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## Mineral industries, growth corridors and agricultural development in Africa

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## ABSTRACT

An extractive industries boom in Africa is driving unprecedented expansion of infrastructure into sparsely populated regions. Much of the investment is in high-volume minerals such as iron and coal that will require heavy infrastructure and large settled workforces. New roads and railways are being built to support these industries. Mineral infrastructure is reinforcing the dynamic of designated “growth corridors”, which are increasingly determining settlement patterns and rural land use in Africa. These corridors are penetrating into areas where agriculture has been constrained by lack of access to markets. They could unleash a major expansion of arable crops in the Guinea and Miombo savannahs, tropical tree crops in Congo Basin rainforests and irrigated agriculture on the floodplains of several African river systems. Rapidly growing African cities are largely dependent on imported food but growth corridors linking them to hinterland areas could favour shifts to African-sourced foods. Governance weaknesses may allow outside investors to make land grabs along growth corridors and further marginalise poor smallholders. New pressures on environmentally sensitive areas may emerge. Policy changes are needed to avoid negative impacts of this major new development trend and to exploit the potential for poverty alleviation and food-security benefits.

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### 1. Introduction

Mineral extraction has influenced population distribution and development patterns in Africa since pre-colonial times. The ancient civilisations of Ghana and Mali existed because of trans-Saharan trade in gold and salt. The Great Zimbabwe ruins were linked to gold exploitation. European colonists discovered gold in South Africa in 1886; colonial gold mining in Zimbabwe started in the early 1890s and copper mining in Zambia in 1895 (Economist, 2011; Pakenham, 1991). Development in present day South Africa, Zimbabwe, Ghana, Zambia, and Congo was driven by mineral exploitation in the early days of European colonisation.

An unprecedented mineral boom is now occurring in Africa. Six of the ten fastest growing economies in the world are in Africa and all of them have thriving mineral sectors (Economist, 2011). The mineral boom is contributing to the emergence of “growth corridors” where infrastructure upgrades will improve the competitiveness of agriculture and other economic activities (African Agricultural Development Company Ltd., 2013; Delgado et al., 1998).

Much of the recent increase in foreign direct investment in Africa is linked to extractive industries (Fig. 1). The number of projects

under study or being negotiated with African governments is at an all-time high (AusAID, 2011; Cheung et al., 2012; Department of Foreign Affairs and Trade, 2011; Huang and Wilkes, 2011; Janneh and Ping, 2011; The Americas Team, 2010; WWF, 2011; Zhang and Wilkes, 2010). For example, in 2011 close to 150 Australian mineral companies were investing ~\$20 billion in more than 40 African countries (Negin et al., 2011). China is rapidly increasing investments in minerals in Africa (Fig. 2). Much recent mining expansion is for high-volume resources such as coal, iron and other heavy metals of importance to the steel industry (Fig. 3). The extraction of these minerals requires railways or significant road infrastructure and ports (Carmody, 2009; Jalloh et al., 2013; Zhang and Wilkes, 2010).

Here we review trends in new mineral activities in Africa and argue that they will be major drivers of change in settlement patterns and agricultural development. We relate new mining activity and its associated infrastructure with the location of land that has agricultural potential. We examine the extent to which the economic changes associated with mineral activities may impact on farming, food security and rural livelihoods.

### 2. Growth corridors

Infrastructure is the key to agricultural development in Africa (Delgado et al., 1998). This has led to recognition of the “African

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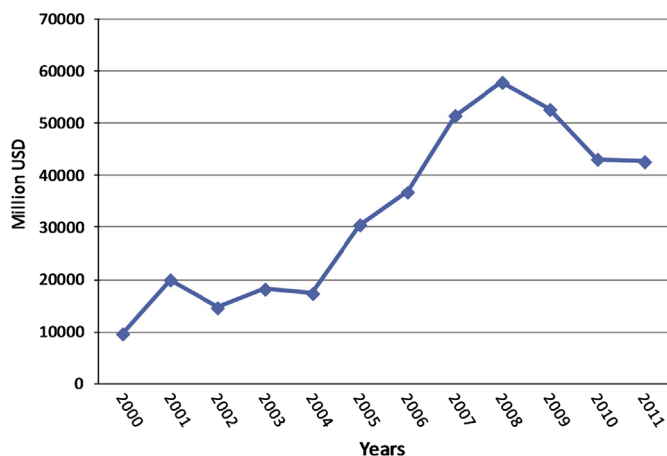


