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Are Small-scale Apple growers in Balochistan Cost Efficient? Empirical Evidence Using Data Envelopment Analysis (DEA)

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Abstract

Despite being the leading apple producing province of Pakistan and well known for its unique taste and quality of apple, yet the farmers of Balochistan have always been correlated with low socioeconomic indicators because of low productivity and profitability. Such support would not be effective unless farmers' managerial skills are improved. Keeping in view the potential of apple production in the province and the importance and need of efficiency analysis, this study estimates cost efficiency (CE) of apple production at exclusively farmers' conditions using data collected through a multistage random survey of 181 officially designated small farmers in Mastung district in Balochistan. An input-oriented Data Envelopment Analysis (DEA) methodology was employed to evaluate cost efficiency. The results elucidated that average cost efficiency of surveyed farms was 65.4% and cost efficiencies of large farms were significantly higher than that of medium and small farms. Among 172 cost-inefficient growers, their mean CE score was 65.6% for Katja and 60.8% for Red-delicious varieties, indicating that there is still ample scope for inefficient farmers to reduce cost on input-use by 34.4% and 39.2% in the said varieties, respectively, without compromising the given yield level just by using optimal input-mix following practices of their efficient counterparts. Maximum contributions to total savings were from labor, farm yard manure (FYM) and urea. An improved understanding of inefficiency can help farmers allocate resources more wisely and assist policy makers in designing agricultural programs to reach least cost goals.

Keywords: Cost efficiency, Small-scale apple farms, Better input-mix, Efficient resource allocation, Data Envelopment Analysis (DEA), Balochistan.

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1 Introduction

Balochistan is the leading apple-producing province of Pakistan, accounting for 92% of the total apple cultivated area and 83 % of the total apple production in 2012/2013. Pakistan had produced 598,804 tons in 2011/2012, of which 497,600 tons were produced in Balochistan (GoP, 2013). By virtue of favorable temperate climatic condition and suitable soils, apple produced in this province is well known for its unique taste and quality. Balochistan supplies the major proportion of the production to other provinces as well as other countries for export. Driven by the ever increasing domestic and international demand for apples, the area under apple had increased from 11,200 hectares in 1987/1988 to 95,482 hectares in 2012/2013, leading to a production increase from 105,000 tons to 461,279 tons during the respective years. However, the apple yield had decreased from 9.38 tons/hectare in 1987/1988 to 4.83 tons/hectare in 2012/2013 (GoB, 2013). There was a wide inter-district variation in the yield and technical efficiency (TE) of apple production (Murtaza, 2010; Murtaza and Thapa, 2015) and variation was present even at the farm-household level (Murtaza and Thapa, 2017). But yield-per-hectare figures are of little use when the amounts of non-land inputs (labor, FYM, electricity and fertilizer) used differ among farms. Similarly, simple cost comparisons do not tell us what part is due to the incorrect choice of input ratios, given the input prices faced by the farmer (cost allocative inefficiency).

Despite such huge potential, the agriculture sector of Balochistan has always been correlated with low socioeconomic indicators because of low productivity. To enhance productivity, generally, at least three measures are adopted: 1) improve farmers' productive efficiency, 2) enlarge farm size to enjoy scale economy, and 3) develop new technologies for enhancing productivity and profitability. According to Belbase and Grabowski (1985) and Khai et al. (2008) it was more cost-efficient to go with the first option with existing technologies rather than introducing new ones resulting in higher profit for farmers. Small-scale farmers face challenges such as the use of traditional technology, high input prices, inadequate credit and extension services, unstable market and poor distribution of agricultural inputs. These constraints play a major role resulting higher production cost and inefficient use of input mix. Assisting farmers to increase productivity has always been the agenda of agricultural policies in the developing word. For instance, in the case of Balochistan, the most common interventions are provision of agricultural credits and extension services and generous support, such as heavily subsidized electricity, has been provided for irrigation to boost agricultural production. Such support would not be effective unless farmers' managerial skills are improved, and their access to essential resources is guaranteed. One of the main reasons for the unsatisfactory returns from agriculture in developing countries is the failure of farmers to fully exploit the potential of available technologies and to allocate resources in an efficient way (Abatania et al., 2012; Piya et al., 2012; Umanath and Rajasekar, 2013).

