How equipped are the regulated agricultural markets? evidences based on selected markets in Uttarakhand

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ABSTRACT

The study compared the status of market infrastructure across the selected regulated markets of Uttarakhand by market infrastructure development index computed for three categories viz., trade infrastructure, storage infrastructure and support infrastructure. Haldwani emerges as the best-equipped market as per the combined index (score of 0.62) and also outscores highest among the trade, storage and support infrastructural categories. Kashipur stands next in the category due to its better positioning in trade infrastructure while Dehradun scores low in the combined index due to poor trade and storage infrastructure despite standing second in the infrastructure support category. A positive and significant association was noticed between the commodity arrivals (potato and tomato) and market infrastructure categories. A panel regression analysis between potato arrivals, price, and market Dummies reveals that price has no time varying effect on the arrival of potato, but showed a significant and positive relationship between the markets and arrival reflecting the dependence of arrivals on market attributes.

Keywords: Regulated markets, market infrastructure, infrastructure development index, trade infrastructure, storage infrastructure, support infrastructure and Uttarakhand

Marketing infrastructure is vital for effective and efficient marketing improvement and is essential not only for the performance of various marketing functions and expansion of the size of markets, but also for transfer of appropriate price signals leading to improved marketing efficiency (Acharya, 1994). The inadequacy of market infrastructure has been the main reason for market imperfections. Inadequate market infrastructure leads to higher marketing costs and results in low share of the producer in consumer's rupee (Bala, 2009). Studies have reported that markets in India are devoid of basic market infrastructural facilities particularly for

perishable and high-value commodities. It has been reported that market arrivals have increased at a much higher rate than the growth in production, indicating a widening gap between the increase in marketed surplus and the number of markets (Chand 2012). The benefits received by the farmers by sale of agricultural produce in main and sub-yards of regulated markets vary from area to area because of the variation in their spread over the regions and availability of infrastructural facilities in the yards of these regulated markets (Acharya, 2004). Basic infrastructure facilities are the requirement for an agricultural market to prosper. Availability of different marketing infrastructural affects the choice of technology to be adopted, reduces the cost of transportation produces powerful impetus to production and also affects income distribution for small and marginal farmers by raising their access to the markets (Ahmed and Donovan, 1992). Infrastructure plays a strategic role in producing large multiplier effects in the economy with growth in agriculture (Mellor, 1976).

Marketing infrastructure is well developed in the states of Punjab, Kerala, Tamil Nadu, Haryana and Gujarat but continues to be weak in Eastern Uttar Pradesh, Bihar, West Bengal, Rajasthan, Orissa, Assam and parts of Madhya Pradesh; the farmers in the states with poorly developed infrastructural facilities do not get adequate price signals for adoption of new technology which may be a reason for lower economic status of farmers in these states (Acharya, 2004). For Indian agriculture to be globally competitive, it needs investment in infrastructure that can promote efficiency by reducing transaction costs and market risks. This requirement becomes much more intense in difficult terrains and remote areas. The larger part of the Uttarakhand is characterized by a steep terrain, undulating topography, isolated and inaccessible villages, sparse population, tiny land holdings, agriculture-based economy and weak market infrastructure. The topographical, infrastructural and environmental constraints do not allow proper utilization of resources available in the inner parts of this fragile region (Tuteja, 2013). Development of the hills is primarily linked to the development of agriculture and its allied activities, as the mountainous region of the country has tremendous potential for cultivation of many

high-value agricultural commodities. Uttarakhand is one such state with the dominance of agriculture and about 70% of the population depending on agriculture for their livelihood. Agricultural production is largely contributed by the smallholders (91%), the average land holding being around 0.68 ha. The consumption of large marketable surplus available with farmers is outside the state, and it further adds to the losses due to lack of proper infrastructure in the form of cool chains, pack houses, mechanized grading and packing machinery, efficient transportation/connectivity, markets, etc., (Tuteja, 2013). All these facts accentuate the need for a detailed study on the status of market infrastructure existing across various markets of the state. The detailed studies on the status of market infrastructure in Uttarakhand are practically non-existent. Considering this, the study takes a snapshot of market infrastructure across various markets in Uttarakhand and compares the relative functioning of selected markets among different categories.