Fig. 1. African Inward foreign direct investment flows.  
Source: UNCTAD <http://unctadstat.unctad.org/TableViewer/tableView.aspx> (accessed 22.03.13)

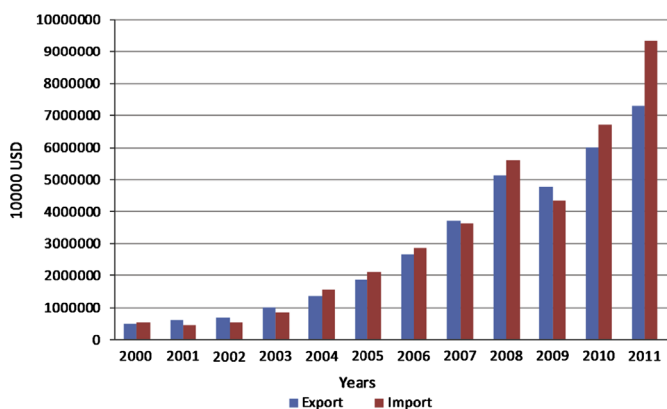


Fig. 2. Chinese import and export trade with Africa.  
Source: China Statistical Database <http://www.stats.gov.cn/english/statisticaldata/yearlydata/> (accessed 25.03.13)

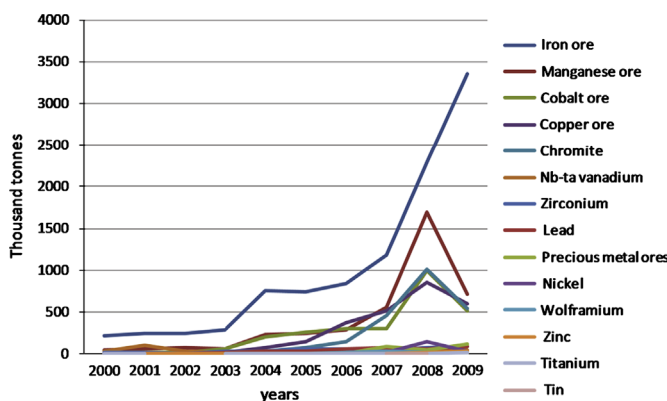


Fig. 3. Chinese metal ore imports from Africa by volume (2000–2009). In addition crude oil exports to China increased very rapidly from 3.62 million tonnes in 2000 to 38.94 million tonnes in 2008, then declined to 24.04 million tonnes in 2009.  
Source: Zhang and Wilkes (2010). Trends in Chinese trade and investment in Africa's mining sector. Beijing: Chinese Academy of Land Resources and Economy (accessed 15.7.12)

Agricultural Growth Corridor" concept at the UN General Assembly in 2008. Growth corridors achieved a high profile at the World Economic Forum in 2009 and 2010 at meetings in Davos, Switzerland and in Dar es Salaam, Tanzania (Paul and Steinbrecher, 2012). There is a proliferation of web-based material on growth corridors

(African Agricultural Development Company Ltd., 2013) but few systematic studies have been published. The logic is simple – improved access and the existence of new settlements with well paid workers will create conditions where agriculture can readily be intensified (Laurance and Balmford, 2013). The assumption is that, with improved access to markets and agricultural inputs, the principle barriers to agricultural innovation and intensification will be broken down.

Mining is a major driver of economic growth in many African countries (Scott, 2009). Growth may encourage development of secondary industries in cities and create new opportunities in services and manufacturing. Urban populations with increased purchasing power will demand more and different agricultural products. This could address one of the most serious constraints to African agriculture, the absence of domestic markets (Collier, 2007). Profitable urban markets could enable farmers to make investments in agricultural inputs and close the large yield gaps that at present exist in African smallholder agriculture (Lobell et al., 2009).

