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AN ASSESSMENT INTO THE RISK FACTORS IN INTER-TEMPORAL SUSTAINABILITY OF CROPPING SECTOR: FINDINGS OF A SURVEY IN PAKISTAN

Abstract:

This paper aims to determine the Inter-Temporal situation of Pakistan's Agricultural sector while assessing the Risk factors in both, past and current time-periods using a Cross-Sectional setting. A lot of other previously published papers do not discuss the inter-temporal effects on sustainability; instead they talk about policy changes and using a secondary research. It also accounts for the role, involvement and the need for further involvement of government into this sector, taken on an ordinal scale as measure in econometric models. The paper also looks into the intent of subsistence to commercialized farming, accounting for all the factors affecting and or supporting them. Few of the main important questionnaire sections that aided in the write-up and model development are; Production, Incomes, Sales, Inputs and Food Reserves, use of technology in Operations and Government policies to Support Agriculture in Pakistan. Using advance econometric models, such as Tobit Regression model, thus, the conclusions are made alongside policy improvement suggestions, choices for risk aversion methods, diversification within this sector and techniques to empower Pakistan's agricultural sector. However, both the models indicate and point towards sustainability criteria, provided proper agricultural development policies are undertaken.

Keywords:

Industrialization, De-industrialization, Sustainable Development, Green Revolution, Structural Transformation, Export Led Growth, Government Intervention, Market Integration, Policy Uncertainty, Policy Risks, Tobit Regression and Risk Aversion Techniques.

PART I: INTRODUCTION

1.1 An Overview of Performance and Sustainability Conditions in Cropping Sector of Pakistan

Pakistan has an enormous natural resource potential, stretching its wings over a sufficient variety of ecological and climatic regions; for this reason, the country has immense potential for manufacturing all types of food supplies. Agriculture has a significant direct and an indirect role in triggering economic development. The significance of Pakistan's agricultural sector to the economy is by and large viewed in three main conducts. Firstly, it is a source food to consumers and inputs for local businesses, such as thread or fibres. Secondly, it provides for limited foreign exchange income and lastly, it is a source to market and advertisement for industrial goods.

Studies like (Mahmood Hasan Khan and Ijaz Nabi; Agricultural Policy Issues in Pakistan) discovered that around 15 to 16 most important crops have been occupying around 85 percent of the whole cropped area for around the last three decades. The lingering 15 percent of this area is assigned to the many minor crops such as orchards tobacco crops, and vegetables etc. The main crops are cotton (seed cotton), rice, sugarcane, wheat, and maize, potato etc.

Pakistan has gained remarkable agricultural expansion in the last few years. Even so this expansion is not sustainable because it has been obtained primarily through a discovery in regions of cultivated ground, instead of a rise in productivity[1]. Government intrusion, similar to public-sector harvest marketing, provision of rural financial services, price shifts and controls, and trading farm inputs has been fruitless. The intervention has aloof incentives for technological advancement, private sector participation efficiency improvements. Policies to control water-logging and salinity have not yet overturned the falling trend in irrigation and soil water quality.

Whereas agricultural growth has improved food poverty conditions in rural areas, it has not led to an extensive increase in incomes. It has benefited big landholders' as compared to small landholders and the landless. The increase in total income has not resulted in improved access to education services and health services for the less fortunate in the rural areas.

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[1] Productivity is an average measure of the efficiency of production.

1.2 An Overview of Policies and Reforms for Agriculture in Pakistan

The performance of agricultural sector has not been extra ordinary or stable over the last 35 years.The fifties was a time of stagnation, as shown in the table which was followed by the healthy expansion period of the Six-ties, but with noticeable slow-down in the early Seven-ties and a little revival in the delayed Seven-ties. Early eighties period (first 2 years) showed a healthy growth rate of around 4%.

