ARTICLES

Characteristics and Determinants of Contract Design of Wheat Seed Farming in India: A Basis of Decision Making

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I

INTRODUCTION

The post-WTO policy reforms in the field of agricultural trade induced changes in the institutional and market conditions that led to the entry of the private sector in agribusiness (Government of India, 2000) and brought a shift in the relative position of different players in the market. It has created sharp discontinuities in the role of the state and the functioning of the market. The agri-food marketing system is changing from adhoc transactions towards coordinated systems like cooperatives, producers' associations and contract farming (Birthal *et al.*, 2005). Strategic changes in farming have come from the demand side, while changes in consumers' preferences and emerging availability of new market instruments, viz., futures trade, supply chain, contract farming, etc., have come from the supply side along with a more market oriented approach due to the availability of wide wet grain market options. These supply and demand changes and regulatory policy have propelled farmers towards a reassessment of their production management. In this changing environment, the good news is that the process of change can become driving forces for India's agricultural development. The bad news is that if current leaders of the market institutions and the commodity associations do not manage to put the process of change into motion, then, change can be forced upon them. However, in sequel to this, agricultural contractual arrangements have varied over time and space depending on various social, economic, political, technological, agro-climatic factors etc. (Haque 1999).

The private seed sector growth in India was induced by the policy changes undertaken during the late 1980s by the establishment of public private participation in terms of joint ventures, technical collaboration and the entry of large domestic firms and Multi-National Corporation (MNCs) (Singh, 2004).

The Haryana State Seed Certification Agency (HSSCA) is the nodal agency for the certification of seed farmers of public and private sectors. The contract farmers of

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both sectors have to register themselves with the HSSCA for getting their seed certified as per standards. In addition, the role of capital and management of seed business firms in contract farming have motivated them to search for novel contract characteristics to be embedded in the contract designs of seed farming in conformity to the flexibility of market and farmer friendly policies.

Developing, maintaining and re-establishing business relationships are usually conditioned by unique contextual specificity (Goel and Bhaskaran, 2007). Contracts designed according to mechanistically oriented principles will be radically different from contracts designed according to motivationally oriented principles. This seemingly irreconcilable trade off between the two approaches led to a dichotomy – contract efficiency or satisfaction. Several challenges like the conflicting constituent need for contract design, the complexity of business organisation and the practical realities of the farmers' field situations remain for practitioners attempting to implement contract design changes. The varying configuration of contract attributes that are offered to farmers by the public sector and private sector separately and asked them to work as per instruction and guidance of implementing agencies are known as public contract design and private contract design, respectively. These contract designs of public and private sectors are fully legally vetted systems for seed production prevailing in the state as a policy of the Haryana State Seed Development Corporation.

In this backdrop, the study deals with specific issues, first, to examine the extent to which the characteristics of contract design are responsible for differences between the public and private contract designs; secondly, to study the comparative adaptability of the prevailing public and private contract designs and lastly, to discern and quantify the determinants of the public and private contract profiles in wheat seed farming. The knowledge emanating from this study would be of help to all stakeholders in the contract seed farming business as they try to attain conflicting outcomes such as the efficiency and satisfaction of the farmer, especially to policy makers, planners and business entrepreneurs. Further, it would help in aligning their contract design structures and business strategies to prevailing and anticipated changes in the business environment.

II

METHODOLOGY

Data Sources

The purpose of contract design is to ensure the realisation of reasonable expectation of stakeholders engaged in seed business activities. A contract design can be described by the characteristics that generate satisfaction or dissatisfaction to farmers. The attributes of contract profiles of contract regimes and preferences of farmers falling in prevailing public and private contract designs (Appendix 1) of wheat seed farming in Haryana state were collected through the personal interview

method. The data pertains to the year 2002-03. The Haryana state having an area of 4.4 million hectares is divided into two agro-climatic zones, viz., the north eastern and south western zone (Anonymous, 2002). Two districts, i.e., Karnal from north eastern and Hisar from south western zone were selected based on the concentration of the wheat crop. Eighty farmers supplying wheat seed to the public sector and an equivalent number of farmers hooked to the private sector were selected randomly. Equally 160 non-contract farmers of wheat grain were selected randomly from the adjoining areas of contract growers for the study.

<center>III</center>

<center>ANALYTICAL TOOLS</center>

Discriminant Analysis

The pair-wise ranking technique was used to select the relatively highly preferred contract attributes. The rationale of doing so was to ensure that most contract farmers would have had an opportunity to deal with more than one of the contract designs that differ in their specific characteristics. The farmers were asked to identify the attributes of contract designs that they considered important in meeting their objectives, while taking into consideration their prevailing local and other business conditions. To analyse such data sets, discriminant analysis (Hair *et al.,* 2007) is used (1) to identify a linear combination of quantitative predictor variables that best characterises the differences between the groups; (2), combining information from two or more variables that may greatly enhance the separation of groups; and (3) to examine the distribution of each variable individually when the groups of variables overlap and thus there appears to be no separation.