### 3. Linking mining infrastructure and agricultural growth corridors

African countries are heavily dependent on agriculture and the sector accounts for more than 30% of regional GDP and 60% of total employment. In spite of this, only 220 million ha of the 2.4 billion ha of land in sub-Saharan Africa is cropped (with larger areas under various livestock-grazing systems). Much farming is by smallholders using low-intensity methods: less than 5% of existing cropland is irrigated, improved crop varieties are grown on only about 35% of cropland, inorganic fertilizer use averages less than 10 kg/ha, and mechanisation is limited (Diao et al., 2006). The potential for major growth in agricultural production is enormous and lack of infrastructure and markets is a major constraint (Jayne et al., 2010). African smallholders typically have diverse farming systems with multiple tree and arable crops grown mainly for subsistence needs (IAASTD, 2009). Many farmers have small (< 2 ha) plots and do not produce enough to feed their families for the entire year and have to purchase their staple carbohydrate diets during periods of scarcity. The ability to intensify agriculture and achieve increased yields on such small plot sizes is limited by lack of access to markets and fertilizers. Improved infrastructure could allow transformational change in these marginal farms (Limão and Venables, 2001). African cities are growing rapidly and it is projected that they will continue to do so. At present much of the food consumed in cities is imported and smallholder farmers are failing to benefit from this large potential market for their products.

The potential to link extraction of high-volume minerals to agriculture has been recognised in development plans in several countries. Growth corridors associated with mines for iron ore, copper, coal, nickel, and some other minerals are already planned in Tanzania, Northern and Central Mozambique, Namibia, Botswana, Zambia, Ghana and to a lesser extent Liberia and Sierra Leone (Robbins and Perkins, 2012). These minerals require settled populations for their exploitation and robust infrastructure for their transport to ports. The recent expansion of infrastructure for extraction of these minerals is a main driver of the growth corridors. Smallholder farmers should be able to respond to the improved markets and infrastructure provided by these corridors.

We reviewed available literature and web-based sources on existing and planned development corridors in Africa (Table 1). Here we assess the extent to which they are linked to mineral projects and suggest some of the agricultural crops that may expand in the areas opened up by the corridors. Fig. 4 shows the approximate location of the major corridors together with locations

**Table 1**

Potential minerals and agricultural crops in development corridors in Africa

Source: regional SDI programme; NEPAD & numerous web sources and government documents; USGS; FAO <http://www.nepad.org/> <http://www.r-sdi-p.com/> <http://www.eastafrican corridors.org/projects> Accessed 20.3.13–5.7.13.