DATA AND METHODS

The information related to market infrastructure variables along with arrival and prices of selected crops were obtained from various sources, viz., AGMARKNET, market committees, and state marketing department. The markets were selected depending upon the data and information availability regarding the market infrastructure. The absolute numbers of an infrastructural variable do not provide a clear idea about the relative position of a particular market. Thus, the market infrastructure development index was computed for comparison of markets regarding their standing in the infrastructure status. For this, the infrastructure variables were broadly categorized into three categories viz., trade infrastructure, storage infrastructure and support infrastructure based on the extensive infrastructure group information available at AGMARKNET portal. The broad methodological framework adopted by Patra and Acharya (2011) was used for calculation of infrastructure development index. These groups cover several infrastructural facilities, the details of which are presented in Box 1.

Box 1: Classification of market infrastructure

I. Trade Infrastructure	II. Storage infrastructure	III. Support infrastructure
Common covered auction halls	Storage Godowns	Market Office Building
	Rural Godowns	
Common open auction platforms	Commercial Godowns	Farmers' Rest Rooms
Farmers' markets		Canteen
Shops A[1]		Residential Buildings
Shops B[3]		Tea Shops
Shops C[3]		Common Utility
		Parking Facilities
		Banks
		Police & Security Posts

The infrastructure development index is computed as a weighted average of various components of marketing infrastructure services belonging to various categories, where the weights vary inversely to the variation of the infrastructure components. The detailed methodology runs as follow

Let X_{ij} be the value of the ith market infrastructural development indicator in j^{th} market, (i = 1, 2, 3,……. K; j = 1, 2, 3, ………, 15). The score for a given market infrastructure indicator/variable is given by the following equation:

$$Y_{ij} = \frac{X_{ij} - Min_j X_{ij}}{Max_j X_{ij} - Min_j X_{ij}}$$

Where, $Min_j X_{ij}$ and $Max_j X_{ij}$ are the minimum and maximum values of X_{ij} respectively. The scaled values of Y_{ij} vary from zero to one. A value of 1 indicates that the market is best in terms of given infrastructure category and the '0' value reflects that the given infrastructure facility doesn't exist in the market.

From the matrix of scaled values, Y = {(Y_{ij})}, the infrastructure development index for different markets can be computed as,

$$Y_j = W_1 Y_{1j} + W_2 Y_{2j} + …. + W_m Y_{mj}$$

Where, W_i is the weight of respective infrastructure indicator of infrastructure services subject to the condition:

$$0 < W_i < 1 \text{ and } W_1 + W_2 + W_3 + … + W_i = 1$$

Such that,

$$W_i = \frac{K}{\sqrt{Variance\ Yi}}$$

Where, K =

$$\left[\sum_{i=1}^{m} \frac{1}{\sqrt{Variance\ Yi}} \right]^{-1}$$

The infrastructure development index was calculated for three categories viz, trade, storage, and support infrastructure along with calculation of combined infrastructure development index. Thus, the weight for a given infrastructural category changed accordingly in the computation of category and combined index.

To test the hypothesis, whether arrivals in the markets are associated and induced by the status of infrastructure, the correlation and regression analysis was applied. The significance of correlation coefficient was tested using t-test. Arrivals in various markets are assumed to be determined by the crop production, prices, infrastructure, location, etc. When it comes to the choice of market, prices and other market-related effects become much more pronounced. To establish this, the arrival of one of the most important horticultural commodity of Uttarakhand, i.e., potato was regressed on prices and market dummies. In practical situations, it is not possible to include all relevant variables in the model due to measurement problems, insufficient degrees of freedom and many other reasons, thus, such situations might result in omitted variable bias. To overcome this, fixed effect and random effect models on panel data may be useful. The panel data of top five markets viz., Haldwani, Dehradun, Haridwar, Rishikesh and Vikasnagar, which covered more than 75% of potato arrivals in the state, was developed for ten years (2005-2014). The model was tested for fixed effect through F test and random effect through Hausman test. It is found that there is no random effect rather fixed effect exists. Accordingly following one-way fixed effect model was fitted to the panel data with Vikasnagar as the base dummy:

$$Y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon_{it}$$

Where, Y_{it} = Potato arrival in quintals in i^{th} market at i^{th} period

β_i = coefficients of respective variable

X_{1it} = Potato price Rs/quintals in i^{th} market at t^{th} period

X_2 = Dummy for Haridwar market (1 for Haridwar otherwise 0)

X_3 = Dummy for Haldwani market (1 for Haldwani otherwise 0)

X_4 = Dummy for Rishikesh market (1 for Rishikesh otherwise 0)

