Economy and Society

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/reso20

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To cite this article: Sally Brooks (2021) Configuring the digital farmer: A nudge world in the making?, Economy and Society, 50:3, 374-396, DOI: 10.1080/03085147.2021.1876984

To link to this article: https://doi.org/10.1080/03085147.2021.1876984

Published online: 30 Mar 2021.

Economy and Society Volume 50 Number 3 2021: 374–396
https://doi.org/10.1080/03085147.2021.1876984

Configuring the digital farmer: A nudge world in the making?

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Abstract

This paper explores the 'digital farmer' assemblage as an illuminating case of the behavioural turn in international development, in which smallholder farmers are digitally steered towards behaviours deemed necessary for market inclusion. Central to these interventions are digital platforms that function as human technologies to craft new kinds of market subject that can be inserted into value chains and wider circuits of capital and data. As such, they represent both a continuation of the 'long' Green Revolution and a point of departure. The narrowing of options built into their design is likely to further erode processes of skilling central to agricultural practice, while loosening the social ties of mutuality and reciprocity in which such processes are embedded, intensifying vulnerability to climate and market uncertainties.

Keywords: smallholder agriculture; behavioural economics; big data; fintech; agricultural platforms; agricultural deskilling.

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Introduction

The decision of the World Bank to focus its 2015 World Development Report (WDR), *Mind, society and behaviour* on concepts and methods from behavioural economics signalled that behavioural thinking had moved into the mainstream of global development policy (World Bank, 2015). Advocacy of and experimentation with these methods had, however, been underway in various poverty reduction initiatives in the Global South for some years; notably in microfinance (Karlan & Appel, 2011) and the marketisation of smallholder agriculture (Berndt, 2015). As such behavioural economics had already 'transformed from a positive intellectual project … into a normative endeavour' in which development interventions use methods informed by insights from cognitive psychology to transform people's behaviour (Berndt, 2015, p. 571). Nevertheless, the showcasing of these methods in the annual publication of 'the knowledge bank' was a significant milestone (Fine *et al.*, 2016, p. 644).

This 'behavioural turn' in development can be situated within the broader response to the 2008–2009 global financial crisis – a crisis mainstream economics failed to predict – in which the explanatory power of behavioural economics was mobilized to redirect attention from the systemic causes of the crisis to behavioural problems of borrowers (Fine *et al.*, 2016). In the development field, however, a preference for behavioural explanations and solutions over the tackling structural issues (Klein, 2017), is hardly new. Indeed, the transformation of its subjects into self-reliant individuals willing to invest in themselves as human capital has been an overarching aim of development interventions since (and even before) the post-Second World War articulation of overseas development assistance as a key area of US foreign policy (Nally & Taylor, 2015). This is nowhere more apparent than in the domain of agriculture, where a long-standing mission to reorient farmers from 'backward' agrarian traditions to commercial, 'scientific' agriculture has evolved 'from the domestic to the international and from the late nineteenth century to the present' (Nally & Taylor, 2015, p. 51).

The eponymous digital farmer is the subject of an evolving assemblage of institutions, discourses and technologies that has formed at the intersection of a number of currents in contemporary development policy and practice. The first is the evolution of an ongoing effort to 'modernise' developing country agriculture under the banner of a 'Green Revolution'. The latest iteration of what Raj Patel (2013) has called the 'long' Green Revolution is the transformation of smallholder agriculture in sub-Saharan Africa to enable small-scale farmers to 'connect' to global value chains. The second current is the formation of a global consensus around microfinance, recast as financial inclusion, as a strategy for the achievement of the Sustainable Development Goals (SDGs) that cuts across multiple sectors, including agriculture (Lahaye *et al.*, 2017). Third, digitization is identified as the 'technical fix' that can connect even the most remote small-scale farmer, now armed with a mobile phone, to markets (Annan, Conway, & Dryden, 2018). Fourth, the use of tools from behavioural economics, notably 'nudges', are deployed to

steer beneficiaries towards 'correct' choices. In this way, the intractable problem of 'making markets work for the poor' gives way to the more straightforward one of making more effective market subjects (Berndt, 2015).

The paper is structured as follows. The next section discusses the literature on the contemporary behavioural turn in international development. This is followed, in the subsequent section, by an exploration of the longer history of behavioural economics within development thought, with particular reference to agricultural development policy and practice. Having set the background context in these initial sections, the discussion moves on to the digital farmer assemblage itself. Drawing on policy and project documents and academic commentaries, this section explores its key elements; specifically, the use of digital platforms to 'bundle' together agricultural products and informational and financial services offered by partner firms, and of behavioural 'nudges' to steer participating farmers towards their adoption. The next section considers the broader implications of this approach in the context of developments in big data-driven 'hyper-nudging' (Yeung, 2017), particularly within the fintech sector (Aitken, 2017) – one of the main beneficiaries of the 'platformisation' of smallholder agriculture (Iazzolino & Mann, 2019) – and in light of anticipated developments in precision agriculture and land acquisition (Fraser, 2018).

The subsequent section explores in more depth processes of subjectification that configuration of the digital farmer represents. This is illustrated by contrasting mainstream agricultural development as modernization, informed by the methodological individualism of mainstream (neoclassical and behavioural) economic thinking, with alternative approaches informed by a Durkheimian conception of agriculture as group process (Richards, 2007). This analysis highlights what is at stake in the unbundling of farming practice from its 'traditions' so that it can be re-bundled into formal market mechanisms. Digital farmer platforms can thus be viewed as 'human technologies' (Wahlberg & Rose, 2015) that compound effects of earlier Green Revolutions by accelerating agricultural deskilling (Stone, 2007). The paper concludes by proposing as an avenue for future empirical research the exploration of conditions under which it might be possible to resist and/or reappropriate these technologies and move them 'in directions its corporate architects don't intend' (Kloppenburg, 2014, p. 1242).

Global development and the 'behavioural turn'

The global financial crisis of 2008 triggered a 'profound loss of faith' in the tenets of neoclassical economics and the idea of the self-regulating market, prompting previously unseen 'upheavals in the discipline' (Berndt & Boeckler, 2017, p. 284). Behavioural economists stepped into the breach with a set of concepts and techniques for dealing with the new uncertainties. These were designed to correct for market failures in a way that reframed those failures in terms of shortcomings of market subjects themselves. What behavioural economics offered, therefore, was an adjustment to the 'meandering course'

of the economic mainstream that enabled it to retain its 'unifying principles of marginalism, methodological individualism, opportunity costs and the virtuous effect of market exchange' (Berndt & Boeckler, 2017, p. 284; see also Fine *et al.*, 2016). The behavioural economics toolbox was taken up with enthusiasm by governments in the Global North, notably by the Obama administration and the UK coalition government under Cameron, both of whom created special teams at the heart of government tasked with applying these tools across various areas of government policy (Fine *et al.*, 2016). The spread of these ideas spread to the Global South, on the other hand, is taking place primarily under the aegis of development assistance (Berndt, 2015).

As noted earlier, the mainstreaming of behavioural economics within global development policy was signalled by the World Bank's choice of '*Mind, society and behaviour*' as the theme of its 2015 World Development Report (WDR) (World Bank, 2015). The WDR distills lessons drawn from a reading of the behavioural economics literature into three principles: that people tend to 'think automatically', rather than deliberatively; to 'think socially', under the influence of social norms and pressures; and to think within the bounds of 'mental models' that reflect prevailing 'worldviews, ideology and culture' (Klein, 2017, p. 483). Crucially, these cognitive limitations are experienced disproportionately by the poor (Klein, 2017). As the report explains, poverty 'is not only a deficit in material resources but also a context in which decisions are made. It can impose a cognitive burden on individuals that makes it especially difficult for them to think deliberatively' (World Bank, 2015, p. 13).

