

## Towards a fertilizer policy for smallholder agriculture in Sub-Saharan Africa :

# The critical importance of taking a holistic approach

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### Summary

Subsidizing fertilizer prices has been a popular policy tool to increase fertilizer use, but should it be? The main message of this Policy Brief is that it should not be, despite its appeal to politicians and recipient farmers alike. Instead, policy makers should seriously consider a holistic approach to promoting fertilizer. A holistic approach has the potential of effectively addressing a range of key interlocking constraints which condemn smallholders to low input, low productivity, and low profitability choices. A piecemeal approach consisting primarily of fertilizer subsidies has repeatedly been shown not to be able to address these interlocking constraints, especially as their high budgetary cost “crowd out” the delivery of public goods and services needed to successfully transform agriculture.

Limited effectiveness has characterized the fertilizer and input subsidy programs of the 1960s and 1970s in SSA, and more recently, after the early 2000s. The strengths and weaknesses of these input subsidy programs are well exemplified by the much publicized Malawi Farm Input Subsidy Program. Maize production did increase with the subsidies but the gains were not sustained. There were also tradeoffs in terms of undermining farm practices essential for sustainable soil fertility management; and of crowding out private sector dealers and the delivery of priority public goods and services. In short, these

fertilizer and other input subsidies did not promote sustainable on-farm intensification. A survey of 80 Input Subsidy Programs (ISPs) in SSA also raised serious questions regarding their development effectiveness—short and long term.

The bottom line is that fertilizer is but one link, albeit a key link, in the long chain of soil fertility, productivity, and sustainable agricultural intensification. It is no wonder then that the hope that increased fertilizer use would kick-start a long term process of on-farm intensification

and sustained agricultural productivity growth has not materialized.

Fertilizer subsidies alone are inherently a weak policy tool for launching an African Green Revolution as they cannot address the multiple structural constraints that bind smallholders to low productivity agriculture. In fact, given their budgetary cost, they “crowd out” other public expenditures that can better address these constraints. Fertilizer policy should be seen as a component of a holistic approach to promoting an agricultural transformation.

Selected East Asian cases show the power of such holistic approaches under the leadership of visionary leaders. Their agricultural policies were an integral component of an overall long term economy-wide strategy for nation building. Fertilizer use was promoted (not subsidized) as a component of a broader technical package; which in turn was viewed as one component of an overall incentive, institutional and marketing framework. It was this overall framework which contained measures to make the use of fertilizers in high yielding technologies profitable, and which were complemented by other economy-wide measures. Together they made a determining impact on sustained agricultural intensification and productivity.

## Introduction

Taking a holistic approach means that policy makers in SSA should not view increasing fertilizer use as an end in itself. Rather, they should view it as a necessary means to achieving an overall goal of sustained agricultural productivity growth, essential for achieving an African Green Revolution. In other words, fertilizer policy should be viewed as a key component of an overall strategy to promote sustained agricultural intensification, which is at the core of a successful agricultural transformation. Why should policy makers view fertilizer policy as an integral component of a holistic approach? To answer this central question, this Policy Brief addresses four questions.

1. Why is it important for SSA smallholders to increase fertilizer use, organic and inorganic?
2. Why should an increase in fertilizer use be viewed as a means to an end, and not an end in itself?
3. Why should fertilizer policy be a component of a holistic approach?
4. What are the key elements of a holistic approach?

## 1. Increasing fertilizer use in SSA: why is it important?

Soil fertility levels in SSA urgently need to be replenished: Over decades, smallholders in SSA have removed large quantities of nutrients from their soils without using sufficient quantities of manure and chemical fertilizer to replenish them. “This has resulted in a very high average annual depletion rate—22 kg of nitrogen (N), 2.5 kg of phosphorus (P), and 15 kg of potassium (K) per hectare of cultivated land over the last 30 years in 37 African countries—an annual loss equivalent to U.S. \$4 billion in fertilizer” (Sanchez, 2002).<sup>1</sup> Some 30 percent of the agricultural land is degraded according to another estimate, with some countries reaching alarming levels (e.g., Burundi, Rwanda) (Kariuki, 2011: 6).<sup>2</sup> Major contributing causes are decades of nutrient mining, nutrient leaching and an inadequate erosion control due to deforestation, disappearing fallows, and land degradation.