X_5 = Dummy for Dehradun market (1 for Dehradun otherwise 0)

ϵ_{it} = Error term and it follows IIDN $(0, \sigma^2)$

STATUS OF MARKETING INFRASTRUCTURE ACROSS MARKETS

The cropping pattern of any region is determined primarily by the agro-climatic conditions prevailing there. The markets located in U.S Nagar district (namely Rudrapur and Gadarpur) of the state capture maximum arrivals of the cereals, namely paddy, wheat, and maize. On the other hand major chunk of arrivals of horticultural crops is received in Haldwani and Dehradun markets. If a gradual trend towards commercialization and diversification of agriculture is to be sustained and promoted, rural infrastructure supporting trade in farm products and inputs and processing of the produce must be strengthened with an emphasis on its quality (Chengappa *et al.* 2012). Actual buying and selling of commodities take place in market yards and sub-yards of regulated markets, primary and secondary wholesale markets and rural markets/*haats* spread throughout the country. The construction of market yards, sub-yards, and creation of necessary amenities in them *viz.*, auction platforms, shops, godowns and rest houses directly affect the process of sale and are assumed to be positively associated with the farmer's realization (Acharya, 2004). Depending upon the availability of information, fifteen markets of the state were selected to analyze the situation of market infrastructure in the state. Further, agricultural markets of Uttarakhand were ranked based on the market infrastructure development index score. Infrastructural facilities present in different markets of Uttarakhand and their respective scores by infrastructure development index are presented in the following sections.

Trade infrastructure

The term 'infrastructure' is defined as the basic support system like permanent installation for undertaking agricultural marketing activities in any location to enhance the efficiency of the system (Sekhon and Rangi, 2007). Adequate market infrastructure helps in maintaining the quality of agricultural produce as well as in reducing the losses in handling. Trade infrastructure in the agricultural markets connotes the basic infrastructure required for facilitating the trade of agricultural commodities. The main components of trade infrastructure are common covered auction halls, common open auction platforms, farmers' market and the traders' shops to facilitate the trade. Different categories of shops exist to cater to the arrival requirements. A different category also exists where small platforms (with no sheds) are provided for smaller transactions. A very important initiative exists in terms of creation of farmers' markets (usually weekly markets), where small and marginal farmers have been provided space in the markets for direct marketing of their produce to consumers. Mostly, fruits and vegetables are traded in such markets; however, paddy, spices and some other commodities are also occasionally sold. This prevents the margin of smaller farmers being washed away in the long marketing chains.

Highest number of trade infrastructure facilities is present in Haldwani market followed by Haridwar market. Haldwani market comprises of four common covered auction halls, and 88 shop A, 95 Shop B and 150 Shops. The most important components of trade infrastructure are common covered auction halls and common open auction platforms. Auction platforms are created and established for assembling and trade of produce. Common covered auction halls were present in only seven markets of Uttarakhand. However, the size and handling capacity differs across markets. A large size common covered auction hall of 3600 sq mt

is available in Haldwani market, the remaining are relatively very small ranging from 49 sq mt in Khatima to with 1080 square mt in Sitarganj. Common open auction platforms exist in almost all the markets with significantly different numbers. Surprisingly Haldwani, which is relatively a superior market regarding trade infrastructure, has no open auction platform. Kashipur market has the highest number of common covered auction hall and Haridwar has the highest number of common open auction hall. For a drying and auction platform, the area required is worked out at 4 sq. mt. per tonne of daily arrival, the recommended size of each platform is 60m x 6m and accordingly number of platforms should be decided at suitable locations of the yard for better material management; for every 50 tonnes of auctioning material of a day, a covered auction hall of size 30m x 13m need to be provided (NABARD).

There is still lack of conducive market infrastructure facilities for the sale of agricultural produce. Several markets are still found to be poorly equipped to handle the agricultural produce; it is unfortunate that the existing numbers of regulated markets are not

sufficient enough to cater to the expanding agricultural production of the country (Saxena *et al.* 2015). The market committees need to examine and evaluate the arrival cluttering depending upon the seasonal gluts of major commodities arriving in the respective markets. A proper framework and plan regarding the size and location of auction plans needs to be developed for catering to the arrivals needs of agricultural produce. Plan regarding the arrival time of the produce can be decided for different commodities which can help in proper utilization of the auction hall.

