

Executive DRAFT

The Punjab Agriculture Policy

Iqrar Ahmad Khan
Vice Chancellor
University of Agriculture, Faisalabad

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Foreword

The Punjab Agriculture Conference was held on March 19, 2016. As promised, the Chief Minister Punjab has constituted an Agriculture Commission. The commission has been mandated to devise an agriculture policy for the province of Punjab. The policy committee has held stakeholder meetings and deliberated for months. The available policy documents and government plans were reviewed. The policy documents of neighboring country were also reviewed. The federal government has floated a draft Food Security Policy, which was discussed.

A series of consultative meetings were organized at the farmer's level as a bottom up exercise. A draft document was prepared and circulated among the stakeholders widely, including the World Bank, ZTBL, HEC, PARC, IFPRI, FAO, IFAD, CABI and Mr. Sartaj Aziz. The feedback was minutely examined and incorporated where appropriate.

The review and consultation exercise has revealed that there is no shortage of information but a serious lack of implementation. An analysis of the Sartaj Aziz Commission report of 1988 indicated that most of the proposals made then are still valid but failed to produce results due to inconsistent implementation. Considering the current governments' track record, we are quite confident that the policy recommendations made here will be implemented for the betterment of agriculture sector and for prosperity of the farming community.

The information and proposals to be presented were voluminous. Three documents are getting readied. This is an executive version for consideration of the Chief Minister and provincial cabinet. A medium sized document of about a hundred pages is ready for helping the development of project proposals (PC-1) by the administrative departments. A full volume of more than 40 chapters shall be made available within six months as a reference text.

I wish to acknowledge the input and efforts of the policy group constituted at UAF. I am also grateful to a large number of stakeholders who will be listed in the detailed version. The policy committee is honored for having been entrusted this important responsibility by the Chief Minister Punjab.

Iqrar Ahmad Khan

1. Introduction

Agriculture ensures food security in the country. It contributes 19.8% to the GDP, employs 44% of the work force and it provides livelihood to 66% of population (>5 million households). The industrial output in the country is dependent on the raw material and consumption capacity of agriculture-led activities. Exports are also largely dependent on agriculture (65% agro based).

Characteristically, agriculture in Punjab is dominated by small farmers growing five crops and a large population of underperforming livestock. The yields of crops and livestock heads are stagnant. Water scarcity has become evident. Despite stagnation, we have excess of essential commodities and the farmer is losing money. Large surplus of commodities has failed to provide nutritional security for the vulnerable. We have high cost of production which makes us uncompetitive in export markets. Our current food imports are \$5.3 billion. Addressing the decline in agricultural growth would be an important objective of this exercise.

Overcoming stagnation requires continuous development and delivery of technology. Achieving economies of scale and value addition are the other options to make agriculture profitable. Among technologies; GMOs, precision focused mechanization and use of ICTs offer current applications. The technology development requires a long term commitment and investment in agricultural research. It also requires international networking and linkages.

The Federal Government announced a 341 billion package for the farmers in 2015 before the onset of Rabi season. That had yielded significant results.

1.1 The Punjab Agriculture Conference

The Punjab Agriculture Conference was held on 19th March, 2016 which was addressed by the Chief Minister Punjab. He announced a 100 billion development package for the farming sector. He also announced creation of an Agriculture Commission to be chaired by the Chief Minister.

The Chief Minister raised several pertinent points to ponder. That includes aggressive growth agenda, enhancement of rural economy, global trends in commodity prices, stagnant yields, coupling agricultural growth with research and technology transfer, increasing input use efficiency, market connectivity, backward and forward value chain linkages, land records, and international linkages.

The Punjab government has constituted the commission. The commission has further created a policy committee. The committee has launched a multipronged review and consultation process. A short/executive version of the outcome of deliberation of the policy committee and its recommendations are presented in this (policy) document.