Despite much progress, the average use levels way below the target set by African Union Member States: CAADP’s (2003) vision for Africa’s agricultural transformation and the Abuja Declaration on Fertilizer for an African Green Revolution (2006) “resolved to increase fertilizer use from 8 kg/ha to 50 kg/ha by 2015”. Despite much improvement in many countries, the average level has remained low—around 10-15 kg/ha.<sup>3</sup> Much still remains to be done.<sup>4</sup> In the Malabo Declaration of June 2014, African Union Heads of State and Government made a commitment to ending hunger by 2025 and to halve post-harvest losses also by 2025.<sup>5</sup> By the January 2018 Assembly session, the 2017 progress report noted that only 20 out of the 47 countries reporting were on track to fulfill the Malabo commitments. The average Africa

1. Sanchez, Pedro, “Soil Fertility and Hunger in Africa.”, *Science’s Compass*, Policy Forum, Vol. 295, 15 March 2002. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.362.6021&rep=rep1&type=pdf>

2. Kariuki Julius Gatune, “The Future of Agriculture in Africa”, *The Pardee papers*, No. 15, Boston University, August 2011. <http://www.bu.edu/pardee/files/2011/11/15-PP.pdf?PDF=pardee-papers-15-africa>

3. There is, of course, much variation around this average. There is a high level of heterogeneity in African soil, productivity, and production conditions.

4. The Abuja Declaration on Fertilizers for an African Green Revolution: Status of Implementation at Regional and National Levels (June 2011) <https://africafertilizer.org/wp-content/uploads/2017/04/Seventh-Progress-Report-on-the-Abuja-Declaration-on-Fertilizers-for-an-African-Green-Revolution.pdf>

5. African Union Malabo Declaration on Agriculture and Post-Harvest Losses. The declaration is: Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods. <http://www.fao.org/food-loss-reduction/news/detail/en/c/250883/>

Agriculture Transformation scorecard was 3.60 “which indicates the Union is not on-track in meeting the CAADP/Malabo commitments when assessed against the 3.94 benchmark for 2017.”<sup>6</sup>

## 2. Fertilizer use as a necessary means to an end, not as an end in itself

Fertilizer use for sustainable soil fertility and sustainable agricultural intensification: It is clear from the above declarations and assessments that African leadership views increased fertilizer use as a necessary means to achieving a more intensive and productive agriculture, a major step towards a more food-secure Africa. What kinds of fertilizers are needed? While organic fertilizers should be part of any soil fertility management strategy, alone it will not be sufficient to sustain the high productivity and production levels that will be necessary to feed Africa’s growing population. Furthermore, there may not be enough. Therefore, substantial doses of inorganic or chemical fertilizer will be needed, as was clearly recognized by the Abuja Declaration. In addition to higher doses, one must also consider different soil and water management practices that are necessary to address the specific soil-limiting factors. These are deficiencies in the following: nitrogen (N); low soil organic carbon content; phosphorous deficiency; acidity; micronutrient deficiency; and low available water holding capacity.

Fertilizer use is only one link in a long chain for managing soil fertility: Fertilizer use is only one link, albeit a key link, in a long soil fertility supply chain (Middendorf et al, 2017).<sup>7</sup> Being only one key link means policy makers must promote complementary measures which address the structural impediments which undermine smallholders’ ability to use fertilizer efficiently, profitably, and sustainably. There are at least two main groups of factors to consider:

**1. Biophysical:** Factors that impinge on fertilizer-crop response ratios such as extent of soil degradation

or other soil fertility limitations; the correct types of fertilizer, and agronomic practices, as well as required soil and water management techniques;

**2. Policies and institutions:** Factors that impinge on the overall incentive framework and smallholders’ access to basic public goods and services; particularly those that impact their access to agricultural research services and extension advice; transport and communications; markets (local, regional, foreign), marketing infrastructure and information; agriculture/non-agriculture terms of trade; as well as land and tenure security.

Limited long term productivity impact of fertilizer subsidies: A major reason why the fertilizer price subsidies of the 1960s and 1970s failed to have a lasting impact on soil fertility, agricultural productivity and food production is that they focused solely on the issue of price affordability without simultaneously (or sequentially) removing other key structural (underlying) constraints to the farmers’ sustainable fertilizer use. The Malawi Farm Input Subsidy Program (FISP: fertilizer and seed; 2005/06-08/09), supported by the Millennium Development Villages Project (MVP), was lauded as a model for the rest of Africa because Malawi, which had been suffering from chronic food deficits, obtained bountiful harvests in 2006 and 2007.<sup>8</sup> However, some analysts argued that these subsidies may have promoted maize production but not sustainable agricultural intensification, because the subsidies “crowd out” other farm practices critical for long term soil fertility management; and the production of other cash crops that could raise the overall per hectare net revenue.<sup>9</sup> A welfare analysis of the FISP argued that the benefit-cost ratios are well below 1 and that 59 percent of every Kwacha spent was wasted “in the sense that the fertilizer is not sufficiently valued by the beneficiaries.” (Jacoby, 2013: 6).<sup>10</sup> In addition, whether these subsidies have had any enduring effects on maize production, assets,