The score for different trade infrastructure categories has been presented in Table 1. The specific information about the trade infrastructure has already been discussed earlier. The infrastructure score is important as it helps to understand the relative position of different markets for a given infrastructure category. Haldwani market out scores other markets and is the best in terms of existence of shops A and shops B. Kashipur is the best market in terms of common covered auction halls while Haridwar has maximum number of open auction halls. Sitarganj market has maximum number of farmers' markets.

Table 1: Market wise trade infrastructure in the state (scores)

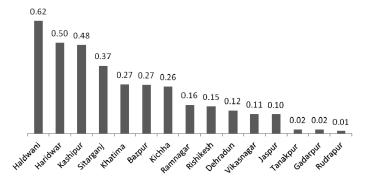| Markets	Common covered auction halls	Common open auction platforms	Shops A	Shops B	Shops C	Farmers' markets
Bazpur	0.25	0.02	0.17	0.42	0.17	0.54
Dehradun	0.00	0.79	0.00	0.00	0.00	0.00
Gadarpur	0.00	0.00	0.00	0.00	0.12	0.00
Haldwani	0.50	0.00	1.00	1.00	0.92	0.21
Haridwar	0.00	1.00	0.11	0.65	1.00	0.28
Jaspur	0.00	0.19	0.26	0.08	0.06	0.00
Kashipur	1.00	0.00	0.47	0.57	0.44	0.47
Khatima	0.75	0.02	0.18	0.13	0.31	0.27
Kiccha	0.63	0.06	0.23	0.27	0.25	0.15
Ramnagar	0.25	0.00	0.15	0.27	0.28	0.00
Rishikesh	0.00	0.42	0.26	0.00	0.12	0.07
Rudrapur	0.00	0.08	0.00	0.00	0.00	0.00
Sitarganj	0.38	0.10	0.32	0.21	0.18	1.00
Tanakpur	0.00	0.02	0.00	0.03	0.03	0.05
Vikasnagar	0.00	0.00	0.06	0.11	0.48	0.00

Source: Computed by authors

Fig. 1: Ranking of markets on the basis of trade infrastructure index

The composite score of all the markets for trade infrastructure was computed based on the methodology discussed earlier. On the basis of trade infrastructure, Haldwani market ranks at first position acquiring highest score (0.62) across the selected markets (Fig 1). Haridwar stands at second position with a score of 0.50 whereas; Kashipur and Sitarganj markets acquiring a score of 0.48 and 0.37 in the trade infrastructure stand at third and fourth position, respectively.

The Government needs to pay due attention to the markets which score very low in terms of market infrastructure index viz., Tanakpur, Gadarpur and Rudrapur. The studies have reported that only two third of the regulated markets are equipped with covered and open auction platforms; only one fourth of the markets have common drying yards (GOI, 2011). Though more than 7,161 market yards and sub-yards have been established in the country, there is considerable gap in terms of the facilities created in these yards. For example, even auction platforms are not available in one-third of these markets and common drying facilities are not available in 74% markets (Acharya, 2004).

Storage infrastructure

Storage infrastructure forms a necessary part of agricultural markets. Lack of inadequate scientific storage facilities causes heavy losses to farmers in terms of huge wastage of quantity and quality of crops in general and of fruits and vegetables in particular (Jairath, 2004). Ramesh (1999) reported that high wastage and value loss are due to lack of storage infrastructure

at the farm level. Food Corporation of India (FCI) has approximately 2 lakh MT of storage capacity in the state (as on February 2013) with utilization level of 82%; this includes 0.24 lakh MT of storage capacity hired by the FCI from the state Govt., 0.41 lakh MT from Central Warehousing Corporation and 0.49 lakh from the State Warehousing Corporation (Government of Uttarakhand). Besides, 15 cold storages have been set up in the state-1 by the cooperative sector, 2 by the public sector and 12 by the private sector and one Controlled Atmosphere (CA) storage (State Horticulture Mission, Govt. of UK).

