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Old tractors, new policies and induced technological transformation: agricultural mechanisation, class formation, and market liberalisation in Ghana

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ABSTRACT

This article examines the recent uptake of tractor ploughing services in northern Ghana. It examines the historical continuities in mechanisation and the emergence of a class of medium-scale commercial farmers. In the light of this, it questions the thesis that the recent uptake of mechanisation and emergence of medium-scale farmers reflects the successes of market liberalisation. It is critical of neoclassical theories of agricultural transformation rooted in theories of induced innovation and argues for a political economy approach that links agricultural transformation to processes of social differentiation and the historical role of the state in promoting agricultural commercialisation.



KEYWORDS

Agricultural mechanisation; state-market relations; agricultural commercialisation; induced technology transformation; Ghana

Introduction

The International Food Policy Research Institute (IFPRI) has conducted a number of important studies into agricultural commercialisation in Ghana, which attempt to revise the framework for agricultural development policy. This points to the emergence of a class of medium-scale farmers that is significantly increasing agricultural productivity and output, and transforming investments in new technologies (Jayne et al. 2019). This is resulting in a significant uptake of agricultural mechanisation in some areas by medium-scale farmers investing in tractors, and among smallholder farmers who are hiring tractor-ploughing services provided by these medium-scale farmers (Diao et al. 2014). This has led a new model of agricultural change in which medium-scale farmers and mechanisation act as a catalyst for agricultural commercialisation.

This framework challenges the dominant paradigms of agricultural development theory that arose in the 1970s and 1980s, which promoted smallholder agriculture, improved seeds and synthetic inputs, and was largely dismissive of agricultural

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This article is part of the Special Forum on 'Tractor politics in Africa' guest edited by Kojo Amanor and Lidia Cabral. The latest wave of mechanisation policies introduced by governments in Africa are framed in the language of liberal markets, enabling states, and public-private partnerships. Besides their role in state-mediated global capital accumulation, tractors are vehicles of accumulation that feed ongoing processes of social differentiation and class formation locally. They illustrate the enduring process of commodification of land, farming, and agrarian relations that benefits the few and subjugates the many. And they continue to stir debates on states and markets in African agriculture that remain fundamentally unresolved. This article has been republished with minor changes. These changes do not impact the academic content of the article.

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mechanisation as inappropriate, given the nature of the factors of production in Africa. The promotion of mechanisation by states was portrayed as facilitating 'urban bias' or elite town-based commercial agricultural interests (Lipton 1977). The most comprehensive critique of mechanisation from the 1970s was associated with World Bank scholars, working on the theory of induced innovation in agriculture, including Hayami and Ruttan (1971) and Pingali, Bigot, and Binswanger (1987). They argued that given the realities of the existing conditions of agricultural production in Africa, mechanisation was not cost-effective. It was characterised by high costs of land clearance, which did not reflect the existing productivity of agriculture, the dominance of rotational bush fallowing systems, and the ready availability of land. Hence, they advocated intermediate technology land-clearing solutions, such as bullock ploughing, and a focus on raising productivity through introduction of new seeds and synthetic inputs. Diao et al. (2014) have revisited this thesis and revised it to account for contemporary conditions, arguing that the favourable conditions created by the liberalisation of agricultural markets have resulted in the expansion of both medium-scale and smallholder farming. They argue that this expansion has resulted in a shortage of labour, creating favourable market conditions for investments in tractors and the use of tractor ploughing services. In arguing this case, they make several assumptions about the relationship between states and markets, about the impact of historical developments in society on contemporary society, and on the continuities and discontinuities of development policies and impact of policy paradigms, which are critiqued within this article.

Mrema, Baker, and Kahan (2008) have argued that the field studies conducted from the 1960s to 1980s that informed theories on induced innovation did not provide sufficient data on which to make sweeping generalisations about mechanisation, and did not incorporate a sufficiently long-term analysis of changing patterns of mechanisation and the impact of state policies on agriculture. Similarly, we argue that the revision of the theory of induced innovation does not develop a sufficiently broad socio-economic framework or historical depth in which to examine the transformation of agricultural mechanisation. Fortunately, the excellent study by Konings (1986) of the role of the Ghanaian state in rural class formation and agricultural commercialisation provides a wealth of detail, which has enabled us to trace back the relationship between the emergence of a class of medium and large-scale commercial farmers and mechanisation back to the 1960s and 1970s. It also provides critical insights into the role of the state in facilitating the expansion of both commercial farmers and mechanisation.

This study critically re-examines the emergence of commercial agriculture and mechanisation in northern Ghana, tracing back the continuities and discontinuities to the 1960s and 1970s. It examines the importance of placing these within a wider political economic framework of rural class formation and capital accumulation. In this it finds that many of the characteristics of medium-scale farmers, including their roots in urban trading and civil servant classes, which have recently been seen as the positive product of the expansion of agricultural markets, are very similar to the commercial farmers of the 1960s and 1970s. It argues that contemporary patterns of mechanisation are the product of a long history with origins in state agrarian policies in the 1960s and 1970s.

This contribution also critically examines political discourses about the relationship between state, market and community contained in these market reform narratives about agricultural mechanisation and agricultural development in northern Ghana. It

explores these relationships through a historical reconstruction based on secondary documents from the 1960s and from the accounts of farmers. This is supplemented by research based on an open-ended questionnaire survey sampling five communities, which focuses on the relationship of farmers to the various factors of production.

The first section of this article critically examines the conceptualisation of the role of the state and market in agricultural development. This is followed by an exposition of the theory of induced technology change and its application to mechanisation and revision in the context of market liberalisation and expansion of private tractor ploughing services. The third section addresses the role of mechanisation in contemporary patterns of agricultural transformation in the Northern Region of Ghana based on interviews conducted with farmers and historical evidence. The final section develops a long-term historical framework for examining mechanisation policy within a political economy framework that traces patterns of capital accumulation and class formation within the agrarian sector from the 1960s, and examines the relationship between patterns of capital accumulation and agrarian policy. This addresses the continuities and discontinuities in the agrarian structure following the introduction of market liberal reforms during the 1980s.