6. African Union. Assembly of the Union. Thirtieth (30) Ordinary Session, 28-29 January, 2018, Addis Ababa, Ethiopia. <file:///Users/isabellelsakok/Downloads/AU%20Inaugural%20Biennial%20Review%20Report%202018.pdf>

7. Middendorf, B. Jan, Garry M Pierynski, Zachary P. Stewart, P.V. Vara Prasad. Sept 30. 2017. Sub-Saharan Soil Fertility Prioritization: II. Summit Results . USAID – Feed the Future, The U.S. Government Global Hunger and Food Security Initiative, and Kansas State University. [https://www.k-state.edu/siil/documents/docs\\_soilfertility/SIIL%20Sub-Saharan%20Africa%20Soil%20Fertility%20Prioritization%20Report%20-%20II.Summit%20Results.pdf](https://www.k-state.edu/siil/documents/docs_soilfertility/SIIL%20Sub-Saharan%20Africa%20Soil%20Fertility%20Prioritization%20Report%20-%20II.Summit%20Results.pdf)

8. Denning, Glenn, Patrick Katambe, Pedro Sanchez, Alia Malik, Rafael Flor, Rebbie Harawa, Phelire Nkhoma, Colleen Zamba, ... Jeffrey Sachs. Jan 27, 2009. Input Subsidies to Improve Smallholder Maize in Malawi: Towards an African Green Revolution. <https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1000023>

9. Komarek, Adam and Siwa Msangi. May 12, 2017. Malawi’s fertilizer subsidies are not a panacea for farmer households. IFPRI. <http://www.ifpri.org/blog/malawis-fertilizer-subsidies-are-not-panacea-farmer-households>

10. Jacoby, Hanan. “Smart Subsidy? Welfare and distributional implications of Malawi’s FISP” DECAR, World Bank. <http://documents.worldbank.org/curated/en/11386146944118315/pdf/107177-WP-153531-PUBLIC.pdf>

and income is not evident. Agricultural productivity remains low and maize production still predominates, with only 14 percent of farmers selling maize and only 26 percent producing peanuts. (WBG, Dec 2018: xii-xiii).<sup>11</sup> More broadly, a review of 80 studies evaluating the performance of these second generation Input Subsidy Programs (ISPs since early 2000s) found that these ISPs did increase national food production in the very short term—in one growing season. Grain yields of recipients also increased in the year they received the subsidized input. However, overall production and welfare effects were lower than expected. The ISPs could jumpstart the dynamic growth process but their impact soon fizzled out. (Jayne et al 2018)<sup>12</sup> Alone, these price subsidies did not have a long term impact on soil fertility, especially as they were also fiscally unsustainable. Although many were supposed to be “smart”, as specified by Morris et al (2007: 103-105),<sup>13</sup> they (i) crowded out private sector input distribution; (ii) did not target farmers who were potentially profitable users of fertilizer but were not heavy users at the time of the subsidies; and (iii) were not part of a broader strategy that “recognized the critical importance of complementary inputs, strengthening output markets, and appropriately sequencing interventions.” The “smart” features were watered down in varying degrees or simply abandoned.

### 3. Why is a holistic approach necessary when considering fertilizer policy?

Fertilizer is not a “magic bullet”—the “magic” is in government leadership: Fertilizer is a key input in the Green Revolution (GR) package that swept through Asia, enabling densely populated countries to avert a Malthusian catastrophe. However, the technology by itself does not deliver a revolution. In Asia, government leadership has been essential for the GR technology

to succeed in raising agricultural productivity growth; reducing extensive poverty; increasing incomes and strengthening food security. Markets alone could not have engineered a GR. (Hazell, 2009: 20)<sup>14</sup> The decisive role of governments overhauling the policy and institutional framework; making long-term investments, and delivering basic public goods and services is evident in all cases of successful agricultural transformation. (Tsakok, 2011)<sup>15</sup> Of course, and unfortunately, there are many cases of governments destroying their agricultures and their economies. The point is that, for better or for worse, government leadership is powerful. The point is government leadership matters.