The report proceeds to recommend behaviour change techniques through which 'automatic decision-making can be thwarted': through adjustments in 'choice architecture' that allow professionals to 'organise the context in which decisions are made, so as to nudge people towards a particular choice'. This can involve 'automatically evoking particular associations' or 'making one option more salient or easier to choose than the alternative' (Klein, 2017, p. 483). The philosophy underpinning these technologies is known as 'libertarian paternalism' (Klein, 2017, p. 492); a term coined by Thaler and Sunstein (2008) in their seminal book, *Nudge*. The authors argue that nudges are paternalistic, guiding individuals towards choices that are deemed good for them; while at the same time libertarian, in that they preserve the individual's autonomy and freedom of choice (see also Lepenies & Malecka, 2019).

The idea that poverty 'poses constraints' on rational decision-making that can be remedied by policy interventions is a marked departure from 'the neoclassical argument that "the poor" have nothing special about them and behave just as rationally as other people do' (Berndt & Boeckler, 2017, p. 288). However, as noted earlier, this 'behavioural turn' is not the challenge to the economic mainstream that it at first appears. Nor does it herald a departure from neoliberalism. Behavioural economics merges a pro-market stance with post-market elements that 'recognise markets need a little help from "incentive-compatible" mechanisms' if they are to function as they should. This 'post-Walrasian' formulation, however, remains 'a neoliberal approach' as

state intervention is justified *solely* as a means to 'advance economic efficiency' in a way that is assumed to benefit the individual (Klein, 2017, p. 489, emphasis added). The role played by behavioural economics is key in that rather than assume individuals are rational (as in neoclassical economics), 'it provides a science for *producing* responsible, efficient and effective subjects' (Klein, 2017, p. 490, emphasis added).

In an era of economic austerity, behavioural economics provides resource-constrained governments with tools to intervene with 'as much state as necessary and as much free market as possible' to keep the show on the road (Berndt & Boeckler, 2017, p. 290). In a similar manner, the incorporation of modern behavioural methods into development practice has facilitated a reinforcement, rather than an unsettling of its most cherished assumptions. Drawing on their analysis of 100 policy and project documents produced by, *inter alia*, multilateral and bilateral donors, academics, think tanks and NGOs recommending and/or implementing these methods, Berndt and Boeckler (2017, p. 289) highlight as a recurring theme the recasting of 'traditional lifestyles' as 'behavioural anomalies' amenable to correction. Behavioural economics has therefore provided development agencies with a framework for the 're-modernisation' (Berndt & Boeckler, 2017, p. 298) of global development, alongside the recalibration of its target as a more malleable, effective subject.

The 'long' Green Revolution

While technologies deployed in the contemporary behavioural turn, as well as the problem they are seen to be solving in a post-crash world may be novel, the influence of behavioural economics in development policy has a much longer history. The Green Revolution, an ambitious programme of agricultural modernization led by two American foundations – Rockefeller and Ford – and rolled out across South and Southeast Asia in the 1960s and 1970s, is a case in point. The Green Revolution was an exemplar of a 'high modernist' project that sought to 'radically simplify' farms and fields so they could be 'more directly apprehended, controlled and managed' through rational, scientific methods (Scott, 1998, p. 262). This transformation required, not only the diffusion of seeds and agrochemicals, but a change in the mindset of farmers. In the Philippines, Raphael Salas, the official charged by President Marcos with overseeing dissemination of the technologies, articulated the necessity to reconfigure the farmer as user (to paraphrase Woolgar, 1990) of the new crop technologies thus: 'Even if it wasn't such a spectacular producer … one would advocate pushing miracle rice culture if only to train the Filipino farmer into thinking in terms of techniques, machines, fertilisers, schedules and experiments' (Cullather, 2004, p. 244).

This focus on behavioural change for achieving a desired political-economic transformation was not merely a manifestation of Cold War imperatives but reflected a set of ideas long held by US development planners and, in particular, the philanthropic foundations that had shaped their thinking. These ideas

had been set out by Andrew Carnegie (1889) in his treatise 'The gospel of wealth', in which he eschewed 'charity' – which he dismissed as counterproductive – in favour of tackling the 'root causes' of poverty by inspiring self-improvement on the part of poor people themselves. 'In short, to improve the world one had to mould the man' (Nally & Taylor, 2015, p. 52). Embedded in this mode of 'scientific philanthropy' was a belief that individuals must be induced to invest in themselves as human capital. This view combined faith in the innate malleability (and hence improve-ability) of individuals, with a calculation that private philanthropy had a strategic interest in facilitating enough – but not too much – wealth redistribution alongside interventions that motivated poor people to 'depend on their own exertions' (Nally & Taylor, 2015, p. 52).

An imperative to create subjects that serve the development of markets has been a continuous thread in what Patel (2013) has called the 'long' Green Revolution that continues to this day: a thread that can be traced back to domestic rural development programmes in the United States in the inter-war years (Rosenberg, 2015). The Green Revolution in Asia took place within a geopolitical context in which national security concerns of the United States and its regional allies converged around a programme to solve the problem of hunger through technocratic rather than redistributionist means (Anderson *et al.*, 1991; Perkins, 1997). The broader project was one of winning an ideological battle between communism and 'free markets' while creating opportunities for US agribusiness. Indeed, in the geopolitical context of the Cold War, 'strategies to orientate social exchanges *away* from subsistence living and *towards* commercial practices formed an integral part of counter-insurgency planning' (Nally & Taylor, 2015, p. 57, original emphasis). While often seen as an exercise in technical engineering, the 'singular achievement' of the Green Revolution was to place human behaviour 'at the centre of its calculations' (Nally & Taylor, 2015, p. 61).

As discussed in the last section, a core assumption underpinning behavioural approaches in development is that it is the behaviour of poor people in particular that needs to change – 'backward' practices are to be replaced with 'modern' ones – and the discourse of the Green Revolution reflected this. In practice, however, Green Revolution agriculture was successful insofar as it raised aggregate production, averting feared grain shortages, and these gains were achieved mainly on larger, resource-rich farms. While some small- and medium-scale farming units in Green Revolution regions benefitted to some extent, as later adopters of the technologies (Lipton & Longhurst, 1989), many more were absorbed into larger farms able to capitalize on economies of scale (Frankel, 1971; Griffin, 1979; Pearse, 1980). This large farm bias was a direct consequence of the programme design: conditions on resource-rich farms closely mirrored those on the agricultural research stations where the technologies had been developed. Such farming systems were relatively simple, and thus amenable to the standardized technology 'package'. Small-scale farms, in contrast, were complex, in ways that the

scientists had neither recognized nor sought to understand (Chambers *et al.*, 1989).

In the 1980s a community of researchers and civil society organizations began to explore alternative approaches focused on the priorities of small-scale farms. What came to be known as the 'Farmer First' movement concluded many smallholders had rejected Green Revolution technologies for good reason. It was not because they were 'ignorant' or 'irrational', far from it (Richards, 2010). Rather, it was because the technology package on offer was a poor fit for 'the complexity and diversity of their farming systems' (Chambers *et al.*, 1989, p. xix). Rather than 'mired in tradition', small-scale farmers were revealed to be, out of necessity, 'experimental in outlook' (Richards, 2010, p. 8). In other words, the behavioural problem lay, not with the farmer, but with 'normal agricultural professionalism' itself (Chambers *et al.*, 1989, p. xix). This insight generated heated debates with the institutions of international agricultural research that had powered the Green Revolution[1], at a time when those institutions were coming under sustained criticism (for example, see Oasa, 1987). In the event, however, the limited reforms that ensued were eclipsed by a recasting of the mainstream international development agenda within parameters set by a punishing agenda of macroeconomic stabilization and structural adjustment (in contemporary parlance, 'austerity'). This recalibration of the development agenda drastically reduced the capacity of both international and national public bodies to maintain existing services, let alone implement a radical change of direction (Brenner, 1993; Tabor, 1995).

