© *The Pakistan Development Review*
64:1 (2025) pp. 53–72
DOI: 10.30541/v64i1pp.53-72

# Strategies for Transforming Agro-Commodity into Agro-industrial Clusters in Pakistan

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The main focus of this study is to propose a plan to transform largely existing agro-commodity clusters in Pakistan having little value addition into agro-industrial clusters in which all stakeholders along the value chain are integrated to supply the quality as demanded by the market. Main triggering factors are to induce quality of agricultural products, establish markets of these, and train stakeholders. To make this transformation small-farmer inclusive, stakeholders have to be organized into groups, incentivize them to participate in small-scale agro-business projects, and link them with markets. The plan will require an investment of US$1039 million, 40% of which will come from the government, giving an IRR of 62%. Project management units (PMUs) to implement the Plan are proposed at the provincial level.

*Keywords:* Agro-commodity Cluster (ACC), Agro-industrial Clusters (AICs), Value Chain, Innovation, Food Quality, Farmers Entrepreneur Groups (FEGs)

## 1. INTRODUCTION

Following Porter's (1998) definition for industrial clusters (ICs), an agriculture-based cluster (ABC) is defined as "a geographically proximate group of commercial farmers of a product or closely-related products, and related companies and institutions for input supply, processing and service provision". The ABCs can be further classified into: (1) agricultural commodity clusters (ACCs), and (2) agro-industrial clusters. (AICs). The ACCs supply fresh but low-quality agricultural products with little grading and processing, while the AICs market graded or processed agricultural products following strict quality standards as demanded by the market (Otsuka & Ali, 2020). In other words, in AICs all downstream and upstream stakeholders along the value chain and related institutions are properly integrated, while such integration is weak in ACCs.

It has been observed that several agriculture commodities, especially high-value products (HVPs), are produced in clusters. Examples of clusters of HVPs are provided by Ali (2020) in Pakistan, Chatterjee & Ganesh-Kumar (2016) in India, Briones (2015) in the Philippines; Zhang & Hu (2014) in China; Cavatassi, et al. (2011) in Ecuador; & Galvez-Nogales (2010) in Asia, Africa, and Latin America. These studies argue strong roles of AICs in enhancing productivity, employment, and stakeholders' income by (i) creating synergistic links among cluster stakeholders; (ii) facilitating collaborative actions to meet the quality standards; (iii) provide better market access; (iv) easing innovation and its dissemination; (v) producing specialised skill labor; (vi) enabling policy makers to sharply focus on cluster issues; (vii) creating spill-over effect of innovations; and (viii) formulating networks to protect cluster interests thus creating social, political, and economic capital. All of these roles of clusters improve competitiveness thus enhancing exports or reducing imports of cluster products.

Despite the established role of AICs in agricultural development, the policies, strategies, and implementation package to develop AICs is not well-defined, especially

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in the Pakistan situation. The purpose of this paper is to propose such a package after evaluating the status of agriculture, and identifying gaps and potential of agriculture clusters in the country. In earlier studies, several individual factors have been highlighted to transform ACCs, but an integrated approach incorporating and prioritising these factors is lacking. Using successful examples from the literature, macro-data, and our consultations with stakeholders in 33 HVC clusters in Pakistan, the role of product quality, capacity building, small-scale value addition and processing units in rural areas, farmers' entrepreneur groups, and linking these groups to markets are underscored. Necessary incentives to encourage first risk-taking movers in a cluster, encourage innovations, and enhance private public-private partnership for the development of cluster infrastructure are elaborated. The necessary policy reforms in the seed, seedling, and output markets, and subsidy structure in Pakistan are outlined. The outline of a unit to implement these reforms is also provided.

The framework of this article is as follows. The data used in this study are explained in Section 2. The status of agriculture clusters in Pakistan is described in Section 3, while Section 4 lays out the cluster-development based agriculture transformation plan (CDBATP) by explaining strategies, cluster-level incentives, and reforms required to transform ACCs into AICs. Section 5 provides financial requirements of the plan and its economic viability, while an implementation structure for the plan is laid out in Section 6. Major findings of this study are summarised in Section 7.

## 2. METHODOLOGY AND DATA COLLECTION

Understanding the importance of cluster approach in the context of Pakistan's agriculture, the Planning Commission of Pakistan (PCP) announced "The Cluster Development Based Agriculture Transformation (CDBAT)-Vision 2025 Project" in 2015. In the first stage of the project, during 2016-17, mapping and prioritisation of 42 agricultural crops was conducted. In the second phase, it was decided to focus on the clusters of 33 high-value crops for detail analysis. The data used in this study were collected under the second phase of the CDBAT project.

Informal surveys (ISs) approach, also called rapid reconnaissance or exploratory surveys, is used to develop a rapid understanding of value-chain circumstances, practices, and problems in each cluster. It has already been argued that IS are most appropriate for rapid evaluation under time and resource constraints without losing much accuracy over formal surveys (Franzei & Crawford 1987). The ISs are in fact first out of the four stages, commonly known as diagnostic stage, and widely used in every farming system research (Behera & France 2023; Rhoades 1982). Commodity specialists were hired for each crop to conduct these surveys. They made literature review and conducted comprehensive consultations with stakeholders along the value hain in each geographic cluster,[1] and analysed secondary data to understand the constraints, gaps and opportunities in each cluster. Thirty three commodity reports comprising the description of various geographic clusters of each commodity, SWOT (strengths, weaknesses, opportunities, and threats) analysis, investments plan to harness potentials, economic viability of these investments using various feasibility parameters like Internal Rate of Return (IRR) and Net Present Value (NPV), and strategies and

[1] The stakeholders consulted were farmers, wholesalers, processors, traders, input and certification service providers, researchers, extension agents, and policy makers at the national and provincial levels.

policies to transform each ACC into ACI are available on the PCP website[2]. From these commodity reports, this study derives an overall description of agriculture clusters in Pakistan, presents the national CDBATP, and a structure to implement the plan.

