Potential of the Agricultural Value Chain Improvement in Pakistan

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This paper analyzes the status of Pakistan's agriculture in the world and quantifies the potential of improving productivity and quality of value chain at its different nodes. A great potential of expansion in the value chain of large number of agricultural commodities produced in Pakistan are observed. Just bringing the average crop yield levels at par to the world average yield can generate over US$11 billion additional revenues to the producers. Despite lower yield, majority of commodities have lower prices compared to the world average prices at the farmgate. However, the country lost its comparative advantage as its export-output ratios (EOR) and export prices are lower than the world average for a large number of commodities. Similarly the quality of the produce in domestic market is observed to be low. If Pakistan can improve its EOR and export prices to the world average levels and enhance the quality of 10% its agriculture output in domestic market to the average export quality, it can generate US$8.8 to various stakeholders in the value chain. Cluster-based development approach is suggested to harness the potential in agricultural value chain. Various measures are suggested to improve productivity and quality of agricultural value chain in Pakistan.

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1. Introduction

In the rising globalization scenario (von Braun and Díaz-Bonilla 2008), increasing competitiveness has becoming a major issue in economics and a key objective amongst policy-makers (Martin and Sunley 2001). To attain competitiveness in a sector, it must be as or more efficient as the world is throughout its value chain starting from production, value addition, trade, and marketing. This is particularly true for the agriculture sector in Pakistan where its value chain is spread over a large number of stakeholders. This has created challenges of improving efficiency, at least to the world averages or better, in production which requires supply of safe and quality foods at low cost as well as in processing, trade and marketing to satisfy consumers increasing demand for standardized, value-added, and certified products.

Many analysts of the Pakistan's agriculture sector believe that the country is punching below its weight as far as its productivity and agricultural export performance is concerned. Specifically it is often argued that Pakistan has a comparative advantage in a number of agricultural commodities but fails to exploit this advantage to its fullest potential in overseas markets (Riaz and Jansen, 2012). Several studies have attempted to analyze the comparative advantage for Pakistan's agricultural exports at the sector or individual commodity level (e.g., Akhtar et al., 2009) for Pakistan's fruit exports, Samaratunga et al. (2007) and CARIS (2008) for a broad categories of agricultural products, Riaz (2009) and Riaz and Jansen (2012) for a wide range of agricultural products. These studies have estimated comparative advantage by considering efficiency of the whole value chain of the sector or an individual commodity, but fall short of analyzing the potentials at various nodes of the value chain thus have limited use for specific investment and policy intervention purposes.

This study fills this void and demonstrates that new insights can be gained by taking the analysis to various nodes of the value chain. The main purpose of this study is to evaluate the status of Pakistan's agriculture with respect to the world agriculture and measure the potential of individual commodities as well as of the whole agriculture sector by comparing the world level average input use efficiencies and prices at various nodes of the value chain. The analysis can be helpful for the public and private stakeholders to make informed investment and policy intervention decisions at appropriate value chain nodes of agriculture commodities.

The section after this explains the theoretical framework and data used in this analysis followed section 3 on methodology that explains the estimation procedure to quantify the potential in Pakistan's agriculture. Section 4 explains the results and Section 5 summarizes the results, suggest development framework to harness the potential, and makes recommendation for future development work.

2. Analytical Framework and Data

The schematic chart to quantify the potential for value chain development in Pakistan's agriculture is shown in Figure 1. Two main sources of value chain development of individual agricultural commodities commercially grown in Pakistan are identified in this study. These are: i) expansion in production through improvement in yield to the world average-yield level, and ii) improvement in quality to the world average quality levels by taking world prices as a measure of quality. The improvement in yields of

various crops will generate additional production which can go into three directions: i) expansion in export, ii) import substitution, and iii) domestic market.