These high growth rates do not summarize the growth performance of agricultural sector on the whole; there are several other important factors that we need to take into consideration. First of all, not all sectors or sub-sectors of agriculture have experienced smooth and sustained growth, that implies that there were some serious issues within the variety of crops over years and all these sectors were not well-coordinated. Second of all, studies reveal that not all expansion was because of an increase in output, but instead it was because of an improvement in efficiency and cost reductions. Lastly, the growth in Sixties was not stable over different agricultural regions of Pakistan or even within one particular region. The growth rates and outputs varied across regions, even in regions, with and without irrigation facilities. Even so much so that provinces with infrastructure and irrigation facilities were equally affected. More importantly, farm groups have also suffered equally, depending upon their area of land and ability to finance inputs for production.

2.1 An Overview of Risk Assessment and Risk Aversion Techniques in the Cropping Sector

One of the main terrorizations to Pakistan's agricultural system is floods. Ever since 2010, every year we hear and read about floods in one river or another. Floods are largely due to heavy rain falls, for they cause the rivers to flood, inundate the nearby areas and root great damage. Roads were underwater, houses were toppled down, bridges swept missing and countless people died in that flood. Nowadays every year, people are facing the same challenges; they lose their crops, their houses, their belongings, their preserved food items, their animals and livestock, and most importantly, their kids and families. They have nothing to feed on and no roof for shelter. So, they suffer and die every year and these situations are most pitiable. Every catastrophe has its end. Likewise, the floods do end but leave the people on the streets. Due to these floods diseases spread and people die in large

figures. The flood takes only hardly any hours to destroy, but it takes years to re-establish the flooded areas to back to its normal life.

The greatest answer of this problem is to plant trees-plantation[2]; trees like Eucalyptus and Mangroves are very supportive, they naturally protect us from floods, tidal waves and Tsunamis. We should plant them near rivers, dams and canals. In fact Eucalyptus has a lot of properties; it is a fast growing tree and a kind of innate insecticide. It is too called a thirsty tree, its roots extend deep underground and dry up all the water, so it is also used to drain marshes and swamps; and the mangrove tress also do the same.

By planting such trees we can get some power over floods. Dams are also supportive; in flood situations we can store excessive water in them, so we should to build more dams. There are many ways to resolve this issue.

2.2 Survey Design, Sampling Framework and Fieldwork

The data was collected using a questionnaire based survey consisting of 217 questions, divided on 18 detailed sections. There were 40 respondents. The sampling group consists of farms on Sheikhpura Road, Jaranwala, Bhai Pheru, Jalalpur Sharif, Kasur and Burki Farms and the data was collected surveying them. These villages were surveyed in order to portrait the big picture. The fieldwork/survey took 3 weeks in total for data collection. The field work was done personally and no other individuals were hired to carry it out. The sample consisted of farmers with financial statuses of; below poverty line, lower middle class, upper middle class and high income group to see the actual picture in this sector and to control for the problem of biasness. All the farms were surveyed between the hours of 9am to 5pm.

Majority of the respondents were males, because male to female ratio did not matter in this research. All of the responses were collected through face-to-face interactions. The sampling of questionnaires and fieldwork was carefully designed to target farmers only.

For the spread of Primary Production Risks (PPR)[3] in the main model, $PPR_{(T)}$[4] was subtracted by the $PPR_{(T-1)}$[5] and then divided by 2. For the Y-variable in the main model, Production/acre $(T-T_{-1})$ was calculated by

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[2] Refers to the Man-made forests.
[3] Primary Production Risks to farms include "Production, Marketing, Financial, Institutional and Human" risks.
[4] $PPR_{(T)}$: Primary Production Risks in the current time period.
[5] $PPR_{(T-1)}$: Primary Production Risks 10 years ago.

subtracting production/acre in the current time period with production/acre 10 years from now.

2.3 Specification of Competing Models of Sustainability in Subsistence Farming; Econometric Modeling Choices

Competing model was developed using Tobit Regression technique, to measure sustainability in subsistence farming as to of commercialized farming. With independent variable as "Reliance on Farm Income" and dependent variables as "Acres Owned, Alternate Source of Income, Cash flow Situation, Risk Averse/Neutral/Taker, Custom Farming, Role of Government, Road Network Availability to Nearest Market".