2. Issues and Analysis (Seven Points Agenda)

2.1 Land and Water Productivity/Sustainability

The diversity of topographic features, land textures, climatic variations, technologies and markets have created a range of agro ecological divisions. That provide us an opportunity to grow a full range of commodities. The urban land use, uneven distribution of ownership rights, and fragmentation are obstructing the optimal land use. The land resource is also faced with degradation due to salinity, water logging, soil erosion, soil compaction, desertification and infrastructure projects. High cropping intensity and use of unfit subsoil water are affecting soil health, organic matter and as a result sustainability of the systems.

The productivity of agricultural lands can be enhanced by precise interventions at the micro zones- and commodity clusters (agro ecological) level by introducing soil and water analysis and plant residue management. There is a need for schemes for wet lands, rain water harvesting, flood canals, river dredging, river lakes/locks, canal water storage, on-farm storage and ground water recharge wells. Restriction on ground water pumping be imposed. Irrigation water should be priced (according to the depth of water table) and cultivation of low delta crops be incentivized for restricting area under rice and sugarcane. HEIS program be reviewed and rewritten after an independent monitoring of the sites developed during the past five years. In Punjab, amount of wastewater disposed off after its treatment is only 22.11 million cubic feet per day out of 552.23 million cubic feet produced.

The irrigation system in the country was an outstanding design at the time of its creation which was developed as a supply model i.e. 'wara bandi' arrangement. Intensification of cropping systems continued to put more demand for water. Corresponding investment in water storage could not be made, resulting in a huge ground water abstraction. The political realities led to freezing of water charges and deregulation of ground water abstraction. Water thefts and distorted allocations are common.

2.2 Productivity Gaps and Stagnant Crop Yields

The agriculture sector has been faced with serious stagnation in productivity and declining growth. The farmers are leaving their profession. Yield gaps for wheat, rice, maize, cotton and sugarcane between progressive growers and national average stand at 43.5, 45.6, 58.55, 30.85 and 61.6%, respectively. Major reasons for this difference are unavailability of quality seed, inappropriate sowing (methods and time), weeds, lack of balanced fertilizer use, partial mechanization and excessive use of unfit irrigation water.

The Stagnation is partly due to small farmer's inability to invest and absorb technology. That means >60% of cultivated land is under performing. Other reasons for stagnation are lack of updated technology and repeat market failures and imperfections. GMO is a nearly missed opportunity and now we are dragging our feet for the adoptions offered by ICTs. Green

Revolution was a case (success) of our ability to adapt while we failed on GMOs in time and time is running out for the use of ICTs. The green revolution (short stature-fertilizer responsive varieties) broke yield barriers in grains. Introduction of heat tolerance in cotton allowed late sowing (after wheat) and created a new cropping system/pattern.

2.3 Five Crops and Diversification

Our agriculture is characterized by the dominance of five crops i.e. wheat, cotton, rice, maize and sugarcane, promoted by the political economy. The diversity of our climate and land features are suited to expand the cropping mix through technology adoptions and incentives.

The PML (N) had issued an election manifesto 2013 with an intention to diversify agriculture emphasizing pulses and oilseed crops. The diversification can be accelerated by incentivizing minor crops with emphasis on pulses and oilseed crops. The maize acreage has increased beyond its existing demand. It is high time to promote maize consumption to improve the quality of food.

2.4 Climate Change

Climate change is a continuous process that has created the warm worlds from the ice ages. The process has been accelerated by the manmade interventions against the natural balance. Revolutionary measures are needed to arrest/mitigate the trends and to adapt to the changes. Pakistan is situated in a region that is regarded as highly vulnerable to adverse impacts of climate change. Specific focus could be on developing monitoring techniques to detect the effects of climate change with emphasis on productivity (crops, livestock and forestry) and devising education and extension framework to disseminate knowledge to the community regarding adapting/mitigating impacts of climate change. There is a need and opportunity to develop heat and drought tolerance and agronomic interventions. Wheat, cotton and rural poultry should be our near future targets to prepare against the vagaries of heat. The methane produced by livestock and poultry must be converted into valuable options of bioenergy and biofertilizers, while claiming carbon credit.

