

INCOME FROM WORK: THE FOOD-POPULATION-RESOURCE CRISIS IN THE 'SHORT AFRICA'  
 Michael Lipton, Sussex University: Leontief Prize lecture, Tufts University, Medford, MA 3 April 2012

I'm very grateful for the honour of this prize. It is a link to previous prizewinners - all fine economists, and some close friends - and to the great Wassily Leontief. Some ignorantly dismiss his huge contribution, input-output analysis, as price-less and linear. But he addressed these criticisms, through a dual price model. He described his "use of a large-scale mechanical computing machine in 1935 and Mark I (the first large-scale electronic computer) in 1943". These paved the way, after advances in computing, for input-output to morph into modern general-equilibrium models from the 1970s.<sup>1</sup> Leontief was a lifelong public intellectual,<sup>2</sup> from protest against repression at Leningrad University in 1921 to work on 'environmental disruption and growth'<sup>3</sup> in 1970-90.

'Africa' in this talk is 'the short Africa':<sup>4</sup> excluding N Africa, Madagascar, Mauritius and South Africa. All these are sharply distinct from the rest of Africa environmentally, agriculturally and economically, and generally well ahead in mean income; poverty reduction; growth; farming (irrigation, fertilizer, seeds); and demographic transition. The short Africa is itself highly diverse, but no more so than is India or China.

'Crisis' (Merriam-Webster a): 'a turning point for better or worse'. Much talk of Africa moans of stagnation or trumpets economic renaissance. We should heed Leontief's modelling of population<sup>5</sup> and his stress on 'environmental disruption'. Africa does not face stagnation or renaissance, but a crisis, in people's ability to get income from work. In 2012-50 this will stride rapidly - either forward or back.

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Between 1950 and 2012, population in the 'short Africa' rose fivefold. It will more than double again<sup>6</sup> in 2012-50 to **11.3** times its 1950 level.<sup>7</sup> Workforces - people aged 15-65 - are rising faster still, thanks to better child survival and some fall in fertility. In 1985 sub-Saharan Africa had 106 people of prime working age for every 100 dependants. By 2012 there were 120; in 2050 there will be 196.<sup>8</sup> That's a **63% rise in workers-per-dependant from now to 2050** - and a 3.5% rise *each year* in the number of people aged 15-64. In South and East Asia, a similar rise in workers-per-dependant proved a demographic window of opportunity, contributing about a third of the 'miracle' of growth and poverty reduction<sup>9</sup> - because those extra workers found productive employment: first, in smallholdings, gaining from a green revolution and usually land redistribution; later, in industry and services, as farm transformation released workers. In 'the short Africa', will the swelling ranks of young workers produce Asian miracles - or worsening poverty, unemployment and violent unrest?

Farming will decide in Africa, as it did in Asia. Farms remain the most important income and work source for over 2/3 of the short Africa's economically active - more among the young and the poor.<sup>10</sup> This will change, but

<sup>1</sup>Ian Sue Wing, 'Computable general equilibrium models and their use in economy-wide policy analysis', *MIT Joint Program on Science and Policy of Global Change*. Technical Note 6, Sep: Cambridge, MA, 2004. At [http://web.mit.edu/globalchange/www/MITJPSPGC\\_TechNote6.pdf](http://web.mit.edu/globalchange/www/MITJPSPGC_TechNote6.pdf)

<sup>2</sup>His 1961 *Scientific American* paper on employment effect of switching from arms spending is still relevant: R. Pollin & H. Garrett-Peltier, 'Employment effects of downsizing U.S. military', WP#152, Economics Dept/Political Economy Research Inst. (PERI), Univ. of Massachusetts: Amherst, MA, 2007.

<sup>3</sup>Citations in this paragraph: W. Leontief (1973), 'Autobiography' at [http://www.nobelprize.org/nobel\\_prizes/economics/laureates/1973/leontief-autobio.html](http://www.nobelprize.org/nobel_prizes/economics/laureates/1973/leontief-autobio.html)

<sup>4</sup>By analogy to E. Hobsbawm, *The Age of Extremes: the short 20<sup>th</sup> century, 1914-1991*, London: Michael Joseph, 1994.

<sup>5</sup>W. Leontief, F. Duchin and I. Sohn, 'Population growth and economic development: illustrative projections', IUSSP: Helsinki, 1978.