The literature is scanty on studies of efficient use of inputs in fruit production in Pakistan. Efficiency analysis studies in Pakistan have predominantly been focused on agronomic issues or on annual crops (wheat, rice and cotton), all concluding that still there is room to improve efficiency (Ullah and Perret, 2014). Keeping in view the potential of apple production in the province and the importance and need of efficiency analysis, this study estimates cost efficiency of apple production at exclusively farmers' conditions using Data Envelopment Analysis (DEA). An improved understanding of inefficiency can help farmers allocate resources more wisely and assist policy makers in designing agricultural programs to reach sector-specific goals. To our knowledge, this is the first approach to estimate cost efficiency of apple production and influencing factors in Pakistan by applying DEA technique. In the next section we introduce the study area and our analytical framework, in section 3 the efficiency results and discussion is done and the paper is concluded with policy recommendations in section 4.

2 Materials and Methods

2.1 Study Area

The research was carried out in Mastung district (Figure 1), which is located in north of Balochistan plateau and is one of the leading apple producing districts of the province (SMEDA, 2009). In 2007/08, Mastung ranked top in terms of area (7,738 ha) and second in terms of production (51,700 tonnes) of apple. Covering an area of 5,896 km^2, the district is mountainous and its climate is characterized by dry, hot summers and cool winters, with an annual average maximum temperature of 28.4C^o and average minimum temperature of 3.6C^o.

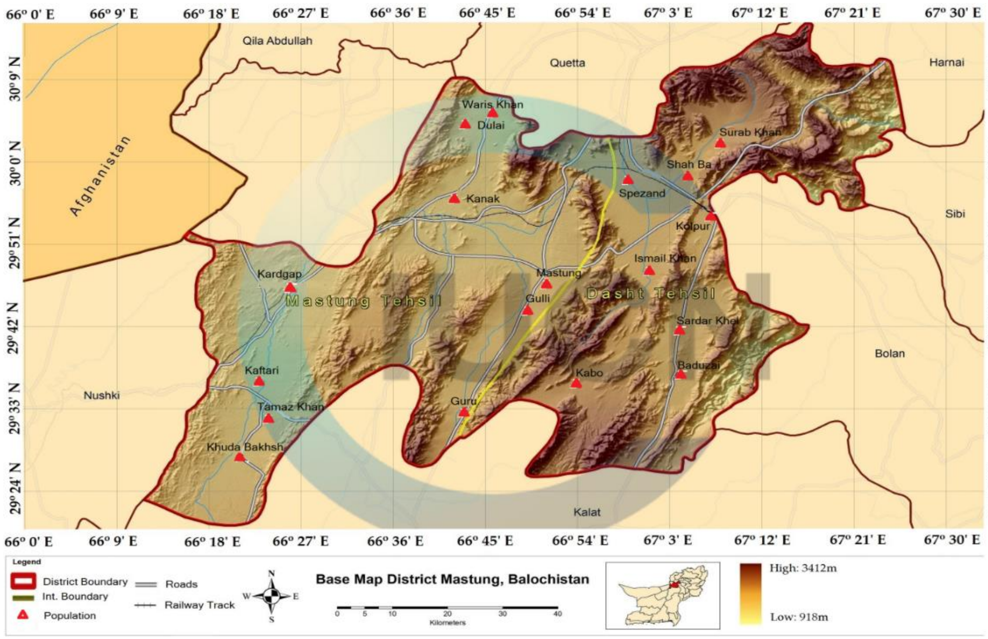

Figure 1: Base map of District Mastung (Adapted from IUCN Balochistan)

There is a wide variation between day and night temperatures, which is considered to be necessary for good apple yields. Rainfall is scarce and most of it occurs in winter from November to March during which snow also falls. The annual average rainfall amounts to about 165 mm. The soils in the valleys are deep gravel and loamy, suitable for fruits, wheat, vegetables and onion production (GoB, 2008).

