

Mechanized Raised Bed Farming System (MRBFS) to Drive a Process for Fertilizer Subsidy Reform in Egypt

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In a nutshell

- Current modalities for the distribution of subsidized fertilizer, together with national campaigns for wheat production, may be stifling nutritional security within rural areas;
- Reliable access to water is a critical constraint to enhancing agricultural productivity for small Egyptian landowners; thereby necessitating the need for equitable and affordable access to mechanized water and labour saving technologies;
- With human and financial resources within Egypt's public agricultural extension services dwindling over the past two decades, the role of private and civil society advisory services in generating and disseminating knowledge is of key contemporary importance;
- In post-2011 Egypt, the delivery of publicly subsidized fertilizer and improved seed varieties will be more effective if undertaken in collaboration with private machinery service providers, backstopped technically through effective public extension systems, and particularly so when tied to technologies which enhance land and water productivity;
- A reform of the fertilizer subsidy programme in Egypt, similar to recent reforms on bread subsidies, is likely to bode well for a more diverse set of crop mix choices and enhanced nutritional availability within rural areas.

The Challenge

Publicly available estimates suggest that close to 30% of total employment in Egypt is generated from the agricultural sector (World Bank, 2016). In percentage terms, the figure is in line with many economies, both industrialized and developing. Considering population estimates of close to 90 million, the number of people (27 million) economically engaged within an arable land area equal to 3% of the total area is however overwhelming. Given cultural norms for inheritance, coupled with population growth, farm holdings have steadily decreased over time. With an average land parcel of 1 feddan (0.42 hectares), rural farm households are constrained in the efficient and effective use of commercialized machinery, and disputes over the sharing of irrigation water within public canals are not uncommon.

These irrigation channels, publicly maintained and regulated, divert water from the Nile through a system of principal, main, branch, and sub-branch canals. Spanning a distance of close to 40,000 kilometers, this expansive network delivers water to more than 2 million farm households across the republic. With a growing population, and thereby food demand, a national strategy to open up new lands for agricultural production places pressure on the supply to existing canals; and particularly so in light of fixed (national) water allocations which are based on regional water sharing agreements.

The Context

As one avenue for mitigating these concerns, mechanized raised bed production offers a paradigm shift in land and water use management practices with sound environmental underpinnings. The concept of agricultural production on raised beds is not new and has been practiced by Egyptian farmers for centuries, largely through manual effort. Fragmented landholdings limit the efficacy of commercial machinery, given an inability to negotiate wide turns due to limited (wide) road access, and thereby having to traverse over adjacent parcels of land. Over the past decade, joint research undertaken by The International Centre for Agricultural Research in the Dry Areas (ICARDA), the Agricultural Research Centre (ARC) Egypt, and the Food and Agricultural Organization (FAO) of the UN, has been aimed at testing proof of concept for context specific mechanization in raised bed production for small farm holdings. Of key mention in terms of the outcomes achieved through the development and testing of mechanization in raised bed production has been yield improvements in wheat production (11%), reduction in labour requirements (15%), reduction in seeds applied (36%), reductions in fertilizer application (15% on average), and most notably, a 49% increase in water productivity (crop per unit of water applied) (Kassam *et al.*, 2016).



Yet, despite increasing farmer demand, private machinery service providers have not expressed overt interest in purchasing the newly developed equipment. One explanation has been strong interest on the part of the Ministry of Agriculture and Land Reclamation, as well as by international organizations funding project based agricultural initiatives, to utilize the machinery within an ongoing national campaign aimed at fostering self-sufficiency in wheat production. Provided largely for free, or at minimal cost to farmers, these public initiatives diminish the economic incentives for private machinery service providers to purchase newly developed equipment. This represents a missed opportunity in so far as the potential for private machinery service providers to jointly deliver publicly subsidized fertilizers with public systems of distribution, within an environment which shifts the policy focus away from subsidizing wheat production, and towards one which focuses on public investments for enhancing human and soil nutrition.

Contemporary and Inclusive Approaches for Distribution of Subsidized Fertilizer

One outcome sought from the process of developing, testing and uncovering options for broad uptake of context specific machinery for Egyptian farmers in the Nile Delta was savings in labour and water. Testing proof of concept for raised bed equipment, however, led to the realization of a whole host of other relevant issues ranging from those of economic incentives, environmental concerns, as well as gender based concerns of inclusivity, empowerment, equity and access to nutrition. These challenges are of significant importance for consideration in any strategy aimed at out scaling the newly development machinery; and particularly so given a national focus on wheat self-sufficiency.