Many of the conditions smallholders need for fertilizer use to be effective are beyond their control: The persistently low use of fertilizer by SSA’s smallholders is a strong evidence that the vast majority consider its use of little value to them. One obvious reason is that smallholders are virtually powerless to change many conditions they need to manage the fertility of their soils effectively and profitably. The key structural constraints include the following:

To begin with, millions are constrained by their access to the land and water they need. For example:

- Farm land: Surveys of five African countries (Ethiopia, Kenya, Rwanda, Mozambique, and Zambia) undertaken by Jayne et al (2003) show that farm sizes have been declining over time and that roughly a quarter of agricultural households in these countries are virtually landless. Moreover, there has been an increasing concentration of land distribution within the small farm sector. The Gini coefficients for Kenya, Ethiopia and Zambia were 0.52, 0.59, 0.60 respectively; all considerably higher than the averages for Latin America. (Jayne et al, 2003: 258).<sup>16</sup> Going beyond these five countries: farm sizes are declining in many countries as land abundance is only in a minority (8 only) of countries. In a context

11. World Bank Group. Dec 2018. Malawi: Systematic Country Diagnostic – Breaking the cycle of low growth and slow poverty reduction. Report # 132785. <http://documents.worldbank.org/curated/en/723781545072859945/pdf/malawi-scd-final-boa-rd-12-7-2018-12122018-636804216425880639.pdf>

12. Jayne, Thomas S, Nicole M. Mason, William J. Burke, Joshua Ariga. Review : Taking stock of Africa’s second generation agricultural input subsidy programs. Food Policy, Vol. 75. Feb 2018:1-14. <https://www.sciencedirect.com/science/article/pii/S0306919217308618>

13. Morris, Michael, Valerie A, Kelly, Ron J Kopicki , and Derek Byerlee. 2007. Fertilizer Use in African Agriculture: Lessons Learnt and Good Practice Guidelines. The World Bank, Washington D.C. <https://openknowledge.worldbank.org/bitstream/handle/10986/6650/390370AFROFert101OFFICIALHOUSEONLY1.pdf?sequence=1&isAllowed=y>

14. Hazell, P. B. (2009). The Asian Green Revolution: Vision 2020 Initiative. IFPRI Discussion Paper # 00911. International Food Policy Research Institute. Washington D.C. Retrieved from <http://cdm15738.contentdm.oclc.org/utis/getfile/collection/p15738coll2/id/29462/filename/29463.pdf>

15. Tsakok, Isabelle. 2011. Success in Agricultural Transformation: What it means and what makes it happen. Cambridge University Press.

16. Jayne, T.S., Takashi Yamano, Michael T Weber, David Tschirley, Rui Benfica, Anthony Chapoto, Ballard Zulu. Smallholder income and land distribution in Africa: implications for poverty reduction strategies. Food Policy. 28. (2003): 253-275

of poor land governance and widespread land tenure insecurity (especially for women farmers), the three factors of concern, but outside of the control of smallholders, are:

- ▶ Increasing farm land scarcity;
- ▶ Rising land inequality (e.g., Gini coefficient for Nigeria 0.70!) (Jayne et al, 2014: Tab 1 & 2, 3-4);<sup>17</sup> and
- ▶ Extensive land sales/leases (land grabs) to large farmers and foreign investors.<sup>18</sup>

Land scarcity in a context of rising land inequality, and tenure insecurity, are not conducive to smallholders investing in the fertility of the soil, as such investment is labor and cash demanding.

- Water control: African agriculture is mainly rain-fed with only 6 percent or so of the cultivated land that is irrigated. With the dire warnings of climate change—warmer climate, changing rainfall patterns, more extreme and frequent weather events (e.g., floods and droughts), water control for smallholders is likely to become even harder unless substantial investments are now undertaken to increase farmers' water control and resilience.<sup>19</sup> Soil fertility and water management are inextricably linked as “Soil water content is the single most important factor controlling the rate of many biological processes, which influence nutrient availability” (Drechsel et al, 2015: 3).<sup>20</sup>

A second set of constraints over which smallholders have virtually no control is the availability and quality of public goods and services which they need to improve

the fertility, productivity and profitability of their soils and water. There are important inadequacies, such as in the poorly funded agricultural research, extension, and farmer education services; and in the hardware and software of expanding market access. The millions that governments allocate to fertilizer price subsidies—14-26 percent of their combined annual expenditures on agriculture (2011-14) (Jayne et al, 2018: Tab 1)—represent a major opportunity cost in terms of unfunded or poorly funded delivery of these public goods and services. The high opportunity cost of misallocated public funding is illustrated in the case of improved maize varieties as discussed below:

- The case of “Maize revolutions in Sub-Saharan Africa”: Smale et al (2011: Abstract, 9-10)<sup>21</sup> showed that despite the substantial spread of improved maize seeds in large parts of SSA—covered 44 percent of maize area (2006-07) in Eastern and Southern Africa (outside South Africa), and 60 percent of the maize area (2005) in Western and Central Africa—the return was poor, in terms of:
  - ▶ low overall yield growth—one percent for the half past century;
  - ▶ continuing low fertilizer use—17 kg/ha of nutrients compared to an average of 100kg/ha in developing countries;
  - ▶ inefficient fertilizer use; and
  - ▶ the remaining half of the total maize area in SSA still planted with farmers' maize varieties.

In short, the wide adoption of improved maize varieties did not generate a productivity-increasing revolution in maize, the key food-security staple. The voucher-based input subsidies to encourage the adoption of improved maize varieties could not overcome the weight of the numerous structural constraints smallholders labor under. Not only were these subsidies ineffective in triggering sustained and widespread maize yield increases, the authors argue that these subsidies were actually detrimental as they “crowd out” the private sector and are financially unsustainable. As repeatedly shown in other contexts, economy-wide reform of the

17. Jayne, T.S., Jordan Chamberlin, Derek D. Headey. Land pressures, the evolution of farming systems, and development strategies in Africa: A Synthesis. *Food Policy*, 48 (2014):1-17.

18. Aryeetey, Ernest and Zenia Lewis. June 25, 2010. African land grabbing: whose interests are served? *Brookings*. <https://www.brookings.edu/articles/african-land-grabbing-whose-interests-are-served/>

19. Malabo-Montpellier Panel, December 2018. The potential for expansion is from the current 7.7 m ha to 38 m ha. in SSA. More than 2/3 of current irrigated land is concentrated in only 5 countries, 3 of which are in North Africa.

20. Drechsel, Pay, Patrick Heffer, Hillel Magen, Robert Mikkelsen, Harmandeep Singh and Dennis Wichelns. 2015 “Managing water and nutrients to ensure global food security while sustaining ecosystem services”; Ch 1 : 1-7, in *Managing Water and Fertilizer for Sustainable Intensification*; (Edi) Drechsel, Pay, Patrick Heffer, Hillel Magen, Robert Mikkelsen, Dennis Wichelns. International Fertilizer Industry Association; International Water Management Institute; International Plant Nutrition Institute; and International Potash Institute.

21. Smale, Melinda, Derek Byelee, Thom Jayne. May 2011. Maize revolutions in Sub-Saharan Africa. Policy Research Working Paper. WPS # 5659. Development Research Group. Agriculture and Rural Development Team. The World Bank. <https://openknowledge.worldbank.org/bitstream/handle/10986/3421/WPS5659.pdf?sequence=1&isAllowed=y>

policy and institutional environment is needed as it has the potential of actually launching an agricultural revolution, a maize revolution in the case of SSA, a key component of an African Green Revolution. A holistic approach is necessary.

#### 4. Key elements of a holistic approach to agricultural transformation

A holistic approach does not mean everything has to be done at the same time: Everyone knows that everything is related to everything else, but this is not the rationale for a holistic approach. Conceptually, a holistic approach to addressing a development challenge is anchored in an understanding of the close interdependence of component parts which together impact on the functioning of the whole system. Practically, holistic means that piecemeal measures, such as input subsidies, that are not part of an overall strategy, are of limited effectiveness at best. Operationally, holistic means that governments should view the functioning of any part of the system, in this case low fertilizer use and stagnant grain yields, as outcomes of deeper structural problems in agriculture as a whole, and view agriculture itself as an integral component of an entire open economy. It does not however mean that governments must deal with all the interdependent problems at the same time. That is impossible. What is possible and necessary is to develop an overall strategy—develop a holistic approach—that addresses these interdependent problems over time. What the scope of this holistic approach is, necessarily varies with the vision to be achieved, and the range of interlocking issues to be addressed. Determining the required scope and implementation mechanisms to translate the vision into action is context-specific. It is a challenging task.