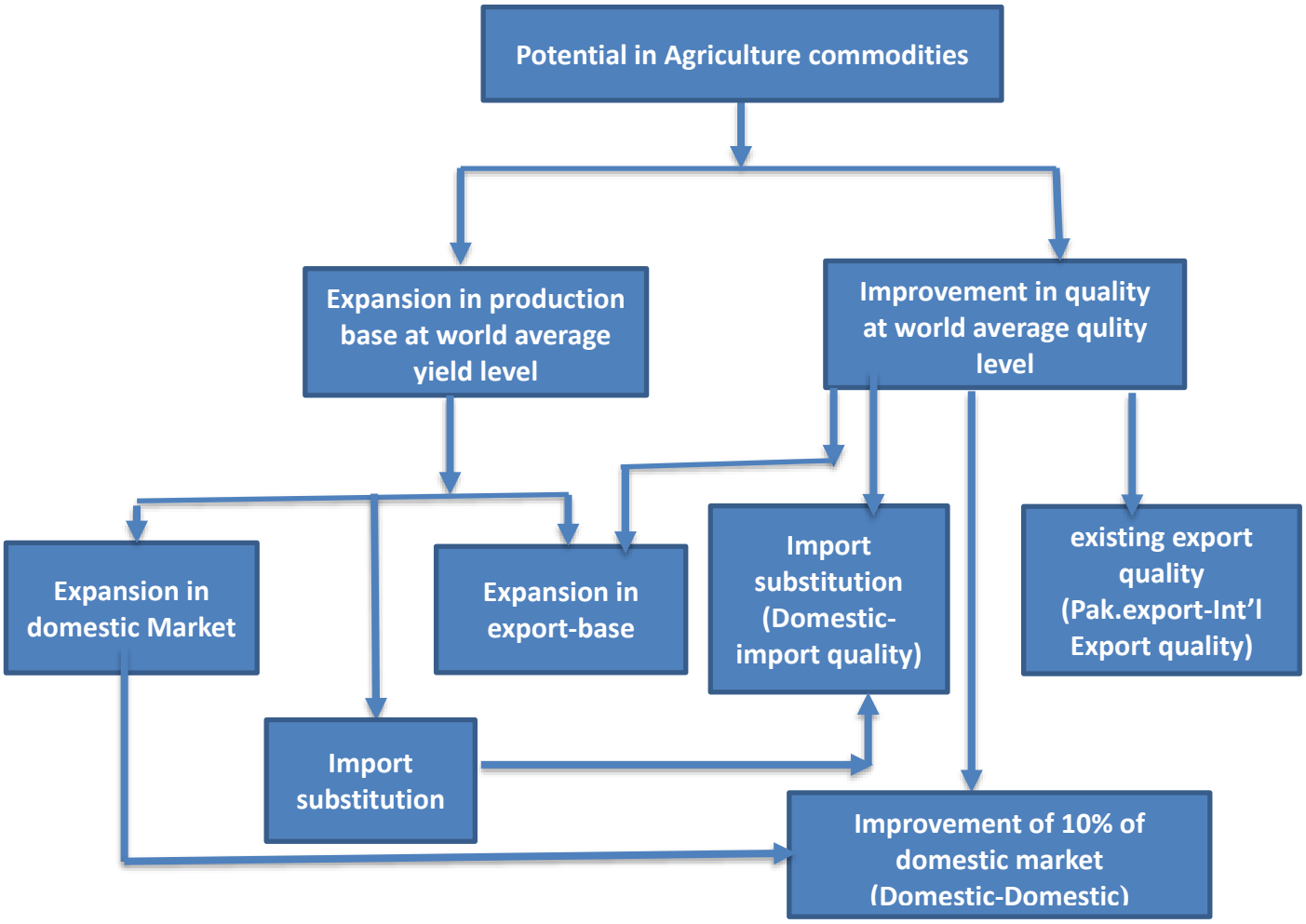

Figure 1. Schematic chart of identifying potential for cluster development in Pakistan's agriculture

Improvement in quality can be attempted at four points of the value chain: i) where expansion in domestic production goes to export; ii) where expansion in domestic production goes to import substitution, iii) where Pakistani export fetches lower than the world average prices, and iv) ten percent of the domestic production, both original and expanded production destined to domestic market after export expansion and import substitution.

The above framework is developed in a manner to minimize the disturbance in domestic market so that domestic wholesale prices will not change with the expansion in domestic production or improvement in the quality of ten percent domestic production. It is assumed that increased in yield to the world average level will not change the existing cropping pattern in the country so that existing production pattern will not change. Moreover, it is assumed that Pakistan is small player in international market, so expansion in Pakistani export or its quality will not disturb the international market. Estimating the

Pakistan's cluster development potential by bringing the country at the world average yield, export, and quality levels is only the minimum that Pakistan should attempt in the first phase of its development. Of course, in the later stage the country can go to the higher levels.

The data on area, production quantity, production value, export and import quantities, and value of export and import of all agricultural commodities commercially grown in Pakistan during the year 2013 and comparable data for the same commodities at world level were obtained from FAOSTAT website of the Food and Agricultural Organization (FAO). In case any such data is missing, it was obtained from the Agricultural Statistics of Pakistan, Pakistan Economic Survey, and Punjab Agricultural Information Services (AMIS) websites. Only those commodities are considered commercial agricultural commodities in Pakistan for which all the above data are available from any of the above source.

3. Methodology

Pakistan's place in international agriculture is evaluated by estimating various ratios, like Pakistan's share (in percentage) in world's population versus its share in arable land, land equipped with irrigation, agriculture production, and export, total number commodities commercially grow, exported, and imported, and relative value of EOR.

The first potential of the value chain is estimated at the farm-level by comparing the average yield of different crops in the world and Pakistan, assuming that the farmers in the whole world, on average, may be facing similar constraints with respect to the access to markets and quality of resources engaged in agriculture production.[1] The expansion in production, estimated as the difference in the world average and Pakistani yields multiplied by the current acreage of the crop, evaluated at the farmgate prices indicates the minimum potential of the crop that Pakistan should attempt to attain in its first stage of its agriculture development.

As discussed above, the expansion in production (as above) can go into three directions as follows: i) expansion in export estimated as the difference in average EOR multiplied by the total production of the crop (although it is also limited to the extent expansion in domestic production can allow), ii) import substitution constrained by the availability of surplus from the expansion in domestic production, and iii) expansion in domestic market estimated as the residual of the expansion in production after allocation for export expansion or import substation. The expanded production in all three directions is initially evaluated at the farmgate prices within the country as initially no improvement in quality is assumed in evaluating the expanded production going in various directions.

The second potential is estimated at the international level by taking the difference in world and Pakistani EOR and multiplying it with the expanded production (as above) evaluated at the existing Pakistan's export prices to get the potential of expanding export to the world EOR level.

[1] Sometime average yields in a country are compared with the yield levels on progressive farmers' fields or on experiment fields. This sets too high criteria for average farmers because progressive farmers or experiment fields are operated under optimal conditions of resource quality and access to input and output markets and service delivery system.

The third potential is also estimated at international level by comparing export prices that Pakistani traders earn in export market versus international world average export prices to enable Pakistani produces, after value addition if any (although still remain primary agricultural produce), earn at least the world average prices. The gap multiplied by the current Pakistan export gives the improvement in the value chain of existing export. In addition, the expanded production for export (as above) evaluated at the difference in world export price and 20% higher of farmgate price will give the potential of improving the value chain of the additional export level. Summing these two will give the total potential of improving the value chain at the export level.

The fourth potential is estimated by taking the difference in the import and farmgate prices. The difference in import price and Farmgate price, after adding 20% farmgate to retail margin, indicates that the domestically produced commodity has some quality problem. The import substitution, if available from the expansion in domestic production (as above), evaluated at the difference in the price of imported commodity and 20% higher of farmgate price gives the potential in domestic production used in import substitution.

Several studies have shown poor food quality supplied in the domestic market, like for example heavy metal contamination in vegetables (Ahmad, et l., 2012), raw meat (Ahmad 2016), and poultry meat (Imran, Hamid and Amjad 2015) and high aflatoxin level in milk and milk products (Iqbal, and Asi 2013). Poor quality food in the domestic markets has reduced its competitiveness in the international market. The fifth potential in the value chain of agricultural commodities identified in this study lies in improving the quality of the domestic market. It is assumed that the quality of 10% of the domestic production (current and expanded as above) can be raised to the average international export quality. Thus the difference in the international export prices and farmgate prices (after adding 20% margin to bring it retail level) and multiplied by the 10% of the domestic and expanded production of each commodity will give the potential of improving the quality of domestically marketed output in the first phase.