Conceptualising the state in agriculture

The concept of state-led mechanisation, in which governments distribute and subsidise tractors for wealthy farmers, or create tractor centres that hire out services to farmers, is problematic in that African states never manufactured tractors. The tractors that ploughed state farms came from the factories of John Deere and Massey Ferguson. Their operations on these state farms involved complex networks of relationships between the state, private dealers, multinational corporations, international agricultural development agencies, and aid donors, all operating within a framework of agricultural modernisation. Thus, the framing of 'statist agricultural policies' needs to be deeply scrutinised since this has been used to conflate a wide range of differing socio-political and economic relations; this includes state farms, state organisation of farmer cooperative societies, and 'urban bias' (Lipton 1977).

The concept of market distortion through subsidies in agriculture also needs unpacking. This has been a staple of theory justifying the rolling back of the state in agriculture and external conditionalities following Bates (1981). However, the development of agricultural markets following structural adjustment has been problematic, resulting in low demands for farm inputs and high cost of inputs in relation to farmers' income (Hailu 1990). Consequently, non-governmental organisations (NGOs) played a large role in distributing agricultural inputs to farmers at concessionary prices or through soft loan programmes. The most prominent programme in the 1990s was Sasakawa Global 2000, which distributed large amounts of seeds and fertilisers to farmers. This programme was closely linked with the state, and in Ghana the programme was implemented through government agricultural extension services. When the programme attempted to move to a more strictly implemented cost recovery model it collapsed under the burden of failed loan recovery (Breth and Dowsell 2003). During the early 2000s this was replaced by 'smart subsidies' of seed and fertilisers, which was inspired by the Millennium Villages Project (Sachs 2005). The objectives of 'smart subsidies' was to place inputs in the reach of small farmers, through donor-supported programmes in which government paid a subsidy to private sector input suppliers to maintain lower prices. Again, this programme was implemented through government services with agricultural extension agents

issuing coupons to farmers to redeem against the purchase of inputs. This clearly shows that in contrast with the theory of a new era of private markets facilitating accumulation and expansion of agricultural production, agricultural markets have continued to rely on some form of overt or hidden subsidy paid either by government or programmes sponsored by donors. It is not only Indian and Brazilian tractors that are being subsidised, but also fertilisers and proprietary seeds (Crawford, Jayne, and Kelly 2006; Meyer 2011; Jayne et al. 2019).

Within a historical context the distinction that is been made between state-led and open market agricultural mechanisation policies is very finely drawn. The era of state agricultural services lingered into the early 1990s, when state farms and the large private estates finally collapsed. If a new form of agricultural mechanisation based on liberalised markets emerged in the early 2000s, we cannot assume that there are not substantial continuities between the two, given that a large part of the older developments was characterised by state support for commercial farmers.

The large numbers of tractors that existed in the 1990s did not suddenly vanish. They continued to operate and provide services to farmers, and these services operated within pre-existing tractor service markets. State tractor services were not provided freely, and many of the large-scale commercial farmers also hired out tractor ploughing services to farmers within the communities in which they farmed. While ownership of some tractors may have been transferred from state to private operators following the collapse of state farms, many private operators existed within the period of state-led agricultural commercialisation, and they have continued to exist and operate within historically constituted markets. While the large-scale commercial farmers may have declined during the 1980s their assets must have logically continued to exist in some form or other – they could not all have vanished into the *ash heap of history*. Some of these assets could have been sold on the market, or resuscitated and reconstituted as the economic situation of their owners improved.

A similar problem exists with the depiction of medium-scale farmers as a new development reflecting the success of liberalised market policies. These medium-scale farmers bear strikingly similar characteristics to the commercial farmers that developed under state patronage. They are often urban-based professional and civil servants, just as the old commercial farmers that have been dismissed as representing the political distortions of ‘urban bias’ (Lipton 1977).

The problem of historical continuities can only be disentangled by examining policies critically within a historical context, and by resisting attempts to erase history to serve the creation of doctrines of development (Cowen and Shenton 1996). The linkages between the processes of capital accumulation in agriculture and the formulation of policy and policy discourses need to be investigated critically. The various linkages between the dominant economic and political interests in the commercialisation of agriculture and the processes of social differentiation and capital accumulation need to be explored in a continuous historical dimension, rather than subjected to a static binary conception of statist and free market epochs. Hence this work focuses on the continuities and discontinuities in agriculture across the period of structural adjustment and governance reforms.

Induced innovation and changing factors of production

The theory of induced innovation in agricultural development postulates that farmers are inclined to search for technical alternatives that save increasingly scarce factors of

production by shifting to less scarce factors or by placing demands for new technology that substitute for the more scarce factors. Therefore biological innovations in crop varieties arise to deal with scarcity of land and mechanical innovations arise to deal with labour scarcities. The relative changes in factors of production induce farmers to transform production to compensate for factors that have become scarce or relatively expensive (Hayami and Ruttan 1971).

In applying the theory of induced technological change to agricultural mechanisation in Africa, Pingali, Bigot, and Binswanger (1987) argue the tractors only become effective when land is abundant and labour scarce. In the 1970s land in Africa was abundant but the dominant farming systems were based on low intensity bush fallowing with low labour requirements. This did not create a large demand for hired labour. Moreover these fields were full of tree stumps that easily damaged tractors. This made adoption of mechanisation dependent upon a highly expensive process of clearing the land to create suitable conditions in which tractors could operate. Tractors only become cost-effective when there is a transition to a more intensive farming system, characterised by annual cropping and removal of woody fallows, and where labour scarcity is high. According to Pingali, Bigot, and Binswanger (1987) this stage had not arrived in most parts of Africa during the 1970s, where the prevalence of woody fallows, woody growth and stumps within most African environments required high outlays of capital and labour in clearing and stumping the land which constrained the uptake of tractors. Pingali, Bigot, and Binswanger (1987) argue that mechanisation will remain uneconomical in African farming systems until land and labour become scarce and farming practices are transformed from bush fallowing to more intensive practices. They argue that the most significant evolutionary transition in African farming systems (during the 1970s) was the gradual transformations to more permanent forms of cultivation in which animal traction became significant in replacing manual labour. Animal traction has the advantage of not requiring expensive processes of clearing stumps to make way for ploughing, since draft animals and small ploughs can easily be manoeuvred between trees and stumps. They concluded that although Africa states had invested heavily in promoting tractors, the returns to investments have been poor and unsustainable and often guided more by political patronage than by economic factors.