Name	Minerals	Agriculture crops	Main types	Status
North–South DC Zimbabwe	Coal, iron ore, platinum concentrate from Great Dyke, coal from South Africa, chrome and gold	Large commercial and smallholder, maize mixed farming, root crops, Highland perennial crops (tea etc), agro-pastoralism, millet/sorghum	Railway	Active
Maputo DC Mozambique– South Africa	Major supply line for South African mineral fields. Transport of coal, iron, manganese platinum, chrome and gold	Large commercial and smallholder farming, maize mixed agro-pastoral, millet/sorghum, sugar plantations in South Africa	Railway/ road	Active
Lubombo DC Swaziland– Mozambique– South Africa	Heavy mineral sands (titanium, zircon)	Root crops, maize mixed farming	Railway/ road	Proposed
Limpopo DC Zimbabwe, South Africa– Zambia	Various commodities to supply Zimbabwe mines (gold, chrome, lithium, asbestos etc)	Maize mixed farming, root crops, commercial sugar in SE Zimbabwe	Railway	Active
The Beira DC Mozambique	Main fuel supply line into Zimbabwe. Supplies mineral fields of North Zimbabwe (gold, nickel, copper, chrome and platinum) concentrate for smelters in Zimbabwe	Highland temperate mixed farming, cereal-root crops mixed farming	Railway/ road	Planned upgrade (Machipanda railway and road)
Zambeze DC Mozambique– Zimbabwe– Zambia	Main supply line for the Tete coal fields, also Malawi coal (some other minor mining activities; e.g. gold)	Cereal–root crops mixed farming	Railway	Planned upgrade (Sena railway)
Nacala DC Mozambique– Malawi–Zambia	Limited mining could enable exploitation of Malawi coal, phosphate, rare earth elements and some gold and pegmatite	Cereal–root crops mixed farming, maize and root crops, cashew, cotton, forestry products, macadamia, pulses, rice, sesame, sugar, tobacco and tea	Railway	Planned upgrade (Nacala railway), A new line
Mtwara DC Tanzania	Unlocks the coal fields in the Rukwa Rift and the gold fields near Mbeya. Potential for oil and gas in the Rift Valley. Also future potential for gold mines, and base metals in SW Tanzania	Root crops, maize mixed farming	Railway	Active
Uhuru/Tazara DC Tanzania and Zambia	Supply line to the copperbelt (copper, cobalt gold) and coal fields in the Zambezi rift. Also passes the coal fields in the Rukwa rift	Maize mixed farming	Railway	Planned upgrade (Tanzania–Zambia Railway)
Central DC Tanzania	Supply line to the lake Victoria gold field, also opens mineral potential in Rwanda, Burundi and Eastern DRC (copper, nickel, gold, tin, coltan), plus link to Uganda (gold and copper)	Highland perennials, Jatropha, root crops, maize mixed farming	Railway	Active
Tanga DC Tanzania	Could provide a link to gold fields in NE Tanzania	Root crops, maize mixed farming, agro-pastoralism, millet/sorghum	Railway/ road	Planned upgrade (extension of Tanga–Arusha Railway and roads)
Northern DC Kenya, Uganda to DRC	Opens up the oil fields in lake Albert and provides access to the mining centres in NE DRC (existing gold mines, potential iron ore and a range of other commodities)	Agro-pastoralism, millet/sorghum, maize mixed farming, highland perennial crops – vegetables and tea	Railway/ road	Planned upgrade (railway from Mombasa to Kampala)
LAPSSET DC Ethiopia, South Sudan	Oil	Maize mixed farming, fishing, pastoralism, agro-pastoralism, millet/sorghum, pineapples, avocados, rice, asian vegetables, cattle hides	Railway/ pipeline	Proposed
Mombasa– Nairobi–Addis Ababa DC Kenya–Ethiopia	Would access the gold mining district in S Ethiopia	Diverse agriculture crops	Road	Proposed
Djibouti DC Djibouti	Will open up the gold and base metal mining district in SE Sudan and N Ethiopia	Pastoralism, highland temperate mixed farming, maize	Railway	Proposed
The Dakar-port Harcourt DC Nigeria, Senegal, Mali, Niger	Opens up coal fields in Nigeria and mineral potential in central West Africa (gold, iron, uranium, coal, phosphates)	Agro-pastoralism, millet/sorghum, cereal–root crops mixed farming, tree crops, rice	Railway	Proposed
Conakry– Buchanan DC Guinea, Liberia, Ivory Coast	Allows wider exploitation of bauxite deposits in Guinea (aluminium) and iron and gold deposits in Liberia/Ivory Coast	Tree crops, root crops and mixed farming	Railway/ Pipeline	Proposed

Table 1 (continued)

Name	Minerals	Agriculture crops	Main types	Status
The Sekondi/Ouagadougou DC Ghana and Burkina Faso	Manganese, gold and iron	Cereal–root crops mixed farming, tree crops, rice	Railway	Proposed
Gulf of Guinea DC Coastal West Africa	Gold, iron, nickel, copper, chrome and others. There is also extensive oil and gas potential along the coast	Tree crops, mixed farming, rice	Coastal Highway	Proposed
Douala-N'djamena and Douala-Bangui DC Cameroon, Central African republic and Chad	Gold, aluminium and potentially several other minerals	Tree crops especially oil palm and a wide variety of arable crops	Railway/road	Proposed
Cameroon–Chad DC Chad, Cameroon	Oil, this opens up the oil/gas fields in Chad	Little impact on Agriculture	Pipeline	Active
Mbalam DC Cameroon, Congo Republic	Opens up mineral fields in E Cameroon and Congo (iron, nickel, manganese, bauxite and gold)	Tree crops, fishing, forest products, Oil palm	Railway/road	Proposed
Libreville-Lomié DC Gabon–Cameroon	Opens up mineral fields in Gabon (especially manganese and iron with potential for diamonds, gold, phosphates) and SE Cameroon (iron, nickel, manganese, bauxite and gold)	Tree crops, timber	Railway/road	Proposed
Bas Congo DC DRC	Main supply line for the DRC and anything that comes down the Congo river above the falls. Not specific for mining	Cereal–root crops mixed farming, tree crops	Railway	Active
Luanda Cabinda DC Angola	Connects the oil/gas rich enclave of Kabinda with the main part of Angola	Fishing, tree crops, mixed cereal–root crops	Pipeline	Proposed
Malanje DC Angola and DRC	Opens up the diamond fields of NE Angola and SW DRC, also good potential for gold. Could be extended to the Lubumbashi mining district (copper and cobalt)	Cereal–root crop mixed farming, tree crops, root crops, cassava, coffee, maize, palm oil, rice and wheat	Railway/road	Proposed
Lobito DC Angola	Direct route to the copper belt of Zambia/DRC: copper, cobalt, gold)	Cereal–root crop mixed farming, highland temperate mixed farming	Railway	Planned upgrade (Benguela Railway)
Namibe DC Angola	Opens up SE Angola with potential in Kunene Complex (nickel, copper, titanium, iron)	Pastoralism, agro-pastoralism, millet/sorghum, root crops	Railway/road	Planned upgrade (Mocamedes Railway Line and road)
The Walvis Bay DC Namibia and Botswana	As above, as well as supply line for gold and copper in Namibia. Potential supply line to mineral prospects in N Botswana, and access to coal fields in S Zambia	Pastoralism, agro-pastoralism, millet/sorghum	Railway/road	Active

