

## Food Security and Efficacy of the Intervention Mechanism in India

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## ***Food Security and Efficacy of the Intervention Mechanism in India***

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### **1. Introduction**

Rice and wheat are the two major foodgrains whose production growth determines the self-sufficiency of the country. Per capita production of rice and wheat has substantially increased from 120 kgs in 1981 to over 144 kgs during the recent year. Meanwhile, the food basket has become much more diversified. Dramatic changes in food consumption patterns have taken place in India in the post green revolution period (Meenakshi, 2001). Consumers' preference is more towards non-cereals and among cereals the preference is rice and wheat to coarse cereals. Coarse grains are now increasingly used as cattle or poultry feed and hence their importance in foodgrain availability for human consumption is considerably reduced. There is a shift in the consumption pattern in favour of superior food items like milk, vegetables, fruits, animal foods and so on. The demand projections for cereals, which take into consideration changing consumer preferences, come out with demand estimates for cereals, which match favourably with the supply projections indicating that the requirements of cereals in the country will be adequately met by domestic supplies during the period of at least upto the year 2020. Praduman's (Kumar, 1998) projections with constant growth in total factor productivity and with deceleration in total factor productivity, the cereals supply will be 309 and 270 million tonnes respectively. Projections of G.S. Bhalla (1999) by extrapolating 1965-1993 trends the supply would be 347 million tonnes and 251 million tonnes by increased fertilizer use and irrigation. Through the IMPACT model of IFPRI the base calculation projects the cereals supply to 256 million tonnes and with additional land degradation 234 and 271 million tonnes with reduced land degradation. The supply forecasts therefore range from 250 to over 300 million tonnes (Arvind Virmani and Rajeev, 2001).

Availability of food grains is not a sufficient condition to ensure food security to the poor also necessary that the poor have sufficient means to purchase food. The means are by raising the level of incomes by additional employment and supply food grains to the poor at subsidised prices through government mechanism. In this line farmers' income is prevented from falling to lower levels by minimum support prices (MSP) at reasonable levels during years of good crop yield and also through various welfare programmes. The problem of chronic food insecurity due to poverty is being checked by the operation of Public Distribution System (PDS) through which foodgrains are distributed at subsidised prices. PDS has been one of the most crucial elements in food policy and food security system in country since 1939, first set up in Bombay by British (Shankkar Aiyar, 2005). The Government of India introduced a targeted PDS (TPDS) in 1997 under which foodgrains are being allocated to the states on the basis of the estimates of population the poverty line (Dev *et al.*, 2003). It is regarded as a safety net to the poor whose number is more than 330 million and are nutritionally at risk. Further, it is regarded as an important delivery channel in the management of food security system of India; with a network of nearly half a million Fair Price Shops (FPS) catering to the needs of 199 million of ration cardholders. It is one of the largest of its kind in the world, handling around 15 per cent of the total availability of foodgrains in the country (State Planning Commission, 2004).

Fluctuations in agricultural output mainly due to weather uncertainty, inadequate irrigation facilities and heavy dependence on monsoons resulted poor price or income realization and may lead to transitory food insecurity. Buffer stock operations ensure the welfare of the consumers as well as producers and stabilize the price of food grains. The national objective of growth with social justice and progressive improvements in the living standards of the population make it imperative to ensure that foodgrain is made available at reasonable prices. PDS has been evolved

to reach the urban and the rural population in order to protect the consumers from the fluctuating and escalating price syndrome. Continuous availability of foodgrain is ensured at fair price through about 0.46 million FPS spread throughout the country.

## **2. The Issue**

### *2.1. Higher production and procurement price but poor offtake*

At present the problem in the country is not the shortage of foodgrains but in search of ways and means to manage the accumulated surplus. Despite a decline in area under foodgrain crops in India the two main staple grains together registered annual production growth of 3.59 per cent in the 1980s and 2.28 per cent in 1990s which was above the population growth rate of 1.9 per cent (Economic Survey, 2003). A marginal growth in output of two staple grains, rice and wheat, which exceeds the growth of population results additional availability of a few million tonnes.