The first potential is considered as expansion in the value chain while the last four potentials are aggregated as the improvement in the quality of value chain of individual agricultural commodities. All potentials of individual commodities are aggregated at two levels: i) by crop and livestock sectors, and ii) exportable and importable items.[2]

So far, potential of improving value chain in terms of total revenue by sector and trade groups were compared. This relative potential of commodity mainly reflects the relative size of these groups. Assuming that the cost to achieve these potentials will be proportionate to the original size of the commodity, Net Potential of Improvement (NPI) in the value chain was estimated by dividing the total value of the potential with the original production value at three stages: i) expanded production at the farmgate, ii) improvement in quality of the whole value chain, and iii) total improvement of the whole value chain. Although the net potentials are not the percentage rate of return in true sense, it helps to rank agricultural sector sectors and commodities.

[2] All commodities have positive trade surplus is considered exportable and those have negative trade surplus will be included in importable group.

The various parameters estimated to analyze the Pakistan's space in international agriculture and quantify the potential of improvement at identified nodes of the values chain are explained in Table 1.

Table 1. Estimation of the parameter values used in the quantification of the potential of cluster development in Pakistan's agriculture

No.	Variables	Source of data	Estimation of the parameter
1	i. Total production of ith crop in the world (Q_{iw}) and Pakistan (P_{ip}). ii. Total acreage of ith crop in the world (A_{iw}) and Pakistan (A_{ip}) iii. Yield (t/ha) of ith crop for the World (Y_{iw}) = Q_{iw}/A_{iw} and (Y_{ip}) = Q_{ip}/A_{ip} for Pakistan.	i. FAOSTAT, if not in FAOSTAT, Agricultural statistics of Pakistan (ASP) ii. FAOSTAT, if not in FAOSTAT, then from ASP.	i. Potential of expanding production at farmgate ($PtEP_i$)= (Y_{iw}- Y_{ip})*A_{ip} when $Y_{iw}>Y_{ip}$, otherwise $PtEP_i$ =0.
2	i. Total value of ith crop production at farmgate for the world (VQ_{iw}) and for Pakistan (VQ_{ip}) ii. Farmgate average prices (US$/t) for the World ($FPr_{iw}$) = VQ_{iw} / Q_{iw} and for Pakistan (FPr_{ip}).= VQ_{ip} / Q_{ip}	FAOSTAT, if not available in FAOSTAT then farmgate prices obtained from Punjab Agricultural Marketing Information Services (PAMIS) which were multiplied by the quantity of the ith commodity produced (QP_{ip})	i. Pakistan's share in world production (PSWP)= $\sum_{i=1}^{43} \mathrm{VQiw}/\ \mathrm{VQip} * 100.$ ii. Pakistan's competitive edge in ith crop in the domestic market at the farmgate level ($CEgF_{ip}$) = (FPr_{iw}-FPr_{ip}) when $FPr_{iw}>FPr_{ip}$, otherwise $CEgF_{ip}$=0. Pakistan should be exporting the ith crop when $CEgF_{ip}>0$, and importing otherwise.
3	i. Export quantity of the world (QE_{iw}) and Pakistan (QE_{ip}) ii. Export value of the ith crop of the world (VE_{iw}) and Pakistan (VE_{ip}). iii. Export average prices (US$/t) for the World ($_{EPriw}$) =$VE_{iw}$ / QE_{iw} and Pakistan (EPr_{ip})=VE_{ip} / QE_{ip}	i. FAOSTAT (trade data) ii. FAOSTAT (trade data)	i. Pakistan's share in world export value (PSWE) = $\sum_{i=1}^{43} \mathrm{VPiw}/\ \mathrm{VPip} * 100.$ ii. Pakistan's potential in improving export quality of ith exportable crop at export level ($PtIEQ_{ip}$) = (EPr_{iw}-EPr_{ip})*QE_{ip} when $EPr_{iw}>EPr_{ip}$, otherwise $PtIEQ_{ip}$=0.
4	Percentage share of export in total production in the World ($PgPE_{iw}$) = VP_{iw} / VE_{iw} and Pakistan ($PgPE_{ip}$).= VP_{ip} / VE_{ip}	-	Value of Pakistan's potential of expanding its export ($PtExE_{ip}$) = ($PgPE_{iw}$-$PgPE_{ip}$)*(Q_{ip}+$PtEP_{ip}$)*EPr_{iw} provided $PgPE_{iw}>PgPE_{ip}$, otherwise $PtEE_{ip}$=0. Moreover, if $PtExE_{ip}$ < $PtExP_{ip}$, otherwise then $PtExE_{ip}$= $PtExP_{ip}$
5	Quantity of additional production going for import substitution	-	Import substitution (IS_{ip})= QI_{ip} provided $IS_{ip}<PtExP_{ip}$, otherwise IS_{ip}= $PtExP_{ip}$

6	i. Import quantity of the world (QI_{iw}) and Pakistan (QI_{ip}). ii. Import value of the ith crop of the world (VI_{iw}) and Pakistan (VI_{ip}). iii. Import average prices (US$/t) for the World ($IPr_{iw}$) =$VI_{iw}$ / QI_{iw} and Pakistan (IPr_{ip})=. VI_{ip} / QI_{ip}	iii. FAOSTAT (trade data) iv. FAOSTAT (trade data)	The maximum potential of improving the quality of domestically produced importable product = ($PtImQI_{ip}$) = (IPr_{iw}-1.2*FPr_{ip})*IS_{ip} when IPr_{iw}>IPr_{ip}, otherwise $PtImQI_{ip}$=0.
7	Flow of expanded production in 1 above $PExP_{ip}$		Expansion in export = $PtExE_{ip}$ or Import substitution = IS_{ip} Expansion in domestic market ($ExDM_{ip}$)= $PExP_{ip}$- $PExE_{ip}$ or $PExP_{ip}$ - IS_{ip}
8	Improvement in domestic market quality	-	Value of improvement in domestic quality ($VImDQ_{ip}$)= 0.1*($ExDM_{ip}$ + $PtExP_{ip}$)*(EPr_{iw}-1.2*FPr_{iw}). This improvement in quality is summed up separately for the crop and livestock sector as well as for the importable and exportable.