Hypothesis[6]:

The study is aimed to test the following hypothesis; is there any inter-temporal positive/negative effect on farms production/acre keeping in view the primary production risk spread (over the last 10 years), role of government and their involvement and effectiveness over time and whether the farmers are diversifying their products or not. And another hypothesis will test the intent of commercialized and subsistence farming by regressing their reliance on farm incomes against the amount of land holdings (acres of land owned), alternative sources of incomes, cash-flow situation, whether the individual is a risk averse, neutral or a taker.

3.1 Profile of Survey Respondents: Key Observations

The data was collected using a questionnaire based survey throughout different cropping areas in Punjab. Farms on Sheikhpura Road, Jaranwala, Bhai Pheru, Jalalpur Sharif, Kasur and Burki Farms were surveyed instead of just surveying a single one and farms lying in lower, middle and upper income group were surveyed to eliminate the problem of biasness. A minimum of 4 respondents were taken from each of these farms. There were 40 respondents in total and majority of them were males, the male to female ratio does not really matter in this research since we are taking the whole Agricultural Sector into account. Moreover, because Punjab is the main hub for agricultural sector in Pakistan and holds majority of the large farmers, its areas were mainly targeted for research purposes. Furthermore, majority of the respondents were into commercialized farming instead of subsistence farming which somewhat

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[6] Hypothesis is a proposed explanation for a phenomenon.

gave in the view of preferences to chose commercialized over subsistence farming, just by looking at the data. The farmers were reluctant in providing with their contact details, and most of them claimed not to have an email account or a permanent phone number. And all of the farm owners that were surveyed during the research had a history of more than 20 – 30 years in the cropping sector.

3.2 Estimates of Competing Models and Model Consolidation Tests
Table: Final Estimated Regression Results in Tabular Form

(Specific questions used in modeling are stated in Appendix B)

Regressors:	Regressands:	
	Tobit Regression Model[7] with Production/acre spread: T-(T-1)/2 [question #28 (T) and question #29 (T-1)]	Tobit Regression Model with Reliance on Farm Income (question #44)
Primary Production Risk Spread [t-(t-1)/2] [question #51 (t) and question #52 (t-1)] (scale 1-5)	-12.06656 (-0.43)	-
Product Diversification (question #71) (scale '0=Yes, 1=No')	117.7208** (2.43)	-
Outreach of Financial Institutions (question #96) (scale '1=Bad, 2=Satisfactory, 3=Good')	54.74324* (1.73)	-
Role of Government (question #217) (scale 1-5, '1=Worst, 5=Best')	7.536764 (0.29)	.035274** (2.53)
Acres Owned (question #10)	-	.0054852*** (6.38)
Alternate Source of Income (question #43) (scale '0=Yes, 1=No')	-	.2485439*** (10.64)
Cash flow Situation (question #90) (scale '0=Good, 1=Bad')	-	.2606684*** (8.44)
Risk Averse/Neutral/Taker farmers (question #62) (scale '1=Risk-averse, 2=Risk-neutral, 3=Risk-taker')	-	.0414673* (1.84)
Custom Farming (question #77) (scale '0=Yes, 1=No')	-	.2663319*** (5.56)
Road Network Availability to Nearest Market (question #184) (scale '0=Yes, 1=No')	-	.1109845* (1.77)
Goodness of Fit Estimates		

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[7] Tobit model is a statistical model developed by James Tobin (1958), to describe the relationship between a non-negative dependent variable and an independent variable.

R^2	-	-
Adjusted R^2	-	-
Prob > F	-	-
F statistic	-	-
Log likelihood	-240.21583	48.513563
Model Post-Estimation Tests		
Breusch-Pagan / Cook-Weisberg Test for Heteroskedasticity	-	-
White's Test for H_0 Homoskedasticity	-	-
Note: Below the coefficient value, in ( ) parentheses, we report t-statistic. * denotes significance at 10 % level, ** denotes significance at 5 % level while *** denotes significance at 1 % level.		

Primary Model:

Production/acre [T-(T-1)] = -12.06656*Primary Production Risk Spread + 117.7208*Product Diversification + 54.74324*Outreach of Financial Institutions + 7.536764*Role of Government + 110.7496*/sigma.