2.5 Postharvest Losses and Agricultural Marketing

There are huge economic losses during the harvesting operations and onwards to the consumption points. The conservative estimates indicate 16% losses in grains during harvesting and storage due to lack of drying and storage structures. The horticultural commodities suffer losses because of faulty harvesting practices and due to lack of cool chains. The bulky nature of fruits and vegetables and glut during harvest seasons require cold storage and processing to avoid losses due to short shelf life. The losses of fresh produce can vary from 25% to 90%, with an average accepted losses of 40%. There are no technological solutions that can increase the production of grains by 16% and fresh produce by 40% in a year. While the prevention of such losses by investment in postharvest technology and infrastructure are possible.

The biggest cause of marketing disadvantage to the farmer is his inability to hold the commodity, generally because of lack of storage or because of seasonal debts. Warehousing, trading platforms and future markets offer some solutions. Other options include investing into value addition along the value chains. This is a proposition which has unique requirement for every given commodity. The cluster approach can work to support the farmers during the production cycle followed by warehousing and marketing. Heavy losses of produce also occur due to poor transportation, inadequate grading, very heavy spread in price between consumer and farmer, and tough competition with the imported goods. The Punjab Government's rural roads program and revamped cattle markets are good examples of corrective measures.

Our lack of competitiveness in the international market is our biggest challenge which is because of high cost of production as well as because of our inability to meet the compliance requirements. Our regional trade has three major (India, Iran and China) and several adjoining partners. The current value of trade with India is estimated at \$3 billion. The trade with Iran and along the CPEC connected one belt one road has a brighter future. We have to prepare the system to respond to the emerging market access in the near future. That could mean developing new products and skills.

2.6 Social Disparity and Gender Mainstreaming

Agricultural growth reduces poverty on a much larger scale than the growth in other segments of economy. There are studies available to support this statement. The growth in agriculture cascades the economic activity in the rural industries and businesses, provide jobs closer to home, halt migration from rural areas and improve livelihoods on a larger scale.

The contribution of women to the enterprise largely goes unacknowledged. The income to farm household is usually a mix of on- and off farm engagements. The migration from rural to urban centers has been a continuous process. That has led to erosion of skill and transfer of resources from rural to urban areas. The part migration of family members has benefitted agriculture by allowing some resource transfer back to farming at critical times of the year. Overseas migration from rural areas is also another debate. The critical issue is how to retain healthy and skilled workforce in the farming sector while promoting investment available from the income of out-migration.

Infrastructure and services in rural areas are grossly insufficient and substantial improvements are needed. That include physical infrastructure, education and health facilities, safe drinking water and sanitation. Above all, deterioration of social institutions and disappearance of conflict resolution mechanisms promote out-migration.

2.7 Malnutrition

Micronutrient deficiency known as hidden hunger is wide spread in Pakistan with major indications from the rural areas. The National Nutrition Survey (2011) revealed that 43.7% of the

children are stunted while 15.1% are wasted and 31.5% are underweight. The survey data showed that stunting and wasting in 2011 has increased over the past decade. These problems are higher in rural areas as compared to the urban centers. The suffering is higher in women and children i.e. anemia (61.9%), iron deficiency (43.8%), zinc deficiency (39.2%), vitamin A deficiency (54%) and vitamin D insufficiency (40%). This situation demands nutritional interventions to combat the threat of hidden hunger. There is a need to launch School Nutrition Program. It is pertinent to include food and nutrition subject in school curriculum coupled with media awareness campaigns and counselling. Legislation for mandatory wheat flour fortification with iron should be introduced. Breeding programs for genetic fortification of food crops for nutritional enrichment and fertilizer use efficiency are a long term solution. The greater good could only come from a social and behavioral change towards food.

3. Vision

Making agriculture competitive, profitable and sustainable through enablement, efficiency and value addition for food/nutrition security and socio-economic development.