4. Results and Discussion

4.1. Pakistan's position in World agriculture

While Pakistan's share in world population is 2.8%, it owns 2.2% of the world arable land which can be used for cultivation. In 2013 FAO statistics, out of 223 commodities for which crop production are reported, 190 commodities are commercially produced, i.e., they have production value data as well (Table 2). In Pakistan, however, only 43 agricultural commodities are produced commercially and have complete production, value and international trade data. This is only 23% of the commodities for which such data is available internationally suggesting vast potential for horizontal diversification of Pakistan's agriculture by introducing new crops with proper research and development investments to make these commodities adaptable to local conditions.

The value of Pakistani commodities at the farmgate level in Pakistan is US$30.0 billion compared to US$2.2 trillion of the value of these commodities in their respective countries farmgate thus Pakistan's share in the world value of **these** commodities is only 1.35% and the country's share in **total** world agriculture drops to just 0.74% (Table 2). These numbers reflect terribly poor to a country having one of the best alluvial soils and flat and fertile lands of River Sind delta, best irrigation system of the world that entrenched to almost 75% farms in the country, suitable climate for year round cultivation and near to the big agriculture markets like China, Middle East, and Central Asia.

Table 2. Position of Pakistan's agriculture in the World during 2013

Parameter	Pakistan	World	Pak. share (%)
Population in 2017(million)	210	7467	2.8
Arable land (million ha)	30.47	1407.2	2.2
Area equipped with irrigation (%)	66.3	23.5	6.1
Agricultural commodities commercially produced (No.)	43	190	22.6
Value of ag. production (billion US$) [commodities produced in Pakistan only]	30.0	2220.6	1.35
Value of all commodity production (billion US$)	30.0	4054.0	0.74
Fresh ag. export (billion US$) [commodities Pakistan export]	3.5	265.7	1.30
Export of all agriculture commodities (billion US$)	3.5	1340.0	0.26
Export-output ratio (only commodities Pakistan export)	11.5	12.0	-
Ag. fresh imports (billion US$) [commodities Pakistan import]	1.3		
Exportable commodities	31	398	7.7
Importable commodities	12	398	3.3

Source: estimated by the author from FAOSTAT data.

4.2. Pakistan's Agriculture Value Chain in the World Market

4.2.1. Farm-level

Surprisingly, only 7 crops and 2 livestock products none of them major, out of 43 Pakistani agricultural commodities commercially produced and traded, have higher yield than the world average. These are mango, plums, potato, almond, walnut, chilies, tobacco, goat meat and eggs. All the remaining 29 crops and 5 livestock products have lower yields than the world average. Even the crops or livestock products in which Pakistan ranks highly in world production, like buffalo milk (2nd), buffalo meat (2nd), goat meat (4th), cotton (5th), sugarcane (6th), apricot (6th), dates (6th), wheat (8th), onion (8th), etc showed higher yield than the world average. This out rightly puts Pakistan on loosing grounds in international markets as it indicates that Pakistani farmers have poor performance compared to the world average under the current policy environment in the country as well as at the world level. Some of the higher yields at the world level can be explained due to certain protective policies, which is not in Pakistan's control. But same may be true in Pakistan which if corrected can affect the yield performance of various crops. This in fact creates a big challenge as well as a big potential to raise yields at least to the world average level in the first step to revitalize the Pakistan's agriculture.

To further support the identified potential, the average yields of major crops in Pakistan are also compared with the neighboring countries (Table 3) having similar eco-region and infrastructure situation. Pakistan is fast losing the competitiveness ground because all major crops have now lower yield not only with respect to the world average (as discussed above) but also with respect to its neighboring countries.

Table 3. Crop yields (t/ha) in Punjab and selected Asian countries during 2014

Crop	Pakistan	India	China	Vietnam	World average
Wheat	2.8	3.1	5.2	-	3.3
Rice (Paddy)	3.2	3.6	6.8	5.8	4.5
Maize	4.2	2.6	5.8	4.4	5.5
Sugarcane	57.5	70.2	71.3	65	70.7
Pulses (Lentil)	0.5	0.8	2.0	0.8	1.3
Potato	21.8	22.9	16.9	14.1	19.4
Tomato	9.9	20.7	51.4	98.5	34.5

Source: FAOSTAT

To trace down the causes of lower yield levels in Pakistan, input use efficiency (only land and fertilizer for which consistent FAO data is available for all countries) are compared across countries. Following the partial factor productivity procedure in Ali and Byerlee (2002), the value of all crops in a country evaluated at farmgate prices was separately divided by land and fertilizer quantities in the respective country. The results in terms of indices using Pakistan as base value are reported in Figure 2. China was excluded while Sri Lanka was included in the analysis as the data on value of all crops was not available for the former country.

It can be seen from the figure that average fertilizer and land use efficiencies in the world are each more than 2.5 times higher than in Pakistan. In the region, all countries have higher land and fertilizer use efficiencies especially Sri Lanka has 2.4 time higher fertilizer and Vietnam has 5.3% higher land use efficiency. So lower yields levels in Pakistan can be largely explained in terms of lower input use efficiencies. As these indices are measured in terms of value, other reason may be the lower outputs price in Pakistan which is discussed in the next section.

