0.023
						[0.29]
INFLATE REGRESSION						
INFOTRAINING	-1.94***	-1.94***	-2.04***	-1.98***	-1.99***	-1.99***
	[-4.94]	[-4.95]	[-4.92]	[-4.99]	[-4.93]	[-4.96]
PROVINCE	-1.48***	-1.47***	-1.56***	-1.50***	-1.50***	-1.51***
	[-3.55]	[-3.57]	[-3.62]	[-3.60]	[-3.54]	[-3.58]
SAVING	-1.27**	-1.25**	-1.27**	-1.29**	-1.26**	-1.25**
	[-3.16]	[-3.16]	[-3.11]	[-3.21]	[-3.11]	[-3.13]
N. Obs.	300	300	300	300	300	300
Wald chi2 (5)	27.82	26.71	41.11	32.50	24.08	19.91

*** significant at the 0.1% level, ** significant at the 1% level, and * significant at the 5% level. The t statistics are in brackets. The constants are not shown in the regressions tables. Nonzero observations = 221. Variables E and D refer to 'strongly' or 'somewhat agree' answers, respectively. Other results for dummies E and D are available on request. The Stata command 'technique (nr 15 dfp 5 bfgs 5)' is introduced to implement a different estimation procedure and allow convergence.

Analogous to the PM-NBM model comparison, the ZIP and ZINB can be relatively assessed through the AIC and BIC values. Again, the two tests show similar figures, which tend to slightly favour the ZIP. Additionally, the likelihood test does not reject the null hypothesis that the ZIP and ZINB[22] are equal[23].

[22] Due to the possible existence of local maxima in the ZINB, as the ZINB often converges to local maxima of the likelihood function (Santos Silva, 2017), the ML iteration often does not converge. The Stata command 'technique (nr 15 dfp 5 bfgs 5)' is introduced to implement a different estimation procedure and allow convergence.

[23] The evidence from the ZINB results is the same as that from the ZIP models, which to some extent replicates the mixed evidence delivered by the PM – NBM tests. The ZINB results are available on request.

Overall, the various estimation procedures (PM, NBM, ZIP and ZINB) convey very robust evidence on the intensity of the innovation drivers across models. Overdispersion does not seem to be a crucial issue in the case of the intensity of adoption.
Various information from sections D and E (four from D) are significantly explaining innovation variance, in addition to the set of core socio-economic covariates. A diversified set of behavioural attitudes regarding the vision and perspective on the good farmer role, which captures communitarian/individualistic motivations and concerns social stigma effects, enriches the understanding of innovative behaviour in a rural community of farmers exposed to a transition towards new, and possibly more innovative, inputs. In order for innovation adoption to increase both economic performance and social wellbeing, the social features and latent/nonobservable motivations that exist in a given community should be considered and analysed in detail. The sustainability of innovation adoption depends on considering a diversified set of heterogeneous motivations, preferences and attitudes of the community, which show individuals and relationships between individuals, with strong consolidated ties that have developed over time. The roles of education, information and training, saving and the economic and cultural factors that characterize the relationships within a community are crucial.
The key messages are that the transition towards a more intense innovation activity is determined by (i) education, information and training, which are relatively more relevant to creating an innovative milieu (turning noninnovators into innovators); (ii) communitarian and individualistic ways of thinking both play a role as innovation drivers, where the transition needs to learn from the past, be rooted in local cultural values (community relationships), and include new behavioural determinants (individualism).

4.3 Radical innovation adoption: drivers and barriers

The set of estimates regresses the set of dependent variables about *radical innovations* on a vector of covariates that pertain to socioeconomic elements (age, gender, income, literacy, saving and borrowing actions) and to training and learning. We then test specific hypotheses regarding the effects of good farmer social norms on radical innovation by introducing information derived from sections D and E of the questionnaire.

Table 12 presents a set of estimates – corrected for heteroscedasticity - that show that various elements play a role in determining radical innovations: income, literacy (capacity to read and write), saving and borrowing behaviour, and information received on input issues. Geographical effects are also impactful, while age and gender (being female) do not seem to prevail in a multivariate setting. Chi-squared test figures and the pseudo-R^2s show that the regressions are significant and robust.

High income and information received ("*Has your household ever received any information on how to use input or technologies (including training)?"*) support the more radical adoptions (RAD3 and RAD2), which is consistent with the results already achieved in other papers. More specifically, risk aversion in situations in which insurance markets are absent generally induces wealthier farmers to be more likely to adopt new technologies, at least initially, given their ability to afford both pecuniary costs and the opportunity costs in terms of the labour and land that must be devoted to the new technology (Dercon and Christiaensen, 2011; Moser and Barrett, 2006). In addition, this is even stronger for more radical technologies that are riskier and often need

complementary inputs to be adopted. Regarding the role of the learning process, it is elemental to encompass ignorance both on the returns connected to the new technology and on how to use the new technology to receive higher returns. In the case of farmers in developing countries, the main sources of information are training, their own experience, and other farmers' choices (Bandiera and Rasul, 2006). Increasing the role of the learning process should accelerate adoption and diffusion, especially in situations of new and more sophisticated technology (Duflo et al., 2011; Nelson and Phelps, 1966)[24].

