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Understanding farm trajectories and development pathways: Two decades of change in southern Mali

Gatien N. Falconnier [a,b,*], Katrien Descheemaeker [b], Thomas A. Van Mourik [c], Ousmane M. Sanogo [d], Ken E. Giller [b]

[a] International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), BP 320 Bamako, Mali
[b] Plant Production Systems, Wageningen University, PO Box 430, 6700 AK Wageningen, The Netherlands
[c] Helen Keller International, Africa Regional Office, PO Box 29.898, 11 Nord Foire Azur, Yoff, Dakar, Senegal
[d] Institut d'Economie Rurale (IER), ESPGRN-Sikasso, P.O. Box 186 Sikasso, Mali

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ABSTRACT

Institutional support for smallholders has been the motor for the expanding cotton production sector in southern Mali since the 1970s. Smallholder farms exhibit diverse resource endowments and little is known on how they benefit from and cope with changes in this institutional support. In this paper we explore farm trajectories during two decades (1994 to 2010) and their link with farm resource endowment and government support. We distinguished a favourable period for cotton production and an unfavourable period during which institutional support collapsed. A panel survey that monitored 30 farms in the Koutiala district in southern Mali over this period was analysed. Based on indicators of resource endowment and using Ascending Hierarchical Classification (AHC), farms were grouped into four types: High Resource Endowed farms with Large Herds (HRE-LH), High Resource Endowed (HRE) farms, Medium Resource Endowed (MRE) farms and Low Resource Endowed (LRE) farms. Average yield, labour productivity and food self-sufficiency status of each type were calculated. Farms remaining in the same type were classified as 'hanging in', while farms moving to a type of higher yields, labour productivity and food self-sufficiency status were classified as 'stepping up', and farms following the opposite trajectory of deteriorating farming conditions were classified as 'falling down'. The LRE farms differed from all other farm types due to lower yields, while both LRE and HRE farms differed from the MRE and HRE-LH farm types due to a combination of less labour productivity and less food self-sufficiency. During those two decades, 17% of the farms 'stepped up', while 70% of the farms remained 'hanging in', and only 13% of the farms 'fell down'. We found no obvious negative impact of the collapse of government support on farm trajectories. For MRE, HRE and HRE-LH farms, average N and P use intensity increased from 1994 to 2004 and then decreased during the following cotton crisis. On the other hand, organic fertilizer use intensity increased continuously over the entire monitoring period for HRE-LH and MRE farms. Crop yields did not change significantly over time for any farm type and labour productivity decreased. We discuss how technical options specific for different farm types (increase in farm equipment, sale of cereals, incorporation of legumes and intensification of milk production) and broader institutional change (improvement in finance system and infrastructure, tariffs) can enhance 'step up' trajectories for farming households and avoid stagnation ('hanging in') of the whole agricultural sector.

1. Introduction

Cotton production and export from West Africa grew rapidly over the last four decades and government support provided inputs for more than one million cotton-producing smallholder farm families (Gabre-Madhin and Haggblade, 2004). In Southern Mali, cotton earnings have been used to invest in livestock, providing animal traction (Dufumier and Bainville, 2006) and contributing to enhanced land and labour productivity and food self-sufficiency (Tefft, 2010). Smallholder farms are diverse in their resource endowment and production objectives (Giller et al., 2011), and respond differently to changing conditions, with the poorest often left behind (Hazell et al., 2010; Valbuena et al., 2014). In West Africa, fluctuating cotton world prices and restructuring or privatization of state-owned companies intensify uncertainties for farmers (Fok, 2010). Little is known of what types of farm households benefited most from institutional support for cotton production, nor of how farmers cope with changing production conditions. Farm typologies can help in understanding farmer diversity and

* Corresponding author at: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), BP 320 Bamako, Mali.
E-mail addresses: gatien.falconnier@wur.nl, falconniergatien@yahoo.fr (G.N. Falconnier).

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allow analysis of the impact of development interventions (Iraizoz et al., 2007). Typology studies have revealed links between the current farm resource endowment and soil fertility status (Tittonell et al., 2010; Zingore et al., 2007), adaptation strategy (Zorom et al., 2013), land productivity, profitability and labour productivity (Senthilkumar et al., 2012). Yet most studies depend on single snapshots in time from one-off household surveys (Senthilkumar et al., 2012; Tittonell et al., 2010; Zorom et al., 2013) and do not allow analysis of how farms cope in response to fluctuating external forces. In a developed country context, based on detailed agricultural censuses and land use monitoring datasets, Mignolet et al. (2007) showed the link between the European Common Agricultural Policy and specialization of farms towards cash crops and disappearance of livestock at regional scale. Landscape spatial organization dynamics in link with farmer decisions, market conditions and public policies has also been well documented in various European countries (Schaller et al., 2011; Stoate et al., 2009). Dynamic farm typologies in Guadeloupe (Chopin et al., 2014) showed how access to irrigation schemes can trigger diversification of farm systems. In the African smallholder context, studies explaining trends in agricultural systems are rare. Some explored the long-term impact on land use change of political context, demography and markets at village or regional scale (Benjaminsen et al., 2010; Ebanyat et al., 2010; Sassen et al., 2013). Others relied on individual recall of household heads to understand how they cope in response to changing production conditions (Dufumier and Bainville, 2006).