Table 2: Market wise score of storage infrastructure in the state

Markets	Storage Godowns	Rural Godowns	Commercial Godowns
Bazpur	0.00	0.00	0.18
Dehradun	0.12	0.00	0.00
Gadarpur	0.00	0.00	0.11
Haldwani	1.00	0.14	0.00
Jaspur	0.27	0.00	0.00
Haridwar	0.00	0.00	0.00
Kashipur	0.12	0.00	0.18
Khatima	0.00	1.00	0.05
Kiccha	0.00	0.29	0.79
Ramnagar	0.20	0.14	0.00
Rishikesh	0.00	0.00	0.00
Rudrapur	0.01	0.00	0.00
Sitarganj	0.01	0.14	1.00
Tanakpur	0.00	0.43	0.00
Vikasnagar	0.00	0.14	0.00

Source: Computed by authors

As far as the storage infrastructure across markets is considered, the major storage infrastructure comprises of storage godowns, rural godowns and commercial godowns. The Rural Godown Scheme was started by the Government of India in 2001 with a capital subsidy to establish the godowns near to farmers' fields to prevent the distress sale and minimising the losses during the post-harvest handling, however, only 16 rural godowns were established in the market yards. Storage godowns were present in highest number with 81 in Haldwani

market, 22 in Haridwar, 16 in Ramnagar and 10 in Dehradun markets. Commercial godowns were present only in Sitarganj, Kiccha, Bazpur and Khatima markets with highest number in Sitarganj (38). The infrastructure score for different categories of storage infrastructure are presented in Table 2. The performance of Haldwani and Khatima was found best in terms of storage and rural godowns, respectively, while Sitarganj tops the list in terms of existence of commercial godowns. Despite receiving the bulk of horticultural produce like potato, tomato, apple, mango, no cold storages exist in the markets. Development of cold chain infrastructure is an utmost requirement of the time as significant proportion of fruit and vegetable production is wasted due to the post-harvest losses (Tuteja, 2013). This needs immediate attention of the policy makers and market officials to take appropriate action in this regard.

Haldwani ranks highest with a score of 0.41 among other markets in the state in terms of storage infrastructure also and followed by Khatima, Sitarganj and Kiccha markets with a score of 0.36, 0.35 and 0.33, respectively (Fig. 2); however, the score is less as compared to trade infrastructure. There is absolutely no storage infrastructure in Jaspur and Rishikesh, which is a matter of concern.
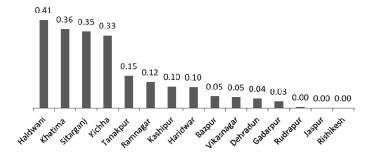

Fig. 2: Ranking of markets on the basis of storage infrastructure index

Processing infrastructure plays a vital role in minimizing the post-harvest losses, extending the shelf life and increasing the supply of value-added products; it is especially important for the state due to great potential for cultivation of high value crops like fruits, vegetables and spices. However, we could not get the details of processing infrastructure in the market yards except

mills. Many small groups in hills are functioning and involve in processing the commodities on a very small scale, where marketing remains a major constraint. The monopolistic operation of the market committee also acts as a disincentive to private sector in setting up processing unit for value addition, as they do not have direct linkage with the farmers, which would otherwise help them in getting raw materials of assured quality and quantity (Uttarakhand Perspective Plan, Undated). The amended APMC Act may provide entry to the private sector which may facilitate the processing activity also.

Support infrastructure

The support infrastructure in agricultural markets is essential for providing a congenial and comfortable atmosphere for the market participants specially farmers as they visit the markets from far off places for the trade of agricultural commodities. It includes the place for staying i.e., farmers' rest houses, food outlets like canteens and tea shops, the office paraphernalia to handle the queries and conflicts, banks to ensure smooth transactions, security and common utility services. Though Vikasnagar receives quite considerable volume of market arrivals, however, no support infrastructure has been reported in the market profile. Farmers' rest houses are essential important support infrastructure as, however, only a few markets have this facility. Further, the details on the functionality and capacity of these rest houses are not known. Haldwani market, like other infrastructure categories, outscores in terms of support infrastructure too (Table 3). Dehradun market is also found best equipped in many support infrastructure categories like farmers' rest house, parking, common utility etc.

Haldwani with a score of 0.84 ranks highest among other markets in support infrastructure facility, followed by Dehradun market (0.62). It is interesting to note that other markets like Ramnagar, Kichha and Rudrapur lie far below in score than Haldwani and Dehradun market (Fig. 3). All the other markets acquired low score with respect to the provision for support infrastructure and thus ranked very low.