Pingali, Bigot, and Binswanger (1987) also recognise that there were some African environments in which ploughing could thrive, including floodplains and grasslands. The floodplains are characterised by heavy soils and sparse vegetation. The soils are extremely difficult to work with manual implements, resulting in low population density in these areas. The low population density results in a large availability of land but a scarcity of labour, which creates a favourable combination of relative factors of production to encourage investments in mechanised cultivation. These are suitable environments for the development of commercial rice farming. Grassland areas are also favourable for tractor ploughing when labour is a scarce factor. Since grasslands are difficult to clear with manual labour and fire (and fire does not destroy the root structures or lead to a significant build up of nutrients in contrast with woody fallows), tractors can provide a viable alternative to clearing with hired labour when labour costs are high.

In hindsight, one of the major problems with this theory of induced innovation is the failure of the predicted intermediate stage of animal traction to have taken off in Africa. While manual implements still continue to be used in many areas, others have moved

towards the use of tractor ploughing without any discernible transitional stage of the uptake of animal traction or other alternative forms of small-scale mechanical traction (Mrema, Baker, and Kahan 2008).

Diao et al. (2014) seek to update and revise the theory of induced involution to account for the increasing use of tractors in land clearance in northern Ghana and the current transformations in agriculture. The main revision to the theory of induced innovation lies in accounting for the factors that have resulted in a movement to tractor ploughing without an intermediate stage of animal traction. Diao et al. (2014) argue that there was a pronounced move to annual cultivation in many areas of Ghana in the early 2000s, and an expansion of cropped farms, particular in the main food producing areas in Brong Ahafo, the Northern and Upper West regions following the introduction of favourable market policies. They argue this has resulted in increasing scarcity of agricultural labour, which created favourable conditions for introducing labour-saving technology such as tractors. There has also been a significant emergence of farmers with larger holdings in this period. Farmers cropping more than five hectares of land grew from 12 percent of total farmers in 1992 to 17 percent in 2005/6.¹ They argue that this expansion of a middle stratum of farmers has been carried out without the expropriation of land from smallholders, and smallholders have also expanded their cultivated areas. This has created a situation of rising labour scarcities in relation to land, which creates favourable conditions for the adoption of labour-saving technologies such as tractors. The rapid expansion of urbanisation has also resulted in increasing demands for rice and maize, which are more labour intensive than other crops. At the same time urbanisation has exercised a pull on rural labour, resulting in a scarcity of agricultural labour and the rise in agricultural wages. A 2013 IFPRI survey conducted in the Northern Region founds that 60 percent of farmers used tractor ploughing, including 50 percent of smallholders who hired tractor services (Diao et al. 2014). The expansion of medium-scale farmers has resulted in an increased demand for tractors. But since tractors are capable of ploughing larger areas than those farmed by the medium-scale farmers, they have hired out their excess ploughing capacity to smallholders. This has facilitated the expansion of smallholder farms beyond what they could clear with manual labour. Thus, Diao et al. (2014) argue that market liberalisation policies have created a favourable environment for agricultural expansion of both smallholders and medium-scale farmers, creating increasing demands for labour and favourable conditions for investments in tractors.

The failure of an intermediary stage of animal traction to have materialised in northern Ghana, however, does not really need to be explained, since it is covered by the caveat on floodplains and grasslands. Mechanised agriculture within northern Ghana predominantly takes place in these two environments: floodplains in which rice is cultivated, and grassland environments in which maize is farmed. But these are not newly opened up areas; they are areas with a long history of mechanisation, which were first stumped and cleared in the 1960s and 1970s before structural adjustment. Outside of the Northern Region the major area in which mechanisation is practised is around the Ejura State Farm, another area with a history of state involvement in promoting an infrastructure of tractor ploughing services and synthetic input distribution.

¹This is based on data collected from the Ghana Living Standards Survey of 1991/2 and 2005/6.

The analysis of Diao et al. (2014) is pinned upon the existence of two distinct phases of mechanisation, a failed period of state intervention ending with the market reforms of the 1980s, followed by a phase of market reforms encouraging private sector agricultural growth and the rise of medium-scale farmers. However, this categorisation into two distinct phases is questionable, and undermined by another branch of IFPRI research on mechanisation that is more policy-oriented. This argues that there are two current trends in mechanisation within Africa. The first results from the expansion of the market and dynamic social capital networks between tractor owners, medium-scale farmers and smallholders, which has facilitated the adoption of ploughing services to the needs of smallholder and diverse farming communities (Houssou et al. 2013; Cossar, Houssou, and Asante-Addo 2016; Daum and Birner 2017). The second is constituted by state interventions, and the procurement of subsidised tractors by the state from newly industrialising countries, such as India and Brazil, under concessionary bilateral aid, which threatens to distort markets and undermine private sector tractor dealers. This threat suggests there is no clear-cut distinction between a statist and liberal phase of agricultural mechanisation, and that the state continues to have some influence within agricultural mechanisation – even if this is assumed to be negative. When the existence of various ‘smart subsidies’ in agricultural input markets and civil society interventions into agricultural technology distribution are taken into consideration, this suggests a much more varied market exists, which involves significant public-private partnerships, in which the state intervenes to promote commercial agribusiness solutions.

Contemporary patterns of agricultural commercialisation in northern Ghana

This section examines the main changes in farming practice in contemporary times among smallholders in the Northern Region of Ghana. In contrast with the analysis of Diao et al. (2014), this does not only examine changes in the factors of production, but also in the relations of production at the household level, which are not addressed in the neoclassical framework of induced innovation. It is argued that significant changes have occurred in farming within households, which has resulted in the decline of the extended family compound farm under the authority of the lineage elder, and the rise of the individual farms of younger males and women. These developments are closely connected with both the commercialisation and commodification of agriculture, and the rise of tractor ploughing that enables individual farmers to establish farms without access to a large labour force. However, these developments are associated with the rise of commercial production, the expansion of large farms, and an increasing scramble for land that results in a process of social differentiation. While youth and women are increasingly able to farm in their own right unlike in the past, this takes place in the context of the increasing cost of production, economic pressures and competition for land. This section provides an analysis of the main characteristics of the farming systems in some areas of the Northern Region in which mechanisation has been adopted, and farmer perceptions of the significant changes that have occurred in the relations of production.