<sup>6</sup>(Precise multiples: 4.9, 2.3). Comparable growth in S, E and SE Asia was less, and slowed more and faster, due to slower, later African fertility fall: S Asia 489.6m (1950), 1752m (2012) and 2394m (2050, medium projection); E Asia, respectively, 672m, 1586m, 1512m (a fall of 4.7%); SE Asia 173m, 696m, 759m; 'short' Africa 168m, 835m and 1902m: UN (ECOSOC), *World Population Prospects: The 2010 Revision* at <http://esa.un.org/unpd/wpp/index.htm>

<sup>7</sup>For comparison with this 11.3-fold rise in 100 years in the short Africa, world population rose tenfold in the 300 years 1700-2000.

<sup>8</sup>Ibid. at <http://esa.un.org/unpd/wpp/unpp/p2k0data.asp> All 2050 data are UN middle projections, and may well be underestimates (see below).

<sup>9</sup>R. Eastwood and M. Lipton, 'Demographic transition in sub-Saharan Africa: How big will the economic dividend be?' *Population Studies*, 65: 9-35, 2011.

<sup>10</sup>M. Lipton, 'Learning from others: increasing agricultural productivity for African human development' (Background Paper, UN Africa Human Development Report, 2012) at <http://www.michaellipton.net/>, Table 2; FAO, *Statistical Yearbook 2009*, at <http://www.fao.org/economic/ess/publications-studies/statistical-yearbook/fao-statistical-yearbook-2009/a-resources/en/>; <http://faostat.fao.org/site/368/DesktopDefault.aspx?PageID=368#ancor>; World Bank, *African Development Indicators 2008-9 - Youth and Employment in Africa: the potential, the problem and the promise*, p.8. At <http://books.google.co.uk/books?id=PBuaS8bBHDEC&pg=PA5&lp=PA5&dq=world+bank+unemployment+%22africa%22+table+OR+statistic+OR+estimate&source=bl&ots=87SOK35co&sig=n3dRswxfjwGOU5MDFIXQ5jg2LKg&hl=en&ei=e08zTentEljMhAfcPym2Cw&sa=X&oi=bookresult&ct=result&resnum=6&ved=0CDsQ6AEwBQ#v=onepage&q=world%20bank%20unemployment%20%22africa%22%20table%20OR%20statistic%20OR%20estimate&f=false>. Many of the 70% of workers, whose main activity is farming, do significant nonfarm work; offsetting that, many of the nonfarm 30% do significant farmwork.

not fast. Official rural-to-urban migration data and projections in Africa are huge overestimates.<sup>11</sup> Neither mines nor manufactures have so far offered many affordable workplaces, especially to the unskilled poor.

Within farming, smallholdings (up to 1-5ha dependent on land quality) are central, for two reasons. First, they support the vast majority of farm people in Africa, and will long do so. Second, on a big weight of macro and micro evidence, small farms are 1. efficient resource users; 2. though risk-averse, keen innovators; 3. in developing countries, where farming relies more on supervised family labour than on capital, get more output *per hectare*, and provide far more employment and labour income *per hectare*, than large farms. Africa is running out of spare land, so small farmers' higher output *per hectare* is key. They need intermediation for processing and supermarket access, but, once they have enough surplus to sell, this usually works, in Africa as worldwide.<sup>12</sup>

In 1977-84, when China reformed land into fairly equal family smallholdings and relaxed controls, these farms - most below 0.7ha - used water-control, fertilizers and improved seeds to raise rice and wheat output by over 6 per cent per year for six years. My colleague Peter Timmer analyzed - and assisted - a comparable transformation in Indonesia. Much of India, Bangladesh and other parts of Asia also did extremely well. Some areas and smallholders did not benefit, but radical improvements spread far beyond the innovators and the best lands: in China and India many 'backward' areas now show the highest returns on most farm investments.<sup>13</sup> Asia's demographics also improved sooner and faster than Africa's: child mortality fell much faster, and this is the prime mover lowering fertility.<sup>14</sup> In 1950, most agreed that S and E Asia, near the land frontier, had been dealt a worse demographic and resource 'hand' than Africa; yet large swathes of Asia in 1965-2000 showed that smallholders can lead a process of transformation *within* agriculture - and hence, and afterwards, transition out of agriculture. The conditions are public infrastructure and commitment; new science; and firms (sometimes, large farms) - and social capital - helping smallholders to co-operate, process, and liaise with expanding or globalizing, markets.<sup>15</sup>