Since discriminant analysis assumes that the distribution of the independent variables is multivariate normal, to look at distributions to ascertain the credibility of the assumption, stepwise method of minimisation of Wilks' lambda (λ) is used for the analysis because the discriminant function can discriminate reliably between the two groups on the basis of performance on the independent variables. Moreover, discriminant analysis involves deriving a variate. The discriminant variate is the linear combination of the two (or more) independent variables that will discriminate best between the two regimes. Discrimination is achieved by calculating the variate's weights for each independent variable to maximise the differences between the two regimes defined by sector (Z_{jk}).

The variate for a discriminant analysis is known as the discriminant function. The form of discriminant function is:

$$Z_{jk} = a + W_1 X_{1k} + W_2 X_{2k} + \text{----------} + W_n X_{nk}$$

Where
Z_{jk} = discriminant score Z of discriminant function j for object k.

a   = intercept,
W_i = discriminant weight for independent variable i,
X_{ik} = independent variable i for object k.

Discriminant analysis is the appropriate statistical technique for testing the hypothesis, whether the group means of a set of independent variables for two or more groups are equal. By averaging the discriminant scores for all the individuals within a particular group, we arrive at the group mean referred to as a centroid. The centroid indicates the most typical location of any number from a particular group, and a comparison of the group centroids shows how far apart the regimes (groups) are in terms of that discriminant function as outlined in Hair *et al*., 2007.

Logit Model and Hypothesis

The preference of farmers in varying characteristics of contract designs of public and private sectors was a dichotomous-dependent variable. The farmers were put into two groups, viz., (i) public sector contract farmers and non-contract grain farmers; and (ii) private sector contract farmers and non-contract grain farmers, for discerning the determinants of contract adoption. The logit model based on logistic cumulative distribution function (McFadden, 1974 and Madala, 1983) is used. This analytical tool is aptly useful in situations where the researcher either did not have enough information to decipher how the actual decisions were made or were just interested in understanding the relative importance of determinants likely to affect such decisions in a probabilistic sense. The combined effects of seed business environment and context can influence the perception of the farmer regarding the choice of different contract regimes. A code sheet for the description of explanatory and corresponding binary (prefer or not) variables requires a prior selection of key variables, used in the model as shown in Table 1. To analyse the dichotomous variables, classical linear methods are inappropriate as they can lead to heteroscedasticity variances. This problem is typically remedied by using maximum likelihood estimation (MLE), although heteroscedasticity in MLE is also a potentially serious problem leading to inconsistent estimators (Greene, 2000). Since logit and probit models with flexible functional forms in the independent variables tend to work well and provide parameter estimates which are asymptotically consistent, efficient and Gaussian so that the analogue of the regression t -test can be applied (Pindyck and Bubenfeld, 1981).

The logit model is

$$Y_i = f(G_i) \qquad\qquad\qquad ....(1)$$
$$G_i = \beta_o + \Sigma\beta_k . C_{ki} \qquad\qquad\qquad ....(2)$$

Where

Y_i = The observed response of the i-th farmer (i.e., binary variable);

Y_i = 1 for adoption of contract wheat seed and Y_i = 0 for non-adoption of contract wheat seed,

G_i = an underlying and unobserved stimulus index for the i-th farmer. (Conceptually, there is a critical threshold (G_i^*) for each farmer, if $G_i < G_i^*$, the farmer is observed to be a non-contract adopter, if $G_i > G_i^*$, the farmer is observed to be a contract adopter),

f = is the functional relationship between field observation Y_i and the stimulus index G_i which determines the probability of choice of contract production,

C_{ki} = The k-th explanatory variable of i-th farmer,

i = 1,2,3,….. n , where n was the number of farmers,

k = 1,2,……..m, where m was the total number of explanatory variables,

β_o = Constant and β = Vector of coefficients.