Commission for Agricultural Costs and Prices (CACP) is for advising the government in respect of pricing agricultural commodities. At present 25 agricultural commodities are covered under its mandate. The Commission is required to recommend the Minimum Support Price (MSP) to the Government well before the sowing season of the crop. Relatively higher prices of MSP for rice and wheat increased the profitability of these crops and motivated the farmers to divert their areas to these crops from coarse cereals, pulses and even oilseeds especially in the Punjab and Haryana (PTI, 2004). Higher the production and MSP the farmers bring maximum possible quantum of produce for selling it to the Food Corporation of India (FCI). With price stabilization concern, higher level procurement of rice and wheat by FCI has resulted in huge surplus stocks, which are much above the buffer stock norms. At the same time the deficit states like Bihar, Assam and Eastern Uttar Pradesh in the past, have started generating surpluses of cereals and draw less from the central pool. Poor offtake of foodgrains under PDS (Table 1) has also aggravated

effects of abundant stocks. Differential pricing to Below Poverty Line (BPL) and Above Poverty Line (APL) affects the off take position.

**Table 1. Foodgrains allocation and offtake under public distribution system**  
(Million Tonnes)

Year	Wheat		Rice	
	Allocation	Offtake	Allocation	Offtake
1991-92	10.56	8.83	11.36	10.17
1995-96	11.31	5.29	14.62	9.46
1999-00	10.37	5.76	13.84	11.31
2000-01	11.57	4.07	16.26	7.97
2001-02	13.14	5.68	17.23	8.16
2002-03	29.45	6.12	27.35	7.39
2003-04	-	49.16*	-	-

**Source:** <http://indiabudget.nic> and *Economic Survey (2004-05)*

\* Wheat and Rice together

## 2.2. Why mounting foodgrains stock a concern?

The existence of large stockholding seems to be a proof of how India has become a surplus producer of foodgrains but carrying cost of buffer stock has been rising at the rate of 15 per cent per annum in the 1990s (Srinivasan and Jha, 1999). A steady availability of foodgrains at reasonable prices is assured to people, which is lower than actual costs due to subsidy that accounts for about 45 per cent of the economic cost. In addition to higher carrying cost increase in procurement price also raised the economic cost. Increase in food subsidy is also due to high carrying cost of stocks in excess of the buffer norms. The efficacy of buffer stocking policies is reflected in the stability of foodgrain consumption and prices. However, it is becoming increasingly evident that stabilisation operations involving physical handling of foodgrains are fiscally expensive (World Bank, 1999). The annual food subsidy involved in maintaining the system is huge and share of food subsidy to the total government expenditure is rising (Table 2).

**Table 2. Share of food subsidy to total government expenditure**

Year	Food subsidy* (Rs. Crore)	% of Total Government Expenditure
1990-91	2450	2.33
1995-96	4960	2.78
1999-00	9200	3.03
2000-01	12125	3.61
2001-02	17612	4.83
2002-03	21200	5.17
2003-04	25800	-
2004-05	17639	-

**Source:** Arvind Virmani and Rajeev (2001), <http://indiabudget.nic> and Shankkar Aiyar (2005) and Economic Survey (2004-05)

**\*Food subsidy covers sugar also**

The minimum support price (MSP) scheme served the country well in the past three and a half decades helped exploiting the opportunity created by green revolution and led to much high levels of production as well as public stock of wheat and rice. But expenditure reforms commission has recommended that the cost of holding stocks in excess of the requirement for National Food Security and for PDS, arising from generous MSP and procurement, be reflected in the budget as producers' subsidy rather than consumer subsidy. Food subsidy policy seems helping the surplus farmers more than the poor consumers. Because of the farm lobby, the government has been procuring the entire quantum offered by the farmers instead of procuring only to the nominal stock level (Table 3). As a result, there has been a remarkable accumulation of stocks in recent periods (Patnaik, 2000).