Forty years after the Asian Green Revolution, after what was arguably a long period of neglect, agriculture was back on the development agenda; with the spotlight now on sub-Saharan Africa. In 2004, Kofi Annan, then UN Secretary General called for a 'uniquely African Green Revolution' (McKeon, 2014); acknowledging that such a revolution would need to place the needs of the smallholder sector – a sector responsible for 80 per cent of agricultural production in the region – at its centre (Annan & Dryden, 2018). Would this be the 'Green Revolution from below' that the Farmer First movement had advocated (Richards, 2010)? In the event, a very different set of priorities came into play; in a post-adjustment era in which the agricultural development agenda was shaped by the priorities of the transnational agribusiness sector (McKeon, 2014). The resulting programme, launched in 2006 by the Gates and Rockefeller Foundations under the banner of an 'Alliance for a Green Revolution in Africa' (AGRA), followed a different path. Like the WDR 2008 '*Agriculture for development*' published the following year (World Bank, 2007), AGRA prioritized the incorporation of smallholder farms into global value chains led by transnational firms (Alonso-Fradejas *et al.*, 2015). A new consensus formed around a mission to 'kick-start' smallholder agriculture as an entrepreneurial enterprise (McMichael, 2015). Lessons from Farmer First were side-lined as smallholders were cast as consumers of technologies delivered by an increasingly privatized pipeline (Ashby, 2009; Scoones & Thompson, 2011).

'The rise of the digital farmer'

The digital farmer is the development subject at the centre of an emerging assemblage of discourses, institutions and technologies in which the idea of the smallholder farmer as an entrepreneur-in-the-making is aligned with the prioritization, by the donor community, of 'financial inclusion' as a cross-cutting strategy for achieving the Sustainable Development Goals (SDGs) (Lahaye *et al.*, 2017; Soederberg, 2013; World Bank, 2013). While microfinance (or more specifically, microcredit) has been a fixture in the development landscape for at least two decades, the financial inclusion agenda expands this agenda in two ways: firstly, by increasing the range of financial services offered 'beyond credit' to include, *inter alia*, savings and microinsurance; and secondly by capitalizing on the spread of mobile devices to reach the previously 'credit-invisible' (Gabor & Brooks, 2017). The point of departure for digital farmer initiatives is to offer digital financial services alongside services normally accessed through face-to-face interaction with a government (or NGO) agricultural extension agent or a local agro-dealer from a single digital platform. In digital farmer programmes, 'miracle seed' technologies are de-centred in favour of *digitisation* as the technical fix to surmount the primary obstacle to market integration, remoteness (Annan *et al.*, 2018).

In a special issue of *Foreign Affairs* entitled 'African farmers in the digital age' (Annan *et al.*, 2018) a roll call of Green Revolution luminaries, past and present, set out a vision in which African smallholders become connected to multiple markets through which their full incorporation into global value chains is assured. Key strands of this discourse include the familiar imperative to modernise 'backward' farming units and 'connect' them to value chains; alongside two new elements. The first is the identification of 'financial exclusion' as the primary barrier to the purchase of commercial farm inputs 'in the absence of state subsidies'. Deftly avoiding serious consideration of the merits of public subsidies, the authors suggest risks incurred in planting unfamiliar crop varieties are best addressed through the use of financial services 'beyond credit', such as insurance (of which more later), savings, and monetary transfers 'to smooth consumption' (Okonjo-Iweala & Madan, 2018, p. 107).

Second, the central role of digital technologies in 'shattering the isolation' of smallholder farmers (Annan & Dryden, 2018, p. v) is emphasized; as a way to 'shorten the distance between smallholders' and other components of the food value chain (Annan *et al.*, 2018, p. xiv). The lead authors stress that farmers 'need financial services, seeds, and fertilizer before they begin planting; after they harvest, they need storage, transport, processing, and marketing. *Every step in this process can be an opportunity for entrepreneurial activity*' (Annan & Dryden, 2018, p.vii, emphasis added). Digital technology 'can help advance all these principles *simultaneously*. It makes connections possible, transfers information instantaneously, and can help build virtual communities even among widely separated and remotely located individuals and communities' (Annan & Dryden, 2018, p. viii, emphasis added). Bill Gates' (2018) chapter

takes this argument further to predict that communication improvements secured through digitization will extend formal markets to the point where informal institutions become redundant; unleashing a 'two-way conversation between Africa's producers and Africa's consumers' in which 'each party will be able to express its needs to the other *for the first time ever*' (Gates, 2018, p. 93, emphasis added).

To what extent is this vision being realised? The NGO Mercy Corps, together with the Mastercard Foundation, have led the way with a series of 'Agrifin' initiatives. AgriFin Mobile was launched in June 2012 in Indonesia, Uganda and Zimbabwe 'to test and explore new business models and alliances to increase harvests and incomes for smallholder farmers, by bundling mobile financial services with technical services for farmers' (Peake, 2012, p. 15). This was followed in 2015 by the more ambitious AgriFin Accelerate (AFA), a US$ 25 million, six-year initiative in Kenya, Tanzania and Zambia to enable emerging 'digital farmers' to 'rise' and 'blaze a new path' (Mastercard Foundation, 2016, n.p.). In Kenya, AFA has partnered with Safaricom, the leading telecommunications firm and parent company of the iconic mobile money service, M-PESA (see Mas & Morawczynski, 2009), to launch DigiFarm: 'an integrated mobile platform of digital services for farmers' (Shrader *et al.*, 2019, p. 8).

Elements common to these interventions include, firstly, their design around a digital platform through which participating farmers are registered and 'profiled', and can access information about 'technology, loans and microinsurance' (Mercy Corps, 2015, p. 5). Underpinning the platform model are 'narratives of digital disintermediation' through which all actors in the chain are said to benefit (Iazzolino & Mann, 2019, np) – lenders who can better manage risks (by profiling borrowers), smallholder farmers liberated from the control of 'exploitative middlemen', and input providers able to understand and therefore serve their customer better (Iazzolino & Mann, 2019). This platform model enables a second core element; the strategy of 'bundling' agricultural products and informational and financial services in a project package that mirrors the programme partnership structure. Bundling provides obvious synergies for project partners. For example, in AFA farmers take loans to buy inputs from the multinational seed company, Syngenta, for whom 'working with bundled loan customers' helps them 'increase the number of clients and acres … covered' (Mercy Corps, 2015, p. 4). The programme targets 'farmers … recommended by the grain-traders and Syngenta's farmer leaders so as to ensure higher repayment rates'. In this way, a circular logic sets partners' products as the norm to be achieved, in a process that is nevertheless described as 'farmer centred' (Mercy Corps, 2015, p. 5).

The inclusion of index-based agricultural insurance (IBAI, also known as microinsurance) in digital farmer 'bundles' warrants further discussion. IBAI has been strongly promoted by development agencies, from the World Bank's private sector arm, the International Finance Corporation (IFC) to large international NGOs as a way to 'climate-proof' agriculture (Isakson, 2015). IBAI is innovative in that it circumvents the barriers that have, in the

past, prevented the spread of conventional insurance products to more remote rural settings by releasing payments not in response to actual losses, but when recorded weather conditions (such as rainfall) in an area within a certain time period fall below an index set for the product. IBAI is therefore better understood as a derivative product which invites farmers to manage climate risks by offsetting bets on financial products (Isakson, 2015; see also Breger-Bush, 2012). These products are viewed as an alternative to government subsidies that shifts responsibility for risk management from the collective to the individual farmer (Isakson, 2015).