TABLE 1. DESCRIPTION OF VARIABLES AFFECTING FARMERS' CHOICE IN DEVELOPMENT OF CONTRACT DESIGNS IN CONTRACT WHEAT SEED FARMING

Variable (1)	Unit (2)	Description (3)	Mean (4)	Standard deviation (5)	Expected sign (6)
AGE	Binary	Age of the household If less 45 years = 1, else = 0	0.43	0.069	-
EDU	Ordinary	Education of the head of the household If less high secondary school = 1, Graduation = 2, Post Graduate = 3	1.46	0.120	+
OHOLD	Binary	Operational holding If seed farm size criterion = 1, else = 0	0.14	0.132	+
OFINCOM	Ordinary	Off-farm income, If Rs. 10,000 = 1, Rs. 10,001 to Rs.15000 = 2, Over 15001= 3	1.60	0.119	+
EXTC	Binary	Extension contact If yes=1, else=0	0.11	0.23	+
PRATIO	Ordinary	Ratio of contract and open market price If less 8 = 1, 8.1 to 16 = 2, Over 16 = 3	1.97	0 .68	+
TC	Binary	Transport cost vis-à-vis distance If reimbursed Yes = 1, else = 0	0.45	0.092	?
CFCOST	Binary	Certification cost If yes = 1, else = 0	0.48	0.13	-
TRANCOST	Binary	Transaction cost If yes = 1, else = 0	0.68	0.59	-
PQTO	Binary	Physical quantity take off, If limit = 1, else = 0	0.38	0.24	?
SPART	Binary	Social participation If yes = 1, else = 0	0.58	0.42	+

Source: The author's own field survey and official records of HSSCA, Panchkula, Haryana.

The logit model postulated that P_i, the probability that i-th farmer preferring contract regime, was a function of an index variable G_i summarising a set of the explanatory variables. Here G_i was equal to the logarithm of the odds ratio, i.e., the ratio of the probability that the farmer preferred contract regime to the probability

that he did not prefer and it could be estimated as a linear function of explanatory variable (C_{ki}). This could mathematically be expressed as Equation (3):

$$G_i = \ln\left[\frac{Pi}{1-Pi}\right] = \beta_o + \Sigma_{k=1}^m \beta iCki \qquad ....(3)$$

Equation (3) was the logit model (Pindyck and Rubinfeld, 1981); and once this equation was estimated, P_i could be calculated as :

$$Pi = f(Gi) = f(\beta o + \Sigma \beta iCi)$$
$$= \frac{1}{1 + e^{-zi}}$$
$$= \frac{1}{1 + e^{(-\beta_o + \Sigma_{k=1}^m \beta iCki)}}$$

Where 'e' represents the base of the natural logarithms and appropriately equals to 2.718.

Hypothesis

Age of the Household Farmer: Age of the farmer has deterred contract undertaking. It means with the increase of the age of the farmers, the option of choosing contract production decreases. Moreover, flexibility and exertion are associated with the preference for work. Hence the expected sign is negative.

Education of the Farmer: Terms and conditions in the contract are laid down in agreement well in advance with the object of the realisation of the reasonable expectation of the parties involved in contract farming. Education of the farmers plays an important role in understanding and implementing the contract seed programme. Hence it is anticipated to be positive with the adoption of contract farming.

*Operation Holdings***:** Public sector business firms contract the farmers of medium and large size of holdings because they have the capability of quality seed production on a large area due to less transaction cost and their better financial position. The firms of private sector contract all categories of farmers irrespective of their size of holdings but these should be in a compact area to reap the benefit of scale of economies of seed certification costs and other transaction costs. Hence landholding size of contract farmers is expected to be positive.

Off Farm Income: Contract farmers, who have additional off farm income, reduce their need for financial support from the business firms. This variable is positively related with quality seed production with available infrastructure and facilities at the disposal of the farmers.

Extension Contact: Number of times the representative of the business firm made visits to the farmer's field and the implicit involvement of the business firm in various stages of crop growing activities, is a proxy used to provide incentives in the form of know-how to induce the grower to make the necessary level of efforts to produce crop of a desired quality. Hence a positive sign is anticipated.

Ratio of Contract and Open Market Price: Incentive price motivates a farmer to enter into a contractual arrangement with a business firm. The mutually agreed ratio of contract and open market price employed in a contract will reflect not only a trade off between the firm and the farmer against various forms of risks but also offered the farmer to meet the extra cost incurred by him in producing the desired level of quality of produce. This is expected to have a positive relationship between the price and the quality of seed.

Transport Cost: This is a part of the marketing cost. Contract seed production sites of the public sector are located far from the seed processing plant. But in the case of private contract farming, production sites are located around the processing points most preferably in the compact area near the processing plant. Hence it may take either a negative or positive sign depending on a farmer's preference for getting a reimbursement of transport cost.

Certification Cost: As the size of the seed crop cultivated area goes on increasing, the fixed costs for seed certification and seed testing as per agreement goes on spreading more and more on per unit of output. Hence the certification costs tend to be inversely related with the size of the seed cultivated area.

*Transaction Costs***:** These are the cost of establishing and administering the business within and between firms or individuals, including those costs associated with opportunistic behaviour and haggling ex-post. It also includes the costs of writing and enforcing contracts. Hence the transaction cost is negatively correlated with the size of the seed crop area.