Three approaches exist for taking the developed technology to scale (broad uptake). The first is a conventional approach of handing over the prototype to national research and extension agencies with a hope that dissemination will be fostered through public delivery systems. Given evidence of a significant decline in the numbers of extension officers, and in light of continued flux at the level of policy, it is unlikely that there will be much efficacy in machinery provision through this avenue. This, in addition to historical evidence globally that the incentives for public extension to deliver effective machinery services are limited to a very few handful of cases. The second is to induce the private sector to engage, through commercial business approaches which incentivize the purchase of equipment at market rates and through the promise of fee based service delivery at going market rates. Issues of equity in access however loom large in this case of private provision. While willingness to pay in order to guarantee access to service is a form of (vertical) equity, limited supply of machinery may lead to the exclusion of poorer farm households, as prices are likely to be higher than when there is a balance between supply and demand for machinery services. Is there middle ground as a third option in order to ensure equitable and equal access to the machinery developed?



One option for agricultural policy in Egypt is consideration of a hybridized model of subsidized fertilizer distribution, wherein both parastatal cooperatives and licensed private machinery service providers are involved in distribution. The former through conventional methods of farmers accessing subsidized fertilizer through

community based parastatal cooperatives, and the latter on the basis of subsidized fertilizer tied to the provision of machinery services which embody environmentally sound underpinnings. Expanding this option to further include the provision of publicly disseminated improved seed varieties and associated technical advisory services is surely on good footing in terms of broad uptake at scale. Public extension would have a significant role to play under such a scenario, and specifically in terms of training machinery service providers in relevant agronomic knowledge, as well as in the dissemination of key messages and learning to farmers serviced. In working with private service providers, the reach and effectiveness of limited public extension officers is surely to be enhanced and is in line with more contemporary thoughts on effective innovation systems (Rajalahti, 2012).

Agricultural policy in Egypt continues to maintain a heavy focus on wheat self-sufficiency (but often stated as wheat security). At the farm level, the focus is on finding optimality in crop mix choices which embody concerns related to profitability, considerations of household labour, and availability of inputs (water, seeds, fertilizers and other productive inputs). The importance of nutrition is often relegated to small garden plots at the household level, and with an assumption that households will purchase any gaps in nutrition from the market. Evidence of malnutrition and stunting rates in rural Egypt suggest that this may not be a sound assumption. well-founded argument.

Reforming fertilizer subsidies in a manner which allows farmers choice in the type of fertilizer, and accessed through multiple sources (private and public) would surely enhance rural well-being and secure greater efficiency in national mandates for food security (not simply wheat security). Recent reforms of bread subsidies provide a valid and relevant example of how this reform may be effectively undertaken.



The Normative Role for Egyptian Civil Society within the Process of Innovation

Historically, the development and dissemination of agricultural technologies has generally been linear in process, through research undertaken in a laboratory or on a research station, tested for proof of concept with a handful of farmers, and subsequently disseminated through public systems of agricultural extension services. Globally, there is now a contemporary and significant push towards the refinement of more pluralistic and participatory process for innovation. One key driver in this paradigm shift is the inability for many governments to continue funding public extension and advisory services. In Egypt, numbers of public extension personnel dropped from 35,000 in the early 1990's to 6,378 in 2011 within an environment which is reflective of a number of continuing economic and structural adjustment programmes (Dhehibi *et al.*, 2016). Dissemination of knowledge to farmers through public funded dissemination schemes is therefore limited, and in line with global advocacy, calls for more pluralistic approaches to supporting knowledge generation and dissemination.

In light of this decline in public extension services, the role of rural institutions, funded and technically backstopped by international organizations is, and will likely continue to be for some time, a significant source of knowledge for farmers. Exact figures are sketchy, but in piecing together various accounts, there would appear to be approximately 40,000 non-governmental organizations and more than 5000 agricultural cooperatives (both community based and parastatal) operating in Egypt. Caution, however, should be exercised in romanticizing the role of these civil society organizations. One area of concern relates to the nature of funding, typically in cycles of 3 to 5 years, and therefore little opportunity to generate long term institutionalized processes for rural advisory services. Regulatory concerns also exist, particularly in Egypt and within the wider region, and which relate to a fear of political motives embedded within the mandates of non-governmental organizations. Taken together, opportunities exist for leveraging the role of civil society in the dissemination of knowledge and technology for improved agricultural productivity; yet, contemporary sensitivities and concerns may limit the scope and effectiveness within the short to medium term.