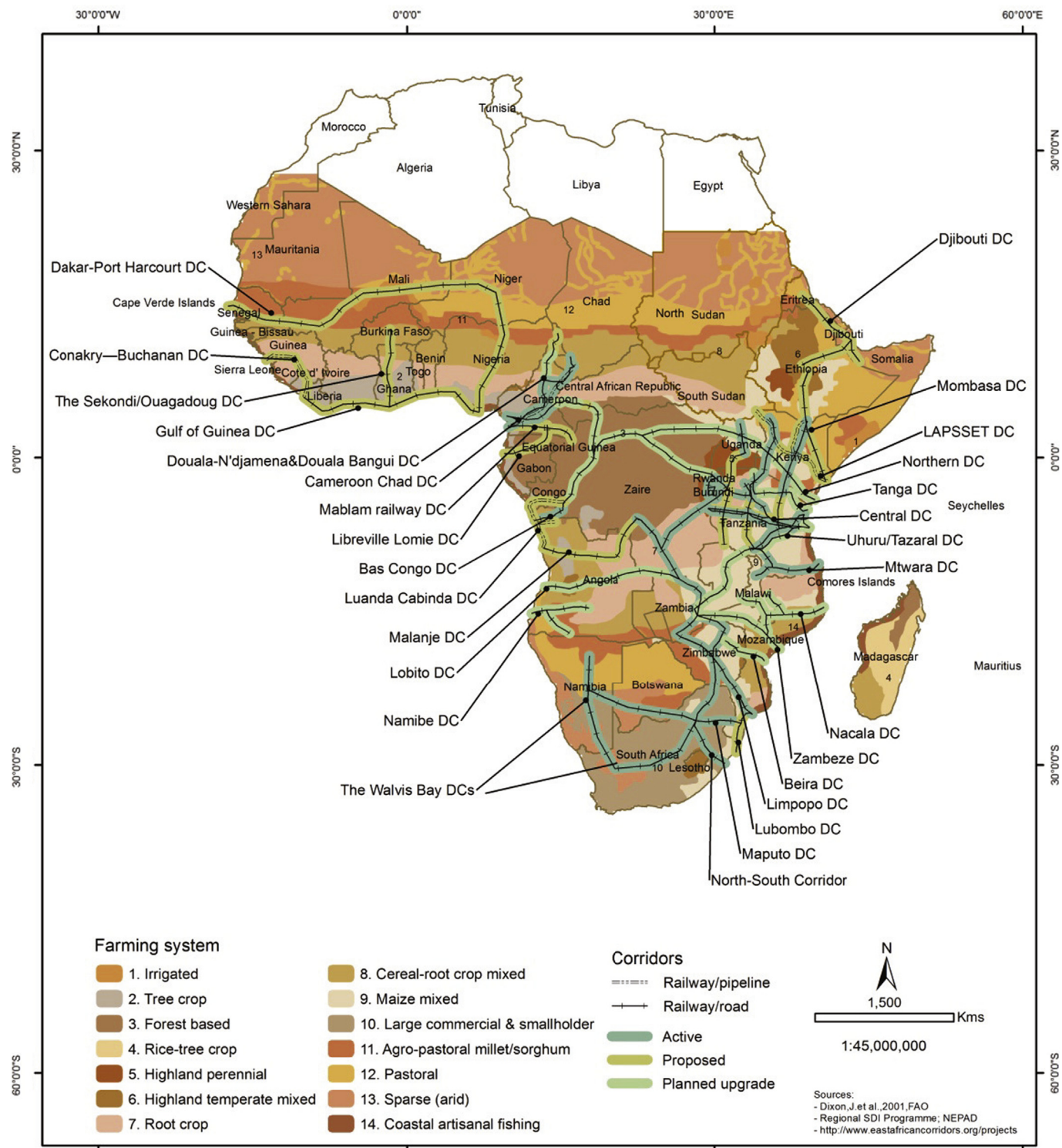
\*Proposed refers in many cases to the potential upgrading of existing infrastructure.