Holistic approaches in practice—the cases of Taiwan, China, and of the People’s Republic of China—under ideologically opposite leadership: Both Taiwan, China, and the People’s Republic of China were devastated by decades of war, when Mao Zedong and his Communist party were victorious in China in 1949; and Generalissimo Chiang Kai Shek (also referred to as Jiang Jieshi)<sup>22</sup> and his Kuomintang party had to flee for safety to Taiwan. Both

22. Jiang Jieshi is Chiang Kai Shek’s name in a different dialect, the national dialect or Mandarin. Chiang Kai Shek is in Cantonese. It is just one of his several names as explained below. [https://en.wikipedia.org/wiki/Chiang\\_Kai-shek](https://en.wikipedia.org/wiki/Chiang_Kai-shek)

parties claimed allegiance to Sun Yat Sen<sup>23</sup> whom they consider the father of modern China. Both Chinas were primarily agrarian economies where the impoverished peasantry, the majority, wanted land reform. Both wanted to remake China according to their vision of what a stronger, more secure, more egalitarian, and more prosperous China is. How they would implement their visions was, however, radically different. In both cases, how leadership dealt with the millions of its impoverished smallholders was the central challenge. The challenge was, in particular with respect to

1. smallholders’ relationship to the land they till;
2. their incentives for managing the fertility of their soils,
3. the productivity and profitability of their farming, and
4. the income-earning opportunities they can exploit beyond the farm.

How to address these was an integral part of an economy-wide strategy on how the leadership was to implement its vision of a new modern China. How these different visions and political ideologies shaped their approaches (mainly during the first 3 decades or so after the end of WWII) to this central challenge is hereafter briefly discussed.

Agriculture in Taiwan, China under the leadership of Chiang Kai Shek (1949-75) and his Kuomintang Government: After a humiliating defeat in 1949, CKS was determined to make “new history” and to build the nation in Taiwan along Dr. Sun Yat Sen’s vision as stated in Sun’s Three Principles of the People.<sup>24</sup> After a decades-long struggle, the province of Taiwan was the last opportunity for CKS to implement Sun’s Three Principles of the People: (1) Nationalism—unify China; (2) Democracy—inspired by Lincoln’s “Government of, by, and for the people”; (3) People’s Livelihood—land-to-the-tiller and improving people’s lives, rural & urban. CKS was fortunate in that he inherited a Taiwanese

23. Dr. Sun Yat Sen (Nov 12, 1866-March 12, 1925) was the first leader of the Kuomintang (Nationalist) party and first president of the Republic of China. After the fall of the Qing (Manchu) dynasty in 1911, China was a republic from 1912-1949, years during which China was ravaged by wars – against warlords, against Japan, and civil war between the communists and the nationalists. One of Sun Yat Sen’s basic political goals when he formed the Tongmenghui in 1905, was the redistribution of land and land rights. The Tongmenghui (同盟会) or Alliance Society was a revolutionary movement to overthrow the Manchu rulers.

24. In his diary, CKS wrote (May 7, 1949) “With a ray of hope and my allegiance to Dr. Sun Yat Sen, I will continue my struggle without fail.”

agriculture that had benefitted from 50 years of Japanese agricultural development efforts. Factor productivity grew at 2.5 percent per year (1920-39) (Tomich, et al, 1995: 319).<sup>25</sup> He also received substantial aid from the United States until 1965 (4 billion USD of which 60 percent or 2.4 billion was military, and 1.64 economic). (Ho, 1987: 38)<sup>26</sup> Working closely with the Joint Commission on Rural Reconstruction (JCRR),<sup>27</sup> the KMT government imposed a uni-modal land distribution and invested heavily in public goods and services in agricultural and rural areas which made farming productive and profitable. In particular, it undertook the following:

► **Private property and use rights system:** The land reform made owners of the former tenants, with an ownership along the lines of the Torrens registration system. (Chang, 2014:5)<sup>28</sup> Indeed, respect for private property rights has been a fundamental tenet of the KMT and of Taiwan's anti-communism. The reform was inspired by Sun Yat Sen's principle of "land to the tiller". It was accomplished in three stages from 1949-53.

► **Technology transfer:** Working with the JCRR, the KMT built on the achievements left by the Japanese. They continued (i) the strengthening of agricultural research and extension; (ii) the investments in infrastructure, particularly for irrigation, drainage, and water control; and (iii) the operation of producers' and irrigation associations to maintain the infrastructure (Tomich et al, 1995:321-22, 331, 325)

► **Market access:** Improving market access was a major priority as soon as the pre-war level of production was reached in 1950-52. The government invested in both the hardware and

software of marketing, including the training of personnel; the undertaking of marketing studies; and the promotion of exports. (Shen, 1970: 184-197).<sup>29</sup> Such investments contributed to the increased share of marketed output from 58 to 62 percent of an increasing agricultural output (1950-69). (Tomich et al, 1995: 310, 327-329). The achievement was not only in terms of the increase in marketed output, but also in terms of the diversification of agricultural output and the increase in value added.