Table 12: Baseline results for radical innovations

Estimation method	LOGIT			
Dependent variable	RAD2	RAD2	RAD3	RAD3
	[1.]	[2.]	[3.]	[4.]
AGE	0.0127 [1.30]	-0.001 [-0.09]	0.0161 [1.66]	-0.0014 [-0.09]
GENDER	-0.222 [-0.71]	-0.244 [-0.54]	-0.093 [-0.30]	-0.115 [-0.22]
LITERACY	0.457 [1.57]	-0.008 [-0.02]	0.741** [2.59]	0.301 [0.66]
SAVING	0.573* [2.06]	0.272 [0.71]	0.629* [2.23]	0.411 [1.00]
BORROW	0.702* [2.30]	0.519 [1.26]	0.586 [1.88]	0.478 [1.10]
INFOTRAINING	0.956*** [3.38]	1.315*** [2.79]	1.077*** [3.88]	1.357*** [2.58]
HIGHINCOME	0.639 [1.71]	1.317*** [3.23]	0.472 [1.23]	1.354*** [3.18]
PROVINCE	-0.046 [-0.16]	-1.098** [-2.59]	-0.162 [0.56]	-0.945* [-2.04]
N. Obs.	300	300	300	300
Wald chi2(8)	41.18	30.29	46.35	28.26
Pseudo R^2	0.119	0.116	0.138	0.121

*** significant at the 0.1% level, ** significant at the 1% level, and * significant at the 5% level. The t statistics are in brackets. The constants are not shown in the regressions tables.

Next, to test the set of core hypotheses, a series of regressions that insert the various information derived from sections D-E of the questionnaire in the baseline regression is conducted[25].
For simplicity, the various and specific regressions that present the main evidence over the correlations between the answers to questions in sections D-E and radical innovations (the vectors rad2, rad3, RAD3, and RAD2) are available on request, and a summary table of the results is constructed (Table 13) for visualizing main outcomes.
Overall, the econometric results using logit and two-step Heck-probit regressions[26], when fitting, show that the relevant behavioural features that drive or correlate with radical innovation adoption are those related to questions D23, D25, D26, E12 and E23. Both positive and negative correlations

[24] In addition, if simpler radical innovation adoption (*of at least one category of innovation*) is defined as the dependent variable, the regression is robust and mainly driven by three factors: saving, information and training on how to use inputs and geographical dimensions (Manica area showing other things being equal to more innovation adoption). Results are available on request.

[25] We insert dummies that have a value of 1 when the answer is either 'strongly agree' or 'strongly agree or somewhat agree'. A series of regressions are tested by varying the different covariates from sections D and E, which are inserted in the baseline regression. We present the summary of all series of regressions. All the results are available on request.
[26] The model is a probit with sample selection. In the first stage, only innovation adoption is explained; then, within the set of innovators (221 out of 300), the determinants of radical innovation are investigated (see Cainelli et al. 2020).

are highlighted. The results (table 13) are shown and commented on below. The evidence of the covariates that informed the baseline specification are overall unaffected by the introduction of the additional dummies from sections D and E.

Table 13: results about good farmer social norm and radical innovation

Questions in section D		*Significance and correlation with radical innovation category*
D23	A good farmer should support the other farmers in his/her community (even if they are not friends or family) whenever they are having hard times, even at the cost of his/her farming results	Positive correlation (statistically significant at 10%) with RAD2[27]
D25	A good farmer should always prioritize her/his own farming result, even if this means s/he is not able to help other farmers in the community (that are not friends and family)	Positive correlation (statistically significant at 5% in the heckprobit model with selection, 1% in the simple logit model) with respect to RAD3, rad2, rad3[28]
D26	A good farmer should always prioritize her/his own farming result, even if this means s/he is not able to help other farmers in the community (even if they are friends or family)	Positive correlation (statistically significant at 5%) with respect to 'non innovation adoption'.
Questions in section E		
E12	They consider me as an example to follow to improve their farming work	The heckprobit estimation shows Positive correlations between rad2 and rad3 and the dummy representing both 'strongly agree and somewhat agree' are found (Statistical significances are 5 and 1% across regressions) In addition, positive correlations between RAD2, RAD3 and the dummy 'strongly agree' are found (Statistical significances are 5 and 1% across regressions).
E23	You are envious of his/her results but you let him/her continue to success	The heckprobit estimation shows that The correlation is *negative* (with respect to rad3) at 10% and 1% of significance by using 'strongly agree and somewhat agree' or only 'strongly agree' as dummies