**Table 3. Central Foodgrain Stocks against Minimum Buffer Stock (beginning of January)**

(Million Tonnes)

year	Wheat		Rice		Total	
	Minimum Norm	Actual Stock	Minimum Norm	Actual Stock	Minimum Norm	Actual Stock
1995	7.7	12.9	7.7	17.4	15.4	30.3
2000	8.4	17.2	8.4	14.2	16.8	31.4
2001	8.4	25.0	8.4	20.7	16.8	45.7
2002	8.4	32.4	8.4	25.6	16.8	58.0
2003	8.4	28.8	8.4	19.4	16.8	48.2
2004	8.4	12.7	8.4	11.7	16.8	24.4
2005	8.4	8.9	8.4	12.8	16.8	21.7

**Source:** Economic Survey (2004-05)

The minimum support prices at levels much above market clearing prices are not desirable. Whenever MSP is raised farmers find it more lucrative to sell their produce to the Government than to sell it in the open market. For a number of recent past few years, the government has set prices particularly of wheat, at higher levels than recommended by the CACP (Table 4).

**Table 4. Minimum Support Prices for Fair Average Quality Wheat and Paddy**  
(Rs/Qtl)

Year	Paddy			Wheat		
	CACP	MSP revised	Difference	CACP	MSP revised	Difference
1990-91	205	205	-	200	215	15
1995-96	355	360	5	360	360	-
1999-00	465	490	25	490	550	60
2000-01	510	510	-	550	580	30
2001-02	520	530	10	580	610	30
2002-03	530	550	20	585	620	35
2003-04	550	550	-	630	630	-
2004-05	560	560	-	640	640	-

**Source:** *Economic Survey (2003 and 2004-05)*

MSP of other agricultural commodities also increased from time to time for a balanced response by farmers who greatly responded towards the higher MSP to rice and wheat especially in Punjab and Haryana. This decision increased the budgetary burden. As FCI is not able to offload its stocks, open market prices rise sharply. The procurement policy of the government is thus resulting in higher food stocks, higher inflation for foodgrains and a bigger food subsidy (Arvind Virmani and Rajeev, 2001). The government will have to finance the addition to stock. This is done by cutting some other expenditure especially adjusting the investment. Less would be invested in agriculture. Irrigation capacity would not grow as much. The cumulative impact of lower irrigation would reduce growth rate of agricultural output despite higher procurement price. Farmers themselves could be worse off compared to what they could have been had investment in irrigation not reduced (Parikh *et. al.*, 2003).

### *2.3. Efficacy of the Mechanism*

Along with higher procurement price, increasing carrying cost thus the economic cost and inefficiency in stocking and distribution further tighten the situation. Dutta and Ramaswami (2001) at Indian Statistical Institute examined the food subsidy pattern and found only 56 to 58.5 per cent of the total food subsidy (Centre and State combined) reaches the PDS consumers. Leakages range from 15 to 28 per cent of the subsidy while 16 to 26.5 per cent of the subsidy is absorbed up by the inefficiency of the government procurement and distribution system (FCI and State level) relative to the market. Persistent inefficiencies in the operation of FCI are another reason for increasing economic cost (Jha and Srinivasan, 1999).

As any monopoly, FCI suffers from inefficiency. Physical storage of grain by government agencies can lead to several inefficiencies. Most storage godowns with FCI are small-scale, low-quality structures; sometimes, grains are also stored in the open (known as covered and plinth storage-CAP) leading to heavy storage losses. A World Bank report (1999) states that half of FCI's grain stocks is at least two years old, 30% between 2 and 4 years old, and some grains as old as 16 years. There is shortage of good quality storage facilities and mismatch in grain allocation to states leads to poor offtake, resulting in the rotting of grains in godowns and quality deterioration due to pests (storage insects and rodents) and microorganisms (toxin producing fungus). In addition to that at least 3 million tonnes of these food stocks are stolen or rotted because of inadequate storage conditions.