Physical Quantity Take Off: The public agency (HSSCA) has put a maximum limit of 18 quintal seed per acre for its acquisition from the farmer for seed production agency; whereas farmers hooked to private seed firm had no such limit on per acre basis and acquire the whole produce. Hence the reaction is mixed.

Social Participation: Farmers are not participating in any formal social organisation leading to zero participation and vice versa. They have begun to function in an organisation which provides strengths and assistance in exploiting new business opportunities by ways of forming business networks and contacts through co-operatives, farmers clubs, personal connections, etc. It has contributed increasingly to the manifestation of contract farming preference. The farmer believes that participation in contract farming gives him identity and reflects his social status in the farming communities. Hence the expected sign is positive.

IV

RESULTS AND DISCUSSION

The socio-economic characteristics of the sample farmers are presented in Table 2. Age-wise there was not much difference between the farmers of public and private agencies. The average ages of contract farmers of public agency and private agency were of 45 years and 42 years respectively but the age of non-contract farmers was 53 years. Accumulation of knowledge via education in human beings is an important factor of economic development. The comparison of average education status of the contract and non-contract farmers of wheat seed showed that farmers under both contract regimes had attended secondary school, whereas independent farmers had attended school up to the eighth standard. Contract farmers being younger and more educated compared to non contract farmers could gain from available technologies and assured markets using appropriate institutional structures like contract farming. The average operational holding size of the farmers with public and private seed agencies and independent category were found to around 6.5 hectare, 1.65 hectare and 1.23 hectare respectively. This shows that private seed agencies were indiscriminately opting for farmers of all categories. Besides this, government seed agencies were giving production programme to the farmers with landholdings of minimum 5 acre. The contract farmers of public seed agencies have almost double the size of off-farm income of private seed agencies and have almost 4 times the size of off farm income of non contract farmers. This deciphered less reliance of contract farmers on the source of farm income. The family size of non contract farmers was the highest followed by farmers of private agencies and public agencies. As per survey data, livestock was the major component of the existing farming system in the study area. The livestock population was 2.14 per hectare of the farmers with public agency followed by private agency but it was the highest with independent farmers. Transaction costs in input-outputs markets and other compliance measures of contract increase with the complexity of the performance of the contract. The per hectare transaction cost of public seed agency was almost 5 times more as compared to that

TABLE 2. PROFILE OF FARMERS' SURVEY

			(mean value)
Item	Public agency	Private agency	Non-contract farmer
(1)	(2)	(3)	(4)
Age of farmers (years)	45	42	53
Education (years of formal education)	13	12	08
Operational holdings (ha)	6.50	1.65	1.23
Off-farm income of household (Rs./annum)	62000	38650	18526
Family size	4.16	4.68	6.25
Total animals (No. /ha)	2.95	3.47	4.66
Transaction cost (Rs./ha)	165	35	368

Source: Field survey, 2002-03.

of the private seed agency. On the other hand, the per hectare transaction costs of non-contract farmers were almost 10 times and 2.5 times more than that of the contract farmer of private and public seed agencies respectively. To overcome transaction costs, vertical integration with farmers was reported to by the private contract agency in the state.

The contracts differ in their nature and effect due to the variations in the nature of crops, contracting agencies, farmers, crops technology, and the context in which they are practiced (Singh, 2004). The attributes of contract designs of public and private sector are discriminated depending upon the preference given by the farmers. A comparative analysis of a group of contract designs provides to the farmers not only an opportunity to examine the reasons for the persistence of contract attribute preference but also to understand how far the public and private contract designs differ with respect to these attributes. The results from the discriminant function applied for contract designs of public and private sectors are presented in Table 3.

TABLE 3. STATISTICS OF THE DISCRIMINANT FUNCTION

| Discriminant function (1) | Discriminant variable (Wilks' lambda) (2) | Centroids | | F (5) | P (6) |
		C1 (3)	C2 (4)		
1	3.74	16.03	-15.59	213.35	0.001

C_1 = Centroids of the public contract design,
C_2 = Centroids of the private contract design,
F = difference between public and private designs expressed by Fisher test,
P = degree of error.

Centroids in the discriminant space are apart for 31.62 of the standard deviation. The value of the discriminant function expressed by F-test shows statistical significance as F =213.35. This infers that there is a statistically significant difference in public- private contract designs. Hence the hypothesis that there is a difference in the attributes of contract designs of public and private contract profiles- can be accepted with a degree of error P = 0.001. The findings of Singh, 2004 lend support to the arrived conclusion that the contracts of private agencies are brief thereby providing scope for disputes and also offer more differentiated, quality based prices, incentive and faster payments and are quicker in dealing with issues like lifting of rejected seed from the processing plant. But the public agency contracts are of longer duration and have more stringent acreage conditions and also offer more benefits to the farmers in terms of input provisions and service orientation. Shiva and Crompton, 1998 revealed that the contract systems adopted by different seed companies differ in their provisions so far as the relationship with the farmer is concerned.