Farming systems, factors of production and use of inputs

To gain insights into the relationship between farming practice, changing factors of production and uptake of mechanised technologies an open-ended questionnaire was administered to 500 farmers in five settlements in the Northern Region in 2017.² The survey included 296 men and 204 women. The settlements consisted of areas with a significant inflow of commercial farmers (Nabogu), those situated in the peri-urban fringes around Tamale in which farmland is rapidly being converted into residential properties (Kpunylin and Bogupaligu), and dominantly peasant farming settlements with less land pressures in which fallow land continues to exist on a significant scale (Guntingli and Dohi).³

At Bogupaligu, Kpunylin and Nabogu permanent cultivation is dominant. Only six percent of farmers at Bogupaligu and seven percent at Kpunylin have more than 10 acres of land available for farming, in contrast with 39 percent of farmers at Guntingli and 44 percent at Dohi. At Kpunylin 68 percent of farmers cultivate permanent plots, which falls to around 27 percent of farmers at Dohi. Despite these differences in land scarcity and cultivation, there is a very significant uptake of tractor ploughing – 99 percent of farmers used tractors in clearing land and only one percent animal traction.

The dominant crops planted in all settlements are maize, rice and groundnuts, followed by pepper, yam sorghum and maize (see [Table 1](#)). As agriculture has become more intensive, yam, sorghum and millet cultivation has declined and maize has replaced millet and sorghum as the main staple crop for domestic consumption. Rice and groundnuts are now largely grown for the market. Maize is mainly for domestic consumption but surplus production is also marketed. In the past groundnut was identified as a woman's crop. This is no longer the case as with increasing market demand many men now cultivate groundnuts. With the increasing commercialisation and individualisation of production many women also grow maize and rice. But groundnuts still continue to be the most popular crop among women, because they often only get access to less fertile land, which has been passed on to them by men when it is no longer productive for cereal production. They also have less access to capital to purchase fertilisers to cultivate cereals on less fertile land. This also means that men without sufficient capital to use chemical fertilisers often turn to groundnuts as the fertility of their land declines.

Aside from tractor ploughing, a significant part of farmers' expenditure is on other labour – saving technology. This includes herbicides for weeding, which are used by all farmers on their maize and rice plots. A large number of farmers also hire manual labour, including 63 percent of those cultivating maize, 57 percent cultivating rice and 65 percent of groundnut farmers (see [Table 2](#)). Perhaps, what is most significant is the high patronage of mechanised harvesting services, with around 60 percent of maize and rice farmers hiring combine harvesters or rice shellers to harvest their crops. As noted by Diao et al. (2014) this reflects the high demand for labour, resulting in perceived high prices for manual labour, and competition from labour displacing technology. There is also a high usage of chemical fertilisers on maize and rice farms, which is not surprising since the use of tractor ploughing usually entails a reduction in soil fertility caused by

²The questionnaire dealt with wider issues of agrarian change within northern Ghana, but included a subset of questions specifically dealing with mechanisation issues and access to the various factors of production.

³See Amanor (2019) for a more in-depth analysis of this survey.

Table 1. Main crops planted.

Crop	Male (%)	Female (%)	Total (%)	Total no. of farmers
Maize	90	59	74	370
Rice	90	38	69	343
Groundnut	65	77	70	351
Pepper	31	5	20	102
Yam	19	1	11	56
Sorghum	61	46	55	274
Millet	50	33	43	217
<i>Total no. of farmers</i>	296	204	500	500

Source: Authors' own table.

turning over the topsoil. Expansion of ploughed lands also results in permanent cultivation to maximise returns to the cost of land stumping which also leads to increasing use of synthetic fertilisers. In contrast with the high use of labour-saving technologies and fertiliser few farmers purchase seeds, in spite of the major emphasis of agricultural development programmes and NGO projects on encouraging farmers to use modern varieties and hybrid seeds. The main priorities of farmers are thus with labour and labour-saving technologies. These developments are closely connected with a major transformation in the relations of production. The availability of tractors and ability of farmers to accumulate some modicum of capital have enabled many smallholders to farm in their own right by hiring tractors and labour, rather than work as part of an extended lineage work team under the compound head.

Changing relations of production

According to farmers, in the past the main constraints in farming lay in the short window of opportunity for land clearance. Usually there was about a one-month period between the early drizzles and the onset of heavy rains in which the land had to be ploughed. Too early land preparation would result in the soil drying out and becoming hard before planting. Too late would result in poor yields since the crops missed the heavy early rains. In the past, to meet these constraints a successful farming compound needed access to a large family labour force that could rapidly clear sizeable areas of land in the critical period. This constraint deterred individual farming and the family elders were able to control the family compound farm and the labour of the youth, who played a critical role in clearing and ridging the land. Thus by pooling resources under the control of the elders the family was able to guarantee its food security needs. The coming of tractors removed these

Table 2. Percentage of maize, rice and groundnut farmers using inputs.

Input/service	Farm type		
	Maize (%)	Rice (%)	Groundnut (%)
Tractor ploughing	98	99	100
Mechanised harvesters	63	57	65
Hired labour	63	57	44
Herbicides	100	100	44
Chemical fertilisers	76	76	0
Seeds	20	4	5
No of farmers	370	337	339

Source: Authors' own table.

constraints and enabled individuals to clear large areas of land in their own right by hiring ploughing services. At Nabogu, Fuseina Abukari explained:

Before people started relying on tractors for clearing farmlands it was difficult for the compound (*yiya*) even with a lot of young men to clear more than 20 acres in a season. Now a single young man can clear more than 50 acres in a season.⁴

Farmers are adamant that the rise of tractor ploughing on their lands is not a recent phenomenon, and that the most significant developments, the clearance and stumping of trees, were carried out during the 1960s and 1970s. Haruna Abdulai, an eighty five year old Sub chiefs at Nabogu narrated:

[D]uring the time of Kwame Nkrumah, some Yoruba men and rich people from Tamale brought young men to clear some of the plots towards Pong-Tamale. At first, one Yoruba man tried using bullocks to plough the land, but they could not do much. The soil was heavy and compact. They were not able to plant much that season before the area got flooded. Then, the following year he and his brothers brought a tractor from the south to plough all the land they had cleared. They were the first group of farmers to start using tractors here. Later, I think during the time of Acheampong, people came here with bulldozers to clear most of the rice fields around here.⁵

Similarly, Issahu Abdulai, a farmer interviewed at Nabogu, commented:

Our shift to cultivating large farms started when the government brought bulldozers some years back to clear the *bahi* (floodplain) land around here. The year they cleared these areas, there were a lot of tractors in this village. I think it was the time of Acheampong.⁶ Come and see! The educated men from Accra and Tamale brought their tractors to this village and they were working day and night. It was these town people (*fong nima*) who came with their money and tractors that changed our way of farming in Nabogu here.⁷