4. Mission

Reform the agriculture sector as a profitable industry by promoting investment in the infrastructure, research, outreach, skills, value chains, agroindustry and rural development. The economies of scale are to be achieved for land cultivated by the small farmers to narrow the productivity gap. The application of ICTs should become integral to the value chain management. The distortion of terms of trade against agriculture and the rural economy must be stopped. The agriculture led growth of the economy shall bring prosperity for the masses.

5. Objectives:

5.1 Technology/Precision

- To ensure sustainable use of natural resources (land, water and air)
- To increase productivity through delivery of quality inputs, credit and services
- To minimize harvest and post-harvest losses from farm to fork
- To promote nontraditional farming segments, practices and crops

5.2 Institutional Reforms

- To strengthen the regulatory framework and enabling legislations
- To ensure sustained investment in research/knowledge systems and outreach
- To promote productive employment of rural youth through skill development and off farm activities by promoting rural development and alternate income

5.3 Infrastructure

- To revamp/invest in marketing systems to become transparent, just and equitable
- To accelerate inter-provincial and regional/CPEC integration of the agriculture sector

6. Short Term Strategies

Priority 1: The low hanging fruit is to narrow the yield gap between the average and progressive farms. That will require working with the small land holders for the timely provision of inputs, services and credit alongwith guaranteed irrigation. The cost of production must be contained initially by input subsidy to be followed by productivity enhancement. The farmer will also respond to the market signals i.e. support price and public procurement initiatives. The current yield- gaps and stagnation must be treated separately. The yield gaps can be addressed by the delivery/adoption of available technology while the potential stagnation cannot be broken without investment in research to develop new precision tools and biological interventions. Reducing the yield gap by a half is an achievable target for wheat, rice and cotton by simply optimizing the plant population, enough to accelerate the GDP growth to 4%. And that will spare about 2 million Ha land for crop diversification. The implementation of 100 billion Kissan package could address this priority well.

Priority 2: Crop diversification is a challenge. The complication arises from the political economy of food security. We can broaden our choices by focusing on two crops i.e. wheat for food security and cotton for cash. The productivity enhancement of two crops can easily spare land for oil seeds, edible legumes, soybean, fodders, vegetables, coarse grains and orchards. There are good reasons to deemphasize rice and sugarcane due to water cost to the public. The 5th crop, corn in its present rotation system is also unsustainable. It must be rotated with a legume, preferably soybean for sustainability. The farmer's uptake of new crops will depend on the market signals or a public procurement policy. The government has to offer guaranteed minimum returns for the alternate crops. The diversification can also be promoted by crop zoning based on agro-ecological or agro-economic advantages and offering the incentives within the zones for commodities/products. A part of wheat procurement budget should be diverted to minor crops. Alternative to support price/public procurement and subsidies lies in efficiency and precision to gain higher productivity for reducing the unit cost of production systematically.

Priority 3: Climate change has thrown new challenges to sustain agricultural productivity. There has to be an elaborate plan to mitigate and adapt. The immediate option is to redefine crop zones on the basis of long term climate trends, soil and water analyses, available technologies, skills, markets and industrial demands. The province of Punjab can be divided into about 30 different crop zones and sub-zones. That will allow a precise decision mechanism for technology transfer and incentive packages.

Priority 4: There should be an emergency plan to curtail the postharvest losses by a half. That will need an investment in the training programs to promote value addition by product development and for market preparations along the value chain. Home science group should be introduced in the rural development and extension programs. The investment is also required in the transportation and storage infrastructure. The marketing system needs a long term improvement plan in terms of new markets, legislation and governance reforms. The Punjab rural roads programs must be amplified and the example of cattle markets should be replicated to create a new structure of grain and produce markets. CPEC routes should be marked for the establishment of new agro-processing zones and markets for exports to the regional markets.