Not all variables of contract designs participate in discrimination between two mentioned regimes of contract wheat seed farming system. Eight out of the eighteen variables statistically significantly participate in the creation of the discriminant function. These variables participate in the differentiation of the contract design of public and private sectors with the highest discrimination coefficient and the correlation coefficient with discriminant function as shown in Table 4. The highest value of the standardised discriminant coefficient for a variable indicates the most pressing attribute in discrimination between these contract regimes. The higher is the discriminant coefficient and the correlation coefficient with the discriminant function, the higher is the power of discrimination of that coefficient. The positive and negative signs of the discriminant coefficients indicate the farmers' preference and non-preference of the attribute of contract designs. The probability of the univariate F ratios indicates when the attributes are considered individually. The discriminant function uses the information in all independent variables and does a better job than any one independent variable.

TABLE 4. RESULTS OF DISCRIMINANT FUNCTION

	Univariate F Ratio		Standardised discriminant coefficient		Correlation variable with discriminant function
Variable (1)	F Ratio (2)	Probability (3)	(4)	Rank (5)	(6)
Ratio of contract and open market price	6.84	0.02	0.308	1	0.668
Quantity of produce	5.67	0.05	-0.154	5	-0.263
Mode of payment	4.10	0.03	-0.065	6	-0.164
Reimbursement of transport cost	3.84	0.04	0.016	8	0.182
Timely certification procedure	3.96	0.07	0.216	3	0.432
Timely seed take off by firm	3.88	0.25	-0.064	7	-0.132
Technology backup to farmer	6.11	0.05	0.314	2	0.651
Adequate financial support	5.32	0.03	0.196	4	0.377

Relative Importance of Attributes of Public and Private Contract Profiles

The relative importance of the individual attribute in the complete attribute profiles of public and private contract regimes would vary across policy context. Different discriminating powers of the attributes of contract profiles reveal the inclination of the farmers towards attributes entrenchment across the contract régimes.

The ratio of contract and open market price better satisfies the requirement of farmers in the public contract regime than in the private contract regime. The value of standardised discriminant coefficient is 0.308 which is the highest and statistically

significant at p = 0.02. This has acquired first rank. Hence it becomes the most alluring and motivating factor for farmers in contract wheat seed farming.

The term of public contract, viz., maximum physical take off limit is of 18 qtl/ acre whereas private contract does not put such a limit. Simply put the private firm buys back all produce per acre produced at farmer's field under its supervision and certification. The value of standardised discriminant coefficient is negative (-0.154). This term of contract does not satisfy the requirement of the farmers of the public sector and acquires the fifth rank in the order of importance.

The mode of payment of value of produce to the farmers by contract firms differs in contract profiles of public and private sectors. In public contract design, two-third payment of the total value of produce is paid to the farmers at the time of sale of produce at seed processing plant and the rest one-third payment is paid to the farmers after getting an 'O.K.' test report from the designated seed testing laboratory whereas in the private contract regime, the lump-sum payment is made at a single go to the farmer at the time of the sale of produce at the seed processing plant. The value of the standardised discriminant coefficient of the mode of payment variable is negative (-0.196). It infers that this term of contract is not preferred by the farmers of the public sector and acquires the sixth rank.

The cost of movement of produce from the site of production to the seed processing plant forms a small part of the total cost of production. The cost of transport of the produce was reimbursed to the farmer of the public seed agency on the basis of distance as per terms of contract but it is missing in the contract of the private seed agency. The value of the standardised discriminant coefficient of the transport cost variable is 0.016 and is statistically significant. It infers that this attribute of contract design satisfies the requirement of the farmers in getting the reimbursement of transport cost especially of those farmers who had to travel a long distance to deliver the produce at seed processing plants in the public sector only.

The private seed firms bears all the expenses of seed certification and testing procedures on behalf of the farmers since they feel that the money remains within the seed business. This relieves the farmers from the botheration of acceptance and/or rejection of any portion or the whole plot of the seed crop at critical stages as per standards of the National Board of Seed Certification and Testing by the Seed Certification Officer of the HSSCA. Moreover, officials of the HSSCA are duty bound to accomplish the seed certification of field crop at critical stages as per standards of the National Board of Seed Certification and Testing. On the contrary, the farmer of the public contract design had to manage to get timely certification and seed testing done at his own cost. The value of the standardised discriminant coefficient of the timely certification variable is 0.216 and found to be statistically significant, which acquires third rank in the discrimination of public and private contract designs.