## 1. Agricultural Clustering in Pakistan

### *1.1. Agriculture Based Clusters*

It is important to recognize that sharp regional agglomeration and connectedness of small scale agricultural producers already exist in most agricultural commodities in Pakistan. Various agro-ecological regions are defined based on specific crop(s) dominant in the region and on ecological conditions (Ali & Byerlee 2002; PARC 2019). In some cases, the agro-large processing enterprises and market activities are also located in the nearby commodity production areas. For example, agriculture fresh produce markets were established near fruits and vegetable (F&V) production centers in the peri-urban areas. Sugar mills and cotton ginning in Pakistan are clustered around their respectively production areas. Rafhan Maise (Private) is located in the hub of maise production area in Faisalabad which collects maise from farmers in surrounding districts for starch processing. Hot Water Treatment (HWT) plants are now surfacing in the mango clusters of Punjab and Sindh. The grinding facilities of fresh chili into powder are largely located in Jacoobabad where chili production is clustered. Despite these large scale marketing and processing units mostly located in urban or peri-urban centers, small-scale industrial-bases in rural areas, with few exceptions, are largely absent.

The ABCs are formulated based on regional contiguity, market needs, and/or similarity in product specification. For cherry, for example, two regional clusters are known each producing similar cherries but for different markets, one in Pakistan and the other for abroad. Milk clusters can be defined based on the end-market such as peri-urban fresh milk, milk supplied to processing industry, milk used in local milk products especially ghee, and so on. Two basmati rice clusters can be defined based on product specifications: (i) polished (or 'katcha' rice), (ii) par-boiled (or 'pakka rice') both have concentration in different areas (with some overlapping) and each having its' own value chain. Defining clusters in this manner can give region- and product-specific perspectives of the commodity value chain with different policy implications for each.

A number of stakeholders and institutions are involved in each ABC which may include farmers, input suppliers, processors, traders, people providing logistical and storage services, financers, donors, researchers, non-government organizations (NGOs), community workers, certifiers, service providers, and so forth. The engagement of relevant stakeholders in most ABC's suggests that these clusters have reached at least a certain level of commercialization on which rural industrialization can be built upon.

In the 33 commodities analysed in the CDBAT project, 76 clusters were identified along with their respective focal points (district) across the country.[3] Each cluster has its own Focal Stakeholder (FS). For example, milk processor is the FS in the case of processed milk, "Dhoji" (or milk distributor) in the case of fresh milk, and commission agents, wholesalers, collectors, or contractors in case of most F&V. The role of super markets has not yet reached to the level they can be placed as a focal

[2] See https://www.pc.gov.pk/web/agriculture.

[3] Small and Medium Enterprise Development Authority (SAMEDA) has also defined clusters for most agricultural commodities in Punjab using similar geographic boundaries and focal point for each cluster (see "Cluster Mapping of Agriculture Commodities in Punjab 2023.pdf").

stakeholder in Pakistan as they mostly purchase their products from F&V markets through commission agents.

The FS supplies key inputs especially loans to producers, but they hardly bring innovations in the value chain to improve food quality, thus they are least interested to opt for formal contract farming (CF) to meet specified food quality needs of the market.[4] The main hindrance to move from informal quantity-based contracts to formal quality-based and time bound contracts is the lack of mechanism (in government or private sector) to train stakeholders for post-harvest management and to maintain food quality along the value chain. The cost of such training for individual traders or farmers is too high. Providing information about the changing demand dynamics for food quality in national and international markets and improving skills of FS to manage the change are critically important to innovate ACCs in Pakistan.

### 1.2. Current status of AICs in Pakistan

According to the analysis of CDBAT project, the links among various stakeholders in AICs in Pakistan are informal and weak, innovations are lacking, and investments on these clusters have dried down. As a result, agricultural commodity clusters have become survival clusters and they have been losing their competitiveness in the national and international markets. This is largely because the structure and management of these clusters are such that: (a) it largely failed to identify and communicate the changing demand for quality of agriculture commodities to various stakeholders so as to induce innovations and/or (b) stakeholders do not have capacity and skills to make or handle the innovations. In addition, the links between research organisation and clusters stakeholders are weak and the former do not understand the need of the latter for innovation.

To be more specific, the current status of AICs in Pakistan is characterized by (1) little market of certified seeds and seedlings, (2) lack of state of the art certified nurseries and tissue culture labs (3) small market of safe pesticides, (4) inefficient credit market, (5) lack of focus of agriculture research system on the constraints of AICs, (6) ineffective extension service for new or improved food quality products and product management, (7) by and large little incentive for stakeholders to improve product quality, (8) lack of capacity of cluster stakeholders to innovate or adjust their activities to the upcoming innovations, and (9) absence of consumers' consciousness between low- and high-food quality.

This status has created several constraints at the cluster-level on transforming ACCs, which are explained in general, although these vary from cluster to cluster: (1) old and low-yielding and low quality fruit trees, vegetable and crop varieties, and animal breeds, resulting in lower yields than the world average, (2) the potential of these is further reduced by inappropriate management practices such as low fruit plant density, unscientific nursery preparation, low use of mechanical power, and so on, (3) inappropriate varieties for processing, (4) high-post harvest losses of agriculture products mainly because of inappropriate harvesting, packing, transportation, and storage methods, (5) poor value chain management, which also reduces the quality of agriculture products below international standards, (6) low percentage of the produce that go into small scale rural-level processing, (7) poor links of producers and other

[4] The FS meets the quality requirements of consumers by sorting the produce which is usually visual.

stakeholders with national and international markets which limits export-production ratio.

We believe, however, these market and institutional constraints, and cluster environments are not permanent in suppressing the transformation of ACCs into AICs. On the contrary, it is argued later that these can be opportunities if appropriate strategies, incentives and policies are adopted.

## 4. STRATEGIES, INCENTIVES AND POLICIES FOR TRANSFORMING ACCS

After concluding that most clusters in Pakistan are ACCs, and analysing the constraints that limit their potential, now the question is how these can be transformed into AICs. This section lays down the strategies, incentives and policies required for this transformation, and the next section will spell the financial needs for this.

### 4.1. Strategies for CDBATP

#### *4.1.1.Develop and Promote Markets for Food Quality*

To transform ACCs into AICs, the first step is to induce quality of the cluster product. Developing and promoting markets for food quality within the country also improves the country's reputation as a 'clean supplier of food' in the international market. Innovation would be required to meet food quality demand at affordable per unit cost, thus inciting dynamism in the cluster. To induce quality of agricultural products, concerted efforts would be required both at the supply and demand fronts.