2.2 Data Collection

Mastung district is administratively sub-divided into three *Tehsils*[1], namely, Mastung, Dasht and Kardgap. Each *Tehsil* has been further divided into Union Councils locally called *Patwar Halqa*[1]. Altogether there are 13 Union Councils in three *Tehsils*. In view of poor security situation in particularly Kardgap *Tehsil*, the field survey was carried out in six Union Councils of Mastung and Dasht *Tehsils*. A sample size of 194 was determined at the confidence level (z) of 95% using the method developed by Arkin and Colton (1963). A Multi-stage random sampling technique was used to determine farm households to be surveyed. Firstly, six Union Councils with relatively high intensity of apple farming were selected in consultation with the concerned *Patwaris*[1]. Then, 110 households from 18 selected villages of Mastung *Tehsil* and 84 households from 10 villages of Dasht *Tehsil* were randomly surveyed. However, 13 households were not included in the analysis because of incomplete information.

A reconnaissance was conducted in June 2011 to get the first author, who supervised the survey, acquainted with the study area and to collect information required for designing the research. The original English version of the questionnaire was translated into Urdu and was pre-tested to check possible flaws and inconsistencies. The questionnaire comprised questions related to landholding size, area and production by variety of apple, amount and cost of inputs used, access to credit and extension services. The questionnaires were administered to the heads of sample farm households with the assistance of the *Patwari* of the concerned *Patwar Halqa*. The household survey was conducted from the mid-May to late-August, 2012. Supplementary information was collected through semi-structured interviews from key informants including the manager of the Agriculture Development Bank and information on electricity price and subsidy for agriculture was collected from the regional office of the Water and Power Development Authority (WAPDA).

The State Bank of Pakistan considers farmers in Balochistan with landholdings up to 32 acre (or about 13 ha) as marginal farmers (SBP, 2010 pp:v). According to the latest agricultural census, 84% of farms in the province do not exceed 25 acre (GoP, 2010). In view of smallholders confronting with more production in developing countries (Thapa, 2009; Thapa and Gaiha, 2011), this research focused on officially defined small farmers. However, they were classified into three groups: lower-, medium- and upper-small farmers as there was a wide variation in their landholding size. Farmers with landholdings below 11acres were considered as lower-small farmers, 11-21 acres as medium-small and above 21 acres as upper-small farmers (Table 1).

Table 1: Distribution of small farmers by landholding size

Farmer Type (Area in Acre*)	Frequency	%	Mean	SD
Lower-small (Below 11)	65	35.9	7.55	2.135
Medium-small (11 - 21)	71	39.2	17.47	2.690
Upper-small (Above 21)	45	24.9	28.22	2.930
Total	181	100.0	16.55	8.405

Source: Field Survey 2012. *2.47 Acre = 1 Ha; SD= Standard Deviation

2.3 Methodology

2.3.1 Input-Oriented Data Envelopment Analysis (DEA)

In a relatively short period of time DEA has grown into a powerful quantitative analytical tool for measuring and evaluating performances of agricultural and non-agricultural enterprises. Because DEA requires very few assumptions, it has also opened up possibilities for use in cases which have been resistant to other approaches because of the complex (often unknown) nature of the relations between multiple inputs and multiple outputs involved (Cooper et al., 2011; Liu et al., 2013). Cost Efficiency (CE) of apple production was analyzed using *input-oriented* DEA method. CE reflects the degree of maximum feasible output from the use of a given bundle of inputs given the input prices (*output-oriented*), or the use of minimum feasible inputs mix (given prices) to achieve a given amount of output (*input-oriented*) (Dao and Lewis, 2013; Umanath and Rajasekar, 2013). Any researcher should select the input- or output-model based on what (inputs or outputs) are majorly under producer's control (Coelli et al., 2005; Ullah and Perret, 2014; Wang et al., 2013). In our case, the farmers controlled only the amount of inputs that they had access to (FYM, fertilizer, pesticides, labor and other costs). Thus, the *input-oriented* efficiency model was selected.