Agricultural output rose by nearly 140 percent from 1952-72 (Tomich et al, 1995: 331) and mass hunger was eliminated. The government focused on developing: (i) an egalitarian land distribution structure; (ii) a supportive overall incentive and institutional framework; and (iii) strong market and other linkages between agriculture and the overall economy. Since they were profitable, farmers adopted high input and high yielding technologies within this overall supportive framework.

Virtuous circle of agricultural and non-agricultural growth: The high productivity growth in agriculture was made sustainable by the overall economic transformation itself due to the 1950-68 macro and trade reforms, resulting in high growth rates of non-agricultural output, incomes, and jobs. Labor productivity in agriculture grew at an annual rate (percent) of 4.5 (1961-70) and 6 (1976-81). (Myers, 1984: 65)<sup>30</sup> Agriculture and non-agriculture grew synergistically.

Mao's vision of a collective agriculture to build modern China's industry (1949-79): Mao believed in the superiority of collective agriculture, even after the disastrous Great Leap Forward (1958-60) during which the communist party built giant communes. Commune members were paid in work points, the value of which was determined by the cadres in charge, after the harvest was in, quotas delivered, and taxes paid. This method of remuneration was not incentivizing to farm households as the official recognition of the Household Responsibility

25. Tomich, P. Thomas, Peter Kilby and Bruce F. Johnston. 1995. *Transforming Agrarian Economies: Opportunities Seized, Opportunities Missed*. Cornell University Press: Ithaca, London.

26. Ho, Samuel, P.S. 1987 "Economics, Economic Bureaucracy and Taiwan's Economic Development", p 32-54 in Ravenhill, John (ed). 1995. *China, Korea, and Taiwan*. Edward Edgar Publishing Ltd. Vol.2. Also in *Pacific Affairs*, 60, (2) Summer, 226-47.

27. The JCRR was created in 1948, China Aid Act, Public Law 472, while the KMT was still on the Mainland. It then operated in Taiwan in the 1950s-1960s ; became the Council of Agricultural Planning and Development in 1978, until it was merged with the Council of Agriculture in 1979. Lee Teng-Hui, President of Taiwan (1988-2000), worked with the JCRR as an agricultural economist in the 1950s.

28. Chang, Yun-chien. 2014. "The Evolution of Property Law in Taiwan: An Unconventional Interest Group Story. (Accessed March 8, 2018). <http://www.law.ntu.edu.tw/aslea2014/file/Evolution%20of%20Property%20Law%20in%20Taiwan%20140329.pdf>

29. Shen, T.H. 1970. *The Sino-American Joint Commission on Rural Reconstruction: Twenty Years of Cooperation for Agricultural Development*. Cornell University Press: Ithaca and London.

30. Myers, Ramon H. and Adrienne Ching. 1964 "Agricultural Development in Taiwan under Japanese Colonial Rule". *The Journal of Asian Studies*, Vol. 23 (No. 4), Aug 1964. (p 555-570). Published by the Association of Asian Studies.

System (HRS)<sup>31</sup> under Deng Xiaoping clearly showed.<sup>32</sup> Mao also saw the primary role of agriculture as being the main source of surplus for investing in heavy industry, the top priority; and for making China food (mainly grain) self-sufficient. Within this vision and overall strategy, collective agriculture was heavily taxed. Procurement prices and state marketing for staples – rice and wheat – were important tax measures. There were mass labor mobilizations for public works; e.g., irrigation, roads. Government did invest in agricultural research and extension despite the ups and downs typical of Mao's politics (e.g., The Great Leap Forward 1958-60; the Cultural Revolution 1966-76). The extension staff of each collective promoted the use of fertilizers, among other farm practices. Thus, under Mao's collective agriculture, there was a rapid rise in the use of chemical fertilizers, although they were taxed. Usage increased from an estimated 22.5 kg/ha (1962) to 291 kg/ha (1978). (Srinivasan, 1994: 36).<sup>33</sup> There was also substantial use of organic fertilizers, inferred from visitor reports and data on hogs and draft animals, kept mainly on private plots. For fertilizers to promote yields, they must be accompanied by new varieties which were produced by agricultural research as early as the 1920s. By the early 1960s, China produced high yielding varieties of rice, well before IRRI released its first high yielding rice variety.<sup>34</sup> (Yusuf and Perkins, 1984: 53-55)<sup>35</sup>