Low-quality products produced in ACCs using traditional system are generally not suitable for AICs. Hence, new HVPs (e.g., special varieties of potatoes for chips and tomatoes for puree and sauces, and high-quality milk for pasteurization and cheese) have to be introduced to producers to transform ACCs into AICs. In order to produce safe pasteurised milk, for example, hygienic cowsheds must be constructed to raise exotic cows, the use of antibiotics and other toxic chemical and adulteration must be stopped, chilling and pasteurising machines must be installed to reduce bacterial infection and increase the milk shelf life, and refrigerated trucks would be required to safely and efficiently transport milk. The availability of improved high-quality inputs, especially chemicals and certified seeds and root stocks of fruit trees, has to be ensured through robust monitoring system.

Promotion of branding of agricultural products can be used as a tool to establish the market for food quality. Brands distinguish one product from another in the minds of consumers based on some unique character of the product.[5] This gives special quality producers a kind of leverage with buyers (Docherty, 2012).

Promotion of a brand starts from harmonising the production of the commodity throughout the cluster. For this purpose, varietal development and seed production of various varieties of the commodity have to be harmonised. Then farmers and other stakeholders including wholesalers, processors and traders have to be trained to

[5]The unique character of the product may be real or fake created in the minds of consumers through aggressive advertisement. For example, 'citrus of Bhalwal' characterizes the sweetness and shininess citruses produced in Punjab cluster with Bhalwal its focal point, 'Sheikhupura basmati' represents the aroma produced in basmati cluster with Sheikhupura its focal point, and 'Sindhri mango' having special sweetness and shape in Sindh mango cluster.

maintain and exploit the differentiated character in national and international markets, so that consumers become willing to pay higher price than for the similar other product.

The demand for certification of food quality and safety also emerges in the process of introducing high quality, although at a slightly later stage. To meet the demand for certification would require costly infrastructure to be built both at farm and public levels.[6] But, unless supported by the government, such infrastructure is expensive for individual small farmers. Therefore, they may need support or even direct subsidy to build such infrastructure. Producer groups can play a key role in assuring the quality of the produce at the group-level, which can be a substitute for formal certification. Alternatively, international certification companies and private sector may be involved to build certification infrastructure, but this must be done after resolving other constraints in the value chain along with a careful analysis of its costs and benefits (World Bank 2005).[7] In addition to infrastructure for food certification, enhancing producers' capacity to fulfil the requirements for certification will be essential.

The government can also help establishing markets for HVPs through organising and facilitating the participation of stakeholders in international trade fairs and export promotion visits. Sometimes, the intervention of a senior government official, political leader or celebrity can help open doors in foreign markets. Market infrastructure such as farm storage, reefers, village to market roads can also help farmers to maintain and enhance the quality of agriculture products. Efforts to improving small farmers' participation in the market, e.g., organising them in groups, promoting contract farming and developing information portal will help producers to understand the quality demands of consumers.

Appropriate regulatory framework plays an important role in the promotion of food quality. The institutions to implement the food quality laws, such as provincial food authorities (PFA), have already been constituted in all provinces of Pakistan and The Pakistan Standard & Quality Control Authority (PSQCA) has prescribed the minimum food quality standards. However, other food laws have yet to be prescribed, especially for correct labelling on food items and for activities such as transportation, post-harvest processing, cooking, and so on. Main emphasis should be to promote quality standards through the market by creating awareness among consumers and involving them to regulate the food industry for quality, but care should be taken not to stifle the industry through stringent regulations that can provide a source for corruption. For this purpose, discretely powers of PFA have to be removed, and evaluation based on set regulatory quality limits (such as fungal and bacterial infections, etc.) in scientific laboratories has to be introduced.

### *4.1.2. Capacity Building of Stakeholders*

Since inputs and technologies to produce quality outputs, make value addition, and undertake processing are new, lack of capacity to supply and use these inputs, rather than lack of resources, is generally the major constraint for traders, farmers and input suppliers to enhance product quality (Otsuka and Ali 2020). For example, majority of

[6] Despite these costs, ensuring food safety and quality has lots of potential for the growth and transformation of agriculture, the modernisation of national food systems, and for a country's efficient integration into regional and international markets (Jaffee et al., 2019).

[7] The initiative by the Punjab government to build storage facilities at airports is an example of such misadventure in which the facility was built without resolving other constraints such as lack of sufficient supply of quality output and weak link of farm production with these facilities.

milk farmers do not know how to produce pasteurised milk and cheese with appropriate quality standards, and extension workers and market agents are not familiar with improved production and handling methods for such milk. Similarly, many producers are unaware about the production method or source of high-quality vegetable seeds and fruit seedlings, the prohibition on the use of toxic chemicals, appropriate spacing of planting, and efficient harvesting method, even though they are all important components of producing quality and safe agricultural products.

The lack of capacity spreads across the whole value chain in AIC. For example, trainings have to be provided to farmers for improved cultivation and animal raising practices along with rules of contract farming (such as keeping records of input use, its quality, sale proceeds, and following strict schedule of planting and harvesting), to seed companies and nursery operators for maintaining and supplying the quality and certified seed and seedling, to logistic providers, wholesalers, traders, and retailers to maintain the quality of a produce when it passes through the value chain, and processors to exhibit the quality standards on labels. These training become even more important in ACCs where quality concerns are limited or absent and only a limited number of knowledgeable extension workers are likely to be available to provide advanced training on new technologies and processes. Due to the skill limitation of extension workers, the public sector must consider the use of private consulting companies, donors' agencies, and foreign advisers with needed expertise to train its staff or nurture new experts as trainers on new management practices in AIC. In the provision of capacity building training to various stakeholders, however, the public sector must guard against elite capture by large and influential farmers, seed companies, wholesalers, retailers, and the like.[8] In addition, the training program for farmers must include the promotion of agricultural cooperatives, which are expected to ensure production quality through self-monitoring the production activities of member farmers and make contracts on behalf of them. Training on various aspects of marketing shall also be an important component.