Most of Africa has suffered decades of policy neglect and extraction - from both farmers and natural resources. It faces harsher problems in favourably resolving the demography/smallholder/resource crisis than Asia did. To produce more, let alone to do so sustainably, farms need enough land, water and soil nutrients. In 'the short Africa', below 1% of cropland is irrigated (20-25% in S/E/SE Asia in 1965; 35-40% now). Below 2 kg/ha of main plant nutrients - nitrogen, phosphorus, potash - are applied (>150kg/ha in S/E/SE Asia).<sup>16</sup> Lack of water control makes farmers reluctant to apply fertilizer even if available. There are successes: some agronomic advance; hybrid maize in Zimbabwe and elsewhere; *perhaps* new cassava and rice in West Africa; Malawi's fertilizer subsidies; the Alliance for a Green Revolution in Africa's pilots of improved local input development and delivery; ambitious, pre-financed land-water development (in the pipeline since 2003!) in the Comprehensive Africa Agriculture Development Programme. But widespread, fast yield growth without fertilizers and water-control is bricks without straw.

Without rapid growth of food staples yield, how have Africans - five times more now than in 1950, and mostly farmers - got a basic minimum of extra work, income and food? Mainly by land expansion, but this did not suffice. Africa's data for output of food staples are largely worthless, but there are decent data for nutrition, food trade, and dollar-a-day poverty (affecting a stagnant 50% of Africans in 1981-2005 despite cheaper food). These data imply that calorie output and intake per person in most of Africa are no higher than in the early 1960s.

Farmers' strategy of feeding themselves by land expansion - forced on them by insufficient public attention to irrigation, fertilizer access and seed improvement - not only failed to maintain living standards: it has run out of

<sup>11</sup>D. Potts, 'Whatever happened to Africa's rapid urbanization?', London: Africa Research Inst., 2012, at <http://www.africaresearchinstitute.org/counterpoint-article.php?i=6PZXYPBMW7&p=1>; M. Lipton, *Why Poor People Stay Poor: urban bias and world development*, Harvard and Temple Smith, 1977, 224-6.

<sup>12</sup>M. Lipton, *Land Reform in Developing Countries: property rights & property wrongs*, London: Routledge, 2009, ch. 2; R. Eastwood, A. Newell & M. Lipton, 'Farm size', in P. Pingali & R. Evenson (eds.), *Handbook of Agricultural Economics vol. 4*, Rotterdam: Elsevier, 2010; T. Reardon & J. Berdegue, 'Retail-led transformation of agri-food systems', Washington, D.C.: World Bank, 2007 [www.rimisp.org/getdoc.php?docid=9851](http://www.rimisp.org/getdoc.php?docid=9851); T.W. Schultz, *Transforming Traditional Agriculture*, Yale 1964; A. Berry & W. Cline, *Agrarian Structure & Productivity in Developing Countries*, Baltimore: Johns Hopkins 1979.

<sup>13</sup>Fan, S., P. Hazell & S. Thorat, 'Targeting public investments by agro-ecological zone in rural India', *Food Policy* 25 (2000): 411-28; Fan, S., Z. Linxiu & X. Zhang, 'Growth & poverty in rural China: the role of public investments', International Food Policy Research Institute, Washington, D.C., 2000.

<sup>14</sup>D. Conley, G. McCord & J. Sachs, 'Africa's lagging demographic transition: evidence from exogenous impacts of malaria ecology & agricultural technology', WP#12892, National Bureau of Economic Research (2007) at <http://www.nber.org/papers/w12892>; Lipton & Eastwood 2011, loc. cit.

<sup>15</sup>On combining on-farm actions where small farms have advantages, with off-farm transformations requiring scale, see M. Lipton, 'The family farm in a globalizing world: the role of crop science in alleviating poverty', International Food Policy Research Institute, Washington, D.C., 2005.