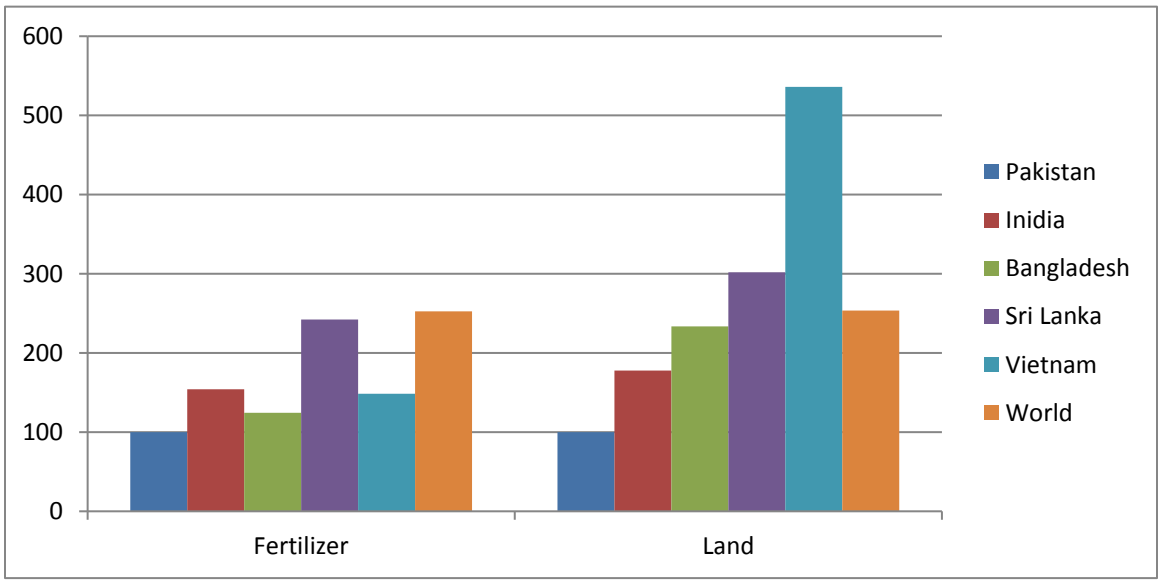

Figure 2. Land and fertilizer use efficiencies in selective countries of Asia.

The lower crop and animal yields in the country may be due to the poor investment on technical capacity of farmers, infrastructure, and service delivery systems in the country. This in fact creates a great opportunity to improve the first point of the value chain, i.e., the farm-level by bringing yield and input use efficiency levels at least to the world average level. Bringing the yield levels at international levels will generate a large surplus to expand exports and substitute imports which will generate huge revenue to different value chain players as discussed in the coming sections.

4.2.2. Domestic farmgate

The market situation within the country, however, is still not that bad. Despite lower yields than the world average of large number of crops, majority of agricultural commodities, 29 out of 43, have lower farmgate prices compared to the weighted average world farmgate prices of the commodities in their respective producing country. This situation, on one hand, creates constraints on farmers for using higher level of yield enhancing inputs, like fertilizer and water, and adopt improved production technologies thus producing lower yield-levels than the world, while on the other hand, generate opportunities for traders as these lower prices gave these commodities **apparent** comparative advantage under the given policy environment, i.e., protection levels, in Pakistan as well as at the world level.[3] In fact all these 29 commodities, except cotton, have built certain export potential as export in these commodities are higher than their imports, although in many cases these levels are infinitesimal. Cotton has lower farmgate prices in Pakistan still it is being imported mainly because of the monopsony of All Pakistan Textile Mills Association (APTAMA) in purchasing cotton from the domestic market which forces the domestic price lower than the international market price thus creating shortage in the country. The export levels of certain commodities are controlled through non-price measures like export taxes or sometimes export ban on these commodities especially on milk, meat, potato, etc. These measures sometimes are unpredictable and thus become the major constraint on the cluster development as investors no longer invest under such uncertain environment.

Remaining 14 commodities are out rightly not competitive as their farmgate prices are higher than the world average. All these commodities, except sugarcane, have already attained the importing status as their imports are higher than exports. In sugar, the high prices of sugar are protected through import duties and exports are encouraged through export rebate under the political influence of sugar industry in the country. The import level of certain commodities, especially wheat, is highly controlled through import duties.

[3] The **Real** competitiveness can be obtained after accounting for the nominal and real protection rates at the world and Pakistan levels (Balassa 1989). The real competitiveness is good to estimate for professional purpose, however, the **apparent** competitiveness used here to estimate the potential in Pakistan's agricultural value chain given the existing protection rates both at the world and Pakistan levels. Policy makers may be more interested in apparent competitiveness as correcting for protection rates, especially at the world level, is a long-term phenomenon. Moreover, even if they can be fixed within the country, it is in their hand to correct these protection rates at the world level.

4.2.3. International export

Many analysts of the Pakistan economy believe that the country is punching below its weight as far as agricultural export performance is concerned (Riaz and Jansen 2012). This assertion is confirmed here as Pakistan's EOR could reach only 11.5% compared to 12% EOR of the world (only in the commodity in which Pakistan participate in international trade) and 33% in overall value of all agricultural commodities. In the international market, Pakistan's share in the value of world agriculture export in 43 commodities is 1.3%, while the share drops to only 0.26% if the world total agricultural export is considered (Table 2). This not only indicates that Pakistan trades in low priced commodities but also reflects on inefficient commercial strategies at the export point of the primary agricultural commodity value chain. Expansion of Pakistan's share in overseas export markets is crucial for further development of the country's agricultural sector (Riaz and Jansen 2012).

There is clear possibility of increasing Pakistan's share in world export market. Firstly, Pakistan set up a target to reach at least (or even higher) world average EOR in each individual commodity in which Pakistan has comparative advantage. Once Pakistan has competitiveness at farmgate and attained some export level in large number of commodities (34 out of 43 as noted earlier), any amount of the commodity should be available for export assuming constant return to scale in production and Pakistan as a small player (thus facing inelastic demand) in international market. Secondly, as discussed earlier, huge surplus can be made available for export expansion as well import substitutions if proper investments are made at the farm-level to enhance yields of large number of commodities where they are lower than the world average.

Currently, however, large number of commodities exported from Pakistan has lower export than world average EOR. Out of 29 commodities being exported, Pakistan exceeds EOR only in six commodities which are basmati rice, mango, citrus, potato, banana, and dates. In all remaining 23 commodities, Pakistani exports are far lower than the world average EOR. This not only shows inefficiencies at the value chain level in terms of not transforming the agricultural commodities into demanded products but also poor business strategies and government trade policies to promote exports of agricultural commodities. Correcting these strategies and policies at the value chain level can create a great potential of expanding Pakistan's exports.

Not only there is a potential of expanding exports by improving the quality of exported quality and adopting better commercial strategies, but also clear indications exist of potential of improving the quality of exports. Out of 29 commodities being exported from Pakistan, 25 are not able to earn even the respective average international export prices. The only four commodities which are able to earn higher than the world average prices are plums, apricot, and goat and poultry meats. The export quantities of these commodities are infinitesimal so the higher export price edge in these commodities may be just a chance.