Demand for IBAI remains stubbornly low, however. Despite its promotion in several countries, smallholders have repeatedly rejected microinsurance (Johnson *et al.*, 2019). The response to what would appear to be a clear market signal from smallholders is indicative of the behavioural turn in development outlined earlier. Development agencies attribute low adoption to 'farmers' faulty rationalities' rather than unsuitability of the product itself (Isakson, 2015). In this context, bundling offers a means to reduce farmers' room for manoeuvre and induce them to adopt products in which they have failed to register an interest, but which private sector partners view as key to incorporating smallholders into value chains. The example of Agriculture and Climate Risk Enterprise Ltd (ACRE), an initiative of the Syngenta Foundation, is instructive. Through a suite of strategies, including bundling IBAI into loans, packaging 'insurance contracts as scratch cards in bags of improved seeds', and a conventional contract farming model, ACRE has brought 200,000 farmers into agri-food chains (Isakson, 2015, p. 7).[2]

A third element of the digital farmer programme design is the use of explicit behavioural change methodologies. As the ATA Tanzania White Paper[3] argues, 'behavioural and attitudinal barriers for farmers … are important to consider in order to ensure uptake and active use' of the components of the programme bundle (AgriFin Accelerate, 2016, p. 11). Unlike during the Green Revolution era, however, when the ubiquitous government extension worker was the mainstay of behavioural transformation efforts (Nally & Taylor, 2015), its 'uniquely African' variant has had to rely on uneven networks of agro-dealers as its *de facto* extension service (Odame & Muange, 2011). In this context the ATA model disintermediates a service that has suffered decades of erosion. In the absence of face-to-face contact, AFA farmers are categorized, based on their engagement with the platform, in terms of four 'personas' – 'aspirer', 'striver', 'achiever' and 'trapped' – each with defined 'financial' and 'tech' behaviour patterns (Mercy Corps, n.d.-b). Through a 'farmer capability initiative', farmers are linked up to markets and services based on a 'service delivery model' designed for their 'persona'. These delivery models, developed in association with Syngenta's business development team, combine 'on-demand training', use of 'behavioural nudges' (to 'drive behaviour change') and the integration of Syngenta product information into the 'free' training provided (Mercy Corps, n.d.-b).

A language of farmer-centredness containing echoes of Farmer First narratives (see earlier) is thus, paradoxically, translated into strategies designed to

steer farmers towards choices made *for* them, rather than mobilize their innovative capacity and agency. Moreover, the bundling/nudging combination provides a short-cut that averts the need for the kind of labour-intensive effort that was central to the Asian Green Revolution – that of training farmers to '*understand, evaluate, choose and take responsibility*' (Nally & Taylor, 2015, p. 60, original emphasis). Nudges are reinforced by product information limited to that of just one supplier, project partner Syngenta, though 'social norming' techniques that set farmers adopting Syngenta products as the 'benchmark' (Mercy Corps, n.d.-a). In this way, farmer subjectivities are 'corrected' to reflect norms derived from the component parts of a project package itself; in a self-reinforcing loop that reflects the structure of the project partnership.

'Data is the new soil'

Behavioural monitoring of the type used in digital farmer programmes has been made possible by the rapid diffusion of mobile phones. First generation behavioural nudges (of the type used by AgriFin Mobile) worked primarily though text messaging on older, 'basic' (also known as 'feature') phones (Klein, 2017; see also Karlan & Appel, 2011). These first generation, 'static' nudges are increasingly giving way to what Yeung (2017) calls 'hyper-nudges' in the era of 'big data' and 'smart phones'. Big data uses analytical software to 'identify patterns and correlations through the use of machine learning algorithms applied to … multiple data sets, converting these data flows into a particular, highly data-intensive form of knowledge'. It is thus able to identify 'useful correlations within data sets *not capable of analysis by ordinary human assessment*' (Yeung, 2017, p. 119, original emphasis).

The implications of big data-driven harvesting of personal data reach beyond privacy concerns 'due to the *particular way* in which that data are being utilised to shape decision making' (Yeung, 2017, p. 119, original emphasis). It operates through a technique known as 'priming, dynamically configuring the user's informational choice context in ways intentionally designed to influence her decisions'. In this way, the individual's choice environment can be *continuously* tracked and fine-tuned 'based on the analysis of the target's constantly expanding data profile' and in light of 'population-wide trends identified via population-wide big data surveillance and analysis'. Big data-driven nudging is thus 'nimble, unobtrusive and highly potent' (Yeung, 2017, pp. 121–122). This is nowhere more apparent than in the field of financial technology or 'fintech'.

The example of Cignifi, a US fintech firm with links to the Omidyar Network (the for-profit philanthropic organization started by the founder of eBay), American Express and the IFC is illustrative of the potency of big data-driven hyper-nudging. Cignifi's signature product is an algorithm used by telecommunications firms and financial partners to make 'highly predictive risk assessment decisions about people who have never had a bank account or

credit card, based on their mobile phone behaviour' (Aitken, 2017, p. 10). Many of Cignifi's projects 'extract data from unbanked mobile users in Africa … In Uganda, for example, Cignifi collaborates with the IFC and Airtel Uganda', a major telecommunications company. It 'promises to access billions of detailed Airtel records relating to both online footprints and Airtel money transactions in order to identify prospective users' (Aitken, 2017, p. 284). Through novel methods of big data-driven credit scoring, unbanked people are 'sorted' into behaviour-based risk categories as the basis for targeted marketing and risk pricing (Aitken, 2017).

The example of credit scoring algorithms developed by firms such as Cignifi (for other examples see Bernards, 2019; Langevin, 2019) illuminates how interwoven are developments in big data analysis with the fortunes of a rapidly growing fintech sector. As we saw in the previous section, the financial inclusion discourse is one of the key elements of the digital farmer assemblage; and early indications are that fintech firms are likely to be big winners from agricultural platforms that 'bundle' their services with seeds and fertilizers while enabling them to 'harvest' participants' behavioural data for more finely tuned creditability assessment (Iazzolino & Mann, 2019). The extent to which farmers are able to resist such categorisations and their consequences is an empirical question that warrants further study. Nevertheless, while previous microfinance schemes based on the Grameen model allowed a degree of latitude for borrowers and local officers – the 'street-level bureaucrats' (Lipsky, 1971) of microfinance – to negotiate around or subvert its more punitive aspects (Shakya & Rankin, 2008), digital platforms by their very design seek to close such spaces of local agency.

Less clear, at this point, is who will be the main beneficiaries of agroecological data gathered via digital farmer platforms (Annan *et al.*, 2018, p. xiv). Ethiopia's Agricultural Transformation Agency, for example, a Gates Foundation-funded body established in 2010 to accelerate commercialization of the smallholder sector (Ethiopean Agricultural Tranformation Agency, n.d.), runs an 'agricultural hotline' that boasts '500,000 users', and is developing a national soil information system, EthioSIS, able to analyse 'soils down to a resolution of ten kilometres by ten kilometres' (Annan & Dryden, 2018, p. viii). It is worth exploring, albeit somewhat speculatively, how such data might connect to ambitious techno-futures that are, thus far, only in evidence in 'spaces of early adoption' in the Global North. Fraser (2018) draws attention to developments in 'precision agriculture' (PA); a term referring to 'techniques that monitor and optimize production processes by advising farmers and/or remotely adjusting machinery to optimally apply fertilizer or chemicals to the land and feed to animals'. These increasingly use algorithms, sensors and computational models to '"crunch", build on and roll out data about human agricultural practices, the lives of animals and the biophysical qualities of land' (Fraser, 2018, p. 2).