of mines and mineral infrastructure. Fig. 5 shows the alignment of these corridors superimposed on a map of African farming systems. These corridors are not always new. Many represent upgrades of existing infrastructure and this will improve access to existing agricultural areas. However many corridors pass through so-called hinterland areas where agricultural activity has been severely constrained by lack of access. The most significant changes will be in these hinterlands. Phalan et al. (2013) provide maps of areas in the tropics that have agricultural potential as identified by IASA and FAO. Many of the growth corridors shown in Figs. 4 and 5 will provide access to areas that have significant unrealised agricultural potential.

Growth corridors are being developed in areas of the Guinea and Miombo savannahs that have major agricultural potential. The Guinea savannahs have been described as one of the major untapped agricultural areas in the world (Ker, 1995; Morris et al., 2009). Human settlement was earlier limited in these areas by endemic diseases, notably Onchocerciasis (River blindness) and Trypanosomiasis (Sleeping sickness). Vector control programmes have eliminated River blindness in much of West Africa and Sleeping sickness in Eastern

and Southern Africa (Matzke, 1979). There are now large areas of Savannah Africa which are potentially available for agricultural expansion where lack of infrastructure is the only remaining constraint. These areas have similar biophysical conditions to the Cerrado in Brazil, which has seen large-scale expansion of commercial agriculture in the past decade (African Agricultural Development Company Ltd, 2011; Chiza, 2012). This has been referred to by some as the “Miracle of the Cerrado”, and there has been debate about the potential for similar agricultural expansion in savannah Africa. The influential Economist magazine (Piauí, 2010) has posed the rhetorical question, “Can Brazilian farmers achieve the same in other parts of the world?” The expansion of agriculture in the Cerrado required heavy fertilisation with lime. Supplies of lime may be more limited in the savannahs of Africa and nitrogen and phosphates may be more important constraints. However, the success of commercial farming initiatives in the Miombo savannahs of Tanzania suggests that, with adequate investments in fertilizer inputs, these environments will support intensive agriculture (Chiza, 2012; Jenkins, 2012; Shetto and Owenya, 2007).

The Mtwara development corridor in Southern Tanzania is one of the better documented initiatives aiming to achieve integrated



**Fig. 4.** Farming system and development corridors in Sub-Saharan Africa.

Source: Dixon et al., 2001, FAO; Regional SDI Programme, NEPAD; Mineral Facilities in Africa and Middle East (<http://minerals.usgs.gov/minerals/>) Accessed 20.3.2013-5.7.2013

development around new mining infrastructure in a savannah area (Smith, 2005). This corridor will centre on the roads and/or railways needed to extract iron ore from Ludewa district in Iringa region, and coal from the Njoloma region in southwest Tanzania close to lake Nyasa (Kobayashi, 2009; Mtegha et al., 2012; Tanzania National Development Corporation, 2013). There are ambitious plans for agricultural development along this corridor where the agro-ecological conditions are suitable for maize, soy, jatropha and a diversity of other crops.

The roads and railways being constructed to access iron ore in south-east Cameroon, northern and central Republic of Congo and diverse mineral resources in the Democratic Republic of Congo all pass through areas that are suitable for a diversity of tropical crops. Infrastructure being constructed for these new mines is likely to trigger accelerated development of oil palm, soy, sugar cane and local food crops. The potential for oil palm expansion is particularly high in many parts of the Congo Basin where lack of infrastructure has until recently been a limiting factor.



for major oil palm development and Indian and Chinese investors are now joining the traditional European companies in expanding oil palm cultivation. China has negotiated extensive oil palm concessions in Democratic Republic of Congo but has yet to begin developing them. The Singapore/India Company Olam ([Earthsight Investigations, 2013](#)) has acquired forestry interests in several Congo Basin countries in areas suitable for oil palm. The company is a major oil palm trader and appears likely to exploit the potential for oil palm around its newly acquired forestry operations.