The stumping of land in northern Ghana was initially carried out in the 1960s and 1970s. From the 1960s the cooperative societies promoted stumping and ploughing on small-holders' plots. During the 1970s there was a significant expansion of stumping by commercial farmers and they also provided tractor services for farmers within the area. The collapse of the large estates owned by southern farmers during the 1980s and their retreat from northern agriculture created opportunities for farmers within the localities to move into these lands. As Ibrahim Mohammed at Nobogu narrated:

Here At Nabogu rice is our main crop. This is made possible because in the past – I was not born by then but I hear it was under the Acheampong government – the government sent bulldozers to this area to clear all the rice fields here ... We were told that after the Acheampong government was gone most of the farmers abandoned their farms. It is these farms that people in this village are now farming. I only had to do some small clearing of a few trees on my farm when I started farming there. But now I can say it is my farm because no one was farming there again before I went to claim it.⁸

The availability of cheap Chinese bicycles and motorcycles during the 1990s also enabled growing numbers of young farmers to cultivate these areas beyond the village lands

⁴Fuseina Abukari interviewed 27 July 2017 at Nabogu by Azindow Idrissu.

⁵Interview with Haruna Abdulai at Nabogu, 16 July 2017.

⁶Colonel Acheampong was the military head of state from 1972 to 1978.

⁷Issahu Abdulai interviewed 17 July 2017 at Nabogu by Azindow Idrissu.

⁸Interview with Ibrahim Mohammed at Nabogu on 2nd April, 2017).

(Ntewusu and Nabigne 2015). Yakubu Issahaku stated: 'With motorbikes, we can now have farms in villages not close to us here'.⁹

The collapse of the commercial farms and state farms also meant that tractor owners were looking for new markets for their services and began targeting settlements of small farmers within these areas of stumped and floodplain land. These developments enabled a large number of younger and middle-aged rural people to begin farming in their own right, which undermined the control of labour by lineage heads.

This erosion of the control of the household elder over youth labour and land and the availability of ploughing services and means of transport has also enabled women to develop their own farms. According to Salamatu Yussif at Nabogu:

Like the men in this village, I also have a bicycle that I use to ride to my farm. Because of that I don't have to rely on my husband or anybody for a farmland close to the village. I have managed to get people to stump about five acres for me around Gushie where I can go with my bicycle anytime.¹⁰

Similarly, Mariam Kojo at Guntungli recounted:

When we were young, it was very difficult to prepare farmland. Mostly it was the heads of households who used to have large farms. Some of the men in the compounds could also have farms but not women. As for women, our farm activity was collecting shea nuts. Women and even young men are now having their own farms because farming is made easy by these tractors. How was a woman like me going to get people to farm for her? We could not even ask our own children to help prepare farmlands for us. Now we see young women who have not even given birth more than once having their own farms. They do *kaya* (head portering) work or sell their shea nuts [and use the money] to get a tractor driver to clear the farm for them.¹¹

An increasing articulation of gender issues within development programmes and targeting of women's uptake of new technologies may have also encouraged women to establish their own farms. However, NGOs have not only targeted women; many NGOs distribute packages of inputs and seeds freely to farmers or as part of a loan package, which further encouraged and facilitated this expansion of agriculture by individual smallholders. In the 1990s the dominant NGO programme was Sasakawa Global 2000. In 2005 the Agricultural Production Support Programme started distributing packages of inputs, fertiliser and cash to farmers. In the late 2000s Yara and Wienco fertiliser and input companies created the Masara N'arziki programme, which organised farmer groups around the supply of loans in inputs, seeds and ploughing services in contracts in which farmers supplied agro-processing corporations with specific crops (Mangnus and van Westen 2018). The main focus of the Masara N'arziki programme has been to encourage the uptake of hybrid maize varieties and synthetic inputs by smallholder farmers. A similar arrangement has been developed by ACIDI/VOCI, a US NGO working with direct support from DuPont Pioneer and USAID (Guyver and MacCarthy 2011). These developments contrast with the scenario presented by Diao et al. (2014) of dynamic free markets encouraging the expansion of agriculture in the 2000s. In reality, donors have pumped large amounts of credit into the agricultural economy and supported NGOs to encourage

⁹Interview with Yakubu Issahaku at Bogupaligu on 5th May, 2017.

¹⁰Interview with Salamatu Yussif at Nabogu on 20th July, 2017.

¹¹Interview with Mariam Kojo at Guntungli on 2nd May, 2017.

farmers to take up new proprietary crop varieties and inputs through various incentives that are similar to subsidies (Crawford, Jayne, and Kelly 2006; Meyer 2011).

This growth of smallholder agriculture occurs alongside the expansion of medium-scale and commercial farmers. This is creating a scramble for land in the farming areas most conducive to mechanised cultivation and within the hinterlands of the main towns and markets in the Northern Region. Although the Northern Region continues to be characterised by low population and large areas of available uncultivated frontier lands, land is becoming scarce in some areas. The average population density of the Northern Region lies at 35 per km²,¹² the lowest regional population density in Ghana. Although land is readily available in many areas of the Northern Region, many farmers are constrained to move from their villages because of the costs involved in opening up new areas, which is related to the lack of available labour in these areas, the lack of access to tractors, and the high costs of clearing and stumping the land to make way for tractors. Tractor operators are often unwilling to plough in these areas because stumps and root structures exert a high toll on their machinery, and because the distance of these lands from the main settlements where they are based results in high fuel costs. The decline of new state investment in mechanisation has resulted in a decline in the opening up of new plough land. Many private sector investors are unwilling to invest in land clearance since it exerts a high toll on machinery. Ibrahim Napari, a tractor driver based at Nobogu, reflected:

It is becoming very difficult to clear new areas these days. A lot of the rice fields here were cleared when many of us were not even born. I am told they used bulldozers, which were easy to get in those days to clear the farmlands. Today, not many of us can afford to hire a bulldozer. So, we are not making much progress anymore. We are stuck in our old farms because we cannot clear new areas.¹³

In a study of the recent commercialisation of agriculture the Nunumba North District, Aminu (2016) records that the rising commercial farmers are not indigenes within the villages, but civil servants who had accumulated capital and purchased tractors and invested in agriculture. The local chiefs, landowners and elders experience difficulty in getting tractor operators to plough their lands and in finding local labour. Therefore they offer land to commercial farmers in exchange for providing ploughing services. There are no specific terms to the contracts, determining how much land should be ploughed in exchange for access to specific plots of land, but if the landlords are not happy with the areas ploughed they can withdraw it from use by the commercial farmers in subsequent seasons. Some of the commercial farmers are gaining access to large areas of land under these arrangements causing land shortage for smallholders (Aminu 2016).