2.3.2 Empirical model

Charnes et al. (1978) developed a non-parametric input-based model known as Data Envelopment Analysis (DEA). This model assumes constant returns-to-scale (CRS). As a refinement of this model, variable returns-to-scale (VRS) was developed by Banker, Charnes and Cooper in 1984, that is why it's also known as BCC model (Banker et al., 1984). The distance of any farm-output to the frontier provides a measure of that farm's efficiency. Hence the variable returns-to-scale (or BCC) model envelopes more data and more options for improving efficiency (Cooper et al., 2007; Cooper et al., 2011; Kokkinou, 2012). In order to identify the best practices in minimizing total production cost while with current level of output (*input-orientation*) for apple production in the surveyed sample and looking for possible improvement suggestions in minimizing input-cost, the input-oriented DEA model was used as tool to assess farmers cost efficiency by apple variety and by farm size. Slack variables derived from the model were also studied to enable us to estimate potential reduction in input-cost creating room for some policy recommendations.

The cost efficiency (CE) can be calculated using a cost-minimizing model, where the cost (input quantity × Price) of each input per acre is used instead of the physical units for those inputs. The cost-minimizing approach leads to the CE of apple farms using a strictly positive vector of input prices "pi". The CE is the ratio of the smallest total cost of the input vector to the observed total cost of the input vector. The cost-efficient frontier (Equation 1) provides the minimum required expenditure to produce a given output. The problem of the farmer, therefore, was to select combination of particular inputs-mix which would minimize total input cost without compromising output (yield). Our sample included 181 apple farms assuming that any orchard "j" (j = 1, 2, 3… n) produces a single output "y_r" (apple yield) using a combination of six inputs x_{ij} (FYM, urea, pesticide, labor, electricity cost for running tube-well and miscellaneous costs) given their respective prices "pi" (Table 2). The CE of apple farms was obtained through solving the following *cost minimization linear programing* (LP) problem:

$$\text{minimize } C = \min(PiXi) \qquad \text{(Equation 1)}$$

Subject to following constraints,

$$-yi + \sum_{j=1}^{n} y_{rj}\lambda_j \geq 0\,, \qquad r = 1,2,\dots,s$$

$$xi - \sum_{j=1}^{n} x_{ij}\lambda_j \geq 0, \qquad i = 1,2,\dots,m;\ j = 1,2,\dots,n$$

$$N1\lambda_j = 1$$

$$pi, \lambda_j, y_r, x_{ij} \geq 0; \qquad for\ all\ i, j, r$$

Where pi is a vector of input prices for the ith farm and xi^* (which is calculated by LP) is the cost minimizing vector of input quantities for the *ith* farm, given the input prices pi and the output levels of yi.

3 Results and Discussion

3.1 Farm Household Characteristics and Apple Production

The average landholding size of the lower- medium- and upper-small farmers was 7.55, 17.47 and 28.22 acres, respectively. Apple was planted on average 5.77, 9.37 and 15.02 acres, accounting for about 78%, 54% and 47% of total landholdings of the respective farmer groups. Inputs consisted of organic farm yard manure (FYM), urea, pesticides, labor (both owned and hired), electricity for running tube-well and miscellaneous costs. Results of the analysis revealed that the lower-small farmers were using significantly higher amounts of inputs per unit of land than other two groups of farmers, resulting in the highest yield of apple (Table 2).