India has capacity in irrigated agriculture. Only 5% of Africa's croplands are irrigated compared to 34% in Asia ([Hillel et al., 2008](#)). Expansion of irrigation could transform African agriculture. Growth corridors will provide access to the flood plains of the Niger, Zaire, Zambezi and Nile river systems and many smaller rivers that have potential for irrigated agriculture.

## 5. Conclusions

The explosive expansion of mineral industries and their impact on growth corridors will have complex and to some extent unpredictable impacts on African development. Many of these impacts go beyond the scope of this paper. We share the concern of other authors that wilderness and sensitive environments will be threatened ([Laurance and Balmford, 2013](#); [Phalan et al., 2011](#)). There is legitimate concern about the social impacts of the likely large movements of working-age men to mines where they will be attracted to work along growth corridors and in large-scale land-conversion schemes.

For these and many other reasons there is hope and simultaneously criticism of the growth-corridor concept ([Kaarhus, 2011](#); [Kuhlmann et al., 2011](#); [Paul and Steinbrecher, 2012](#)). At one level, growth corridors are a well-established economic policy instrument that has been pursued in many countries. Growth corridors provide transport infrastructure and electrification which increase agricultural supply-chain efficiencies. The clustering of population and economic activity creates poles of demand for agricultural products. Growth corridors will link remote hinterland areas with markets in Africa's cities and with ports from which agricultural products can be exported.

However, extractive industries could also have negative impacts on agriculture. There are claims that mineral companies have contributed to corruption and bad governance ([Cockcroft, 2012](#); [Standing, 2007](#); [Times et al., 2012](#)). Weaknesses of local institutions and governance structures are a constraint to agricultural development in Africa ([Losch et al., 2011](#)). Mining may further weaken governance and thereby impede development of all sectors of the economy, including agriculture. So-called "Dutch Disease", where extractive industries distort exchange rates and raise labour costs ([Benjamin et al., 1989](#); [Humphreys et al., 2007](#)), may lower the competitiveness of agriculture in Africa. Governance failures may expose farmers to the risk of losing their land to outside investors. Extractive industries may facilitate land grabs as commercial agricultural expands along the infrastructure developed for mines ([Ajayi, 2006](#); [BBC, 2012](#); [Paul and Steinbrecher, 2012](#)). Weak land rights and differential movements of men and women and different ethnic groups will all pose significant problems for equitable and sustainable development in rural areas.

Mining-related infrastructure and development corridors therefore present both risks and opportunities. To achieve favourable development outcomes, spatial planning and zoning will need to be improved, land titling programmes accelerated, local institutions strengthened and local stakeholder processes put in place to reduce negative social impacts. Corridors developed from the coast to the locations of extractive industries provide valuable opportunities for transformative change in African agriculture.

They could bring together the conditions needed to allow African farmers to innovate and realise the full potential of their land. Carefully planned foreign direct investment in large-scale land transformation can also play a valuable role. In conditions of weak governance, however, all of these developments can have harmful social and environmental outcomes.

Mineral companies, especially those from East Asia, have been criticised for failing to observe social and environmental safeguards ([Carmody, 2011](#); [Moyo, 2012](#)). Mineral extraction may be driving macroeconomic growth but may not alleviate poverty or improve food security and can cause environmental harm. For instance, Sierra Leone and Equatorial Guinea have amongst the highest economic growth rates in the world, largely driven by minerals, yet score poorly on the United Nations Human Development Index ([African Development Bank Group, 2012](#); [Jalloh et al., 2013](#); [Ordu et al., 2011](#); [UNDP, 2012a, b](#)).

The mines and associated infrastructure that are presently being planned throughout Africa could profoundly influence patterns of agricultural and rural development on the continent. At present, regulation of mining tends to focus on local and short-term impacts in the immediate vicinity of individual mines and ignores larger-scale, longer-term effects that require more integrated, holistic planning and social processes. Without a broader assessment of mineral ventures and the large-scale infrastructure required to bring new mines into operation, opportunities for agricultural growth will not be exploited in an optimal manner and the potential for environmental degradation and marginalisation of rural people may be increased. Conversely, good agricultural, environmental and rural outcomes are possible if infrastructure needed to open mining districts is planned to serve multiple, broad development objectives and investments are made in appropriate governance arrangements to ensure equitable outcomes.

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