There are increasing frictions in communities resulting from chiefs releasing land to commercial farmers at the expense of local farmers. Tensions exist between elders, youth, and women over access to land, labour obligations to elders, and increasing social differentiation arising out of the commodification of agriculture. The waning of old patriarchal structures is associated with increasing freedom for non-elders and women to make their own farms. But the repercussions of the commodification of agriculture are increasing expenditures in farming and mounting debt. This results in new

¹²In comparison the neighbouring highly populated Upper East Region has a population density of 109 people per km². The average population density of Ghana is 124 per km².

¹³Interview with Ibrahim Napari, at Nobogu on 18 June, 2017.

processes of social differentiation, in which rising numbers of farmers are now forced to supplement small plot production by hiring out their labour to gain money to invest in agricultural production. There is a ready demand for labour among the rising class of commercial farmers, but also among smallholders who can no longer rely on support from their kin, and who are able to significantly expand the areas they cultivate by hiring tractors to plough the land.

Ploughing has freed up the labour of individual farmers to work on their own. But access to ploughing services is socially stratified. The larger farmers negotiate with the tractor operators to come and work in their farming settlement. They also need to convince small farmers to plough their lands to achieve economies of scale. Access to ploughing is staggered according to wealth and social distinction. The tractors usually plough the farms of the wealthier and senior farmers first and the poorest farmers and women last. Ploughing for the poorest farmers is often late and results in poor yields, reaffirming and deepening the social hierarchy and process of social differentiation. Mangnus and van Westen (2018, 11) report a farmer's comment: 'The plows first attend the bigger and richer farmers, often times they arrive too late at my place, I should already have planted.'

This is clearly a far more complex social situation than that the portrayal by Houssou et al. (2013) of a dynamic social capital and market working in communal solidarity to achieve agricultural development.

Agrarian accumulation, class formation and state agrarian policy

To gain a deeper insight into agricultural commercialisation and the role of tractors in this, the final section examines wider national processes of agrarian accumulation and the relationship between the state, commercial agriculture and the peasantry in this process, tracing back mechanisation policies to their inception in the 1960s as part of a strategy of agricultural modernisation that has shifted between modernising smallholder agriculture and promoting larger commercial farms.

The first attempts to modernise agriculture in Ghana took place in the terminal colonial period during the 1950s, when a public agricultural research system was first created around experimental farms. The Colonial Development Corporation (CDC) played a central role in British agricultural development initiatives, and in developing an ambivalent framework, torn between objectives of supporting private sector agribusiness initiatives, British investors, notions of social welfare and community development, and the local colonial state (Cowen 1984; Grischow 2006; Bracking 2009). The first major intervention in developing agricultural modernisation in the Gold Coast was the Gonja Agricultural Scheme, a CDC initiative implemented in the early 1950s. This sought to combine peasant agricultural work teams with agricultural mechanisation on a 30,000 acres estate in northern Ghana. However by 1953 only 4000 acres of land had been cleared and in 1957 the project was liquidated. Frequent breakdown of machinery and the unsuitability of much of the terrain to tractor cultivation severely thwarted progress (Miracle and Seidman 1968a; Grischow 2006). Other experiments in developing mechanised estate agriculture in the Gold Coast/Ghana led to similar problems in the late 1950s. Miracle and Seidman (1968a, 11–12) comment:

Efforts to introduce mechanization encountered difficulties. Anthills, steep slopes, stumps, roots and rocks caused damage to machine. Cleared land tended to erode when exposed

to the heavy rains. Improper operations of machinery and frequent breakdowns led to increased costs for spare parts and made it necessary to set up local workshops and servicing centres.

Following independence the Convention People's Party (CPP), under the leadership of Nkrumah, continued to develop mechanised agriculture. Agricultural initiatives were organised around three sectors: State Farms, Workers Brigades, and the Union of Ghana Farmers Cooperative Council (UGFCC). The State Farm Corporation commenced operations in June 1962. The objectives of the State Farms were to diversify export production away from cocoa, increase food production for the domestic market, and produce raw materials for agri-industries. The State Farms focused on rubber and oil palms in the south, cotton in the Volta Region, and rice and maize in the northern sector. By 1965, 105 State Farms had been established, including 42 demonstration and experimental stations. Over 250,000 acres of land were acquired by the State Farms, of which 23 percent of this was allocated to the UGFCC and 13 percent to the Workers Brigades. The Workers Brigades were originally established in 1961 as a programme for the unemployed. In northern Ghana its aims were to establish 2000 acres of arable crop cultivation with mechanised cultivation. The State Farms continued to face problems of devising appropriate management for tractors, which either broke down frequently or badly eroded soils (Miracle and Seidman 1968a).

Although the state farms are often portrayed as a huge failure, this was not the conclusion of Miracle and Seidman in their review of state farms following the 1966 coup d'état (Miracle and Seidman 1968a, 44):

On the one hand, large-scale mechanized farms do not appear to compete effectively with peasant food farmers who have little or no overheads in the initial phase of development. Even this tentative conclusion must be qualified, however, in view of the apparent success of the Soviet-assisted rice farm at Afife.

The origins of the UGFCC lie in the colonial period cooperatives societies of the Agricultural Department, which were organised in the cocoa sector. Following independence the UGFCC became the main avenue for national agricultural extension services, controlling both the distribution of inputs and the marketing of crops of its members. The UGFCC sought to promote modern food crop production in the north, and provided ploughing services to farmers through tractor service centres. Outside the cocoa sector the UGFCC organised 992 cooperative societies with a total membership of 26,098. It acquired 486,335 acres of land for farmers but by 1964 only 23,771 acres were cleared and planted under crops (Miracle and Seidman 1968b, 32). Konings (1986, 169) estimates that between 1961 and 1967, 2638 tractors were imported into Ghana, and Boamah (2001) estimates that the UGFCC, Workers Brigades and State Farms used over 3500 tractors, crawlers, combine harvesters and rice mills. Most of the machinery was allocated to tractor service stations. By the mid 1960s the UGFCC planned to expand its acquisitions of tractors for the period 1965–1968 by a total of 5889 and its combine harvesters for the same period by 1124. It had also entered into negotiations with international tractor manufacturers to establish assembly plants in Ghana (Miracle and Seidman 1968b). But all these plans were thwarted by the 1966 coup.