<sup>16</sup>Ibid: *sub-Saharan* Africa's numbers are 3.7% & 7kg/ha respectively, but almost all are in S Africa, Madagascar & Sudan - outside 'the short Africa'.

steam and is, or is fast becoming, unsustainable in most of Africa. That is, **farmland expansion is inducing, or soon will induce, soil depletion that means net farmland loss.**<sup>17</sup> (That, alongside the water squeeze, burgeoning population and workforce and scant non-farm employment prospects, is why there is a crisis). Forced land expansion has spread exhaustive, largely unfertilized crops (mainly maize) into lands that - without fertilizers or irrigation - can sustain only extensive grazing. In 2002-3 in sub-Saharan Africa, 40% of farmland was losing over 60 kg/ha of main plant nutrients each year 95 million hectares were severely depleted of soil nutrients.<sup>18</sup>

Is the short Africa's farm water position also critical? Few countries outside the Sudano-Sahel face *physical* water stress (>75% of river flows withdrawn annually, net of recycling), and agriculture gets over 80% of fresh water. Yet such aggregates conceal local reality. I hypothesise that the proportion of food staple crops dying for lack of water is higher in the short Africa than in any other region. All but a few countries face *economic* water stress.<sup>19</sup> Without irrigation, this means that many farmers cannot get or buy water at some crucial crop time, even if it's available at some other place and time. Further, much African land expansion has been into margin-ally rainfed land. Most seriously, global warming boosts evaporation and transpiration in the hot peak seasons - and also makes rainfall amount and timing less reliable. Unlike Asia and Northern (and South) Africa - where farmers obtained substantial irrigation before (and enabling) the green revolution - in the short Africa the farmer must fight vociferous, expanding cities, mines and industries for irrigation water that she does not yet have.

Why worry about the determinants of food *supply*? Hasn't Amartya Sen<sup>20</sup> shown that famines, and even hunger, usually occur when there is ample food to go round - because many people lack *entitlements* to that food? The answer is that in Africa most food entitlements, especially for vulnerable people, come from farmwork, largely on family land but sometimes for other farmers. Rural non-farm work (and urban work) matter too, but their growth usually depends on earlier growth of farmers' demand, and hence of farm income, output and employment. Also, expensive and bad transport means that local food adequacy, in many places and times, depends on local food supply. Further, if we look beyond hunger to national development and transformation, these have almost always followed expansion, initially in smallholder agriculture, of both work and productivity.<sup>21</sup>

The short Africa's swelling young workforce; its food farming that stubbornly lags far behind achievable levels; its threatened soil-water base: these faced Asia in 1965 too. Like all crises, they offer not only risks of disaster, but (as Asia's green revolution and demographic transition showed) great opportunities too. Being behind offers a chance for quick catch-up:<sup>22</sup> *not* to large capital-intensive farms, ideal in America and Australia but costly and often disastrous in Africa, but to skilled smallholder intensification, with controlled, carefully managed water and fertilizer. Such farms prevail in most of Asia, and parts of Africa too, but past failures show that small-holder-led development in Africa is not a soft or easy option. How might Africa have a good crisis?

1. Stop kidding ourselves. (a) Faster GDP growth in Africa since 2000 is mainly a mining boom, with dubious benefits. Staples yields (and labour productivity) have not reversed the dismal trends that Peter Timmer diagnosed two decades ago: big, *credible* rises are seen in only a few African countries (e.g. Rwanda, Ghana). The populous ones (Ethiopia, Nigeria, maybe Kenya, above all DR Congo) tell a sad tale.

(b) Mining-first helped Botswana avoid a grazing version of the crisis, but employs few; pumps up corruption;<sup>23</sup> draws incentives and resources away from employment-intensive activities, especially farming; and, with the short Africa's low savings rates, is linked to net capital depletion.<sup>24</sup> Mining can spectacularly raise *domestic* product, but recent *national* product and income growth has probably - once again the data are weak - been much slower, and growth of income retained by nationals in the country slower still.

<sup>17</sup>Even more so if farmland loss due to other causes (erosion, salinity, urban & other building expansion) is factored in.

<sup>18</sup>J. Henao and C. Baanante, *Agricultural Depletion and Soil Mining in Africa*, Muscle Shoals, AL: International Fertilizer Development Corp., 2006. Also see A. Haileselassie, J. Priess, E. Veldtkamp, D. Teketay and J-P Lesschen, 'Assessment of soil nutrient depletion and its spatial variability on smallholders' mixed farming systems in Ethiopia using partial versus full nutrient balances', *Agriculture, Ecosystems and Environment* 108 (2005): 1-16.