7. Long Term Strategies

If implemented, the short term strategies can raise the agriculture sector growth above 4% for the near future. However, for long term sustainability of the system, agricultural growth and poverty alleviation, following are the proposed areas of public policy interventions:

7.1 Food Security:

The food security paradigm must shift from a supply side excess of staple items to integrated nutritional package where diversified dietary needs are met (zero hunger). Food safety issues like pesticide and antibiotic residues in the food, myco toxins, and malpractices associated with the food handling must be addressed. All food secure countries in the world have less emphasis on wheat and rice and more on corn, potato, soybean, vegetables, dairy and poultry. We need to work on diversification of food habits.

7.2 Legal Framework and Institutional Reforms:

Performance of agriculture is linked with the performance of many public and private sector institutions. That requires legislative and administrative measures, political will and social movements. There are federal and provincial legal frame works. With the 18th amendment, many a confusions have arisen which have diminished the role of already under performing federal institutions. The Seed Act, the Plant Breeders Act, the Pesticide Act, the Fertilizer Act, the Cooperative Act, the Market Act, National Biosafety Committee are obsoleted instruments.

7.3 Research System and Research Budgets:

The national (NARS) and international (IARS) agricultural research systems must be complimenting each other for a better agriculture (crops, livestock, irrigation, forest and fisheries). Unfortunately, our NARS are incompetent, full of overlaps and segmented (research, education and extension). There are federal institutions, provincial institutions and universities which have huge investment and strengths. The outcome has been very impressive over a long period of time, however, the current stagnation reflects serious malfunction in the near past. There are institutions which have lost their relevance after 18th amendment that includes

Pakistan Forest College in Peshawar, FSC&RD and to some extent the PARC. The mechanisms are needed for funding research well above the current level of 0.18% of agricultural share in the GDP. Autonomous commodity boards are an option to levy a research tax on the value added agricultural value chains.

7.4 Fiscal Policy:

Fiscal policies and taxation regimes are important determinants of regional trade and commerce. With the passage of time, support prices of various commodities have been withdrawn excepting wheat. Higher general sales tax rates on fertilizer and petroleum products and other taxes on inputs contribute to the escalating cost of production. In order to improve the profitability of various commodities, there is a need to move back to the support price system (selectively) and provision of inputs at subsidized rates (targeted). The ultimate aim should be progressive liberalization and deregulation to let the market forces work.

7.5 Credit and Cooperatives:

Agriculture is a business and every business requires investment. The farmer is always cash strapped and at the mercy of 'rent seekers'. He needs credit. Looking at the agricultural share in the GDP and corresponding formal credit availability, it is evident that there is a case of huge underinvestment. The vacuum is being filled from the non-formal sector at exorbitant costs to the farmer. Cooperatives used to play a significant role in the supply of credit and services. In Punjab, there are 136 branches of Punjab Cooperative Bank which are dysfunctional. We need to create Marketing and Services Cooperatives (default corporatization) to revive the supply of credit through these branches. That will require market reforms, investment in the improvement of supply chains, promotion of clusters and enablement for value addition. Revival of cooperatives can boost the productivity of small farmers in many ways. The development of CPEC offers an opportunity of SEZs (Special Economic Zones) which could be agro focused centers for value addition. That can support credit for entrepreneurship, SMEs and local employment opportunities. A credit task force of Bankers should be constituted to look after the needs.

7.6 Input Supply:

Seed, fertilizer, agrochemicals, and energy/machinery are the major inputs. The farmers who can better manage these elements, they are called progressive and they can harvest optimal yields. The progressive farmers are not necessarily the large owners. They can be landless contractors or small farmers. Generally, large farming operations end up having a better mix of input supply, hence better yields. The state has a role to play in ensuring timely supply and accessibility of inputs (unadulterated) to the farmer regardless of his ability to pay up front. Now, with ICTs becoming easily accessible, the state must enable the farmer with a 'decision support strategy'. Use of ICTs for R&D and dissemination of knowledge and crop/commodity advisories must be fully capitalized. The credit delivery and monitoring should be linked with the ICT

services. The precision agriculture has emerged as a tool for efficiency. The ICT strengths in Punjab are enough to take advantages of precision agriculture technologies.