The UGFCC hired out tractor services to farmers at subsidised rates of £15 per acre for the clearing and stumping of land, and £2/10s per acre for ploughing already stumped

land. This was lower than the operating costs because of the high rate of breakages of equipment and high maintenance costs (Miracle and Seidman 1968b). Only about 50 percent of machinery acquired was operational at any one period. Konings argues that many of the agricultural services allocated by the UGFCC in northern Ghana did not really benefit smallholder farmers and were diverted to 'party officials' and to 'urban petty bourgeois' (small businessmen, contractors, artisans, and civil servants). Nevertheless this laid the foundations for the emergence of 'capitalist rice farmers in the late sixties and seventies' (Konings 1986, 168).

Following the 1966 coup d'état the state agricultural sector was reorganised under the Progress Party (PP). The UGFCC was dissolved and agricultural extension re-organised under the Ministry of Agriculture. Agricultural extension followed the 'progressive farmer' model promoted in US-led international development. This was based on building a clientele of richer 'progressive' farmers whose adoption of new technologies and methods would act as a source of inspiration to small farmers, leading to technology diffusion through 'trickle-down'. This continued to focus on the northern and transition zone as the main area of commercial arable production. The Ghanaian-German Agricultural Development Project, which was founded in 1970, also provided support for large commercial farmers in the north up to 1974 (Bennett and Schork 1979; Konings 1986).

The failure of the PP to halt the downturn in the economy led to popular discontent and a further coup d'état, which brought the National Redemption Council (NRC) to power in 1972. The NRC placed increasing emphasis on supporting a capitalist class of rice farmers who would supply the urban market with cheap food. The NRC attempted to supply aspiring commercial farmers with cheap subsidised inputs and tractors, and low interest loans. But these plans were thwarted by the world oil crisis, which resulted in high fertiliser prices on world markets, and the erratic and poor yields associated with the Sahelian drought. Farmers were unable to pay off their loans and fiscal constraints prevented government from importing large volumes of agricultural inputs and machinery. Government was also forced to increase food imports to meet urban food demands (Shepherd and Onumah 1997). A mounting economic crisis resulted in the overthrow of the military government by junior ranks of the military led by Jerry Rawlings. While initially proclaiming a radical framework of social transformation, the Provisional National Defence Council (PNDC) ultimately adopted an IMF stabilisation programme, structural adjustment in 1983, and introduced market liberalisation policies.

Social composition of commercial farming in the 1970s

Konings (1986) provides an insightful analysis of the social relations of production involved in the expansion of commercial agriculture during the 1970s in his case study of commercial rice cultivation in the settlements of Wiasi and Gbedembilisi in the Fumbisi valley of the Upper East Region. The numbers of commercial rice farmers in this area grew from four in 1974 to 210 in 1977. The bumper harvest of 1976 attracted many newcomers, including civil servants, into rice production. But from 1977, drought, incidences of bushfires and declining government support adversely affected production. By 1980 the commercial rice farmers had declined to 60. Of the 48 farmers interviewed by Konings, 19 percent cultivated less than 100 acres of land, 35.5 percent between 101–201 acres, 33 percent between 201–500 acres and 12.5 percent above

500 acres. Eighty-four percent of these farmers owned at least one tractor and 36 percent more than one tractor. Sixty-five percent of them provided tractor-ploughing services to other farmers. Konings (1986) estimates that 2622 tractors were imported into Ghana between 1971 and 1974. Clearly, the expansion of capitalist rice farming had a significant impact on the provision and uptake of tractor ploughing services in northern Ghana.

The largest farmers included top civil servants, military officers, police officers and ex-politicians. Other groups included traders who were reinvesting accumulated capital into agriculture. A few of these farmers had also accumulated capital within agriculture, which was then re-invested in acquiring large landholdings, land clearance and the purchase of tractors. Chiefs also constituted a significant group in commercial agriculture. They secured land for commercial farmers in return for ploughing services and 'gifts', which enabled them to enter into commercial agricultural production in their own right. For instance the paramount chief of Navrongo, who held a PhD in soil science, acquired seven tractors and two combine harvesters with loans from Ghana Commercial Bank. He cultivated 600 acres of land in 1977. Despite poor yields he continued to expand his farm, cultivating between 800 and 1000 acres into the early 1980s (Konings 1986). Of 210 rice farmers identified by Konings in 1977 as operating in the Wiasi and Gbedembilisi area, 18 percent were civil servants, 23 percent businessmen and traders, 23 percent farmers, 7 percent transport owners, and 3.5 percent chiefs.

While some of the largest farmers were from the south of Ghana, the majority were absentee farmers from northern towns. Local farmers from within the villages constituted only a tiny minority of those engaged in commercial rice production. In contrast with the large farmers none of them owned a tractor. Chiefs often discouraged local farmers from farming rice in the floodplain areas, since they gained considerable rents from the commercial farmers. Most of the commercial farmers drew their permanent workforce from their hometowns and extended families, but supplemented this with locally drawn casual labourers.

Continuities in markets and market interventions

Most of the large commercial rice farms collapsed in the early 1980s. The southern commercial farmers with political connections retreated from agricultural investment in the north. But the commercial farmers from the northern towns continued to farm and possess their farm holdings and tractors. They formed an important hub from which present day medium-scale and large farmers have emerged. The stumped lands continued to exist. It was difficult to revert to bush fallow cultivation on these lands since they had been cleared of trees and their topsoils were destroyed from ploughing. The most cost-effective way of farming them was to continue using tractor ploughing and synthetic fertilisers. The state tractor service centres were disbanded, and the tractors were sold off to the private sector. But they continued to operate alongside the network of spare parts dealers and repair workshops. Favourable tax concessions for import of tractors from the 1980s encouraged the import of secondhand tractors and spare parts. This accounts for the dominance of secondhand tractor markets based around Massey Ferguson tractors within Ghana, the favoured tractor of state-led mechanisation.