<sup>19</sup>International Water Management Institute, 'Trends in water and agricultural development' (2007), at <http://www.iwmi.cgiar.org/assessment/water%20for%20food%20water%20for%20life/chapters/chapter%202%20trends.pdf>

<sup>20</sup>A.K. Sen, *Poverty and Famines*, Oxford, 1981.

<sup>21</sup>Once a region cannot much expand sustainable farmland affordably - increasingly true of the short Africa - if all main groups are to reduce their poverty (a) agricultural labour productivity must grow, but (b) productivity of land (and in many cases water) must grow *faster*, so farm employment rises. This is one of two tightropes that Asia's Green revolution triumphantly walked (Lipton 2005: also staples total factor productivity must grow faster than staples prices fall).

<sup>22</sup>A. Gershenkron, *Economic Backwardness in Historical Perspective*, Cambridge, MA: Harvard University Press, 1962.

<sup>23</sup>P. Collier, *The Bottom Billion: why the poorest countries are failing and what can be done about it*, Oxford: Oxford University Press, 2007

<sup>24</sup>World Bank, *Where is the Wealth of Nations? Measuring capital for the 21<sup>st</sup> century*, Washington, D.C., 2006; Lipton and Eastwood, 2011.

- (c) Manufacturing-first raises serious questions of competition with, say, Vietnam on skills and labour cost.
- (d) Shifts of land to capital-intensive big farms (e.g. land grab) 'raise labour productivity' of those who stay employed but cut it - and income - for many, pushed off the land before non-farming is ready to absorb them. With exceptions big African farms are socially inefficient and cut per-ha employment, work income and output.
- (e) Africa has almost no empty, good, cheaply cultivable cropland.<sup>25</sup> Sustainability requires *reducing* cropland.
- (f) So, as was true in Asia, smallholder-based yield growth is a necessary preliminary to development.

2. Stop denigrating smallholders. The prevailing language of many economists and African leaders bombards smallholders with undeserved disrespect. Family farmers and smallholders are routinely called subsistence, sub-subsistence, part-time. These categories are contrasted unfavourably to 'commercial' farms. Yet each is highly commercial, buys input and sells outputs, and makes at least as good, and with land better, use of resources than big farmers. (That's why land in Asia and Africa has been shifting towards smaller farms.<sup>26</sup>) Smallholders are dismissed as aged women who have failed to make it elsewhere, who need replacement by big farmers with machinery - and whose kids don't want to farm. In India's Punjab in 1967 I saw how semi-dwarf wheat and rice seeds, with fertilizer and reliable irrigation, transformed this: young policemen and factory workers scrambled home from Delhi to double-crop, now they could make good profit out of even half a hectare. In most of the short Africa, over half the people rely mainly on income from smallholding. If young people don't want to do that, it's because the powers-that-be disrespect and under-resource smallholdings, so they can't become scientific, properly serviced or reasonably reliable. Asia in the 1960s typically allocated 20% of public spending to agriculture; the short Africa today allocates 5-10%. Respect and resources are preconditions, but all economic means - composting where humus is deficient, water management, much more irrigation major and minor, better seeds (and biotechnology), sometimes land reform - will be needed to catch up. Most of Asia and some of Africa shows this can be done - and that *afterwards* industrialization, even miracles, can follow fast.

States and experts, unwilling to help smallholder-led transformation, used to scapegoat smallholders for inefficiency. Some still do, but the evidence has made it somewhat passé. Nowadays smallholders are berated for inability to co-operate, form social capital, exploit scale economies in processing and distribution, and do without the State. Smallholders need policies, not homilies: respect, land, infrastructure, semi-public goods, facilitation.

### 3. Set farm policy into its demographic and land-soil-water contexts - make a coherent policy for a single crisis

(a) Population growth must be voluntarily cut, as in Asia. UN projections of 2050 population in the short Africa are used here but - high as they are - are *underestimates*; the projections assume global patterns of fertility decline, but in Africa this has come later and more slowly, especially in rural areas. That is mainly because child mortality has improved more slowly than in Asia (note 13). Further, earnings prospects for women remain low, reducing the attractiveness of bearing fewer children. As in much of Asia after 1965, so in Africa now: for a 'good crisis', i.e. a *resource-sustainable* transition to fast, employment-income-generating farm growth, green revolutions need complementary policies for slower population growth: paradoxically, these demand first slashing child mortality, then maximizing fertility response by enhanced female education, and spreading access to contraception.