7.7 Service provider:

This is an option to narrow the technology gap and to achieve the economies of scale by the small holders. The model has been successful in different parts of the world. The idea is to create a range of crop specific or region specific entrepreneurial setups with farm machinery and input supplies. That could be matched with credit availability when required. The incentivized farmer's cooperatives could be another option. The entrepreneurs be given loans and incentives to start their businesses (corporatization). The goal should be to elevate the productivity of underperforming small farms and to improve the gains of the progressive farmers. Use of Agricultural Drones is a hot topic of research. Crop monitoring, yield mapping and agrochemical spraying can be performed by manned and un-manned aerial vehicles.

7.8 Rural Development:

Agriculture and rural development go together. The rural infrastructure development (roads, school, health) and skill development need massive investment. There is room for social mobilization for collective action and dispute resolutions through community based organizations. Population welfare, gender mainstreaming and youth programs must be targeted for rural communities to raise their aspiration and love for agriculture. The agriculture and veterinary universities should be mandated to prefer students' intake from the rural schools.

8. Way Forward/Policy Commitments

1. Analyze public investment in agriculture sector, particularly post 18th amendment and institutionalize public investment priorities in agricultural infrastructure and marketing with a clear commitment of finances for a considerable time frame:
 - a. Roads-rural roads need many fold more investment than the current commitment
 - b. Storage and Markets-a major infrastructure expansion fund is needed with a clear plan for new markets and market towns where the old artias must be replaced with new faces and options to reduce the middleman influence.
 - c. Water-improvement of irrigation and drainage, on-farm water ponds with HEIS and rain water harvesting (not solar tube wells)
 - d. The urban sprawls must be restricted with the creation of alternate/new Market towns and industrial estates in the hinter lands and along the CPEC routes.
 - e. Credit and Subsidies-innovate institutional credit delivery and refocus subsidies.
 - f. Revamp institutional set up at the provincial level to integrate delivery of information and technology effectively (research, education and extension).

2. Legislate for missing laws and rewrite the obsoleted ones by setting up a committee of experts to review the existing laws and recommend amendments and new laws.
3. Irrigation system needs improvements from the dam up to the farm level:
 - a. Installation of remote water level sensing devices
 - b. Real time discharge data collection at barrages and other nodal points
 - c. Daily review of water supply at head and tail of irrigation system
 - d. Regulate the unrestricted pumping of ground water
 - e. Control water theft and empower PIDAs and WUAs
4. Revamp the marketing system on the analogy of cattle markets to get rid of 'Market Administrators' and cartels. That should be aimed at creating a transparent (Market information and intelligence) and competitive marketing structure.
5. Phase out of public procurement of wheat by creating a PPP model for storage (buffer) and distribution. Incentivize warehousing of major commodities and create commodity exchange. Minimize postharvest losses: Fix targets for reducing overall postharvest losses to the level of 25% for fresh produce and 8% for grains (a half of the present).
6. Incentivize crop diversification by providing a better marketing option or support price for the minor crops/oilseeds/pulses and low delta crops:
 - a. Ban rice cultivation before rain, promote/incentivize direct seeding of rice
 - b. Promote sunflower, canola and soybean by providing seed and support price
 - c. Promote vegetable crops by investing into tunnels and HEIS
 - d. Launch dedicated R&D for Peri-Urban agriculture
 - e. Promote alfalfa, sorghum, millets and other fodder crops
 - f. Expand breeding programs to promote minor crops
 - g. Establish a soybean center of excellence to create a new rotation with corn
 - h. Establish orchard zones along with respective value addition arrangements
7. Create a regional trade policy forum like NAFTA, EU, APAP with a special focus on CPEC:
 - a. Create a think tank of Pakistani and Chinese experts to develop a strategy for the establishment of agro processing zones
 - b. Develop new markets and cities along CPEC on the basis of regional needs/skill
 - c. Establish industrial zones along CPEC at less productive lands