#### *4.1.3. Promote Small Scale Value Addition and Processing*

Quality demands for HVPs may be created or met through improved value addition and processing of these products. For example, international demand for shining-skin appearance of citrus has created a big waxing industry in citrus cluster in Sargodha district, Pakistan; international demand for disease free mango has resulted in installation of hot-water treatment plants in the country. Similarly, demand for pasteurised milk in the country has created large-scale milk processing plants. Sometimes, availability of improved inputs also induces value addition and processing in a cluster. For example, availability of suitable varieties for potato processing in Pakistan has caused a rapid expansion of potato chips and French-fries industries.

These agro-industries, however, are mostly big in size and largely located in urban centers. In fact, Pakistan has failed to bring 'small-scale industrial revolution' in rural areas which is well integrated with large scale industries in urban areas. In the existing agriculture processing model of Pakistan, bulky raw materials produced in rural areas have to be transported to the processors in urban centers, who lose their direct links with raw material supplies. All these create inefficiencies in agro-processing and

[8] Implementing efficient public-sector extension is a major issue in agriculture transformation (Takahashi et al., 2020; Ali et al., 2018).

make processed products uncompetitive in domestic and international markets.[9] Many functions performed by large-size processors can in fact be undertaken more efficiently by small scale processing units in rural areas and provide semi-finished products to large scale industries at low cost.

Due to the importance of the small-sale agro-processing in transforming ACCs, it is proposed here that their establishment be incentivised in rural areas, at least in the initial stage.[10] Such support is justified because of the original bias of policy makers against rural areas resulting in lack of proper infrastructure, education, information, skills, credit, and high risk involved (Otsuka and Ali 2020). Technical skills and liquidity to run these units are major constraints (Ali 2020; Ali, Peerlings and Zang (2014); Winter-Nelson and Temu, 2005; Hicks, 2004). To overcome liquidity constraint, the initial financial support is critical. As farmers have low technical skills and infrastructure and institutional framework are weak to establish and operate industrial units, it makes sense for the public sector to provide technical and managerial support to agro-processors in rural areas.

The knowledge imparted in training small-scale agro-processors is a public good, as it is useful for many similar firms and large firms within and outside the cluster. Moreover, large scale industry can benefit from the training of small scale industry because the products of the latter can be a raw material for the former. Therefore, associations for large-scale agro-processing industry can play a significant role in organising training programs and inviting instructors. Complementary policy should also be implemented to ensure cooperation of various stakeholders with foreign investors in agro-processing, who have invested in supermarkets and agribusinesses development in developing countries (Reardon et al., 2009; Swinnen and Maertens, 2007).

As risk is a major factor that restricts investments on small scale processing units in rural areas, it is suggested that these units may be managed by competent managers financed by donors but controlled by farmers' groups, and a certain level of return from the investments may be ensured for the first few years. Moreover, the risk on the loans obtained may be ensured if the business fails during these years. All these subsidies may be recovered through taxes later when these businesses get well established.

#### *4.1.4. Social Mobilisation for Cooperation*

Special steps need to be taken to make the cluster transformation small-farmers inclusive. Any emerging opportunity in a cluster has high risk of being captured by large influential farmers and processing corporations. The small farmers in Pakistan have neither the skills nor resources to adjust their production and invest on small scale processing units to meet the changing food quality demands. The diseconomies of scale,

[9] Several such inefficiencies are obvious in Pakistan's agro-processing sector. For example, the tomato-catsup industry, mainly located in Karachi is far away from its raw material production clusters, imports most of its raw material 'puree' from China, despite the presence of big tomato producing clusters in Pakistan. Another example is a big unutilised capacity of large-scale milk-processing plants in urban centers because of high milk-fetching cost from rural areas. Similarly, bulky cows are transported to beef processing plants in Karachi about 800 km away, severely dehydrating animals and losing 10-20 percent animal weight.

[10] A large number of small-scale agro-processing opportunities exist in rural areas of Pakistan, some of which have been discussed in Ali (2020). Hicks (2004) has listed such opportunities in several Asian countries, especially those small scale agro-processing projects in Japan that are supported by the government and controlled by farmers' organisations. However, before promoting any such opportunity, the government must possess sufficient knowledge .about their economic viability in the local condition.

poor access to input market especially credit and information, lack of skill and financial capacity of small farmers, and risk-averse attitude preclude their participation in the emerging niche food quality markets. These constraints can largely be overcome by organising farmers into producers' groups. Indeed, the experience of several developing countries suggests that these groups play roles in enhancing livelihood of subsistence farmers (Kumar, et al. 2015 & Bizikova, et al. 2020).

The literature review on producers' grouping in Pakistan suggests that farmers do not generally self-organise themselves into groups. They rather may informally congregate in a cluster around a mutually beneficial economic purpose (e.g. selling to a common agro-processor) or around a piece of infrastructure (built) for collective action (such as aggregating their produce at collection centers) (Horst and Watkins, 2022). To induce formal grouping in Pakistan, the government and several NGOs have successfully organised hundreds of thousands of farmers' groups. However, in these efforts, farmers were grouped to undertake only short-term economic activities (such as building community infrastructure, input supply to the group), thus the groups collapsed after the support for such activities waned (Ali, 2022). These formal or informal groupings, however, failed to pool farmers' resources to start long-term group businesses, such as small-scale value addition and processing as required to upgrade the ACCs into AICs.

In view of the above review and importance of group action in transforming ACCs into AICs, it is suggested here that public sector may help to identify profitable local agro-business opportunities in various clusters, provide support for organising Farmers' Entrepreneur Groups (FEGs) around the particular opportunity, and offer incentives to farmers to collectively undertake projects to harness the opportunity. Later, the private sector may also like to operate through these groups as they have comparative advantage of knowing the local dynamics of the value chain (Ali, 2020).

The government has to develop a legal framework to protect FEGs' investment and their profits.[11] Similar arrangements like for stock market investors has to be introduced for small scale agro-businesses in rural areas. The Rural Support Programs (RSPs), Pakistan Education Foundation and other local NGOs can be engaged in the social mobilisation.

### *4.1.5 Linking Farmers Groups with Markets through Contract Farming*

After developing markets for food quality and the associated small farmers' ability to supply these foods, and organising farmers into groups, the next step is to link them with downstream processors, wholesalers, and traders and upstream input, credit, and information suppliers. For example, FEGs who has invested on tomato puree and juice extraction must be linked with big firms in urban areas who will collect these semi-finished products, further process these, get it branded and take it to consumers' table in domestic and international market.