The cost effective and quality enhancing technology forms the crux of technology back up to the farmers. A farmer of the private contract regime received all the

production technology and extension services whereas a farmer of the public contract regime received only the seed and the rest of the inputs used in seed production had to be managed by him. The standardised discriminant coefficient of contract attribute, viz., technology back up to farmer variable is 0.314 and statistically significant. This attribute is preferred by all categories of farmers of the private sector which got the second rank in the discrimination of the public and private contract designs.

Timely possession of the produce by the buyer from the seller is one of the terms of contract for discharging contract liabilities. The standardised discriminant coefficient of timely seed take off by firm variable is indicated by a negative coefficient but statistically significant. It reveals that the farmer wants to dispose off his produce immediately after harvest, but private seed firms want the produce to be stored at the farmer's homestead till the already accumulated stocks at the seed processing plant get liquidated. So the risk of keeping the produce intact as per the agreed quality remains with the farmer. This attribute got seventh rank in the order of importance in the creation of differentiation between the public and private contract designs.

An attribute, viz., the financial support of the private contract design satisfies the requirement of production as well as consumption loans of the contract farmers. The small and marginal farmers in the group need such financial help to meet the production of the assured quality of produce. The standardized discriminant coefficient of this attribute is 0.196 and statistically significant. It infers that small farmers display a higher dependency on firms regarding timely and easy availability of credit and other inputs. This crucial issue enhances the alignment of direction and control across segments of the contract wheat seed farming system. This attribute acquires the fourth rank in the creation of discrimination between public and private contract designs.

The relative importance of the attributes of contract designs has a significant influence on the utility of the contract farming policy and also varies across policy contexts. This suggests a fair degree of subtlety in the farmer's contract design preferences depending on the implementing agency (public or private sector). Moreover, relevant attributes of policy packages of contract wheat seed farming of public and private sectors include the details of policy implementation.

Determinants of Contract Wheat Seed Farming

The adoption of contract seed farming is always a win-win situation for all stakeholders engaged in seed business. A decision to implement a gainsharing compensation system for a group of contract designs necessitates not only an understanding of the interdependencies between these contract designs but also assessing of contract programmes that encourages the options and use of contract designs. Specifically a logit model is employed to investigate the existence of the preference heterogeneity of the farmers in the contract farming models.

Regression Coefficients of Public and Private Contract Models

The logistic regression coefficients of the determinants of contract wheat seed farming in the public and private sectors in Haryana state are shown in Table 5. A perusal of the table revealed that the estimated models were a 'good-fit' as indicated by the correct predictions (95.24 and 92.38) of the binary (1, 0) dependent variable. The 'goodness of fit' of the model was confirmed by the low negative log-likelihood values (NLL) of 27.34 and 61.75 for the public and private sectors respectively as smaller the values of NLL, better the model fits (Darlington, 1990). The estimates of the logit model of contract wheat seed farming of public sector (Table 5) showed that the farmer's decision to adopt contract wheat seed farming was positively and significantly influenced by the ratio of contract and open market price and off-farm income. The probability of adoption of the contract wheat seed farming has increased by 69 per cent and 14 per cent with one percent increase in variables- ratio of contract price and open market price, and income other than agriculture, respectively. Similarly, the farmer's decision was negatively influenced by the transfer cost and the probability of the adoption of seed farming would decrease by 22 per cent with one per cent increase in transfer cost. The education of the decision maker (farmer) negatively influenced the decision of the adoption of the contract wheat seed farming. If the decision maker was educated adequately, the probability of the adoption of contract seed farming reduced by 41 per cent. A well educated decision-maker's rational decision would, of course, be not to go for contract wheat seed farming but choose alternatives like growing cash crops for niche markets etc. The sign of the coefficient rejects a prior expectation. This result implies that education and opportunities of earning income via contract wheat seed farming are substitutes rather than complements. Asfaw and Admassic (2004) strengthen our findings, that the role of education increasing the possibility of adopting chemical fertilisers is substituted or eroded by other factors such as mass media, traders etc. in modern environments.