The results above show all the variables to be significant except Primary Production Risk Spread and Role of Government. This can be because we are only accounting for 40 respondents in our research and as we add more respondents, this problem will be solved. Moreover, all the variables have a positive relationship with the 'Y' variable except Primary Production Risk Spread, because production risks always have a negative relation with production.

Competing Model:

Reliance on Farm Income = .0054852*Acres Owned + .2485439*Alternate Source of Income + .2606684*Cash flow Situation + .0414673*Risk Averse/Neutral/Taker + .2663319*Custom Farming + .035274*Role of Government + .1109845*Road Network Availability to Nearest Market.

The estimates show all variables to be significant at the respective significance levels as shown in the table above. The competing model is estimated using Tobit Regression technique. All the variables stated above have a positive significant relation with the Y-variable (Reliance on Farm Income). Cash flow Situation on a farm, Alternate Source of Income and Indulgence of a farmer in Custom Farming tends to affect Y-variable the most, having large relationship coefficients.

Because the constant terms were suppressed in the models above, the values for R^2, Adjusted R^2, Prob>F and F-statistics are not accounted for, in the table above. Moreover, the 'X-variable' – Role of Government was

accounted for in both of the regressions above, because it is one of the main variables that help in determining the sustainability criteria.

Furthermore, since it is a cross-sectional research and not a time-series one, Heteroskedasticity as well as Homoskedasticity tests did not run for the models in the table above. These tests are generally for time-series models like, OLS, logit, Ologit/probit.

3.3 Analysis of Findings

Estimates of the main model show a negative relationship of 'Y-variable' – Production/acre $(T-T_{-1})$ with 'X-variable' – Primary Production Risk Spread, keeping the format of coding in mind, the trend in the primary production risks have changed significantly. Currently the farms are majorly affected by either bad weather or lack of access of inputs, while farms 10 years ago were harmed by either pest problems or crop diseases. Moreover, Product Diversification and Outreach of Financial Institutions have positively affected the dependent variable – Production/acre $(T-T_{-1})$ overtime. So, from these findings we can conclude that Pakistan can achieve sustainably agricultural development if provided with the right mix of Government Policies and its Role, if farmers diversify their product line, if outreach of financial institutions is further improved and most importantly, if we control for different production risks to farms.

While, in the competing model, 'Y-variable' – Reliance on Farm Income was not much affected by the size of the land holding (acres owned), whether the farmer was a Risk Averse/Neutral/Taker individual or even whether the government played its due role in the market or not, these 'X-variables' do not significantly affect the dependent variable. But Reliance on Farm Income did comprise of greater chunks of custom farming[8], Cash Flow Situation (good or bad) of a farm, whether the farmers were involved in some other than their farms' earnings (Alternate Source of Income), and as well as the Road Network Availability to the Nearest Wholesale Market. The regression results show that all these variables positively affect the Reliance on Farm Income, which in totally covers and support the idea of commercialized farming over subsistence farming.

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[8] An alternate to leasing farm-land is custom farming. Custom farmer agrees to work on the farm owner's land in return for a fixed charge of fee or return, but even then the owner is responsible for providing for all the inputs.

3.3.1 Impact of Policy Uncertainty and Risk upon Sustainability in Cropping Sector

An unplanned or inappropriate agricultural policy can have disastrous results, and no Pakistani would want that. The main model also shows that government intervention has a great impact on Production/acre and hence, the sustainability of the cropping sector. Any uncertain policy could end up worsening the situation of Pakistan's agricultural sector. Therefore, it should be noted that proper well-thought-out development policies should be incorporated in order to have the desired results which will thus, ensure the sustainability in cropping sector. Policies such as, heavy taxation and removal of subsidies or support prices can very well harm the yield and fruitfulness of this sector as well.