Regarding section D on the prevailing social norm of a good farmer within the rural community, it is worth noting that the information derived from the theme '*A good farmer should support the other farmers in his/her community (even if they are not friends or family) whenever they are having hard times, even at the cost of his/her farming results*', which shows a social proactive behaviour (oriented towards society and community), is positively correlated with respect to RAD2, which has a somewhat strong radicalness, representing 13% of innovators.
On a more individualistic orientation, the dummy constructed on the issue '*A good farmer should always prioritize her/his own farming result, even if this means s/he is not able to help other*

[27] In case D.2.3, the considered answer is 'strongly agree'.
[28] In case D.2.3, the dummy variable the results refer to is constructed on the 'strongly agree' answer, which presents higher statistical significance.

farmers in the community (that are not friends and family)' is also positively correlated with most definitions of radical innovations (but not the previous RAD2). The evidence is strong, showing that a complementary set of motivations exists behind innovative behaviour within the community. It is interesting to note that instead, when focusing on the very polar statement '*A good farmer should always prioritize her/his own farming result, even if this means s/he is not able to help other farmers in the community (even if they are friends or family)*', the correlations with radical innovations are not significant, while people who agree with this statement are more likely to be within the cluster of noninnovators. A very polarized nonaltruistic behaviour undermines innovation adoption in its roots.

5. Concluding remarks

This paper analyses the role of social norms on farmers' innovation adoption in rural farming communities in Sub-Saharan Africa.

The survey of 300 farmers in Mozambique shows that the social norm of 'being a good farmer' is somehow different from that mostly shared in developed market based economies. What emerges in this study is a collectivistic social norm of a good farmer who is extremely concerned about others. Moreover, this collectivistic image does not prevent a positive social perception of achieving farming results better than the average.

The analysis investigates the main drivers of Mozambican farmers' innovation adoptions, especially of the most radical ones, such as fertilizers, pesticides and herbicides. Special consideration is dedicated to analysing whether the collectivistic good farmer identity constitutes an obstacle to innovation.

The message derived from the analysis of 'innovators' and radical innovators through econometric estimations is that information, learning and other socioeconomic factors, such as income level, move farmers towards innovations (of any kind). Education, information and training are relatively more relevant to creating an innovative milieu (turning non-innovators into innovators).

When analysing the information on the various socially or self-oriented perspectives of the good farmer identity, we note that both communitarian and individualistic ways of thinking may be correlated with (radical) innovation adoptions. However, when the individualistic perspective is excessively polarized, the correlations are negative: radical innovative behaviour is undermined by an extreme selfish perception of good farmer identity.

Conversely, the more prosocial perception of good farmers never constitutes an obstacle to radical innovation. Therefore, the prosocial idea of good farmers that prevails in rural communities not only does not prevent farmers from undertaking innovative solutions but also has a significant impact on the adoption of the most radical ones.

Moreover, this community-based identity of good farmers is consistent with feelings of approval and emulation with respect to farmers with highly productive results, so the positive perception of being an example for others when farming results are higher than the average is positively correlated with the adoption of radical innovation. Conversely, the negative feeling of envy that involves active boycotting behaviour is negatively correlated with radical innovation adoption.

While changes to the institutional and socioeconomic structure may incrementally improve innovative behaviour (e.g., more market-based systems, incentives based on rewards, etc.), policies and development strategies aimed at enhancing business performance through innovations should consider the idiosyncratic and historically determined local culture and social structure.

Information and training are crucial, and it is crucial to consider that socially oriented, community-based perspectives might also be positively correlated with innovative behaviour, even very radical innovative behaviour.

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Appendix

Table A1 – Main correlations

	GENDER	LITERACY	HIGHINCOME	INFOTRAINING	SAVING	AGE
GENDER	1.00					
LITERACY	-0.269	1.00				
HIGHINCOME	-0.077	0.160	1.00			
INFOTRAINING	-0.069	0.230	0.052	1.00		
SAVING	0.075	0.159	0.059	0.156	1.00	
AGE	-0.180	-0.029	0.009	0.131	0.049	1.00

Table A2 – Main Descriptive statistics (ind. Variables)

	Mean	Std. Dev.
GENDER	0.343	0.47
LITERACY	0.626	0.48
HIGHINCOME	0.133	0.34
INFOTRAINING	0.610	0.48
SAVING	0.376	0.48
BORROW	0.256	0.43
AGE	42.32	13.88