Contract farming (CF) can help to overcome imperfect markets for improved seeds, safe pesticides, credit, and production information services (Barrett, et al. 2012). Furthermore, price risk shouldered by farmers is lessened as traders offers fixed or stable prices, and undertakes market risk (Reardon, et al. 2009). Initially informal and later formal contracts between FEGs and marketing and processing firms should be

[11] It should be noted that these groups to be entirely voluntary. For this, public sector awareness campaign would be required to highlight the economic benefits of investment on emerging opportunities.

promoted. These contractors also introduce high-quality products in the market through building trust with consumers or establishing brands thus promoting innovations in AICs.[12]

Contract farming may minimise the transaction costs where traders have to collect the desired quantity and quality of produce from large number of small farmers in a cluster. It strengthens interaction of farmers with traders and encourages transformation of ACCs into AICs. Successful contract farming systems require clear regulatory systems, good monitoring mechanisms and efficient systems for contract enforcement. Some countries enact special legislation, as in the case of Thailand's law for contract farming (CFRC, 2018) but these can also be counter-productive if flexibility is compromised. There may also be a role for governments in developing model contracts and dispute resolution (Minot, 2007).

### 4.2. Cluster-Specific Incentives

#### *4.2.1. Incentives to First Movers*

Providing specific incentives to stimulate an AIC is often the trickiest challenge for the government. Tax holidays, import protection and even outright subsidies on quality inputs especially on seed, seedling and credit, can be justified to help first mover firms in an ACC to reduce pioneering risks, allow cluster to reach a sufficient scale, and achieve competitiveness. There are good examples of successful use of such incentives, most notably salmon in Chile (Katz, 2006), forestry sector in Uruguay (Morales, et al. 2018), livestock in China (Galvez-Nogales, 2010), and the palm oil industry in Malaysia (Rasiah, 2006). However, there are several major challenges in administering such incentive programs. First, the schemes need to set clear rules for receiving benefits and administer them transparently to avoid rent seeking by individual firms. Second, the level of incentives should be modest to avoid creating inefficient and high cost industries. Finally, the incentives should be time or volume-bound with an upfront agreement on phasing them out after a certain number of years or volume of sales. Nevertheless, there is a need to incentivise long neglected agro-processing small industries in rural areas in Pakistan; especially to build and strengthen horticulture related processing clusters.

#### *4.2.2. Accelerating Innovation*

An innovation is defined here as change in any activity along the whole value chain that can reduce per unit production, processing or marketing costs, or enhance product quality so that it can fetch higher price. Institutional support, in the form of technology development and extension services provided by universities, research centers or producers' associations and cooperatives plays a major role in upgradation of cluster technologies (Giuliani, et al. 2005). Agro-processor associations have contributed to the development of AICs in Japan and China by introducing innovative ideas from other areas and abroad (Zhang & Hu, 2014). Many countries have established cluster-need based competitive innovation grants (CIG) on a public-private partnerships (PPP) basis, but with mixed success. While several successful examples are available for CIGs to facilitate innovations, the mechanism established through Punjab

[12] A successful example of CF in Pakistan is provided by Rafhan Maize (Limited) in maize cluster in Punjab, Tobacco Board in tobacco cluster in Khyber Pakhtunkhwa, and various private seed companies in potato production.

Agriculture Research Board (PARB) in Pakistan has soon petered out because of lack of political interest, laxities of the private sector for the involvement in the Board, and political control and intervention in Board affairs (Ali, et al. 2018). Most agricultural universities in Pakistan have also established endowment funds but without much success also because of the same reasons.. Recently, the Higher Education Commission is trying to establish the CIG, but its success needs to be seen.

#### *4.2.3. PPPs for Cluster-Specific Infrastructure*

Mostly infrastructure and government support requirements to develop AICs are cluster-specific especially for auction houses, port warehouses, commodity-specific protocols for sea exports, upgraded access roads, human resource development, and for sanitary and phyto-sanitary. Collective action by industry associations can sometimes provide such infrastructure but public sector incentives in the form of co-financing are often needed. The design of such public-private partnerships (PPPs) is challenging given differences in business cultures of private firms and government departments, inefficiencies in public management, and the opportunity for rent seeking. One option is for the public sector to construct an agreed facility and then turn over management and maintenance to the industry association (World Bank, 2013).[13] Another is for the government to make an outright grant to co-finance part of the cost. Whatever the approach, it is critical that funding be allocated transparently and where appropriate, competitively. In Pakistan, several efforts to support drip irrigation and protected-vegetable cultivation under plastic structure so far could not bring the desired results because these efforts were not need-based to resolve cluster-specific issue, had unresolved policy and technical issues, and lacked associated capacity of various stakeholders.

### 4.3. Enabling Policy Environment

The most important policy to convert ACCs into AICs is to create an enabling environment for the private investment. The elements of a good enabling environment are well known—stable macroeconomic policy that minimises sector-specific distortions, ease of foreign investment, good access to regional markets through trade agreements, a transparent regulatory environment, and a competitive tax regime. The World Bank and others now publish annual indices of ease of doing business (www.doingbusiness.org/) as well as specific metrics on the agribusiness climate (www.eba.worldbank.org). Notably, Pakistan ranks low on many of these metrics—147th place out of 191 countries for doing business. For example, for seed business, Pakistan lags other countries in Asia in regulations promoting private sector investment (Ali, et al. 2018). Special reforms which can influence the pace of cluster development are discussed as follows.

#### *4.3.1. Reform Agriculture Markets*

Although collection centers and pack-houses at the village level built under the cluster approach can serve as a primary market places for agriculture produce, a large quantity of the produce is still expected to pass through the traditional wholesale markets. Unless these markets are reformed, the ACCs will not transform into AICs due to inefficiency in the existing markets in linking quality producers with markets.

[13] However, such an initiative of the government of Punjab to build cold storage at airports has not been successful.

Implementation of the Punjab Agricultural Marketing Regulatory Authority (PAMRA) Act in letter and spirit will bring most of these changes in HVP product markets.