The world international export prices can be as high as 200% of the Pakistani export prices. The lower export prices of Pakistani exports indicates either poor value chain development which failed to convert these raw agricultural commodities into specific products for the satisfaction of the demand of foreign

consumers, poor business strategies of traders that force them to sell the commodities at throughout prices, or poor incentive structures and government policies. On the other hand, the import prices of commodities are very close of the international import prices except in millet, eggplants, and chickpea. A detailed commodity by commodity study would be required to find out what causes lower prices for the Pakistani export and what types of intervention would be required to uplift the quality of Pakistani export or the access of Pakistani traders to high-value markets.

4.3. Potential of value chain improvement

4.3.1. Total value chain

If Pakistan improves its crop and animal yields just equal to the world average, develop commercial strategies so that its exports can be expand just equal to the world average EOR, improve the quality of its export equal to the world average, and just 10% of its produce channeled in domestic market is raised to the world average export quality, it can bring US$ 22.2 billion to its different value chain actors. The crop and livestock sectors each have almost equal potential of generating additional revenues by improving its respective value chains and the potential of exportable commodities re much higher than importable (Table 4). The highest potential commodities for improving their respective total value chain are milk, beef, rice, sugarcane, wheat, cotton, apple, tomato, and citrus (Appendix 1) mainly reflecting their relative sizes.

Table 4. Potential of generating revenue with the total improvement in the value chain of agriculture commodities, 2013

Potential source	**Increase in income (billion US$)**
Total value chain	22.22
By sector	
- Crop income	11.36
- Livestock income	10.86
By trade group	
Exportable	19.06
Importable	03.16

4.3.2. Farm level expansion in production

Out of the total potential of US$ 22.2 billion of the whole value chain improvement of all agricultural commodities, Pakistan can make its farmers to earn additional revenue of US$ 13.6 billion provided crop and animal yield levels are brought just at par with international yield levels. The potential of generating additional revenue by improving productivity of crops and animals are almost similar. This is tantamount to increase average farm revenue by US$ 699 per ha and US$ 161 per adult animal unit. Over 62% of the revenue will be generated in the exportable crops and remaining 38% will come from importable.

Table 4. **Potential of expanding the value chain of agricultural commodities at the farm-level (i.e., improvement in yield)**

Potential source	**Increase in income (billion US$)**
Total value chain	13.61
By sector	
- Crop income	7.08
- Livestock income	6.53
By trade group	
Exportable	10.94
Importable	2.67
Average farm revenue (US$/ha)	699
Average farm revenue (US$/animal)	161

4.3.3. Quality improvement

The total potential of the improvement in quality of primary agricultural commodities without much change in the shape of commodities will generate US$ 8.6 billion to its value chain actors. This implies that about 39% of the total potential of the value chain lies in the improvement in the quality of the primary agricultural commodities, while remaining 61% potential lies at the farm level by improving the yield of these commodities at the world average level. Of the total quality improvement potential, the livestock commodities have slightly higher quality improvement potential than crop commodity (Table 5).

Table 5. Potential of improving value chain quality of agricultural commodities at various levels, 2013

	Return from improving value chain (billion US$)				
	New export-International	International-International	Import substitution	Domestic market	Total
Total value chain	2007.8	2462.5	287.3	3849.6	8607.1
By sector					
- Crop income	1090.2	1695.5	287.3	1204.0	4277.0
- Livestock income	917.5	767.0		2645.5	4330.1
By trade group					
Exportable	1971.7	2462.5		3682.4	8116.6
Importable	36.1	-	287.3	167.2	490.5

As pointed out earlier, quality improvement of primary agricultural commodities can be disaggregated at three points: i) export, ii) import, iii) domestic market. Taking appropriate differences in price as explained earlier in methodology, the potential in quality improvement at each point is reported here.

In the crop sector, almost all potential of quality improvement lies in exportable, while there is little indication of problems in the quality of importable produced domestically as domestic prices of these commodities are almost at par to the international import prices.

Out of the total potential of improvement in the quality of primary agricultural commodities (US$ 8.6 billion), about US$2.0 billion can come from the improved quality of enhanced domestic production diverted to export so that this part of the expanded exports get prices at par to international average export prices. Out of this total, US$1.1 billion can come from crop products and US$0.9 from livestock products (Table 5).

Another source of additional revenue is by improving the quality of existing exports so that it can get export prices at par to the international average export prices. This can generate about US$2.5 billion. Out of this, US$1.7 comes from crop exportable while US$0.8 billion from livestock exportable. Relative a small amount of revenue (US$0.28 billion) can also be achieved by bringing the quality of the domestic production used in import substitution at par to the international import prices as domestic prices are already very close to the import prices (Table 5).

Finally, US$3.9 billion gross revenue can be generated if the quality of 10% of the agricultural produce traded in domestic market can be brought at par to the average international quality so that when the former traded in domestic market can get a price at par to the world average export price. The major source of quality improvement in the domestic market is livestock products which when improved to world average quality level can bring US$2.6 billion, while 10% improvement in crop product quality to international standards will generate US$1.3 billion.

The high gain from quality improvement will obtained from milk and beef, while goat meat, poultry meat and eggs have relative little chance to earn additional income by improvement in the product quality. It is worth noting that improvement in milk quality in domestic markets can generate almost 3.5 times higher revenue than the similar improvement in beef, while reverse is true for beef in international market (Table 5).

The primary agriculture products which can generate highest revenues when 10% of their produce is improved to world average standards are rice, sugar, citrus, mango, and potato. Improvement in the quality of some importable products especially cotton, carrots, and sunflower can also bring significant revenues to its value chain actors as in these products domestic prices are significantly lower than imported price (Appendix 1).

4.3.4. Net potential Improvement (NPI)

Potential gains as a percentage of the cost, livestock sector has the higher potential of improvement both in terms of expanding production at the farmgate as well as improving quality at market place. Similarly, exportable products have much higher return at both the value chain nods (Table 6).