These developments have led 'some to anticipate that PA and 'big data' will 'be the driver of the next revolution in agriculture' (Fraser, 2018, p. 2; see also

Hailu, 2018; Hinson *et al.*, 2019). At present the use of PA methods is limited to large-scale agriculture in the Global North, and 'in some parts of the bifurcated Global South, especially on large-scale farms within capital-intensive export-oriented sub-sectors such as Brazil's soybean sector' (Fraser, 2018, p. 904). Future prospects of its rollout across the Global South are best understood in relation to 'processes associated with the land grab' (Fraser, 2018, p. 903). Since the financial and food price crises of 2007–2008, financial investors have gravitated towards farmland investments as a more secure and profitable asset class than, for example, commodity futures, leading to an escalation of land acquisitions in the developing world (De Schutter, 2011; Fairbairn, 2014). IFIs, notably the World Bank's Multilateral Investment Guarantee Agency (MIGA) and IFC, have played an important role by providing 'patient capital' to accompany private capital to 'frontier' land markets in Africa and elsewhere for development purposes (Isakson, 2014).

While technologies for rendering land legible in the twentieth century were cartographical (Scott, 1998); contemporary land acquisition 'pivots on digital knowledge' (Fraser, 2018, p. 903). Satellite imagery and geographic information systems – in conjunction with existing maps and land registers – can provide useful data, up to a point (Millar, 2016). However, investors with an eye on future PA applications will require more detailed, micro-scale data about 'soils, nutrients, watercourses or climate' (Fraser, 2018, p. 905). Data of this kind is being gathered by institutions, like EthioSIS (Annan & Dryden, 2018, p. viii), from thousands of mobile users who, though their enrolment in digital platforms, are engaged in the process of making themselves, and their farming practices and resources, more legible (see Ruppert, 2011). In this case, 'data is the new soil' (Fraser, 2018, p. 901). Such data are likely to be increasingly in demand as 'new portions of land enter contemporary financial calculation' and 'are viewed, assessed and exchanged in distant markets' (Fraser, 2018, p. 905).

Deskilling the farmer: A step too far?

The digital farmer assemblage reinforces a long-held view of development as a process of forming self-reliant individuals who invest in themselves as human capital (Nally & Taylor, 2015). Rather than engage farmers in a learning process as autonomous rational actors, however, as the classical modernization paradigm would have it, the contemporary behavioural economics toolbox offers a short-cut to the creation of the desired kind of subject: a subject defined primarily by their adoption of a prescribed menu of market behaviours which can be monitored, unmediated, from the vantage point of a remote digital platform. In this way, farmers are enrolled into new asymmetries of distance in which they are closely monitored by distant, disinterested actors; displacing the social solidarity provided by 'informal' mechanisms of mutual support and reciprocal exchange (Gates, 2018).

This individualistic vision of agrarian development has been challenged by scholars like Paul Richards, who eschews the methodological individualism of neoclassical and behavioural economics alike, in favour of a Durkheimian view of the individual as 'the product of a group process though which persons are rendered sacrosanct' (Richards, 2007, p. 22). In this view, informal processes of seed reciprocity among African smallholders – processes viewed as suboptimal by purveyors of 'modern' technologies – provide a technical as well as a social function; maximizing the number of seed types 'suited to a wide range of localised applications' while at the same time sustaining 'egalitarian collective representations' (Richards, 2007, p. 23). Linked to this is an understanding of technology itself, not as 'knowledge or kit' but as embodied practice. Technology is, above all, 'a way of *doing* things. Doing things has a double aspect – it both achieves material outcomes and fixes social values through aligning energies and emotional commitments, among the group engaged in the "doing"' (Richards, 2007, p. 23, emphasis added). From this perspective the long Green Revolution can be reinterpreted as a series of attempts to unbundle agriculture as a complex group process and reinsert individuals as autonomous market subjects into wider circuits of commodities and capital.

This view of technology as *doing* underpins Stone's (2007) conception of agricultural practice as a continual, dynamic process of skilling: a process whose interruption can have serious and sometimes irreversible consequences. Agricultural skilling is a dynamic, hybrid, group process integrating environmental and social learning, 'in which farmers observe, discuss, and often participate in each other's operations'. Farmers, as noted earlier, are knowledgeable agents who continually experiment – they 'try and see' (Richards, 2010, p. 3). Conversely, agricultural *de*skilling involves the disruption of skilling, and, crucially, of the balance between social and environmental learning that is so central to it. The consequences of agricultural deskilling are more serious than those of industrial deskilling. 'In contrast to industrial workers' who, once tasks are automated no longer need the skills required to perform them, deskilled farmers *continue to need the skills* that have been downgraded (Stone, 2007, p. 73, original emphasis).

Introduction of new technologies can contribute to agricultural deskilling in a number of ways that are independent of the nature of the technology itself. Deskilling can result from the introduction of a technology whose effects are (or appear to be) inconsistent or difficult to recognize, at least initially. 'For instance, farmers easily recognised first generation Green Revolution seeds, but the more subtle changes bred into subsequent generations caused greater confusion and slower rates of adoption' (Stone, 2007, p. 73). Significantly, considering the centrality of digital platforms as mechanism to accelerate take up of not only one but a 'bundle' of new technologies of different types (biological and financial); deskilling can result from instances of rapid technological change; particularly where there is pressure to skip the experimentation phase. 'Skilling takes time'. If the pace of change is too fast 'the skilling

process may fail to keep up with [the] technological change' (Stone, 2007, p. 73).

Farming practice draws on systems of embedded knowledge that are complex and deeply contextual, in ways that designers of behavioural nudges to shift 'habitual agency, social norms and mental models' (Klein, 2017, p. 483) may not fully appreciate. Generic formulae based on binaries such as automatic versus deliberative thinking fail to capture the embodied cognitive and affective nuances of agricultural decision-making and the mental models on which it is based. As discussed earlier, an attempt to institute new social norms benchmarked to introduced products and technologies, and override existing social obligations, risks eroding the existing fabric of social relations already frayed by successive agricultural modernization interventions. And while architects of the the post-war Green Revolution at least emphasized the 'spirit of openness and inquisitiveness' necessary for agricultural modernization (Nally & Taylor, 2015, p. 60), digital farmer platforms represent a further stage in the narrowing down of options that has resulted from the privatization of agricultural development (Ashby, 2009); in which farners are 'locked in' to a predetermined product/service 'bundle' over which they should have no choice (Iazzolino & Mann, 2019).

The inclusion of IBAI, a product for which there is limited demand, in digital farmer programme bundles can undermine the social relations essential to agricultural skilling. As Isakson (2015) has shown, the conversion of agricultural risk into an asset class is viewed as a crucial step to advancing the capitalization of smallholder agriculture, enabling investors to outsource risk management to smallholders themselves. The design of index-based products involves the de-bundling of environmental risk from agricultural production prior to re-bundling it within digital farmer programmes in ways that benefit private providers (while relieving governments of responsibilities for public provision). Indeed, it should be no surprise that recent investors in IBAI products and businesses include multinational agribusiness firms already well positioned in smallholder development networks such as AGRA (Isakson, 2015). Crucially, IBAI accelerates the individualization of risk, eroding informal systems of risk pooling linked to local institutions for seed saving and exchange that the long Green Revolution has long sought to render obsolete as 'backward'. Meanwhile farmers are not only locked into new financial behaviours, with their associated risks and uncertainties, but also to the purchase of seeds that are likely to be less resilient in the face of climate stresses than their own tried and tested varieties (see McGuire & Sperling, 2016).