A longitudinal survey (i.e. repeated observations of the same variables over time) monitored 30 farms in the cotton zone of Southern Mali from 1994 until 2010 (Djouara et al., 2005; Sanogo et al., 2010). This dataset provides a rich basis to explore the trajectories of farm development in terms of land and labour productivity and food self-sufficiency over two decades in relation to the influence of external factors. We explored two hypotheses, namely that: (i) stratification according to farm resource endowment explains heterogeneity in land and labour productivity and food self-sufficiency and (ii) favourable cotton prices stimulated farm development while unfavourable cotton prices had the opposite impact. We use this analysis to propose options for sustainable intensification that may be suitable to the different types of smallholder farms in Southern Mali.

2. Materials and methods

2.1. Description of the different steps of the method

The methodology for this longitudinal study includes five steps: (i) the building of a farm typology using a set of key resource endowment variables in the first year of the monitoring, (ii) the generation of fixed thresholds for the classification of farms in the remaining years, (iii) the computation of indicators of land productivity (crop yields), labour productivity and food self-sufficiency for each farm for each year, (iv) the assessment and quantification of farm trajectories i.e. change from a type to another, and (v) a focus group discussion with farmers in order to validate the typology and add insights in the different trajectories. Variables explaining yield variability between farms and farm type can be collected/computed and include agro-ecological conditions, input use (e.g. mineral and organic fertilizer), land investment (e.g. soil bunds, trees) (Gigou et al., 2006), access to information (extension services), services (e.g. credit) and markets for inputs and outputs. Food self-sufficiency can be assessed either by measuring the number of months per year when the household is food self-sufficient (Tittonell et al., 2010; Valbuena et al., 2014) or by comparing the sum of basic energy requirements of the different members of the household to on-farm cereal production (Andrieu et al., 2015; Paassen et al., 2011; Tittonell et al., 2009).

2.2. Study area

The study area is located in Koutiala district in the cotton zone of Southern Mali, between the 800 mm and 1000 mm isohyets. Yearly rainfall fluctuates from 600 to 1400 mm (Fig. 1a). The population pressure is relatively high compared with the rest of the country, reaching 70 people km^{-2} (Soumaré et al., 2008). The dominant crops are cotton, maize, sorghum, millet and groundnut where organic fertilizer is applied on cotton, and mineral fertilizer solely on cotton and maize (Kanté, 2001). Farmers rely largely on cotton, maize and livestock for income and on maize, sorghum and millet as staple foods. Crop–livestock interactions are a key element of the farming systems of the area, accounting for good cotton and cereal yields, food self-sufficiency and income generation. Draught power allows for improved timeliness of farming operations to cope with the erratic distribution of rainfall, while application of livestock manure has positive feedbacks on crop productivity (Kanté, 2001).

2.3. Dataset

We analysed a dataset collected by the 'Equipe Système de Production et Gestion des Resources Naturelles (ESPGRN)' of the Malian Institut d'Economie Rural (IER). This dataset contains 17 years (1994–2010) of data on household resource endowment (total cropped land and area of the different crops, composition of the household, animals owned, number of tools), input use (mineral fertilizer, herbicides, pesticides and manure) and farmer-estimated yields (cotton, maize, sorghum and millet) for 32 farms from three villages of the Koutiala area. Of this sample, 12 farms were located in the village Try (12° 16′ N and 5° 23′ W), 8 farms in M'Peresso (12° 17′ N and 5° 20′ W) and 10 farms in N'Goukan (12° 21′ N and 5° 19′ W). The farms were selected purposively

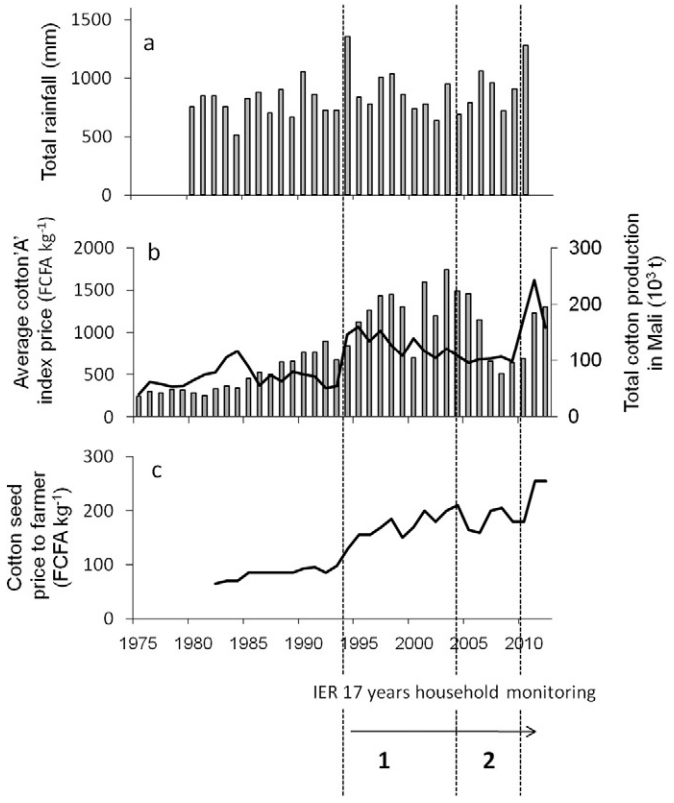

Fig. 1. The context of rainfall and cotton price in the Koutiala area, showing two distinct periods within the household monitoring period (1994–2010). (a) Annual rainfall. (b) Average cotton 'A' index price (line) and total cotton production in Mali (bars). (c) Cotton seed price paid to the farmer. Period 1 = the favourable context for cotton production, period 2 = the unfavourable period when support from CMDT collapsed.