Table 6. Potential of improving value chain as a % of original output value, 2013

Item	Farmgate (Expansion in production)	Improvement in value chain	Overall
Overall (Crop+livestock)	33.0	20.9	53.8
By Sector			
Crop Sector	31.9	19.3	51.2
Livestock Sector	34.2	22.7	56.9
By Trade group			
Crop exportable products			
Exportable	36.5	27.1	63.5
Importable	23.7	4.4	28

The relative NPI by sector and by trade groups discussed in the previous section is useful. This information is useful in allocating resource at different value chain levels, but is little helpful in deciding the relative importance of different agricultural commodities. In this section the NPI analysis is further disaggregated at the individual commodity level (Appendix 1), which can be further go at regional level using the same methodology.[4]

Unlike total potential improvement which was showing high revenues from major commodities, the NPI has different ranking. Mainly, fruits and vegetables come at high ranking for making investment to improve the value chain. For example, ginger, banana, wool, tomato, peaches, grapes, barely, peas and apple are top ten high ranking NPI agricultural commodities for which investment on improving value chain should be higher priority. Each commodity has different value chain point on which intervention can give higher revenues compared to the cost involved. For example, for ginger intervention should be focused on farmgate for improving productivity, while for wool high priority should for improvement in quality. In Annexure 1, it can be seen that improvement in export quality can give higher return than on other points of the value chain.

5. Summary and Conclusion

This study first defines the possibility of expansion in production and enhancement in quality as two main sources of potentials for the improvement in the value chain of agricultural commodities commercially grown in Pakistan. Average per ha average world yield levels are considered as the standards against which potential of expansion is estimated, and export/import and farmgate prices and EOR of a commodity are the standards against which the potential of quality improvement in the value chain of agricultural commodities are evaluated.

A great potential of expansion in the value chain of 29 crops out of 36 and five livestock out of 7 commodities commercially produced in Pakistan are observed. Just bringing the average yield levels of these commodities at par to the world average yield levels can generate over US$11 billion additional revenues to the producers. This potential is almost equally divided into crop and livestock commodities.

[4] For the sake of keeping the paper within a limit, this will be done at a later stage for the practical purpose of investment decisions.

Exportable crop and livestock products have much higher potential of expansion in the value chain than their counterpart importable commodities. Different agricultural commodities have different potential of expansion in the production.

Despite lower than the world average yields of large number of crops, majority of agricultural commodities, 29 out of 43, have lower prices compared to the weighted Average world prices at the farmgate in their respective producing countries. This may partly reflect poor quality of these commodities at the farmgate level but because of the fact that all these commodities accept one are net exporter indicates that lower farmgate prices do in fact suggest their comparative advantage in international markets.

On the other hand, Pakistan loses all the competitiveness attained at the farmgate level when it takes agricultural commodities to international markets.[5] First of all the country could not export even to the level of average world EOR as 29 commodities out of 34 being exported from Pakistan have lower than the world EOR. Pakistan can obtain additional quantities needed to expand its exports to reach to the world average EOR level by exploiting huge potential at the farm-level through improving the land use efficiency (i.e., per ha yields) and other input use efficiencies to at least to the world average levels. Secondly, Pakistan's export prices of all 25 exportable commodities, except four, are lower than the world average export prices. It implies that Pakistani traders mainly export at through away prices partly because of the lower quality of these commodities than the world average quality and partly because the traders may not have access to high-end markets and consumers. On the other hand, the import prices of most agricultural commodities seem closer or higher than the international prices.

These inefficiencies in trade create huge potentials to improve the quality of the value chain of agricultural commodities. It Pakistan can reach to world average EOR in export commodities (by improving quality as well as export strategies), it can generate US$2.0 billion to its actors in the value chain, which is almost equally divided into crop and livestock sectors. Similarly, if the country reaches to the world average export prices (again by improving quality of exports and its market strategies), it can generate US$2.5 billion to the value chain actors, two third of .which will come from the crop sector. In addition, if the quality of 10% of the domestic agriculture produce can be brought to the average world quality of the respective product, it can generate US$3.8 billion to various actors in the value chain of these commodities. Combining these three sources of quality improvements in the value chain of agricultural commodities will bring about US$8.6 billion to value chain stakeholders, which is about 40% of the total value chain improvement (both expansion and quality enhancement). Although main source of improvement in the value chain of agricultural commodities is still expansion in production, but this expansion will not happen unless the quality issues of the value chain is resolved.

The analysis goes further in identifying the above potential of quality improvement in every agricultural commodity commercially grown in Pakistan and ranks them with respect to the total as well as net potential of these commodities. While total potential is highest in big commodities (grown on large area), like rice, wheat, cotton, sugarcane, milk and beef, etc. while the net potential, obtained by

[5] Similar results are observed in milk (FIAS 2006).

dividing the total effect with total original value of the commodity, is highest for fruits and vegetable commodities. The net potential can be further improved by quantifying the investment cost of realizing these potentials at various nodes of the value chain.

Each agricultural commodity has different potential at different nodes of the value chain. For example, the main potential in wheat, sorghum, and ginger lies in improving their yields at the farmgate level and little can be achieved through improving the quality of their value chain, while opposite is true for goat meat, mango, walnut, and wool. A careful analysis of the constraints at the point where main potential lies will be necessary to make informed investment and policy intervention decisions. Such analysis when aggregated at the sector level can produce a master plan for the government and private sector for investment and policy intervention to raise agricultural growth rate currently at 2.4% to 6.0% per annum which is necessary for poverty reduction in the country.

The cluster based development framework is suggested here to harness the potential in agricultural value chain. Development of clusters has become an important policy tool in economic development not only in developed but also in developing countries (Doeringer and Terka, 1996; Zhang, 2012). It synergistically connects all the stakeholders and induces innovations to resolve their issues for improving competitiveness which benefits everyone in the value chain.

Pakistan's agriculture is mostly clustered-based. For example, some form of cluster and stakeholders interaction along the value chain already exist in wheat, rice, cotton, sugarcane, maize, citrus, mango, guava, fish, carrots and many other commodities. However, missing in these clusters are synergistic links among stakeholders that can help to understand and resolve each other's constraints.