Table 2: Description of input costs and output gained for cost efficiency assessment by farm size

Variables	Farm Category						p-value *
	Lower-small		Medium-small		Upper-small		
	Mean	SD	Mean	SD	Mean	SD	
Landholding size (acres)	7.60	2.11	17.51	2.69	28.22	2.93	-
Inputs cost (Rs acre^{-1})†							
Farm yard manure	8272.69	7743.01	6123.24	4042.62	6329.56	6667.57	**0.103**
Urea	3430.21	2510.89	2689.31	2400.59	2203.55	1898.78	**0.022**
Pesticide	1115.47	519.66	803.73	414.18	649.66	360.51	**0.000**
Labor	17282.55	6952.65	15712.85	6583.54	13249.88	6166.30	**0.008**
Electricity costs	6862.10	2766.80	5296.53	2642.89	4822.05	3355.15	**0.000**
Miscellaneous Costs	4986.67	2583.82	4451.98	1912.97	3167.17	1558.56	**0.000**
Output							
Apple Yield (kg acre^{-1})	2874.98	1037.10	2710.55	1060.75	2523.02	994.45	**0.217**
No. of farms	65		71		45		-

Source: field survey 2012.

* Indicates the p-value of difference among means of each input/output variable by farm category.

† all inputs are at annual bases, and 94.50 Pakistan Rupees (Rs.) = 1 USD (reference period Jun 2012 to Aug 2012)

Apple farmers applied FYM along with urea; pesticides were sprayed two to five times. They were also applying a chemical for enhancing the red color of apple. Farmers used both household and hired labor to carry out necessary farming operations. The average share of household labor-use of lower-small farmers was significantly higher than other two groups of farmers. Tube-well irrigation was the common type of irrigation in the study area. On average, a tube-well irrigated about 11 acres. The area was significantly higher for Katja ($p < 0.10$) and for the upper-small farmers ($p < 0.01$). All farmers were using electric tube-wells to irrigate orchards. The upper-small farmers had installed 3-6 tube-wells in their orchards by virtue of their higher earnings and easy access to credit, while some lower-small farmers purchased half to one-third of the required water from fellow farmers who had installed multiple tube-wells. Water reached orchards mostly through traditional ditches wasting considerable percentage of it.

3.2 Cost Efficiency Analysis

3.2.1 Efficiency by Apple Variety

Table 3 summarizes the efficiency results obtained from *input-oriented* DEA model. The Mann–Whitney-U test was applied to test whether the differences in cost efficiencies between apple varieties were statistically significant. The results revealed that sample apple farmers under study were more cost inefficient. Based on the combined DEA model, the average cost efficiency (CE) of apple farming system in the study area was almost 65.4%, ranging from 23.5% to 100% with no apparent difference (p-value = 0.090) found between cost efficiency values of both apple varieties. However, average CE of Katja was (insignificantly) higher than that of Red-delicious. The reason behind such difference was mainly per acre over-utilization by latter variety growers that has offset the higher yield level. Only nine farms (barely 5%) appeared on the DEA model frontier i.e. were most efficient (with CE = 100) in the sample. More than half of both varieties (50.2% of Katja and 54.7% of Red-delicious farms) had CE score below average. Among 172 cost-inefficient growers, the mean CE score was 65.6% for Katja and 60.8% for Red-delicious varieties, indicating that there is still ample scope for inefficient sample farms to reduce cost on input-use by 34.4% and 39.2% in the said varieties without compromising the given yield level just by using optimal input-mix following practices of their efficient counterparts.

3.2.2 Efficiency by Farm Size

Table 3 also shows the estimated CE by farm size. The Kruskal-Wallis test was applied to test whether the differences in cost efficiencies by farm size were statistically significant? The analysis showed that the CE difference between lower-small and upper-small farms was significantly different at the 5% significance level. Nonetheless, the CE differences between lower- and medium-small; and between medium- and upper-small farms were not significant. Lower-small farms had lowest cost efficiency (61.4%, p-value < 0.01) than medium- (66.2%) and upper-small farms (69.9%). It implied that the latter farmer groups were showing superior performance by efficient minimum input-cost in hand. Consequently, the percentage of most cost inefficient farms was highest for lower-small farmer group. Taking only cost-inefficient farms into account, there was still room for cost efficiency improvement of about 39.8%, 35.3% and 33.0% for lower-, medium- and upper-small farmers either by using an optimal mix of inputs or by adjusting the production scale. Poor cost efficiency scores from lower-small farms were possibly attributed to the fact that, although the lower-small land plots produced (insignificant) higher apple yields, yet the (significant) per acre highest cost of almost all inputs caused them to appear inefficient. Almost same level of yield was achieved by the medium- and upper-small farmers with significant lower per acre input-cost. As a result, the highest percentage of efficient farms was observed in the medium- and upper-small farms.