The soft coercion strategies employed by digital farmer programmes can thus be compared with contract farming schemes that spread across the Global South in the wake of structural adjustment and agricultural liberalization policies of the 1980s and 1990s (Little & Watts, 1994). With the 'platformisation' of smallholder agriculture attempted by digital farmer programmes, however, firms are able to exploit farmers' labour within a business model that allows them to pass on risks to 'autonomous' smallholders, while reaping

handsome rewards (Iazzolino & Mann, 2019). Platforms maintain an illusion that smallholders are 'masters of their own destiny' while developing intrusive means of 'psycho-social regulation' to secure conformance to market norms (see Nally & Taylor, 2015). Rather than open up a new world of opportunity to smallholder farmers, as disintermediation narratives suggest, the platform model makes possible the creation of closed 'nudge worlds' (Lepenies & Małecka, 2015) governed by platform developers and partner fintech and agri-business firms keen to extract data and profits from thousands of small-scale farms. In these nudge worlds in-the-making, the imagined digital farmer-subject is a cyborg (Rudy, 2005): deskilled but still sufficiently human to function independently of state and, increasingly, other social supports, but whose behaviour is sufficiently predictable for 'inclusion' in multiple markets.

Conclusion

A win-win narrative pervades the 'data for development' field and the digital farmer discourse is no exception. In this discourse techno-optimism merges with a market-optimism that assumes withdrawal of state and community systems of support will unleash a diverse and vibrant private sector that is more responsive to smallholders' needs (Annan & Dryden, 2018). The view is at odds with the way in which agricultural platforms are evolving in practice, notably in Kenya, the 'quintessential laboratory for digital innovations due to its permissive financial and technological regulation and the overwhelming success of the M-PESA mobile money service' (Iazzolino & Mann, 2019, np.). Comparison with the celebrated M-PESA success story is instructive. Its launch, by Vodafone partner, SafariCom took place in a traumatic period of Kenya's history, when post-election violence led to 1,500 deaths and displacement of 300,000 people from their homes. For a time, M-PESA became indispensable as 'one of the only available channels for the transfer of money and mobile phone credit' (Morawczynski, 2009, p. 518). Moreover, the possibility of mobile money transfer during this crisis period performed an important 'symbolic function. With each transfer, the migrant was sending an important message that they had not forgotten their obligation to the village whilst residing in the city. With each transfer, the migrant was also maintaining relations with their rural relatives' (Morawczynski, 2009, p. 519). Since that time, the service has remained popular, notably because it has been appropriated 'according to existing transaction patterns'; and has helped strengthen social ties 'by facilitating gifts and social payment across networks of kin and friends' (Iazzolino & Wasike, 2016, p. 231).

The contrast between the way in which the M-PESA service was absorbed into the fabric of socio-economic life in a country where, despite its celebration as a fintech poster child (Suri & Jack, 2016), 'cash remains king' (Iazzolino & Wasike, 2016, p. 229), and the *modus operandi* of emerging agricultural platforms is a stark one. The agricultural platform, DigiFarm, it should be

noted, has a stated goal to supercede M-PESA as Kenya's most popular digital platform (Shrader *et al.*, 2019). Should it succeed, the monopoly enjoyed by telecommunication firms like SafariCom in the era of first generation digital finance would be broken, opening up the market to eager fintech firms.[4] Despite claims that this will reduce informational and market asymmetries, however, experience to date suggests the reverse: 'platform developers actually re-intermediate the market and are able to reap profits through lock-in and control over market governance' (Iazzolino & Mann, 2019, np).

The 'platformisation' of smallholder agriculture further entrenches a 'value chain' approach to agricultural development that assumes smallholder farmers benefit from incorporation in agribusiness chains; an assumption that has weathered sustained critiques (Sexsmith & McMichael, 2015). This dependence is intensified through mechanisms of 'bundling' products and services of platform partners and behavioural nudges that steer participating farmers towards adopting the bundle components. The inclusion of microinsurance in the bundle is critical to the atomization of the digital farmer subject as an individual detached from 'traditional' relations of informality and mutuality and thus increasingly dependent on market 'inclusion'. As such, these initiatives represent a continuation of the 'long' Green Revolution (Patel, 2013): through which the sustained superimposition of a narrow concept of agricultural technology has eroded the foundations of farming as an embodied and socially-embedded practice of continual experimentation and innovation (Richards, 1985, 2007, 2010; Stone, 2007). Indeed, initiatives discussed in this paper are designed in such a way as to *accelerate* the severance of agricultural practice from these foundations, and foster market-readiness for a new 'digital' age in which informal safety nets are no longer deemed necessary (Gates, 2018).

While providing 'lock-in' advantages for platform providers and partner firms, digital farmer platforms also present opportunities for financial actors to harvest the types of data they need for assessing prospective farmland investments in distant lands: a trend likely to intensify with the global spread of precision agriculture (Fraser, 2018). In this context, the digital farmer assemblage can be understood as a laboratory, in which digital platforms are deployed as human technologies – 'technologies that take modes of being human as their object' (Rose, 1996, p. 26 in Wahlberg & Rose, 2015, p. 62) – to create a new type of market subject: a self-reliant individual that behaves in predictable ways as producer/consumer, while being primed to function, at some point in the future, as a human sensor emitting real-time data to a wider network of stakeholders, both public and private, through their 'interpassive' engagement with digital platforms (see Ruppert, 2011). In this case, the digital farmer, armed with his or her mobile phone, can be seen as a 'cyborg' (see Rudy, 2005): human enough to continue farming, albeit in an attenuated, precarious fashion, while sufficiently 'non-human' to function as a reliable market subject and data transmitter in a nudge world shaped by 'sensors, devices, software and data flows' (Fraser, 2018, p. 5).

The digital farmer discourse rides the 'long' Green Revolution wave while offering digitization as a 'techno-market fix' that can dissolve, once and for

all, the stickiness of informal institutions and practices that are seen as impediments to the capitalization of all parts of the agri-food (or more accurately the agri-food-finance) chain. Whether the cyborg subject of the digital farmer can continue to function, after the radical disruption to agricultural skilling (on top of previous 'successes') that these initiatives propose, is questionable. Will the digital farmer reconfiguration be a step too far? As Haraway (2006) reminds us, however, the cyborg metaphor can also provide a starting point for new kinds of politics that illuminate how 'techno-human relations create affects and worlds of very particular kinds' and how these might be otherwise (Latimer, 2017, p. 249). Farmers' sustained rejection of microinsurance products (despite determined nudging by the development agency concerned), as well as their strategies of 'side selling' produce outside the value chain (entrepreneurial behaviour, but not of the 'right' kind), on at least one smallholder programme (Berndt, 2015), suggests the path to digitized market inclusion may not be an entirely smooth one. The question, then, is what openings might exist to 'hack' what are still embryonic systems (Fraser, 2018) and use their 'structure and momentum' to move them 'in directions its corporate architects didn't intend' (Kloppenburg, 2014, p. 1242).

Acknowledgements

The author would like to thank special section editors Elise Klein, China Mills, Asha Achuthan and Eva Hilberg and fellow contributor Justin Karter for helpful feedback on an earlier version of this paper, and the five anonymous reviewers for their thoughtful comments and suggestions.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes

1 The Consultative Group on International Agricultural Research (more here: https://www.cgiar.org).

2 Similarly, the agrochemicals conglomerate, Monsanto has also recognized the potential of the IBAI market and purchased insurance underwriter Climate Corp (Isakson, 2015, p. 7).

3 The three AFA country white papers draw on a 2013 study by the McKinsey consulting group which estimates that mobile and internet technology can 'drive up to $3 billion in annual agricultural productivity gains' in Africa by 2025 (McKinsey and Company, 2013).

4 Personal communication, Mastercard Foundation representative, August 2018.

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References

AgriFin Accelerate. (2016). A 2016 Tanzania ecosystem review & strategic perspective on digital financial services for smallholder farmers. Retrieved from https://www.raflearning.org/post/2016-tanzania-ecosystem-review-strategic-perspective-on-digital-financial-services-for

Aitken, R. (2017). 'All data is credit data': Constituting the unbanked. *Competition and Change*, *21*(4), 274–300.