#### *4.3.2. Reform Seed and Seedling Sector*

Existence of a mechanism to supply seed that caters to specification, volumes and quality requirements of a cluster is imperative to create innovation and dynamism in the cluster. For this purpose, the seed sector of Pakistan needs to be reformed by implementing the Reformed Seed Act (2017), especially enforcing the truth-in-labeling in seedling supply. Scientific protocols for raising F&V nursery plants are lacking or these have not reached to the nursery producers. The establishment of certified clean nurseries that can produce genuine, healthy, high-potential and certified fruit rootstocks and vegetable nurseries is pivotal to quickly spread innovations at the farm level. Nurserymen training would be essential for this purpose. Establishment of tissue culture labs would be essential to briskly spread the biological innovations especially in F&Vs.

#### *4.3.3. Replace General Subsidies with Cluster Need Based Support*

A particular policy shift require under the cluster development approach is the gradual removal of the generalised subsidies on fertilizer gas, water, and wheat which go to big companies and large farmers without addressing most critical issues at cluster level. These subsidies can be replaced with need-based and cluster-specific subsidies, such as establishment of certified nurseries and tissue culture labs, provision of certified seeds, building farm-storages, roads and kiosks, enhancing capacity of stakeholders, and the like.

## 5. Investment Requirements and Economic Viability

### *5.1. Major Opportunities*

The value chain mapping of various clusters through informal surveys of stakeholders' helped us not only to develop SWOT for each cluster, but also to identify the types of interventions and corresponding inputs and investment required to resolve the e issues and harness the identified potentials. Deriving from the SWOT, the following potentials at the country-level are identified for investment purposes, although these varied from cluster to cluster.

(i) Average per hectare yields of most commodities can be brought closer to the world average levels with the introduction of known high-potential crop varieties, fruit nurseries, and improved management practices,

(ii) Post-harvest losses can be reduced by 50 percent by introducing appropriate value chain infrastructure (such as collection centers/pack houses, farm storages, and reefers), which were identified separately for each commodity,

(iii) Export-production ratio can be brought near to the world average level in most commodities by introducing proper value chain infrastructure, training of stakeholders, and linking traders with international markets,

(iv) With the above infrastructure and capacity building programs, Pakistan's export price can also be brought near to the world average in most commodities,

(v) 10-15 percent agriculture products sold within the country can also pass through these infrastructures, which will bring the quality and prices of these at par to those of imported/exported quality and prices,

(vi) The value chain mapping also identified the potential of introducing mechanical technologies in certain crop operations,

(vii) Initially, it is assumed that 5-10 percent of the total produce of various commodities can pass through small-scale processing at the local level.

Fixing targets of each potential helped quantifying the revenue that would be generated from the CDBAT plan assuming the prices of fresh and processed products in 2019 obtained from published and unpolished secondary sources.

### *5.2. Investments to Harness the Opportunities*

The technical infrastructure requirements to achieve the above set targets at the focal point of each cluster were estimated in consultation with stakeholders, researchers, extension agents, and policy makers, and these are listed in Table 1. In this exercise, small scale infrastructure was preferred over large scale keeping in view resource constraints of farming communities.

In addition to the infrastructure, needs for establishing new research institutions or revamping the existing ones, capacity building of stakeholders, building linkages, networks, kiosks, incentivising modern nurseries, and implementation of need based extension programs were also identified in consultation with researchers and extension agents to achieve the targets.

Table 1

*Technical Infrastructure Required to Implement the CDBATP by Province*

| Infrastructure | Number of units required | | | | |
|---|---|---|---|---|---|
| | Total | Punjab | Sindh | Balochistan | KP+GB |
| Pack houses | 4160 | 172 | 1753 | 2214 | 21 |
| Harvesters | 1648 | 1532 | 74 | 12 | 30 |
| Planters | 3709 | 3693 | 4 | 8 | 4 |
| Driers | 1140 | 594 | 42 | 150 | 355 |
| Processing units | 1302 | 753 | 178 | 100 | 271 |
| Sugar GPS system | 4 | 1 | 1 | 1 | 1 |
| Juice/pulp/pure plants | 1437 | 864 | 330 | 161 | 82 |
| Porridge units | 12 | 7 | 0 | 5 | 0 |
| Tissue culture labs | 158 | 140 | 6 | 0 | 12 |
| Calf Fattening Units | 683 | 478 | 205 | 0 | 0 |
| Modern cattle market | 12 | 10 | 2 | 0 | 0 |
| Village level feed mills | 346 | 241 | 105 | 0 | 0 |
| Slaughter houses | 89 | 52 | 37 | 0 | 0 |
| Pasteurization Units | 598 | 385 | 213 | 0 | 0 |
| Milk product processing units | 596 | 393 | 203 | 0 | 0 |
| Oil extraction plants | 11 | 0 | 0 | 0 | 11 |
| Turbo Barn in tobacco cluster | 66 | 43 | 19 | 0 | 4 |
| Composed based LS Feed | 715 | 634 | 0 | 7 | 74 |
| Cold storage/reefers | 1 | 1 | 0 | 0 | 0 |
| Grand Total | 16688 | 9993 | 3172 | 2658 | 865 |

*Source:* Ali (2020)

### 5.3. Investment Requirements and Economic Viability

The physical infrastructure, institutions, capacity building, and government support requirements were converted into investments (in US dollar) using average unit price of each in 2019 which were obtained from various published and unpublished sources, suppliers and users of various infrastructures, institutions and services. The operational costs of running these infrastructures, institutions, and adopting advanced farm-management practices were also estimated from these stakeholders. These prices were assumed to remain constant over the period, and the costs were spread over the project life of five years. These investment costs and revenues at the focal point of each cluster were then grouped at the commodity, provincial and national levels.

The total investment requirement for the CDBATP is estimated to be US$1039 spread over a five year period (Table 2).[14] The public sector share in the investment would be 40 percent to provide incentives to the private sector for various investments, strengthening research, capacity building of stakeholders, networking of small farmers, and developing links with international markets. It is expected that these investments by the government will attract the remaining 60 percent investment in the private sector.

The establishment of small scale value chain infrastructure in rural areas and mechanisation of various crop operations will require about US$606 million, or 58.6 percent of the total CDBATP investment (Table 2). These investments on small-scale processing and value addition are critical to provide an 'industrial push' to generate 'small-scale industrial revolution' in rural areas, and to bring agricultural markets closer to farmers both of which will revamp the whole agriculture sector.