8. Improvement of seed sector

- a. Facilitate and regulate the private sector in multiplication and distribution
- b. Develop a clearing house of breeding programs and ensure long term investment by the private sector by allowing DUS and truth-in-labelling criteria. Harmonize new federal enactments with the provincial system.
- c. Enforcement of biosafety rules and DNA barcoding tests of crops, standing at the farmer field and new varieties entering NUVT (National Uniformity Varietal Trial).
- d. Seed treatment with fungicides should be made compulsory for seed sales
- e. Effective quarantine measures during seed import
- f. Train manpower for improving informal seed sector to promote wheat seed replacement process

9. Balanced Use of Fertilizer

- a. Not only N and P but also K and micro nutrients be subsidized
- b. Site specific recommendations based on soil and water analysis
- c. Selection of proper source, method and time of application with improved techniques like foliar fertilization (N, K, Micro) and fertigation.
- d. Burning of crop residues (7-10 t ha⁻¹) in rice-wheat cropping system and similarly, in cotton and sugarcane should be banned and incorporated into soil.

10. Mechanization and Reverse engineering of farm machinery

- a. A crash program for meeting the mechanization gap (drills and deep ploughing)
- b. Duty free import of farm implements and promote reverse engineering
- c. Incentivize local manufacturing of farm equipment, irrigation accessories and food processing machinery
- d. Create a farm machinery zone along CPEC for Chinese farm machinery manufacturers.

11. Establishment of service centers/Rural Business Hubs (RBH) in small rural towns

- a. Mechanization needs to be met according to the crop clusters and industry needs
- b. Supply of inputs and credit could be combined with the mechanization services
- c. That could also act as marketing/trading hub
- d. The centers can also serve as information centers

- e. The fertilizer sales could be linked with soil and water analysis offered by RBH
 - f. Incentivize lease corporate models
12. Climate Change adaptations and Mitigation framework:
- a. Re-Establishment of Agro-ecological Zones / Agro-economic Zones
 - b. Adjustment in sowing dates and techniques
 - c. Cultivation of low delta crops
 - d. Restrict puddled rice and promote direct seeding of rice in rain belt
 - e. Alternating Wetting and Drying (AWD+) in rice
 - f. Development of heat tolerant crop varieties (wheat and cotton)
 - g. Investigate new pest and disease (invasive species) complexes emerging with the climate change
13. Invest in skills for value addition and for promotion of SMEs
- a. The rural youth needs to be trained for SME and service delivery options to create alternate income stream for the families (rural nonfarm sector)
 - b. Value addition training is the low hanging fruit to promote aspirations and create opportunities
 - c. CPEC shall demand new skills
 - d. Link micro finance and youth loans with skills and entrepreneurship
14. Gender mainstreaming by extending benefits of women development programs to the rural areas:
- a. Address inequality by developing women markets and investment in start ups
 - b. Promote machine picking of cotton
 - c. Bikes for rural girls after matriculation
 - d. Nutrition of girl child
 - e. Skill development for women labor force and awareness about their rights.
15. Address nutritional deficiencies in the population through a series of programs:
- a. Consider nutrition as a nexus with agriculture
 - b. Nutrition education campaigns: Add nutrition in the school curriculum
 - c. Future mothers and school lunch programs

