Agriculture in flux: Insights into agricultural transformations and possible scenarios in South Punjab, Pakistan

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Multifaceted challenges and myopic solutions

The Global Climate Risk Index 2019 lists Pakistan as one of the most vulnerable countries to long-term climate risk (Germanwatch 2019). In Pakistan, the agricultural sector employs nearly 40% of the national labor force (Government of Pakistan 2019) and almost 65% of farmers are characterized as smallholders with equal to or less than 2 hectares of plot size (Government of Pakistan 2010). Thus, a majority of the population are agrarian actors with limited resources. Therefore, climate change induced losses in agricultural yields will have devastating and irrevocable consequences.

At the same time, climate change is but one of the many pressures on agriculture. The population is growing at an annual rate of 2.4%t (Pakistan Bureau of Statistics 2017). Rural to urban migration is estimated to increase a staggering 3% per year—and it has been partly attributed to climate change induced decrease in agricultural productivity (Saeed, Salik & Ishfaq 2016). Concurrently, political instability and poor governance especially in rural areas exacerbates the food security situation and adds to widespread prevalence of malnourishment (Newman 2018). The ongoing Covid-19 pandemic highlights the precariousness of a food network marked by severe inequality as millions struggle to meet basic needs as country-wide containment breaks down agricultural production chains. Market instability and price shocks have been brought into public scrutiny for their role in increasing food inequity (Arab News PK 2020). Available productive land is also shrinking; desertification and land degradation is noted to affect 68 million hectares of land due to wind and water erosion as well as depleting fertility of soil (Khan, Ahmed & Hashmi 2012).

Currently, the government's approach to these multifaceted challenges is a policy of agrarian intensification—widely understood as an increase in agricultural output per unit of input—through technological innovation, in continuation of the spirit behind the Green Revolution of (Byerlee & Siddiq 1994). The recently announced 2019 agriculture policy focuses on improving yields of 'high-value' crops through modernization and mechanization (The Express Tribune 2019). Furthermore, under the Chinese Belt and Road Initiative, locally termed China-Pakistan Economic Corridor (CPEC)—currently the largest source of foreign direct investment in Pakistan—major investments to 'modernize' agriculture in Pakistan are planned (The News 2020). Moreover, public research is also investing heavily in genetically modified varieties that are expected to ensure stable cotton supply (ISAAA 2019).

The history of the Green Revolution in Pakistan has demonstrated that intensification and modernization strategies to increase productivity is a myopic solution to agricultural problems as they neglect social and ecological side effects and render the above mentioned challenges as problems to be solved merely by technological solutions. Thus, there is a need of delineating solutions to agrarian problems that include careful consideration of processes of environmental change as well as the needs of lesser affluent strata of farmers.

Context and research methodology

Given the multifaceted challenges and changes faced by agriculture, I attempt to inquire how these changes are manifested and confronted in one of the most significant growing regions of Pakistan: South Punjab. This area is representative of commercial agriculture in Pakistan. Although it grows most of the major cash crops, it is mainly known for cultivating cotton in the monsoon growing season and thus figuratively termed the 'cotton belt'.

The region underwent major agricultural transformations in light of the Green Revolution of the '60s and '70s with the introduction of agricultural intensification via high-yielding varieties, chemical fertilizers, and agricultural machinery. Historical analyses of the Green Revolution in South Punjab have demonstrated that the use of high yielding inputs in Pakistan spawned land degradation and exacerbation of social inequality for decades (Amjad 1972, Byerlee & Siddiq 1994, Murgai, Ali & Byerlee 2001, Niazi 2004). Despite some early productivity gains (Amjad 1972), the strata of society most in need remained deprived of the benefits as the yield benefits remained highly concentrated in the hands of higher classes of farmers who could afford to adopt the new varieties (Niazi 2004).