TABLE 5. ESTIMATED LOGIT COEFFICIENTS: PUBLIC AND PRIVATE CONTRACT REGIMES

Dependent variable P(CA=1)	Public regime		Private regime	
	Coefficients	Probability	Coefficients	Probability
(1)	(2)	(3)	(4)	(6)
Constant				
PRATIO: Price ratio of contract and open market price	0.086* (0.027)	0.69	0.029*(0.010)	0.54
SFS: Seed farm size	0.115 (0.883)	0.24	0.567*(0.168)	0.21
EDU: Education	-0.417* (0.944)	0.41	0.358 (0.688)	0.26
OFI: Off farm income	0.002* (0.001)	0.14	0.023** (0.01)	0.28
AG: Age of household	0.131 (0.089)	0.17	-0.027 (0.031)	0.10
TC : Transfer cost	-0.002* (0.002)	0.22	0.018 (0.013)	0.08
PQTO: Physical quantity take off	0.388 (0.293)	0.34	0.416 (0.137)	0.04
Constant	-69.793 (22.054)		34.863 (7.438)	
-2 Log likelihood	27.347		61.749	
Per cent (%) correct prediction	95.24		92.38	

* and ** denotes statistical significance at 5 and 1 per cent level respectively.
Figures in parentheses indicate standard error of coefficients.

The results conclude that the adoption of contract seed farming in the public sector is influenced by incentive prices, reimbursement of transfer costs and off farm income of the contract farmers. The geographical effects of contract farms are well documented: farms located closer to seed processing plants are more likely to adopt the public model of seed farming. Higher the education of the farmer, higher are the chances of switching from contract wheat seed farming to other lucrative business options.

The parameter estimates of the model for the determinants of the contract wheat seed farming under private regime (Table 5) revealed that the size of seed crop landholdings, and off-farm income were significant determinants influencing positively the farmers' decision to adopt seed farming. It could be inferred that with one unit increase in the average holding size of seed crop and with one percent increase in off-farm income, the probabilities of the adoption of the wheat seed farming were increased to 21 per cent and 28 per cent, respectively. The ratio of contract price and open market price to the farmer proved to be a significant determinant influencing positively the farmers' decision to adopt seed farming. It could be inferred that with one per cent increase in the ratio of market price and open market price, the probability of adoption was increased by 54 per cent. The comparative results of the logit function of the public and private contract regimes on the attribute of the ratio of contract price and open market price indicate a strong preference for public sector than private sector implying that farmers of the public sector are interested in obtaining contracts for more acreage (minimum five acres) on their farms, which is linked to a higher ratio of contract price and open market price. The study by Kumar and Chand, 2004 revealed that public and private seed agencies were found paying contract seed growers 22.5 per cent and nearly 8 per cent respectively more on the minimum support price announced by the Government of India. It reveals that farmers hooked to the private sector are getting a relatively lower incentive price compared to the farmers of the public sector though they are getting more than the wet market wheat grain price. Since the base of the settlement of the incentive price of the seed of private agency depends upon the extent of the increase in the minimum support price announced by the Government of India just before the harvest of the crop and/or the average of the prevailing highest fortnightly wet market wheat grain price. This implied that the incentive price is undiscovered at the time of contract formation. The aim was to keep the incentive price of wheat seed higher than the prevailing wet wheat grain market/procurement price. The Andhra Pradesh State Seed Development Corporation (APPSDC) paid 8 per cent dividend to the farmer shareholders in 1996-97 (Shiva and Crompton, 1998). The common economic determinants, viz., ratio of the contract price and open market price and off-farm income of public and private contract regimes enabled the farmers to procure and utilise vital inputs and technology successfully in the adoption of the contract wheat seed farming. By lending the farmers the necessary technical support, the corporation has earned the goodwill of the local people (Singh, 2004). The results conclude that

the adoption of the contract wheat seed farming of the private sector is influenced by the determinants, viz., the average size of landholding, the ratio of contract price and open market price, and off-farm income of the contract farmer.

The model fitted to the public and private sectors identified the common determinants firstly, the ratio of contract price and open market price which was relatively more satisfying to the farmer of the public sector as compared to the farmer of the private sector; secondly, the off-farm income of farmers. The model fitted to the private sector identified the determinants, viz., the average size of landholding, and the reimbursement of transport costs of the adoption of contract wheat seed farming which were not found to be statistically significant in the public sector. The values in the parentheses associated with each of coefficient estimates of the traits of the public and private contract regimes are standard deviations, indicating the amount of spread that exist around the sample population. This discerns that these coefficients are indeed heterogeneous in population.

V

CONCLUSION

Policy change is the result of the interaction between attributes of varying contract profiles and farmers' preferences according to the new business environment. The real challenges before the seed firms are to apply the fundamental business principles to make business responses sharper and focused. The attributes of the contract design of the private sector are incorporated catering to the new economic setting whereas the attributes of the contract design of the public sector remained invariable due to the policy of HSSDC. The ratio of the contract price and open market price became the most alluring attribute for inducing the farmer to nudge into contract farming followed by technology back up, timely certification of seed crop by the support of sponsoring seed firm, adequate financial support, physical quantity of produce, and the mode of payment acquired importance in descending order and became next pressing attributes in discriminating the contract designs of public and private sectors. This creates a gap between the contract profiles of public and private sectors. It is concluded that weaknesses identified in the contract profile of the public sector were strengths of the contract profile of the private sector whereas strengths identified in the contract design of the private sector were not reflected in the contract design of the public sector. The characteristics in the contract design of the private sector were more flexible, adjustable and quasi-formal catering to the needs and requirements of the farmers as compared to the contract design of the public sector.