#### Deng's vision of "socialism with Chinese characteristics" –

31. The HRS was started in Anhui Province in 1979 and spread without explicit official approval. By 1982, 98 percent of households were under the HRS. It was only at "the 13th Party Congress in 1987 that the constitution was revised to guarantee the right to contract down the household level for the indefinite future." (Vogel, 2011: 443). Fuller discussion of the functioning and impact of the HRS on China's agricultural transformation is in Tsakok (2011: 108-124); on Taiwan's agriculture and broad-based income rise (86-93).
32. Deng Xiaoping broke with Mao's collectivism by promoting private or material incentives in the form of the Household Responsibility System (HRS). The central difference was that households were responsible for profit and loss of their farm enterprises; no longer would households be paid through the work point system. The spread of the HRS undermined collective agriculture and opened the way for further market-oriented reforms which would transform agriculture and over time, the entire economy.
33. Srinivasan, T.N. (Edi) with contributions from Justin Yifu Lin and Yun-Wing Sung. 1994. *Agriculture and Trade in China and India: Policies and Performance since 1950*. International Center for Economic Growth. ICS Press, San Francisco, California.
34. The International Rice Research Institute (IRRI), situated in Los Baños, the Philippines, was created in 1960. The first release of its high yielding rice variety -IR8- was on November 28, 1966. <http://irri.org/about-us/our-history>
35. Perkins, Dwight and Shahid Yusuf. 1984. *Rural Development in China*. A World Bank Publication

for agriculture: Though there were some agricultural achievements in Mao's China, agriculture was barely keeping up with population increase and poverty was still extensive. After 30 years of collectivist agriculture within which promoting material incentives was considered heretical,<sup>36</sup> Deng quietly but skillfully supported material incentives as the main motivator. He allied himself with party officials who supported developing production contracts directly with households, not with large collective units.<sup>37</sup> The Household Responsibility System (HRS) was revolutionary in that it was a rejection of Mao's collectivism and a return to private smallholder farming widespread throughout Asia. Grain production surged and China's agriculture took off (Vogel, 2011: 443).<sup>38</sup> A succession of market-oriented reforms followed which transformed over several decades not only agriculture but China as a whole. Each reform was conceived as an integral component of an overall strategy to rebuild "socialism with Chinese characteristics".

Deng's China was export-oriented, with private markets and government working together to reduce extensive poverty, and to build a more productive and prosperous Chinese nation.

36. Under Mao, the model of socialist farming was Dazhai (in Shanxi Province). Farmers were supposed to be self-sacrificing, be organized in large communes and undertake massive projects like irrigation works including even moving mountains! Patriotic zeal rather than material incentives was to be the main motivator of performance.
37. The transformation of China's agriculture under Deng Xiaoping's vision and its contrast with the Maoist period is discussed more fully in the Policy Paper entitled: *From Asian Green Revolution 1.0 to Sustainable Green Revolution 2.0: Towards a Fertilizer Policy for Smallholder Agriculture in Sub-Saharan Africa*.
38. Vogel, Ezra F. 2011. *Deng Xiaoping and the Transformation of China*. The Belknap Press of Harvard University Press: Cambridge, Massachusetts, and London, England.



## Conclusion

As these East Asian cases show, a holistic approach is long term (several decades at least), but is made up of shorter terms, specific but mutually reinforcing measures across the entire agriculture and rural sector, itself viewed as an integral component of the development of the overall economy. The mutually reinforcing measures together added up to have a determining impact on the entire sector and country. For fertilizer policy to have a lasting impact on soil fertility; on agricultural productivity growth and on sustainable intensification; as well as far reaching poverty reduction and income-increase effects, it must be conceived and financed in such a way that it does not preclude complementary action on the many other fronts required to successfully transform agriculture. A holistic approach to fertilizer policy has greater promise of success but it also has substantial demands. It requires a long term political commitment anchored in a multi-year financial, and institutional support.

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**Isabelle Tsakok** is an adjunct professor at SIPA and a Senior Fellow at the Policy Center for the New South, previously known as OCP Policy Center, who focuses on rural development, agricultural economics, policy analysis, food security and poverty reduction. She holds a PhD in Economics. Dr. Tsakok has worked on development issues for over twenty-five years, first as World Bank staff and since retirement as a consultant. She has specialized in policy analysis, program and project formulation and evaluation, research and training activities in agriculture, agro-business, rural development and poverty reduction. She has worked in most regions of the developing world: Africa, Asia - South, Southeast and East, North Africa and the Middle East and Latin America.

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