Therefore, it is suggested that the constraint analysis, previously confined to farm-level, should be extended to all nodes of the value chain of agricultural commodities. The interaction of these constraints at various nodes shall also be studied and quantified. The investment, infrastructure, and human resource requirements as well as the need for policy interventions at each node shall be holistically studied. Cost-benefit analysis of these investments and policy interventions should be quantified to attract investment at high potential nodes. It is also suggested to analyze the ways and means to improve the interaction and coordination among various stakeholders along the value chain of different agricultural commodities so that they can work together to enhance the competitiveness of these commodities which can improve the competitiveness of the whole agriculture sector. Moving away from farm production to the value chain approach for analysis and investment and using clusters as development approach can easily make Pakistan to join as one of the tigers of Asian economies soon as innovative clusters are seen to be the drivers of national economic growth, and as a key policy tool for boosting national competitiveness (OECD 2001).

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Appendix-1. Total potential of improving agricultural commodity value chain (billion US$) by commodity, 2013

Name of the commodity	Revenue with the expansion of domestic markets	Revenue from improving value chain				Overall Total
Export commodities	(Million US$)					
Crops						
Rice	1266.9	166.0	418.4	278.6	863.0	2129.9
Maize	371.8	15.2	30.6	14.3	60.1	431.9
Sugarcane	730.5	194.3	338.6	84.9	617.9	1348.3
Citrus	82.8	268.1	300.6	125.2	693.9	776.7
Mango	0.0	51.9	88.3	35.1	175.3	175.3
Grapes	62.4	10.7	8.8	18.2	37.8	100.2
Plums and sloes	3.3	1.7	0.0	3.5	5.1	8.4
Potato	78.5	8.3	58.2	70.1	136.6	215.1
Cherries	6.1	2.7	2.2	1.4	6.3	12.4
Peas	13.9	0.0	0.0	6.9	6.9	20.8
Apricot	24.7	21.9	0.0	23.4	45.3	69.9
Almond	5.3	23.1	16.7	9.6	49.4	54.7
Dates	77.0	62.0	226.6	31.3	319.9	396.9
Walnut	0.0	2.6	3.2	5.9	11.7	11.7
Apple	657.6	51.9	49.0	44.8	145.7	803.3
Cucumber and ghorkins	24.7	2.3	2.0	6.8	11.2	35.9
Tomato	580.7	55.3	60.2	142.6	258.1	838.8
Onion	193.0	10.1	29.4	51.6	91.1	284.1
Banana	114.5	9.9	12.2	12.3	34.4	148.9
Chillies	12.9	33.1	9.5	22.6	65.2	78.1
Tobbaco	25.8	49.0	31.4	32.6	113.0	138.8
Peaches	80.3	14.3	9.5	15.0	38.7	119.0
Livestock products						
Milk	3959.2	222.7	62.5	1985.6	2270.8	6230.0
Beef	1704.8	635.2	612.7	576.3	1824.3	3529.0
Sheep Meat	47.6	8.7	4.2	16.2	29.0	76.6
Goat meat	0.0	0.0	0.0	0.0	0.0	0.0
Egg	77.5	13.0	11.0	45.2	69.2	146.7
Chicken	717.5	0.0	0.0	0.0	0.0	717.5
Wool	19.3	38.0	76.6	22.2	136.9	156.2

Name of the commodity	Revenue with the expansion of domestic markets	Revenue from improving value chain				Overall total
		New export-international	Import substitution	Domestic market	Total	
Import Commodity	billion US$					
Barely	43.4	0.64	0.02	0.24	0.91	44.4
Wheat	1352.0	0.00	0.00	0.00	0.00	1352.0
Millet	34.7	0.14	0.14	1.30	1.58	36.3
Sorghum	54.6	0.30	0.00	0.23	0.54	55.1
Chickpea	136.2	0.74	0.41	0.54	1.69	137.9
Sunflower	50.2	14.90	36.99	12.86	64.76	115.0
Rapseed & mustard	169.3	0.00	3.47	0.28	3.75	173.0
Seed cotton	537.8	10.47	241.65	136.42	388.54	926.3
Eggplant	60.8	0.25	0.00	2.99	3.24	64.0
Carrots and turnip	151.5	7.14	0.01	10.78	17.94	169.4
Ginger	2.0	0.00	0.00	0.00	0.00	2.0
Garlic	59.4	0.35	3.18	0.43	3.96	63.4
Lentil	8.0	0.00	1.10	0.09	1.19	9
Pears	9.9	1.10	0.33	1.00	2.43	12
Total crop exportable	4412.6	1054.2	1695.5	1036.9	3786.5	8199.1
Total crop Import	2669.8	36.1	287.3	167.2	490.5	3160.3
Total livestock	6525.9	917.5	767.0	2645.5	4330.1	10855.9
Total exportable (Crop+Livestock)	10938.5	1971.7	2462.5	3682.4	8116.6	19055.0
Total crop (import+export)	7082.4	1090.2	1982.8	1204.0	4277.0	11359.4
Gross total (all Crop+livestock)	13608.2	2007.8	2749.8	3849.6	8607.1	22215.4
Crop income per ha	699.3					
Livestock income per animal	160.5					

Annexure 2. Impact of value chain improvement as a percentage of original production value, 2013

Name of the commodity	Impact of production expansion as % of the original production value	Impact of the quality improvement as % of the original production value	Total impact of the value chain improvement as % of the original production value
Ginger	924	0	924
Banana	396	119	515
Cherries	205	212	417
Wool	48	338	386
Tomato	249	111	360
Peaches	239	115	354
Grapes	145	88	233
Barely	218	5	222
Peas	140	70	210
Apple	172	38	210
Citrus	21	176	197
Cucumber & ghorkins	135	61	196
Eggplant	162	9	170
Lentil	121	18	139
Sorghum	136	1	137
Rapseed and mustard	124	3	127
Almond	10	93	103
Dates	20	82	102
Apricot	33	60	93
Sunflower	40	52	92
Chillies	15	76	91
Rice	52	35	87
Beef	41	43	84
Carrots and turnip	73	9	81
Tobbaco	15	66	81
Pears	64	16	80
Onion	47	22	68
Milk	39	22	61
Walnut	0	59	59
Garlic	46	3	50
Seed cotton	28	20	48
Sugarcane	23	19	42
Chicken	39	0	39
Maize	29	5	34
Millet	29	1	30
Chickpea	28	0	29
Potato	10	17	27

Plums and sloes	10	16	26
Mango	0	21	21
Egg	10	9	19
Wheat	17	0	17
Sheep Meat	7	4	11
Goat meat	0	0	0