Alonso-Fradejas, A., Borras Jr., S. M., Holmes, T., Holt-Giménez, E. & Robbins, M. J. (2015). Food sovereignty: Convergence and contradictions, conditions and challenges. *Third World Quarterly*, *36*(3), 431–448.

Anderson, R. S., Levy, E. & Morrison, B. M. (1991). *Rice science and development politics: Research strategies and IRRI's technologies confront Asian diversity (1950–1980)*. Clarendon Press.

Annan, K., Conway, G. & Dryden, S., (Eds.). (2018). African farmers in the digital age: How digital solutions can enable rural development. *Foreign Affairs,* Special Issue - African farmers in the digital age: How digital solutions can enable rural development. Retrieved from http://www.fao.org/family-farming/detail/en/c/381860/

Annan, K. & Dryden, S. (2018). Food and the transformation of Africa: Getting smallholders connected. In K. Annan, G. Conway & S. Dryden (Eds.), *Foreign Affairs,* Special Issue - African farmers in the digital age: How digital solutions can enable rural development (pp. iii–iix). Foreign Affairs Special Issue. Retrieved from http://www.fao.org/family-farming/detail/en/c/381860/

Annan, K., Dryden, S. & Conway, G. (2018). Foreword: Digital thinking to transform Africa's food system: Overcoming isolation, speeding up change, and taking success to scale. In K. Annan, G. Conway & S. Dryden (Eds.), *Foreign Affairs,* Special Issue - African farmers in the digital age: How digital solutions can enable rural development (pp. xi–xiv). Retrieved from http://www.fao.org/family-farming/detail/en/c/381860/

Ashby, J. A. (2009). Fostering Farmer First methodological innovation: Organisational learning and change in international agricultural research. In I. Scoones & J. Thompson (Eds.), *Farmer First revisited: Innovation for agricultural research and development* (pp. 39–45). Practical Action Publishing.

Bernards, N. (2019). The poverty of fintech? Psychometrics, credit infrastructures, and the limits of financialization. *Review of International Political Economy*, *26*(5), 815–838.

Berndt, C. (2015). Behavioural economics, experimentalism and the marketization of development. *Economy and Society*, *44*(4), 567–591.

Berndt, C. & Boeckler, M. (2017). Economic, experiments, evidence: Poor behavior and the development of market subjects. In V. Higgins & W. Larner (Eds.), *Assembling neoliberalism: Expertise, practices, subjects* (pp. 283–302). Palgrave Macmillan.

Breger-Bush, S. (2012). *Derivatives and development: A political economy of global finance, farming, and poverty*. Palgrave Macmillan.

Brenner, C. (1993). *Technology and developing country agriculture: The impact of economic reform*. OECD.

Carnegie, A. (1889). The Gospel of wealth. *North American Review*, CCCXCI.

Chambers, R., Pacey, A. & Thrupp, L. A. (Eds.). (1989). *Farmer First: Farmer innovation and agriculturalrResearch*. Intermediate Technology Publications.

Cullather, N. (2004). Miracles of modernization.. *Diplomatic History*, *28*(2), 227–254.
De Schutter, O. (2011). How not to think of land-grabbing: Three critiques of large-scale investments in farmland. *The Journal of Peasant Studies*, *38*(2), 249–279.
Ethiopian Agricultural Transformation Agency. (n.d.). Mandate: Strategic goals, vision, mission and values. Retrieved from http://www.ata.gov.et/about-ata/atas-role/
Fairbairn, M. (2014). 'Like gold with yield': Evolving intersections between farmland and finance. *The Journal of Peasant Studies*, *41*(5), 777–795.
Fine, B., Johnston, D., Santos, A. C. & Van Waeyenberge, E. (2016). Nudging or fudging: The world development report 2015. *Development and Change*, *47*(4), 640–663.
Frankel, F. R. (1971). *India's green revolution: Economic gains and political costs*. Princeton University Press.
Fraser, A. (2018). Land grab/data grab: Precision agriculture and its new horizons. *The Journal of Peasant Studies*, *46*(5), 893–912.
Gabor, D. & Brooks, S. (2017). The digital revolution in financial inclusion: International development in the fintech era. *New Political Economy*, *22*(4), 423–436.
Gates, B. (2018). The secret decoder ring: How cell phones let farmers, governments, and markets talk to each other. In K. Annan, G. Conway & S. Dryden (Eds.), *Foreign Affairs,* Special Issue - African farmers in the digital age: How digital solutions can enable rural development (pp. 90–95). Retrieved from http://www.fao.org/family-farming/detail/en/c/381860/.
Griffin, K. (1979). *The political economy of agrarian change: An essay on the Green Revolution* (2nd Ed.). Macmillan Press.
Hailu, M. (2018). Opinion: Drone technology holds great promise across Africa. It just needs the right regulations. Retrieved from https://www.devex.com/news/opinion-drone-technology-holds-great-promise-across-africa-it-just-needs-the-right-regulations-93327
Haraway, D. (2006). A cyborg manifesto: Science, technology, and socialist-feminism in the late 20th century. In *The international handbook of virtual learning environments* (pp. 117–158). Springer.
Hinson, R., Lensink, R. & Mueller, A. (2019). Transforming agribusiness in developing countries: SDGs and the role of fintech. *Current Opinion in Environmental Sustainability*, *41*, 1–9.
Iazzolino, G. & Mann, L. (2019). Harvesting data: Who benefits from platformization of agricultural finance in Kenya? Retrieved from https://developingeconomics.org/2019/03/29/harvesting-data-who-benefits-from-platformization-of-agricultural-finance-in-kenya/?blogsub=subscribed#subscribe-blog
Iazzolino, G. & Wasike, N. (2016). The unbearable lightness of digital money. *Journal of Payments Strategy & Systems*, *9*(9), 229–241.
Isakson, S. R. (2014). Food and finance: The financial transformation of agro-food supply chains. *The Journal of Peasant Studies*, *41*(5), 749–775.
Isakson, S. R. (2015). Derivatives for development? Small-farmer vulnerability and the financialization of climate risk management. *Journal of Agrarian Change*, *15*(4), 569–580.
Johnson, L., Wandera, B., Jensen, N. & Banerjee, R. (2019). Competing expectations in an index-based livestock insurance project. *The Journal of Development Studies*, *55*(6), 1221–1239.
Karlan, D. & Appel, J. (2011). *More than good intentions: Improving the ways the world's poor borrow, save, farm, learn, and stay healthy*. Penguin.
Klein, E. (2017). The World Bank on mind, behaviour and society. *Development and Change*, *48*(3), 481–501.
Kloppenburg, J. (2014). Re-purposing the master's tools: The open source seed initiative and the struggle for seed sovereignty. *The Journal of Peasant Studies*, *41*(6), 1225–1246.
Lahaye, E., Abell, T. E. & Hoover, J. K. (2017). *Vision of the future: Financial inclusion 2025. Focus note 107*.

Washington, DC: CGAP. Retrieved from https://www.cgap.org/sites/default/files/Focus-Note-Vision-of-the-Future-Jun-2017_0.pdf

Langevin, M. (2019). Big data for (not so) small loans: Technological infrastructures and the massification of fringe finance. *Review of International Political Economy*, *26*(5), 790–814.

Latimer, J. (2017). Manifestly Haraway: The cyborg manifesto, the companion species manifesto, companions in conversation (with Cary Wolfe). *Theory Culture & Society*, *34*(7–8), 245–252.

Lepenies, R. & Malecka, M. (2019). The ethics of behavioural public policy. In A. Lever & A. Poama (Eds.), *The Routledge handbook of ethics and public policy* (pp. 513–525). Routledge.

Lepenies, R. & Małecka, M. (2015). The institutional consequences of nudging – nudges, politics, and the law. *Review of Philosophy and Psychology*, *6*(3), 427–437.