Table 2

*Investment (Million US$) by Type and Source Required to Implement the CDBATP*

| Item | Government incentives (Million US$) | Contri-bution (%) | Private Sector (Million US$) | Contrib-ution (%) | Total (Million US$) | Contri-bution (%) |
|---|---|---|---|---|---|---|
| Value chain infrastructure/mechani-sation/processing | 121.2 | 29.6 | 485.0 | 77.7 | 606.2 | 58.6 |
| Renovation of gardens | 40.9 | 9.9 | 131.9 | 21.1 | 172.4 | 16.7 |
| Research improvement | 91.6 | 22.3 | 0.0 | 0.0 | 91.5 | 8.8 |
| Capacity building of VC stakeholders | 87.2 | 21.3 | 0.0 | 0.0 | 87.3 | 8.4 |
| Loan | 61.6 | 15.0 | 0.0 | 0.0 | 61.6 | 6.0 |
| International marketing and linkages | 1.9 | 0.5 | 7.7 | 1.2 | 9.6 | 0.9 |
| PMU | 5.2 | 1.3 | 0.0 | 0.0 | 5.2 | 0.5 |
| Total | 409.6 | 40.0 | 624.5 | 60.0 | 1039.0 | 100.0 |

*Source:* Ali (2020).

It is not just establishing the processing and value addition units at the cluster level, investment requirements for the improvement in capacities of research institutes and stakeholders along the whole value chain (including organising Farmers Entrepreneur Groups (FEGs)), networking of stakeholders, establishment of certified

[14] Investment costs by various heads and revenues generated by the CDBATP investments are available at the cluster-and provincial levels of each commodity in the commodity reports posted at the PCP website (see https://www.pc.gov.pk/web/agriculture).

nurseries, distribution of improved planting materials, renovation of garden, and linking of traders with international markets were also identified (Table 2). All the investments would not only enhance per hectare yields of various crops at least equal to the world average level and reduce post-harvest losses, these will also enhance quality of the produce by improve processing and value addition in rural areas, improve trade, and reduce production costs of various operation.

To run the newly established small-scale processing and value addition units and to implement the improved management practices envisaged in the plan, huge operational costs will be required to the tune of US$5.7 billion just during the last year of the project. The investment on the development of AIC can produce US$1.8 billion of Net Present Value (NPV) in the country over the project period, and generate an internal rate of return (IRR) of 62 percent, higher than on any investment in stock market.[15] However, the key for the success of CDBATP is the capacity building of stakeholders along the value chain as well as of related institutions especially research and extension to deliver needed technologies.

## 6. INSTITUTIONAL STRUCTURE TO IMPLEMENT CDBATP

Project Management Units (PMUs) need to be established in the Agriculture Marketing Secretariats of each province under the Board of Directors chaired by the provincial additional secretary of agriculture marketing and consisting of members from the private sector willing to contribute in the cluster development program, NGOs, and technocrats. It will have the following units:

### 1. Planning and Monitoring Unit

Its functions shall be to (i) notify the high-value and high-potential commodity clusters where funds of the CDBATP can be invested, (ii) Identify or instigate if necessary the demand for quality products and Identify the inputs, technological, value addition, and processing required to harness such new or existing demand for quality; (iii) estimate tentative economic viabilities of the identified project with the help of professional staff with the unit or with the support of other organisation, (iv) prepare a detailed feasibility study and implementation plan after an FEG or individual shows interest in a project with the help of a professional team specifically hired short-term for this purpose. (v) identify the types of machines, infrastructure, human resources, and capacity building that will be required for each project, (vi) submit the project to the Board of Directors for approval, after FEG or individual agrees to pay their share of cost of the project, and (vii) monitor the progress of CDBATP projects and resolve technical issues in their progress with the help of its professionals from universities and research institutes.

### 2. Market Integration Unit.

The unit will work with farmers and FEGs to arrange the upward and downward linkages. It will continuously look into the opportunities to link farmers and FEGs with

[15] These numbers are also available at the cluster, commodity and provincial levels at https://www.pc.gov.pk/web/agriculture. The IRR at sector as well as at cluster-level are quite high mainly because of low investment levels on value addition and processing in AICs. Similar high estimates are reported in SAMEDA pre-feasibility studies, although our estimates are not comparable with those in SAMEDA studies which are for individual agricultural processing units. This in fact shows a big potential of investment on transforming ACCs.

downstream processing companies, supermarkets, exporters/importers, wholesalers, researchers and extension agents, and upstream input, credit, and information suppliers. The unit will establish links with potential buyers of FEGs products, collect information about international price, quality and demand trends, find potential new buyers, and communicate this with the relevant FEGs and farmers by establishing information-portals. The unit will hold trade shows to bring various stake holders together and arrange international trips for exporters. Initially it may promote informal and latter formal contracts with marketing and processing firms.

**3. Social Mobilisation Unit**

The unit will (i) collaborate with National Rural Support Program (NRSP) and other non-government organisations (NGOs) to formulate FEGs in various ACC, and register them according to the FEG ordinance/law to be passed by each provincial government, (ii) keep the record of FEG existing, retiring and new members, (iii) record the financial liability of each member that they will mutually and voluntarily agree upon, (iv) help the group and individual to select a project from the list of viable projects posted by the Planning and Monitoring Unit, and (v) act as an arbitrator in case any dispute arises between members during the implementation of the project.

**4. Financing Unit**

After a project is approved by the Board, the financing unit will (i) help FEGs to get group loans based on group collaterals from commercial banks, micro-finance institutions, NGOs, and the like. The unit can also incite other stakeholders like input suppliers, market agents, processors, exporters, to offer loans for the projects approved by the Board by accepting group collaterals, (ii) solicit the expression of interest from relevant firms to install the project and short list the qualified firms, (iii) request the FEG to submit its share of funds excluding subsidy to the selected firm and send its receipt to the unit, (iv) send the government share of the project cost to the selected firm, (v) keep the financial record of the project and present it to the management Board after every 3 months, and (vi) ensure the distribution of profits according to the contribution of each FEG member.