Equity or Equality and Implications for Gender bias in Access to Subsidized Fertilizer

Initially born as a network aimed at facilitating the orderly transfer of reclaimed land, or new land brought into production, state mandated agricultural cooperatives play an important role today in the distribution of subsidized fertilizer, as well as in monitoring (and influencing) the amount of land placed under key strategic crops. Having access to subsidized fertilizer is attained through membership within these parastatal cooperatives and with equal opportunity in attaining membership. Securing access to subsidized fertilizer is, however, not necessarily guaranteed with membership. Shortages in the delivery of fertilizer to cooperatives, at levels required to service the area under its jurisdiction, naturally results in a process of distribution which will not be seen as being fair across all members. More concerning, however, is field based observation which suggests a limited ability for female headed households to effectively participate as cooperative members in order to successfully secure access to subsidized fertilizer. Where access is attained, it is often based on the intervention of male members within the extended family, in line with social and cultural norms, and who act on behalf of female relatives. Equity in the sense of fairness in securing access is therefore of serious concern for female headed farm households. Equality is grounded on the notion of equal opportunity to access, whereas equity is based on need and the notion of fairness. The current modality of subsidized fertilizer distribution

embodies equality in having access, but with gender related concerns for equity in both having and securing access to subsidized fertilizer.



In Conclusion: Not all Fertilizers are alike and not all Deliver Similar Outcomes

Public subsidies for fertilizer in Egypt are restricted to nitrogen based components. Important in the production of wheat, the subsidization of nitrogen provides one important economic incentive to plant this nationally strategic crop. Fixed state prices for grain at harvest being another. Nutritious for humans, legumes are equally nutritious for soil, given their ability to deliver nitrogen at no extra cost. High in protein and nitrogen content, legumes are typically produced in a rotation with wheat within most production systems. From a production perspective, legumes require phosphate based fertilizers, and when grown in a rotation with wheat have the potential to reduce the amount of nitrogen applied within the following wheat cropping season. This reduction comes about through the delivery of nitrogen into the soil, a valued attribute of legume production. Despite this knowledge, known to all farmers, land areas under legumes (particularly faba bean) have witnessed significant decline over the past three decades in Egypt. In large part, this has been due to a historical inability to deal with debilitating disease, and therefore a fear of planting faba beans due to risk of contaminating the

soil with disease. Recent advances in science have however addressed this challenge, and through effective research partnerships, contextually effective disease resistant varieties of faba bean are now being reintroduced into farmer fields within Egypt. The same level of loving paternalistic attention provided to wheat, through public subsidies, has not however been accorded to faba beans, or food legumes in general.

Encouraging the reintroduction of faba beans into cropping rotations is not solely restricted to good production practices with sound environmental underpinnings, but equally important in terms of enhancing nutritional availability within rural areas. With micronutrient deficiencies and worrying rates of anemia highlighted by multilateral health agencies (WHO, UNICEF), access to nutrition within rural areas is one of key policy concern. Equally important is evidence of an increase in stunting (low height to age) rates for rural Egyptian children. Among others, one well known cause for stunting is poor maternal health and nutrition of childbearing women. With faba beans (legumes more generally) constituting at least one important meal for each Egyptian family, the availability and abundance of locally produced and sourced legumes may assist in lower rates of malnutrition over the long term.

Mechanized options for raised bed planting of wheat has shown significant potential in reducing the application of fertilizer, together with savings in other inputs of interest (water, labour, seeds). This is specifically true in terms of a reduction in nitrogen fertilizer, which is subsidized through public schemes aimed at encouraging wheat production. Less subsidized fertilizer applied leads to savings retained in the public coffers. How the government wishes to capitalize on these savings in fertilizer subsidies is a question of policy choice. One argument is for the state to reinvest the savings on subsidized (nitrogen) fertilizer, attained through an enabling environment for private machinery (and joint subsidized fertilizer) service provision, into a process for simultaneously enhancing human and soil nutrition. This can be attained through providing farmers choice in a variety of subsidized fertilizers: nitrogen based for wheat production and phosphate based for legume production. Many economists have reservations over the long-term use of public subsidies in promoting certain commodities or crops. However, given that the Egyptian government is likely to continue subsidizing fertilizer for some time to come, options for reforming existing fertilizer subsidies, through the provision of choice in subsidized fertilizer - along the lines of recent reforms to bread subsidies - may provide an impetus for broad scale re-introduction of legumes into wheat based cropping systems. This will require a paradigm shift in policy thinking, away from subsidizing a drive to wheat self-sufficiency, towards one of investing in human and soil nutrition.

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