Table 3: Market wise support infrastructure in the state

Markets	Farmers Rest Rooms	Canteen	Residential Buildings	Tea Shops	Common Utility	Parking Facilities	Banks	Police & Security Posts	Market Office Building
Bazpur	1.00	0.33	0.51	0.00	0.00	0.00	0.00	0.00	1.00
Dehradun	1.00	0.67	0.00	1.00	1.00	1.00	0.33	0.00	1.00
Gadarpur	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Haldwani	0.50	1.00	1.00	0.67	1.00	1.00	1.00	0.50	1.00
Haridwar	0.00	0.07	0.35	0.00	0.00	0.00	0.00	0.00	0.00
Jaspur	0.00	0.13	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Kashipur	0.00	0.40	0.65	0.00	0.00	0.00	0.33	0.00	1.00
Khatima	0.00	0.13	0.41	0.00	0.00	0.00	0.33	0.00	0.00
Kiccha	0.50	0.20	0.68	0.00	1.00	1.00	0.00	0.50	1.00
Ramnagar	0.50	0.13	0.41	0.00	1.00	0.00	0.33	1.00	1.00
Rishikesh	0.50	0.00	0.27	0.00	0.50	0.00	0.33	0.00	1.00
Rudrapur	0.00	0.20	0.00	0.33	1.00	0.00	0.00	0.50	0.00
Sitarganj	0.00	0.13	0.68	0.00	0.00	0.00	0.00	0.00	0.00
Tanakpur	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vikasnagar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

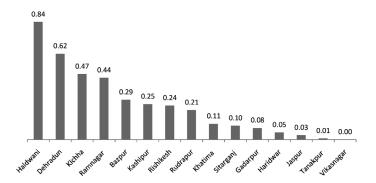**Source:** Computed by authors

Fig. 3: Ranking of markets on the basis of support infrastructure index

A combined index of infrastructural facilities has also been computed by combining all the market infrastructural indicators and exhibited in Fig. 4. The state has been divided into two regions viz, Kumaon and Garhwal; Haldwani and Dehradun emerge as the two most equipped marketing gateways of the two regions. Haldwani is the best equipped market as per the combined index (score of 0.62) and also scores

highest in all infrastructure categories. Kashipur stands next in the category due to its better positioning in trade infrastructure. Dehradun scores low in the combined index due to poor trade and storage infrastructure despite standing second in the support infrastructure category. Sitarganj and Khatima score quite low in the combined index despite relatively better storage infrastructure.
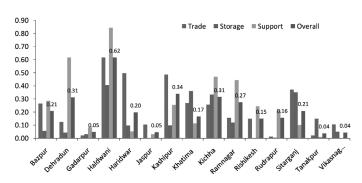

Fig. 4: Ranking of markets: Overall infrastructure development index

Box 2: Estimated Correlation Coefficients between crop arrivals and infrastructure

Commodities	Potato	Tomato
Trade infrastructure	0.63*	0.66*
Storage infrastructure	0.31	0.47
Support infrastructure	0.67*	0.60*
Overall infrastructure	0.73*	0.70*

*Significant at 5% level

WHETHER ARRIVALS ARE INDUCED BY MARKET ATTRIBUTES?

Box 2 shows correlation between different infrastructural categories and arrival of potato and tomato, which are important horticultural commodities of the state with highest arrival. A positive and significant association has been noticed between the commodity arrivals and market infrastructure categories, which indicate that arrivals are strongly associated with trade, support and overall infrastructure categories. A correlation coefficient close to 0.60 or above was observed in almost all the cases, except with storage infrastructure.

An attempt was made to quantify the relationship between potato arrivals, price along with the market attributes. Market dummies were included in the analysis to reflect the attributes other than price. A panel data regression analysis was carried out to find which market exerts more effect on arrival of potato (one of the most important horticultural crop of the state). The market dummies capture here the infrastructure position of the respective markets, convenience of the farmers and small traders in supplying the produce to the market along with the long terms relationship existing among the market participants. For this, five important markets viz, Haridwar, Haldwani, Dehradun, Rishikesh and Vikasnagar with highest arrival of potato were considered. Out of these Vikasnagar was taken as base/reference category, so its coefficient was omitted. Fixed effect (one way) model was considered for the analysis. Fixed-effect models are used when we have to analyze the impact of variables that vary over time.