**5. Capacity Building Unit**

The CDBATP must ensure that all necessary information and training on production processes, record keeping, handling of the produce to comply with stringent quality standards, and so on are provided to all stakeholders along the value chain especially to FEGs members according to the need identified by the Planning Unit. For this purpose, it will identify the training resources and sign Memorandums of Agreements (MOUs) with the related institutes/universities. It will also hold workshops and training courses, and arrange international trips for capacity building of various stakeholders. The training modules will be prepared on various aspects common across different projects. The resources with Small and Medium Enterprises (SMEs) can be tapped, and MOUs can be signed with Lahore University of Management Science (LUMS), Institutes of Business Administration (IBA), Skill University Islamabad, Agricultural universities, and international consultants can also be arranged on need basis.

It is expected that these provincial PMUs in the provinces will ultimately become an independent full-fledged directorate of Agro-Business under the Agriculture

Marketing Secretariat, none so far despite the importance of agro-business in the development of agriculture sector.

## 7. SUMMARY AND CONCLUSIONS

Agriculture-based clusters (ABCs) can be divided into agro-commodity clusters (ACCs) that produce commodities without much value addition, and agro-industrial clusters (AICs) in which food quality concerns are addressed through proper value addition and processing. In Pakistan, analysis of 76 agriculture-based clusters suggests that most ABCs, with few exceptions, are ACCs. This is because the ACCs have largely failed to identify and communicate the changing demands for food quality, or stakeholders did not have capacity to introduce needed innovations to meet such demands. The links between research and cluster stakeholders are weak, and market failure has deprived cluster stakeholders with required inputs such as information, training, quality seed and seedling of modern varieties, value addition infrastructure, timely loans, and so on.

To create dynamism in ACCs, triggering demands for food quality is the first step which will induce innovation in the cluster to meet these demands. For this, efforts have to be initiated both on the supply and demand sides. In production, quality inputs have to be provided and stakeholders especially farmers, nurserymen, and wholesalers have to be trained to use new inputs to produce, process, and handle quality products. While on the demand side, food quality standards have to be defined and implemented. As few extension agents are aware of the protocols to use and handle new inputs and quality outputs, foreign consultants and NGOs may be involved to train the trainers.

The markets for quality products can be strengthened through branding, certification for food safety, holding and participation in food fairs, and the like. Production has to be harmonised throughout the cluster for branding, farmers need to be supported for certification, and they have to be linked with markets. Training of other stakeholders, especially wholesalers and traders, is equally important to maintain and enhance food quality during various processes in the value chain. Market infrastructure to maintain the quality, for example, farm storage and roads, auction houses, reefers and kiosk play important roles to maintain food quality.

The demand for food quality usually opens up new opportunities for value addition and processing. Vigilance would be required against hijacking these opportunities by large scale processing corporates in urban centers. Special strategies would be required to make the cluster-development based transformation small-farmers inclusive. One of the strategies can be to promote contract farming (CF), which can help to overcome market failures in input supply, spread price risk, and promote quality of the output through self-monitoring by members. The contractors may also help to build farmers' capacity to produce the desired quality products. Building regulatory framework especially setting arbitration system can help to build trust of both parties in getting engaged in contracts.

Another strategy to make the cluster transformation small-farmers inclusive is to organise producers' groups. The literature review on producers' grouping in Pakistan suggests that although farmers' are willing to cooperate when they are engaged in profitable ventures (Ali, 2022), they rarely take initiative to organise themselves into business groups (Horst and Watkins, 2022). Therefore, public sector initiatives would be required for social mobilisation to organise Farmers' Entrepreneur Groups (FEGs) around agro-processing opportunity to: (i) incentivise them to undertake combined small-scale businesses, (ii) provide technical and managerial support to run these, (iii)

link them with financial institutions and markets, and (iv) provide a legal framework which can protect farmers' investments in these businesses. The public sector support in linking FEGs with upstream and downstream industries will be key to enable them purchase required quality inputs and sell quality products efficiently. The support from existing public sector organisations and NGOs engaged in social mobilisation and capacity building may be sought for these purposes.

Experience from other countries suggests that providing special incentives at cluster level can induce transformation of ACCs into AICs. These incentives, which may include tax holidays, import protection, and even outright subsidies although with clear exit strategy, can be justified to first mover firms in an ACC to help them overcome the pioneering-risks. Linking innovation-generating institutions to cluster issues is fundamental. One of the strategies for this purpose could be competitive innovation grants (CIG) on a public-private partnerships (PPP) basis. Cluster-specific infrastructure requirements should be clearly identified and supported. Collective action by industry associations can sometimes provide such infrastructures but public sector incentives in the form of co-financing are often needed.

The biggest role of the state in developing successful AICs is to build a pro-active, agile and 'smart' government working in close partnership with the private sector at the cluster-level. The specific policies needed to transform ACCs are to develop regulations for efficient seed, seedling and output markets. In addition, laws to promote food quality in domestic market need to be formulated and implemented, and general subsidies should be replaced with cluster-need based support.

To make the productivity and quality produced in 76 clusters of 33 agricultural commodities just equal to the international level, reduce post-harvest losses by 50%, and enhance agricultural exports, a large number of economically viable investment opportunities are identified in this study, including establishing small scale value addition and processing units, capacity building of researchers and stakeholders along the value chains, renovation of gardens, establishment of the state of the art nurseries and tissue culture labs, networking of farmers and stakeholders, and others. It is estimated that a total of US$1.039 billion capital investment would be required to implement the CDBATP at the national level. The public sector share in total investment would be about 40 percent, which is mainly to give incentive to induce the remaining 60 percent investment in the private sector. In addition to capital investment, much liquidity to the tune of US$5.7 billion per year would be required in the hands of value chain stakeholders to run the newly created processing and value chain infrastructure and to adopt new management practices in production. The investment on the development of AICs will generate NPV of US$ 1.8 and IRR of 62 percent over the project period of five years. Building capacities of stakeholders to produce and handle the quality products would be the key in this transformation.

To demonstrate government's long-term commitment in cluster-development based agriculture transformation, Project Management Units (PMUs) are proposed to be established at the provincial levels to facilitate (i) need-based planning and monitoring new investments; (ii) market integration of stakeholders; (ii) social mobilisation of stakeholders; (iii) link stakeholders with financial services; (iv) monitor financial discipline of those engaged in cluster projects; and (v) capacity building of stakeholders.

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