3.3.2 Environmental Hazards and Sustainability in the Cropping Sector

Climatic change can reduce crop yields, not only because of floods but also as a result of changes in temperatures, which in turn will definitely affect the livelihood of majority of farmers in Pakistan. But agriculture division of Pakistan has still the potential to thrust the economy upwards. Pakistan is in front of most dangerous risks connected to the ever changing climate and environment that cause glaciers to melt, sea level to rise, foods, which ultimately leading to higher average temperatures and longer droughts. The climate shifts are a serious problem in the region. The agricultural scientists, policy makers and environmental experts should expand a complete economic policy for the agriculture sector. Speedy changes in the agriculture sector are happing at the national and international level which has indirect and direct implications for local communities. Numerous factors like economic catastrophe, trade distortions, changing cultivations, technological advances and natural resource degradation are disturbing agricultural efficiency and welfare of the rural community. Synchronized efforts are required to undertake the problem of climatic changes at grass-root level. All people should contribute something which is good for everyone else.

Deforestation is the subsequent most important donor of carbon emissions worldwide after the blazing of fossil fuels, and after seas, forests are the second largest depot of carbon. Studies revealed that standard worldwide temperature has increased around 1 degree centigrade over the time of last 100 years, mainly due to burning of fossil fuels and cutting down of forests. Universal temperature is likely to raise more involving around 1.4 degrees

centigrade to 5.8 degree centigrade by year 2100 and to keep on increasing even after, as per a article in (nation.com.pk). Global rise in temperatures is an explicit reality which causes general problems like quicker glacier melting, rise in sea levels, problems with availability of fresh water, greater than before floods and droughts, more recurrent and extreme forest fires, even more severe storms, extra-intense high temperature periods, agricultural disturbance, the increase in biodiversity failure and contagious diseases. A combined dependability to battle such issues is essential, mainly because it leads to fulfilling the sustainability condition. As discussed in the study done by V. Ratna Reddy (Environment and Sustainable Agricultural Development: Conflicts and Contradictions), awareness and attitudes of individuals at the grass root level, about the environment and sustainability matter the most, if we regard for inter-generational justice)

3.3.3 Experimental Econometrics Modeling and other Determinants of Sustainability in Cropping Sector

The primary model as well as the competing model used in this research is Tobit model, to explain the relationship between the non negative variable 'Y' and an independent variable 'X' and its relationship parameter 'β' is determined by regressing 'X' on 'Y'.

The determinants of sustainability used in the primary model are the spread of primary production risks, product diversification by farmers, outreach of financial institutions and the role of government. These four independent variables concentrate on the sustainability factor and they are regressed on productivity per acre in current time period minus the productivity per acre 10 years ago ($T-T_1$).

'T' is the current time period and 'T_1' is the time period 10 years ago.

3.4 Policy Choices for Risk Aversion and Diversification

Keeping in view the composition of Risk trends in the current time period 'T', weather risks and the problem of lack of inputs should be targeted and solved by a comprehensive policy by the government. Moreover, the previous studies also reveal that floods cause destructions. To target such problems, a policy should be made where government builds several dams throughout the canals and rivers in Pakistan. This will ensure two things, protection against flood water and water reservoir for the farms, which would a blessing for farmers in summers and in drought seasons.

3.5 Conclusion and Policy Recommendations

The price policy is extremely fragile. "In Punjab the sugar cane is sold for 200/Rs. per 40 kg[9]" - as per a article in (pakissan.com). Big industrialists buy and then store sugar cane in their storages for latter use. When Brazil purchased sugarcane from the world market, it's prices increased, the expected boost in demand gave way to Pakistani producers to sell their output at a higher price, which resulted in majority of the crop being exported and consequential in Pakistan facing an extreme sugar shortages. Due to which, Pakistan had to import sugar from the international market, because of which the prices in the local market went even higher.

In order to get rid of our agricultural problems, all issues should be targeted upon carefully and dealt with some solid policy actions. Initially, feudalism[10] should be abolished and lands should be redistributed. It will not just help in improving the efficiency of the farmers but will also assist to increase the output and per acre yield on farms. And to further help poor farmers and government at the same time, taxes should be applied to the agricultural sector but not without setting a base limit for it. Otherwise, it would not be a 'win-win' for poor farmers and or the government.