Table 4: Relationship between potato arrival, price and markets

Variable	Estimate	Standard Error	Pr > |t|	Label
Intercept	214493.8	37558	0.6151	Intercept
X1 (Price)	31.39	48.92	0.5244	
X2 (Rishikesh)	-125054	34258.3	0.0007	Cross Sectional Effect 1
X3 (Dehradun)	13753	34663.2	0.6935	Cross Sectional Effect 2
X4 (Vikasnagar)	-195476	34516.6	<.0001	Cross Sectional Effect 3
X5 (Haridwar)	-69487	34322.7	0.0490	Cross Sectional Effect 4

Table 4 provides the panel regression coefficients among potato arrivals with its price and market dummies. Arrival-price relationship is a very complex kind of relationship as the two variables are found to affect each other. In this case, price has no time varying effect on the arrival of potato. However, significant and positive relationships among market attributes and potato arrival have been observed, which reflect that the arrival of potato crop is driven by the market attributes. Market attributes usually should capture broadly the convenience associated with the markets and convenience can be specifically described in terms of the infrastructural facilities available in the markets, farm-market connectivity, distance of the markets, networking among the marketing chain participants specially farmers and traders, marketing practices existing in the markets etc. As some of these are difficult to measure, the effect has been estimated in the form of fixed effects for the market attributes. As market infrastructure is one of the important constituents of market, thus, one may infer that arrivals in the selected markets may be driven by the infrastructural facilities.

The fixed effects for market attributes provide indications that, except Dehradun market, rest three markets (Vikasnagar, Rishikesh and Haridwar) receive

significantly less arrival as compared to Haldwani market. Dehradun receives 13753 quintals higher arrival of potato as compared to Haldwani market. This is also due to the reason that Dehradun, Uttarkashi and Chamoli contribute close to 50% of the total potato production in Uttarakhand. This is an interesting fact that Haridwar, Vikasnagar and Rishikesh, despite being the closer marketing destinations to the producing region, receive less arrival as received in Haldwani market. Indirectly, this establishes the importance of marketing infrastructure as Haldwani is the best market in terms of various kinds of marketing infrastructure like trade, storage as well as support infrastructure.

CONCLUSION

Adequate market infrastructure helps in maintaining the quality of agricultural produce as well as in reducing the losses in handling. Highest number of trade infrastructure facilities is present in Haldwani market followed by Haridwar market. The most important components of trade infrastructure are common covered auction halls and common open auction platforms. Common open auction platforms exist in almost all the markets, except Haldwani, with significantly different numbers. Kashipur market has the highest number of common covered auction hall and Haridwar has the highest number of common open auction halls. A proper framework and plan regarding the size and location of auction plans needs to be developed for catering to the arrivals needs of agricultural produce. On the basis of trade infrastructure, Haldwani market ranks at first position acquiring highest score (0.62) across the selected markets. Haridwar stands at second position with a score of 0.50 whereas, Kashipur and Sitarganj markets acquiring a score of 0.48 and 0.37 in the trade infrastructure stand at third and fourth position, respectively.

As far as the storage infrastructure across markets is considered, the major storage infrastructure comprises of storage godowns, rural godowns and commercial godowns. The performance of Haldwani and Khatima was found best in terms of storage and rural godowns, respectively, while Sitarganj tops the list in terms of existence of commercial godowns. Haldwani ranks

highest with a score of 0.41 among other markets in the state in terms of storage infrastructure also and followed by Khatima, Sitarganj and Kiccha markets with a score of 0.36, 0.35 and 0.33, respectively; however, the score is less as compared to trade infrastructure. There is absolutely no storage infrastructure in Jaspur and Rishikesh, which is a matter of concern.

The support infrastructure includes the place for staying i.e., farmers' rest houses, food outlets like canteens and tea shops, the office paraphernalia to handle the queries and conflicts, banks to ensure smooth transactions, security and utility services. Though Vikasnagar receives quite considerable volume of market arrivals, however, no support infrastructure has been reported in the market profile. Haldwani with a score of 0.84 ranks highest among other markets in support infrastructure facility, followed by Dehradun market (0.62). Haldwani is the best equipped market as per the combined index (score of 0.62) and also scores highest in all infrastructure categories. Dehradun scores low in the combined index due to poor trade and storage infrastructure despite standing second in the support infrastructure category.