These close linkages between state and private sector agricultural services are not only characteristic of mechanisation. They can be found in other state agricultural sectors. For

instance, during the 1970s, Henri Wientjes, a Dutch businessman, largely procured the fertilisers distributed in northern Ghana by the state. In the era of structural adjustment he registered his activities as a private company, Wienco, which became the largest input wholesale distributor in Ghana under market liberalisation (Amanor 2017). Many elements of state-led agriculture came to be reconstituted within the private sector. Many of the state development officials were also recruited into the NGO sector.

The early policy initiatives to privatise agricultural markets often depressed commercial agriculture and the use of agricultural inputs in the 1990s. The price of chemical fertilisers increased 380 percent between 1990 and 1994. The prices of fertilisers also increased significantly in relation to the price of crops. Hailu (1990) estimates that in 1981 the price of one bag of maize could purchase 5.5 bags of fertilisers compared to 3.3 bags in 1986. As a result of the increasing price of fertiliser the demand declined from an average of 38,595 tonnes for the period 1985–1989 to 24,568 tonnes for 1990–94 (ISSER 1996).

During the 1990s donors began to support and encourage NGO interventions to address the falling demand for inputs. NGO programmes, such as Global 2000, stimulated demand by introducing credit programmes in which farmers were provided with packages of inputs and seeds. Private input distributors, such as Wienco, have also been in the forefront of organising credit facilities for farmers, involving linkages between state, banks, private corporations, and NGOs. By the 2000s donors began to support state programmes for ‘smart subsidies’. While the major focus of donor assistance programmes has been on providing certified seed and fertilisers, the purchase of certified seed has often been a low priority for farmers, who prefer to plant their own varieties or multiply improved open-pollinated varieties (Amanor 2011). In the northern sector the main demand from farmers has been for ploughing services and fertilisers. To promote uptake of new technologies by farmers, government agricultural services and NGOs have added ploughing services to technology packages. But the demand for ploughing services has often been in excess of the available tractors, and government no longer has access to mechanisation service centres. It is in this context that from the early 2000s government has sought to facilitate mechanisation through bilateral arrangements with the rise of newly emerging industrial nations eager to promote their own agricultural industries. Ghana has entered into bilateral loan arrangements with the governments of India and Brazil to provide tractors at concessionary prices, and allocated a portion of these tractors to entrepreneurs interested in establishing Agricultural Mechanisation Service Centres (Benin 2014). However, this has not significantly transformed the tractor market, which continues to be dominated by secondhand Massey Fergusons, which are served by a well-established infrastructure of spare parts dealers and repairers that have been established since the 1970s.

In contrast with accusations that government interventions in agricultural mechanisation are a dangerous throwback to state distortions of agricultural policy (Benin 2014; Diao et al. 2014; Daum and Birner 2017), this analysis has shown that they are a logical extension and integral part of contemporary market liberal policies to induce demand for inputs through market interventions on behalf of the private sector. While the main emphasis of policy since the 1990s has been to focus on seeds and inputs and dismiss agricultural mechanisation; ironically, the areas in which farmers are most likely to take up fertilisers are those with a past history of tractor mechanisation, since this has destroyed the fertility of the topsoil, making fertilisers a necessity. These same farmers

have continued to demand tractor services. Thus state and NGO interventions in input provisioning have logically led to interventions in tractor markets and support for private sector ploughing services for farmers.

Conclusion

In contrast with the existing studies on agricultural mechanisation rooted in liberalised market theory, this study argues that contemporary patterns of mechanisation in northern Ghana are the result of a longer process of change and can be traced back to the interventions in mechanised agriculture of the 1960s and 1970s. Contemporary processes of mechanisation are largely concentrated in areas that were stumped and cleared during the 1960s and 1970s. The infrastructure of support services for tractors originates in this period. The characteristics of medium-scale farmers, widely regarded as evidence of the successes of market liberalisation, bear striking resemblance to the class of commercial farmers of the 1970s, including the class origins of a significant sector in urban civil servants and traders (Lipton 1977). This era of state-led agricultural modernisation was characterised by complex networks of state and private sector actors working together to further commercial interests. These linkages have continued into the present with the networks reconstituted as civil society and private-public partnerships that work together to promote similar objectives in agricultural modernisation, through interventions based on the use of credit and various forms of subsidies. Contemporary theories on liberal markets, induced technology change and social capital have also failed to note the most significant developments that have occurred in the rural landscape in northern Ghana: the decline of the patriarchal lineage-based compound farm, and the emergence of individual farms farmed by younger males and females, tied to a process of increasing social differentiation. This has resulted in conflicts between elders, chiefs and the farming members of lineages over the allocation of lands to commercial farmers at the expense of smallholder farmers, and tensions around access to land and social obligations to elders.

The perspective that private sector tractor operators have engaged in dynamic forms of social capital based on community solidarity, in which tractor owners have used extended family networks to fashion inclusive markets for tractor (Houssou et al. 2013; Daum and Birner 2017), is a gross oversimplification of the reality. While the expansion of tractor ploughing services has created new avenues for smallholders, this is largely the fallout of the expansion of commercial agriculture, which has resulted in complex community conflicts over the control of land. Village chiefs have sold land to commercial farmers and developers at the expense of lineage elders and lineage members (Abdulai 2002; Yaro 2010, 2012). The undermining of the authority of lineage elders has created new opportunities for smallholders, but also enabled commercial farmers to expand the areas they cultivate at the expense of smallholders and lineage members of landholding groups. While women and young male farmers have gained greater freedom to farm autonomously this happens within a scramble for land, and within a structure of increasing social differentiation, in which an alliance between chiefs, the state, commercial farmers and agribusiness is creating economic pressures on smallholders (Yaro 2012, 2010; Aminu 2016). As Aminu (2016) shows commercial farmers with tractors often control ploughing services to gain access to land from chiefs at the expense of

smallholders. This is an essentially a continuation of the class alliances that underpinned agricultural commercialisation during the 1970s, with the main difference being the participation of agribusiness in driving commercial models of change and fashioning demand for inputs, and the new role of NGOs in organising the uptake of inputs and credit facilities among smallholders. The framework of agricultural modernisation in liberal markets denies the importance of political economy and long term processes of historical change linked to class formation and the accumulation of capital. In these liberal market orthodoxies, history and agrarian change flows out of policy frameworks and ideology fashioned in global policy institutes rather than the material conditions of production.

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