Due to the deficiency of strong and active leadership farmers are backward and not coordinated with the changing trends as well as market conditions and requirements. The only communication resources in rural areas are radios or T.Vs. The need to air the programs and run ads linked to the new and improved agricultural techniques and scientific methods can be extremely beneficial. Moreover, if these programs telecast in regional or local languages, like Urdu, Punjabi, Sindhi, Balochi, it can further add to the facility. Additionally, training sessions should be set by the government to help plan the farmers with the most up-to-date farming methods and techniques in practice. The communication gap between straightforward and well-skilled-expert farmers has not been coupled. And because the skilled workforce is not willing to go and work in the rural areas, information on their accessibility is not provided.

Even though authorities like Federal Seed Registration and Federal Seed Certification are publicly standardized, they should also take responsible steps in authorizing seeds. They have permitted 36 fresh new kinds of seeds,

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[9] Kilograms
[10] Dominant social-system, where in return for protection, peasants are obligated to work for the elite class, provide them with the share of their produce, homage and labor services.

already. These are usually cotton seeds, and because they are not tested against the weather conditions and our soil, they are not a success. To further worsen the situation off, global seed developers are sending out such untested seeds to developing countries like Pakistan at a cheaper rate for poor farmers to buy.

An altogether innovative Agricultural policy should be put forward in which following points should be emphasized upon; to help develop Pakistan as a growing agrarian country:

- Development of small-scale farmers needs to be targeted. Main issues of these farmers should be sorted out.
- Provision and availability of most recent insecticides, machinery, fertilizers and pesticides to such farmers must be made certain at a controlled price.
- Buyer-pleasant policy should be developed, e.g. farmers should be provided with easily available loan from banks.
- Efficiency improvement program should be developed to regulate as well as to maintain prices.
- Agricultural-zones must be developed. Seeing that Multan is known for good quality mangoes and citrus fruit crops, it can be developed as a mango and citrus district in the course of which these products can be exported. Businesses need to take part in this situation.
- Commercial farming like giving agriculture lands to Nestle, Mitchells and other international business companies can be a source of long-term income to farmers and it will bring profits and foreign exchange and it can help those who have a hefty area of productive land but fail to administer it. Moreover, these companies will employ local workforce, and hence alongside induction of new agrarian machinery in the country, new farming techniques will also be transferred onto the locals.
- Excess fruits and vegetables should be exported. A policy should be established to develop agro-export processing zone for vegetables, fruits and flowers. It is bound to boost commercialized farming in the country.
- Most up-to-date equipments and machineries should be provided to farmers at subsidized rates to assist in advancing their per acre yield. Otherwise this facility could be on trouble-free installments so the farmers can evade the stress and trouble of loans.

Irrigation structure of Pakistan requires upgrading, as around 67% of the ground is irrigated via canals. Use of up to date methods of irrigation can help sort out the issues of irrigation. These include sprinkle-irrigation and drip-irrigation methods. As a result of these improvement techniques the farmers can save a large chunk sum of money which they compensate for irrigation via tractors and tube wells. That same saved money can then be used to buy capital stock or improve their standards of living.

But for some inflexibility and non-seriousness; Pakistan-India water issues may not be resolved. Therefore, a mass-movement must be called for to force India to give up its claim on Pakistan's water. Also, the government must go on board on an urgent program to build small dams throughout the country, which will play an important role in improving the land's fruitfulness, in that way, increasing the total yield. While India is focused on building small dams throughout their areas we are not taking any solid actions against it. Rivers like Chenab, Jhelum, and Indus rivers are ideal for dams. These dams will not just improve the storage facilities but will also decrease the usage of tube-well water, which floods the land and causes salinity. Therefore, until appropriate consideration and remedial policies are not implemented by both, the private as well as the public sector, our agricultural sector will not raise above all these problems.

Even after all these problems that Pakistan is facing now, I believe that agriculture is the golden goose that can eat away the pest of poverty and keep laying gold eggs for the industry and the country to grow. Let's cherish the golden goose, instead of killing her.

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