(b) Policy for better child nutrition is the linch-pin, holding together population policy (lower child mortality first) and farm policy (technical and institutional change to transform smallholder production of staple foods). Better child nutrition is advanced by malaria and dysentery control, clean water, micronutrient enhancement of staples, and of course more income (not just, although usually, more food output) for poor smallholders.

(c) Sustainability must be pre-screened - especially, soil-water impacts reviewed - in *all* policies. The imperatives to irrigate, to improve water control, to fertilize, can support sustainable soil-nutrient and water use by adding resources that cultivation removes - but also can create new sustainability issues (salinity, nitrates in drinking water), and can interact well or badly with global warming. Rising energy prices and pollution problems, and faster evaporation mean that just *more* far water and inorganic fertilizer - while essential in Africa - have to be accompanied by much higher use-efficiency and care with disposal and recharge. Fortunately smallholders, with their low transactions-costs of labour use, are well suited to respond to appropriate incentives, here as elsewhere.

(d) Hence - as Asia showed - there has to be a social or state-led base, to support private, small-farm-based transformation. Going beyond this, politicians at top level need to integrate *one* sustainable policy for all aspects of the crisis in *productive labour income*: agriculture, food; child nutrition and mortality, reduced fertility; ecology - land, soils, water. This is not a mad planner's dream: for example, in agriculture, most policies will involve cor-

<sup>25</sup>M. Morris (ed.), Africa's Sleeping Giant: prospects for commercial agriculture in the Guinea Savanna Zone and beyond, World Bank/FAO, 2009. The 400m ha include existing *and* newly broken land (both mainly for intensive commercial *smallholding*). Even without health, education and some transport requires huge public spending. Breaking (so far rejected) new land can hardly give as high return as intensifying now very-low-input land use.

<sup>26</sup>M. Lipton, Land reform (fn. 11) (2009), pp.94-102.

recting incentives (e.g. so people bear the external costs of their water use), providing infrastructural and semi-public goods (irrigation, rural roads, much more agricultural research and the much-maligned extension), and in a few cases in Eastern and Southern Africa reforming away gross inequalities of, and barriers to, secure private land access.

Most agricultural economists agree that small-farm-led growth and poverty reduction, while hard, are efficient, normal paths to development and poverty-reduction. It's become fashionable to dismiss this, especially in Africa, as 'new conventional wisdom', outdated by new evidence, dangers or opportunities. Yet:

1. Smallholder-led African development is not conventional wisdom, but a minority taste. It's backed by African organizations like the Alliance for a Green Revolution in Africa, and (with more words than cash) by the World Bank. But it has *never* been accepted by powerful non-experts: macro-economists not specialized in agriculture; urban interests; big farmers; politicians backing land-grabbers; nationalists, and determinists of Left and Right, who see small farming as a dustbin of history, for the backward only. I recently heard a leading economics professor say that "small farmers can't grow much food" and (twice in a 3-minute talk) "are inefficient". That's the conventional wisdom. As usual it ignores the evidence.
2. Since the initial shocking evidence in the 1950s that small farms do better than big ones in poor countries, the debate has advanced. Early objections of statistical method, land quality issues, etc. have been dealt with. Massive evidence from Africa, Asia and Latin America confirms smallholder efficiency. Meanwhile the Green Revolution and land reform have transformed many million small farms. New worries have arisen, about small farmers and processing, supermarkets, and water-soil stresses; remedies have been tested, in the marketplace and in the polity.

'Scientific smallholder intensification' in Africa is no easy path to development. From global evidence, we know it's possible. Is it necessary? Initially, yes. Farm development is only the start of modernization away from agriculture; I'm no agricultural or smallholder fundamentalist. But I'm an income-from-work fundamentalist. 'The short Africa' by 2050 will have 2.3 times today's population - but 3.7 times today's 15-64-year-olds. They need an affordable *initial* path to workplaces giving income and respect. Otherwise, potential demographic dividend will become demographic disaster. But, with half the people still in severe poverty and States cash-strapped too, what initial path is 'affordable'? One, trodden elsewhere, is scientific intensification of smallholder farms. If there's an alternative, what is it?