- d. Targeted fortification of processed food products providing protein and deficient micronutrients
 - e. Outreach activities for product development and diet diversification
 - f. Promote healthy life style and sports (revival of rural sports)
16. School and university curriculum reviews:
- a. Inclusion of agriculture subjects in the school curriculum
 - b. Make rural development a compulsory subject for agriculture universities
 - c. Preference for students from rural schools
17. Extension and outreach:
- a. Promote entrepreneurship and aspirations in agriculture sector
 - b. Venture capital and training for future farmers and PPP projects
 - c. Launch specialized programs on high value crops, fruits and commodities
 - d. Launch regional programs on major pests i.e. fruit fly, pink boll worm, white fly, and disease vectors
 - e. Promote soil and water analysis based nutrient use (Ext. 2.0), soil health card
 - f. Launch residue management programs
 - g. Launch crop packages for diversification (alfalfa, oilseeds, pulses, soybean, sorghum, millet, vegetables) on the basis of agro-ecological zones
 - h. ICT enabled centers with the provision of extension, training of farmers (particularly women and youth).
 - i. Special programs for lead farmers and theme leaders (champions of change)
18. Prioritize agricultural research and introduce funding of commissioned research programs. The research should be internationally compatible (scholarship) on the one end and farmer focused on the other end with innovation as a high priority. Invest in commissioned research in following priority areas:
- a. Seed production and technology for fodders, vegetables, chickpea, and soybean.
 - b. Development of stress-tolerant germplasm for wheat and cotton (Bt issue) and invest in biotechnology
 - c. Invest into new and alternate crops like Quinoa, sorghum, guar, oil seeds
 - d. Special programs on dates, rangelands and orchards

- e. Pest management strategies for fruit flies, ticks, pink boll worm, white fly and vector borne diseases
- f. Control of tree dieback (mango and sheesham in particular) and citrus greening
- g. Ensuring and improving the health and nutritional value of food
- h. Mechanization of farm operations (land development to post-harvest) including technological adaptation to the Pakistan farm setting and precision farming
- i. Increasing viability of horticulture enterprises through zoning and cool chains owned by the marketing cooperatives.
- j. Use of Information and Communication Technology (ICT) in the transfer of agriculture and food systems knowledge and technology.
- k. Policy papers be sought on a number of important topics including: irrigation water pricing; marketing margins; livestock nutrition; regulatory regime in agriculture (seed certification and registration, biosafety, SPS compliance); blending of flour for improving nutrition and public procurement and storage of wheat.
- l. Commodity analyses: wheat, corn, rice, sugarcane, cotton, oil seeds, pulses, citrus, mango, dates, guava, potato, chilies, tomato, onion, carrot, melons, milk, meat, eggs, wool, hides, wood, honey.
- m. Center of excellence for Soybean research and development

9. Conclusion

1. Policy formulation is an evolving process. This is a farmer centric document to be treated as a baseline to establish a continuous review. There should be a 1-3 years plan written as a departmental operations manual with implementation plans. At present, the Agriculture Sector Development Framework of 2015 and a livestock policy paper are in place which must be rewritten by 2018. That can only be effective if position papers on issues and commodity analyses are written within the next six months.
2. Food security must include nutritional security. The political economy of food security must not compromise profitability of the farmer.
3. The immediate targets should be addressing the small farmers' productivity challenges by ensuring quality seed (plant population) machinery, balanced fertilizer, IPM and weed management. The public procurement of wheat should be phased out and the available resources should be used to incentivize crop diversification.

4. Canal water theft must be stopped. The HEIS must be evaluated and redesigned. Medium to long term plans should be devised for land and water resource management (fragmentation, on-farm water storage, rain water harvesting, water pricing).
5. The grain and produce markets are insufficient and imperfect. The infrastructure and legal frame work are needed to enhance the capacity and to promote transparent and competitive business systems, minimizing the role of middleman.
6. Investments should be made in skill development to reduce postharvest losses and to add value. The quality standards and WTO requirements and regional opportunities offered by CPEC must be addressed by becoming globally competitive. A comprehensive market reforms program is needed.
7. The investment in R&D should be linked with the institutional reforms for the integration of education, research and extension. Commodity research boards should be institutionalized. Establishment of two research centers, one each on policy, law and governance and soybean are highly recommended.
8. Long term research experiments be launched to model sustainability of the cropping systems.
9. Rural development must include infrastructure for farm to markets at a much bigger scale than the present. The rural life must be made attractive to arrest migration and by introducing women and youth development programs along with alternate income propositions (at Markaz level or the small town centers).