Lipsky, M. (1971). Street-Level bureaucracy and the analysis of urban reform. *Urban Affairs Quarterly*, *6*(4), 391–409.

Lipton, M. & Longhurst, R. (1989). *New seeds and poor people*. Unwin Hyman.

Little, P. D. & Watts, M. J. (Eds.). (1994). *Living under contract: Contract farming and agrarian transformation in sub-Saharan Africa*. University of Wisconsin Press.

Mann, L. (2018). Left to other peoples' devices? A political economy perspective on the big data revolution in development. *Development and Change*, *49*(1), 3–36.

Mas, I. & Morawczynski, O. (2009). Designing mobile money services lessons from M-PESA. *Innovations: Technology, Governance, Globalization*, *4*(2), 77–91.

Mastercard Foundation. (2016). Smallholder farmers in Tanzania to benefit from new program by Mercy Corps and Mastercard Foundation. Retrieved from https://mastercardfdn.org/smallholder-farmers-in-tanzania-to-benefit-from-new-program-by-mercy-corps-and-the-mastercard-foundation/

McGuire, S. & Sperling, L. (2016). Seed systems smallholder farmers use. *Food Security*, *8*(1), 179–195.

McKeon, N. (2014). *The new alliance for food security and nutrition a coup for corpate capital*. Amsterdam: Transnational Institute. Retrieved from https://www.tni.org/en/publication/the-new-alliance-for-food-security-and-nutrition

McKinsey and Company. (2013). Lions go digital: The internet's transformative potential in Africa. Retrieved from https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/lions-go-digital-the-internets-transformative-potential-in-africa.

McMichael, P. (2015). The land question in the food sovereignty project. *Globalizations*, *12*(4), 434–451.

Mercy Corps. (2015). Agrifin mobile project: Project development and defining the stages of bundling. Retrieved from https://www.mercycorps.org/research-resources/agrifin-mobile-product-develo
pment-and-defining-stages-bundling

Mercy Corps. (n.d.-a). The art of behavior change. Retrieved from https://mercycorpsafa.org/2016/11/04/the-art-of-behavior-change/

Mercy Corps. (n.d.-b). Who is the smallholder farmer? Retrieved from https://mercycorpsafa.org/wp-content/uploads/2016/10/Farmer-Capability-Lab-Kenya-2.pdf

Millar, G. (2016). Knowledge and control in the contemporary land rush: Making local land legible and corporate power applicable in rural Sierra Leone. *Journal of Agrarian Change*, *16*(2), 206–224.

Morawczynski, O. (2009). Exploring the usage and impact of "transformational" mobile financial services: The case of M-PESA in Kenya. *Journal of Eastern African Studies*, *3*(3), 509–525.

Nally, D. & Taylor, S. (2015). The politics of self-help: The Rockefeller Foundation, philanthropy and the 'long' Green Revolution. *Political Geography*, *49*, 51–63.

Oasa, E. K. (1987). The political economy of international agricultural research: A review of the CGIAR's response to criticism of the Green Revolution. In B. Glaeser (Ed.), *The Green*

Revolution revisited: Critique and alternatives (pp. 13–55). Allen and Unwin.
Odame, H. & Muange, E. (2011). Can agro-dealers deliver the Green Revolution in Kenya? *IDS Bulletin*, *42*(4), 78–89.
Okonjo-Iweala, N. & Madan, J. (2018). Shine a light on the gaps: Smallholder farmers represent the next frontier for digital financial services. In K. Annan, G. Conway & S. Dryden (Eds.), *Foreign Affairs,* Special Issue - African farmers in the digital age: How digital solutions can enable rural development (pp. 103–109). Retrieved from http://www.fao.org/family-farming/detail/en/c/381860/
Patel, R. (2013). The long Green Revolution. *The Journal of Peasant Studies*, *40*(1), 1–63.
Peake, C. (2012). New frontiers: Launching digital financial services in rural areas. *Brookings Blum Roundtable Policy Briefs*. Retrieved from https://www.brookings.edu/wp-content/uploads/2016/06/10-new-frontiers-peake.pdf
Pearse, A. (1980). *Seeds of plenty, seeds of want: Social and economic implications of the Green Revolution*. Clarendon Press.
Perkins, J. H. (1997). *Geopolitics and the Green Revolution: Wheat, genes and the Cold War*. Oxford University Press.
Richards, P. (1985). *Indigenous agricultural revolution*. London: Hutchinson.
Richards, P. (2007). How does participation work? Deliberation and performance in African food security. *IDS Bulletin*, *38*(5), 21–35.
Richards, P. (2010). A Green Revolution from below: Science and technology for global food security and poverty alleviation. Paper presented at the Farewell address upon retiring as Professor of Technology and Agrarian Development at Wageningen University on 18 November 2010. Wageningen University, Netherlands. Retrieved from https://core.ac.uk/download/pdf/29238708.pdf
Rose, N. (1996). *Inventing our selves: Psychology, power, and personhood*. Cambridge University Press.
Rosenberg, G. N. (2015). *The 4-H harvest: Sexuality and the state in rural America*. University of Pennsylvania Press.
Rudy, A. P. (2005). Imperial contradictions: Is the valley a watershed, region, or cyborg? *Journal of Rural Studies*, *21*(1), 19–38.
Ruppert, E. (2011). Population objects: Interpassive subjects. *Sociology*, *45*(2), 218–233.
Scoones, I. & Thompson, J. (2011). The politics of seed in Africa's Green Revolution: Alternative narratives and competing pathways. *IDS Bulletin*, *42*(4), 1–23.
Scott, J. C. (1998). *Seeing like a state: How certain schemes to improve the human condition have failed*. Yale University Press.
Sexsmith, K. & McMichael, P. (2015). Formulating the SDGs: Reproducing or reimagining state-centered development? *Globalizations*, *12*(4), 581–596.
Shakya, Y. B. & Rankin, K. N. (2008). The politics of subversion in development practice: An exploration of microfinance in Nepal and Vietnam. *The Journal of Development Studies*, *44*(8), 1214–1235.
Shrader, L., Makau, E. & Karlyn, A. (2019). DigiFarm: A digital platform for farmers. Retrieved from https://mercycorpsagrifin.org/wp-content/uploads/2019/05/DigiFarm-Platform-Case_Final_.pdf
Soederberg, S. (2013). Universalising financial inclusion and the securitisation of development. *Third World Quarterly*, *34* (4), 593–612.
Stone, G. D. (2007). Agricultural deskilling and the spread of genetically modified cotton in Warangal. *Current Anthropology*, *48*(1), 67–103.
Suri, T. & Jack, W. (2016). The long-run poverty and gender impacts of mobile money. *Science*, *354*(6317), 1288–1292.
Tabor, S. R. (1995). *Agricultural research in an era of adjustment: Policies, institutions, and progress*. Economic Development Institute of the World Bank/International Service for National Agricultural Research (ISNAR).
Thaler, R. H. & Sunstein, C. R. (2008). *Nudge: Improving decisions about health,*

wealth, and happiness. Yale University Press.
Wahlberg, A. & Rose, N. (2015). The governmentalization of living: Calculating global health. *Economy and Society*, *44*(1), 60–90.
Woolgar, S. (1990). Configuring the user: The case of usability trials. *The Sociological Review*, *38*(1Suppl), 58–99.
World Bank. (2007). *Agriculture for development: World development report 2008*. World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/5990.
World Bank. (2013). *Global financial development report: Financial inclusion*. World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/16238
World Bank. (2015). *World development report 2015: Mind, society, and behaviour*. World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/20597
Yeung, K. (2017). 'Hypernudge': Big data as a mode of regulation by design. *Information, Communication & Society*, *20*(1), 118–136.

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