Furthermore, the threat of ecological devastation in the form of reduced genetic diversity and increased

vulnerability to wide-spread pest infestation also emerged as a major concern with the advent of the Green Revolution in the region (Freebairn 1995). Most importantly, it has been argued that the yield gains of the Green Revolution came at the expense of resource degradation due to expansion of fertilizer use, increased cropping intensity, and switching from rain fed to groundwater irrigation. (Byerlee & Siddiq 1994).

Currently, South Punjab is particularly subjected to ecological degradation as well as extreme weather events linked to climate change, such as floods and heat waves. Despite these complex challenges, recent scholarship on agricultural adaptation in this region has been largely preoccupied with measures related to maintaining or improving yields under changing ecological conditions. (Hussain & Mudasser 2007, Ahmad, Mustafa & Iqbal 2015, Khan et al. 2016, Ali et al. 2017).

I aim to counter this productivity narrative in agrarian studies by investigating the path dependent land use changes in the cotton belt of South Punjab to uncover: (1) ecological impacts of intensification, particularly in the post-Green Revolution era (post-1974), (2) smallholder perspectives on expensive technological solutions, and (3) actors and elements that are overlooked in productivity focused solutions, which ultimately fail to address the complex question of food security in a changing climate. This study is part of my doctoral research on socially and ecologically sustainable alternatives to agrarian intensification in South Punjab.

As a first step, an explorative field research was held from November till December 2019 in four districts in the cotton belt of South Punjab involving 57 farmers and relevant local experts, such as agricultural extension officers, NGO representatives, and academic researchers. I used guiding questions about recent land use changes, the concerns of farmers, and the changing farming practices to approach (current and future) ecological and social challenges.

Insights on changing ecological elements

Farmers perceive climate change as a warming trend with an increase in extremely hot days per year. Although the source of these microclimatic changes remain to be determined, the slightest temperature increase here is serious as this region historically has the highest nationwide maximum-recorded temperatures (Salma, Rehman & Shah 2012). High temperatures reduce the phenological crop phase of cotton, for instance, and thereby negatively affect the development of the economically significant cotton boll. Erratic rain patterns are also reported by the informants. Drought is of particularly less concern as far as agriculture is concerned, as the region is dominated by irrigated agriculture. However, the untimely post-monsoon rains and storms cause damage to cotton stands and negatively impact yields.

A general adaptive response reported by farmers is to intensify the use of inputs such as irrigation water and chemical fertilizers to "guarantee" sufficient yields and economic gains, which, on the contrary, renders farming so expensive that most smallholders barely break even. Some farmers also vary the sowing and harvesting times to avoid high mean temperatures as well as to capture high prices towards the end of crop season when market supply has diminished. This, however, is an option limited to major landowners as small and medium-size farmers are tied in repeated cycles of debt with middlemen who demand timely payment of debt in the form of agrarian output.

Recurring bouts of pest infestations complicate the situation; the genetically modified (Bt) cotton varieties, once celebrated as the solution to farmers' woes, are now defenseless against the pink bollworm (*Pectinophora gossypiella*), which affects lint and seed quality and has developed resistance against Bt cotton (see Fig. 1). Since its introduction in Pakistan in early 2000s, the overtime cross-breeding of Bt cotton with local varieties is one the factors that has diminished the effectiveness of Bt. This has rendered progressively more area under cotton cultivation vulnerable to pest infestations. Farmers report an overtime increase in pest sprays, partly due to the recurring pest infestations and partly due to the ineffectiveness of "fake" pesticides.

Fig. 1: Farmer showing pink bollworm in Bt cotton boll (Photo: M. Zuberi 2019)

Farmers also report over irrigation and reduced fallowing in an attempt to secure output despite unfavorable weather conditions and fields rife with pest attacks. This is owing to a continuing trend towards mechanization of agriculture. Technological developments and availability of agricultural credit over the previous couple of decades made machinery such as tractors and rotavators a staple on the field that intensify soil use.