Table 3: Frequency distribution and average cost efficiency scores by variety and farm size.

Cost Efficiency Class (%)	Variety				Farm size					
	Katja		Red-delicious		Lower		Medium		Upper	
	f	%	f	%	f	%	f	%	f	%
Less than 40	6	5.7	14	18.7	9	13.8	5	7.0	6	13.3
40-49	14	13.2	17	22.7	14	21.5	12	16.9	4	8.9
50-59	20	18.9	9	12.0	16	24.6	10	14.1	4	8.9
60-69	17	16.0	7	9.3	6	9.2	15	21.1	3	6.7
70-79	16	15.1	6	8.0	4	6.2	10	14.1	8	17.8
80-89	18	17.0	4	5.3	5	7.7	5	7.0	12	26.7
90-99	10	9.4	14	18.7	9	13.8	11	15.5	4	8.9
Efficient (=100)	5	4.7	4	5.3	2	3.1	3	4.2	4	8.9
Total	106	100	75	100	65	100.0	71	100.0	45	100.0

Mean CE (SD)*	**67.2[a] (18.48)**	**62.9[a] (24.18)**	**61.4[a] (21.54)**	**66.2[ab] (19.87)**	**69.9[b] (21.65)**
p-value	0.090†		0.091‡		

f= Frequency; †Mann-Whitney U-test, and ‡Kruskal-Wallis test at 0.05 level of significance.
* Distinct superscripts show statistical significance

3.3 Input Slacks and Potential Input Reduction

Analysis of positive and negative slacks obtained from DEA cost-model (Table 4) defined earlier gives an opportunity to investigate for potential reduction (or improvement) in input-cost per acre of apple to produce yield by variety and by farm category. Following *input-orientation*, a farmer can reduce its expenditure on an input by the amount of slacks (excess expenditure on an input) without reducing its yield if he manages to operate at fully efficient level.

The cost efficiency of a producer less than 100 indicates that, at present, (i) he is spending more Rupees on a particular input than required, or (ii) the inverse case. Therefore, it is preferred to advise realistic levels of input-use for inefficient farmers in order to avoid wastage of input-cost without dropping the yield level. The analyses of slacks highlight the observed actual input-cost for each input, the target input-cost and the percentage of excessive use in inputs for inefficient producers. Analysis showed that if the sources of cost efficiency were improved *i.e.* if all the farmers were 100% cost efficient, there appeared room to significantly reduce all input usage in both varieties and in almost all farm categories.

Table 4: Observed and target input-cost (per acre) and potential reduction in input cost by variety and by farm size

Varity/Farmer group	FYM	Urea	Pesticide	Labor	Elec. Cost	Misc. Cost
Katja						
Observed cost	6129.76	2759.90	869.36	14661.77	5480.46	4501.25
Target cost	5368.94	2381.10	760.48	11884.48	4874.94	4098.30
Potential Savings (%)	31.91	23.86	20.90	32.29	17.99	14.59
Farms using excess inputs	53	47	52	77	47	54