The common determinants of the public and private sectors were found to be the ratio of contract price and open market price, and the off-farm income of the farmers. These two drivers motivate the farmers for the adoption of contract wheat seed farming irrespective of the contract farming regimes. The land holding size was

identified as a sensitive driver of the private contract farming model and the reimbursement of transport cost was identified as the driver of the public contract farming model.

VI

POLICY IMPLICATION

Policies on contract farming are the means of achieving the economic results but it is through configuration of contract attributes that a farmer acquires a preference and is incorporated into the contract design. The critical variables change their significance with changes in the circumstances, these attributes' power and importance in the contract design rise and farmers gain fuller access and benefit to the firms' resources. The less rigid construction of contract attributes in the contract design of the contract farming system in the private sector also makes it easier for farmers and seed firms to act as a symbiotic relationship. This is a powerful force making for attribute preference as well as to ensure that farmers are emotionally attached to the seed firm, becoming its firm supporter as they themselves grow in business stature.

The broad organisational logic of the contract design of the public sector is very rigid. The contract design of the public sector is devised by the policy of the state government which lies at the root of discrimination against attributes of the contract design of the private sector. These constrain the capacity of the contract seed farming system without being adapted to changing the situation. Management of agribusiness firms should improve its ability to anticipate the direction and magnitude of change and accordingly design the contract of wheat seed farming. In order to sustain in seed business, agribusiness firms have to drop old and outdated attributes of contract design and embed requisite attributes to ensure flexibility in contract design.

With the influx of more private seed business firms especially after the WTO, small holders are not driven out of the scheme because land size of the seed crop is not a factor that determines the participation of contract wheat seed farming in the private sector. Agribusiness firms try to promote the farmers' association or co-operatives of not only capturing comparative advantage but also provide their own strengths and assistance in exploiting the new found business opportunities. Domestic firms are organising vertical coordination and have provided stable markets linking contract price to market price and abstain from the extraction of monopsonistic rent in the output market and monopoly rent in the input market. Agribusiness firms in new business environments are careful to bind their farmers to themselves through subtle webs of solicitousness and emotional communication that all their sacrifices like risk sharing and by providing all sorts of help and support in input and output markets will be rewarded if the farmers are successful in contract farming while also subtly conveying that it expects unquestioning loyalty from them as compensation for its sacrifices. Moreover, a reasonable and fair amount of flexible and farmers'

friendly attributes in private contract design becomes the lynchpin of the business affairs- managing all stakeholders engaged in seed business environment.

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APPENDIX 1

COMPARATIVE STATEMENT OF CHARACTERISTICS OF CONTRACT DESIGNS OF
WHEAT SEED FARMING OF PUBLIC AND PRIVATE SECTORS

Characteristics (1)	Public sector (2)	Private sector (3)
1. Price ratio of contract and open market price	(i) Govt. procurement price+ bonus 22.5 per cent on procurement price	Market price+ bonus@ Rs. 50 to Rs. 150 depending on a variety
2. Physical quantity take off	(ii) 85 per cent of produce /unit area (18qtl./ha)	No upper limit
3. Mode of payment	2/3rd payment after harvest and 1/3rd after 'O.K.' seed test report	Lumpsum payment (on spot) after harvest
4. Reimbursement of transport cost	Yes	No
5. Timely certification procedure	By farmer	By private company on behalf of farmers
6. Timely seed take off by firm	After harvest by farmer	Pvt. Firm may ask farmer to store produce for some time after harvest (it depends on trust)
7. Technology backup to farmer	Only seed is given	All kinds of inputs and technical know how.
8. Adequate financial support	No	Yes
9. Arbitration mechanism	Yes	No.
10. Production decision	Independent	Dictates of firm prevail
11. Nature of price	Discovered	Undiscovered
12. Nature of contract	Formal (written)	Quasi-formal (flexible)
13. Categories of farmers	Medium and large	Small, medium and large
14. Rogueing operation	By farmer	By labour of private firm
15. Linkages	Forward	Forward and backward
16. Compensation in crop damage	Nil	Seed + certification charges
17. Registration of farmers to HSSCA	By farmer	By seed firm on behalf of farmers
18. Irrigation facilities and other infrastructure at farm	Yes	Not prerequisite condition