Motorized ground water pumps make sole reliance on canal water for irrigation obsolete—a recourse only available to the more affluent landholder. Resultantly, farmers report that land under cultivation has increased significantly in comparison to some decades ago when parcels of land could be left fallow for a season. These practices, together with a deficient irrigation network—dating back to the colonial era—

with ground water seepage and in the absence of a proper drainage system, contribute to salinization which renders land infertile.

Insights on socio-economic developments

In light of the various climatic and pest related problems facing agriculture, some stakeholders place hope in technological remedies. Despite the unfavorable outcome of genetically modified Bt cotton, the public and private research is investing in development of genetically modified and hybrid heat tolerant varieties of crops. In recent decades, hybrid varieties of rice, maize, vegetables, and fruits have become a significant source of agricultural income for more affluent farmers.

This development has been facilitated by multidimensional factors. The Seed (Amendment) Act 2015 and the Plant Breeders' Rights Act 2016 are some of the policy related underpinnings that have made investment in patented hybrid varieties profitable for local and international agribusiness. This has resulted in a boom for local agribusinesses. Although multinational agribusinesses are attributed to having introduced hybrid varieties, the previous two decades has seen a proliferation of locally owned agribusinesses that distribute imported seeds. Thus, transnational agricultural cooperation also plays a major role in the recent 'hybrid boost'. Especially in the case of CPEC, Chinese agri-investments will likely expand cultivated area in Punjab under hybrid production.

Currently, production of hybrids in combination with tunnel farming was observed (see Fig. 2). Farmers report that the increased income from year-long cultivation of previously only-seasonal fruits and vegetable was a major attraction. Despite questions of loss of genetic diversity and seed sovereignty being raised by academics, the increasing commercialization and modernization of agriculture plays a major role in the wide-spread acceptance of genetically modified and hybrid seeds by most farmers.

Through these developments, in a region that has historically only cultivated cotton in the monsoon growing season, diversification towards other food crops is rampant. Farmers opine that the golden era of cotton, both in terms of yields and market rate, ended around 2014-2015 and so they search for alternatives. While some cotton field have been permanently converted into tunnel farms by affluent famers, some so called "progressive" farmers have responded to the alleviated market for fruits such as mangos and citrus by slowly but steadily converting cotton fields into mango orchards, a process that entails several years of going without economic returns from those plots while fruiting trees mature. This development especially occurs in areas where farmers receive access to the regional markets due to infrastructural development such as roads or highways through the sway of elected political leadership or, in some cases, the Chinese Belt-and-Road Initiative.

Another socio-economically important development is the process entailing reduction of average farm sizes can be discerned as land is passed from generation to generation. Small scale farmers can no longer afford to live from agriculture as their farm plots shrink while they are forced to compete with the economies of scale of affluent famers investing in high-yielding hybrids. When asked about alternative livelihoods in light of unprofitability of agriculture, one farmer answered despondently: *"And do what? There is nothing else to do."*

Fig. 2: Tunnel farms in district Multan (Photo: M. Zuberi 2019)

Conclusion and outlook

The productivity narrative in agricultural policies results in a clear divergence between private profit and public well-being as far as incentives to farmers are concerned. Productivity centered public incentives, such as subsidies for mechanical inputs, beget intensification led increase in yields, however with a degradation of resources overtime. These exacerbate social disparity between the different strata of farmers: the affluent ones accrue profits from their intensive farming practices while poorer stakeholders suffer the brunt of the ecological degradation risks. Secondly, intensification related incentives are by default aimed at enterprising or "progressive" farmers and they further distort already unequal relations of production. The trend towards intensification and higher productivity varieties is pricing smallholders out of agriculture with limited recourse. In a country where the majority of farmers are smallholders this is an alarming situation and deserves a revision of agricultural policy priorities.

Two comparative case studies are planned to investigate the processes, drivers, consequences of, and alternatives to productivity centered agrarian approaches in selected villages. Investigating the diversity of local challenges and adaptive strategies to change should help to demonstrate feasible future sustainability pathways that go beyond yield increases.

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