Red-delicious						
Observed cost	8100.67	2940.20	888.71	17080.99	6108.72	4074.85
Target cost	7222.86	2121.18	776.91	14372.05	5532.98	3581.95
Potential Savings (%)	33.46	30.95	13.81	38.53	20.10	17.55
Farms using excess inputs	27	38	35	34	25	38
Lower-small						
Observed cost	8272.69	3430.21	1115.47	17282.55	6862.10	4986.67
Target cost	7411.60	2740.34	965.41	13858.78	6117.53	4394.47
Potential Savings (%)	36.58	29.31	21.50	42.71	22.29	19.12
Farms using excess inputs	27	31	33	42	24	34
Medium-small						
Observed cost	6123.24	2689.31	803.73	15712.85	5296.53	4451.98
Target cost	5306.96	2177.53	710.01	12793.54	4769.16	3924.27
Potential Savings (%)	31.67	27.43	19.02	36.86	17.75	18.68
Farms using excess inputs	33	30	37	44	30	36
Upper-small						
Observed cost	6329.56	2203.55	649.66	13249.88	4822.05	3167.17
Target cost	5606.07	1750.16	571.49	11744.37	4343.71	3084.49
Potential Savings (%)	28.13	22.17	11.18	20.44	15.67	6.52
Farms using excess inputs	20	24	17	25	18	22

Table 4 showed that, overall, the maximum contribution to the total input-savings was 34.88% from labor-cost (note that opportunity cost had been considered for family labor), followed by cost on FYM (32.55%), and cost on urea (26.80%). These finding tend to support the widely held belief that farmers in developing countries are likely to over-exploit family labor, and hence operate inefficiently (Dhungana et al., 2004). It was interesting to note that Red-delicious and lower-small farms were major per acre recipients of all inputs cost, more specifically, in case of cost on labor, FYM, urea and cost on pesticides. Possibly this could have been the reason to attain lower cost efficiency level of these groups of farmers. In case of cost on labor, FYM and urea, as an example, lower-small farmers could have potentially saved on average 3424, 861 and 690 Rupees per acre, respectively, if those farmers had utilized efficient measures. Moreover, all inputs were used inefficiently by almost two-thirds of the farmers. Moreover, some of the farms were underutilizing the required inputs, meaning that those farmers were spending less Rupees on inputs per acre than the required level utilized by cost efficient farmers. Most number of underutilized farms was in urea where 41.4% of the cost inefficient farms were underutilizing urea fertilizer, followed by 28.2% in miscellaneous cost and 23.8% in pesticide spray.

4 Conclusion and Policy Recommendations

The apple farmers in the study area were more cost inefficient. Average cost efficiencies of Katja and Red-delicious were 67.2% and 62.9%, respectively. On farm size basis, upper-smallholders were most cost efficient (69.9%) followed by medium-small (66.2%) and lower-smallholders (61.4%). The reason being that upper-small holders were taking long-haul advantage over total input-cost resulting in minimum per acre cost than the rest of farmer groups (lower-smallholders were spending significantly high per acre cost to produce insignificantly high per acre yield). On per acre cost basis, apple farms under study were over-utilizing labor (24%, mainly family labor by lower-smallholders), FYM (22%) and urea (18%); Which suggested that these farmers, on the average, could proportionally reduce their current variable cost by 5486 Rs. acre^{-1} on labor, 1639 Rs. acre^{-1} on FYM and 1198 Rs. acre^{-1} on urea without any reductions in the output level. Overutilization seemed apparent over lower-small farms which was the reason of their lower techno-economic performance. The estimates of CE elucidated that majority of the sampled farmers either do not have the best technology available or are not utilizing the available technology efficiently. Any policy intervention directed at bridging this technology gap or lack of utilization of existing technology would improve the cost efficiency at all farm sizes. Currently, the provincial agricultural department's job is to provide agricultural extension services to farmers free of charge and timely arrangement of agricultural related trainings through the District Extension Office. However, any crop specific training was rarely conducted. Inadequate and unqualified extension workers had made the public extension service virtually ineffective in case of apple farming. Therefore, it is suggested to focus on farmers' capacity development through effective extension services and trainings. Positive steps need to be taken to promise access of extension workers to farm-gate in order to diffuse technology at experiment station to farmers' fields. This could be done by developing skills and training of extension workers (training of trainees), through on-farm demonstrations and through arranging timely trainings for farmers, shoulder-to-shoulder with farmer committees. The government needs to provide material and financial assistance to apple farmers to improve cost efficiency by making loans available and accessible to apple farmers.

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