A positive and significant association has been noticed between the commodity arrivals and market infrastructure categories, which indicate that arrivals are strongly associated with trade, support and overall infrastructure categories. The results of panel regression between potato arrivals with the price and market dummies reveal that price has no time varying effect on the arrival of potato. The fixed effects for market attributes provide indications that, except Dehradun market, rest three markets (Vikasnagar, Rishikesh and Haridwar) receive significantly less arrival as compared to Haldwani market. This is also due to the reason that Dehradun, Uttarkashi and Chamoli contribute close to 50% of the total potato production in Uttarakhand. This is an interesting fact that Haridwar, Vikasnagar and Rishikesh, despite being the closer marketing destinations to the producing region, receive less arrival as received in Haldwani market. Indirectly, this establishes the importance of marketing infrastructure as Haldwani is the best market in terms of various kinds of marketing infrastructure like trade, storage as well as support infrastructure. Thus, the Government needs to

emphasize the agenda on creating required infrastructure in the markets to facilitate the trade, minimization of wastages and enhancing the efficiency in marketing of agricultural commodities in Uttarakhand.

FOOTNOTE

1. Large shops, shops A (approximately 8*5 meter dimensions) cater to larger quantity and have higher turnover. Shops B (approximately 6*4 meter dimensions) and Shops C (approximately 4*3 meter dimensions) deal with relatively lower quantities as compared to Shops A (Source: Personal communication with mandi officials).

REFERENCES

Acharya, S.S. 2004. *State of the Indian farmer, A millennium study on. Agricultural Marketing*, Department of Agricultural and Cooperation, Ministry of Agriculture, and Academic Foundation, New Delhi.

Acharya, S.S. 1994. Marketing environment for farm products: Emerging issues and challenges. *Indian Journal of Agricultural Marketing* **8**(2): 162-175.

AGMARKNET. http://agmarknet.nic.in/amrscheme/markinfra033.htm (retrieved on 9 February 2016)

Ahmed, R. and Donovan, C. 1992. *Issues of infrastructural development: a synthesis of the literature.*: International Food Policy Research Institute, Washington DC.

Bala, B. 2009. Marketing efficiency of cooperative marketing societies in Himachal Pradesh: A case study of vegetables. *Indian Journal of Agricultural Marketing* **23**(2):99-108.

Chand, R. 2012. Development policies and agricultural markets. *Economic and Political Weekly* **47**(52): 53-63

Chengappa, P.G., Manjunatha, A.V., Dimble, V. and Shah, K. 2012. *Competitive assessment of onion markets in India*. Institute for Social and Economic Change, Bangalore.

GOI. 2011. Report of the working group on agricultural marketing infrastructure on secondary agriculture and policy required for internal and external trade for the twelfth five-year plan 2012-17. Agriculture division, Planning Commission, New Delhi.

Govt. of Uttarakhand 2016. State Profile: Agriculture marketing infrastructure in the state. *State Horticulture Mission website.* *http://shm.uk.gov.in/pages/display/6-state-profile* (retrieved on 12 February 2016)

Anonymous 2010. Uttarakhand State Perspective and Strategic Plan 2009-27. Water Management Directorate, Dehradun.

Jairath, M.S. 2004. Agricultural marketing infrastructural facilities in India. *Indian Journal of Agricultural Marketing* **18**(3): 52-61.

Mellor, J.W. 1976. *The new economics of growth: Strategy for India and the developing world*, Cornell University Press, Ithaca, New York, USA.

NABARD. https://www.nabard.org/english/regulatedmarkets3.aspx (retrieved on 17 February 2016)

Patra, A.K. and Acharya, A. 2011. Regional Disparity, Infrastructure Development and Economic Growth: An Inter-State Analysis. *Research and Practice in Social Sciences* **6**(2): 17-30.

Ramesh, A. 1999. Priorities and constraints of post harvest technology in India, *In JIRCAS International Symposium Series No. 7*, 5th JIRCAS International Symposium, Tsukuba, Ibraki, pp33-**43**: 9-18 September, 1999, Japan.

Saxena, R., Pavithra, S., Paul, R.K., Rana, S. and Pal, K. 2015. Market intelligence: Need and relevance. *Manual on Price Forecasting Techniques*, pp 1-7 Saxena Raka, Pavithra S, Paul R K, Chayal S and Chaurasia S. (Eds). ICAR-National Institute of Agricultural Economics and Policy Reserach, New Delhi.

Sekhon, M.K. and Rangi, P.S. 2007. Marketing infrastructure for sustainable development: Role of Punjab mandi board. *Indian Journal of Agricultutal Marketing* **21**(1): 111-121.

Tuteja. 2013. Agriculture profile of Uttrakhand. Research Study. *Agricultural Economics Research Centre.* University of Delhi, Delhi.