Central issue prices are different for the same quality of the foodgrains to two different target groups namely the BPL and APL families. The central issue price is determined based on a proportion of the economic cost of the grains (from procurement to distribution). Recently it is decided to charge 50 per cent of the economic cost as the price of the foodgrain distributed to the BPL population and 70



per cent for APL population, which was 100 per cent during the previous period. Perhaps only a limited proportion of the food requirement of the BPL population is met by the PDS, for the rest depend on the private traders.

### **3. Methodology**

#### *3.1. Selection of the model and suitability*

Policy decisions upon the level of procurement, magnitude of revising the MSP and increasing the offtake have great influence over the subsidy. To examine the implications of the policy decisions, Monte Carlo technique was chosen to simulate the base scenario. Simulation is one of the important techniques to observe a real system and not an optimization technique but a statistical experiment. Hence, its output must be interpreted by appropriate statistical tests. This technique is suitable for analyzing a system where arrival and departure of events make significant changes in the system. The procedure for determining samples starts with generating independent 0 – 1 random numbers and then mapping them on the model. These random numbers can be generated using statistical packages that are statistically independent values of uniform distribution.

#### *3.2. The Model*

The most common methods of collecting observations in simulation are Subinterval method, Replication method and Regenerative (cyclic) method. In this present analysis replication method was used to gather the observations appropriately. In this method each observation was represented by an independent simulation run and the observation averages for each batch was computed. The advantage of this replication method is that each simulation run is driven by a distinct (0, 1) random number stream, which yields observation that are truly statistically independent. Making the run length sufficiently large the accuracy of the results increases (Taha,

2003). 5 replications and 5000 runs for each replication were done. Mean and standard deviation were calculated for the gathered statistical observations to test the significance by the confidence interval procedure. For this present analysis level of foodgrains procurement, stock, offtake, inventory cost and subsidy variables are related in the following algebraic equations.

$$1. TE_p = \sum_{i=1}^n q_i p_i$$

Total Expenditure on Procurement (Rs. Crores<sup>\*</sup>) = Procurement (MT) x Procurement Price (Rs/qtl)

$$2. AS = \sum_{i=1}^n q_i - \sum_{i=1}^n O_i$$

Added stock (MT) = Actual Procurement (MT) – Offtake of foodgrains (MT) in the year

$$3. TC_i = \left( \sum_{i=1}^n q_i - \sum_{i=1}^n O_i \right) \times AC_i$$

Total Inventory Cost (Rs. Crores) = Stock (MT) x Average Inventory Cost (Rs/qtl)

$$4. IP_R = \sum_{i=1}^n (O_i CBPL_i + O_i CAPL_i)$$

Revenue from Issue price (Rs. Crores) = Offtake (MT) x Average central issue price between BPL and APL families

$$5. Sub = \sum_{i=1}^n (\Delta MSP_i + TC_i + \Delta CIP_i)_{ot}$$

Sub (Rs. Crores) = Increase in MSP (Rs. Crores) + Total Inventory Cost (Rs. Crores) + Central Issue Price difference (Rs. Crores)

Where i=1 and 2 for rice and wheat respectively and n = 2.

Calculated mean and standard deviation were used to test the significance within the confidence interval using the formula

$$\text{Confidence interval: } Mean - \frac{SD}{\sqrt{N}} t_{\alpha/2, N-1} \leq Actual \leq Mean + \frac{SD}{\sqrt{N}} t_{\alpha/2, N-1}$$

Where N is number of replications and  $\alpha$  is probability level. Test of significance using confidence interval for the simulation results is given in Appendix I.

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\* 10 Million = 1 Crore

#### **4. Simulation results**

In the base scenario (2002-03), level of procurement of rice and wheat were 25.6 and 32.4 million tonnes at procurement prices Rs. 550 and 620 per quintal respectively. This level of procurement added 18.2 million tonnes of rice and 26.3 million tonnes of wheat to the existing stock while the offtake was only 7.4 million tonnes of rice and 6.1 million tonnes of wheat. This level of stock absorbed Rs. 18479 crores as inventory cost in total. Central issue prices for rice and wheat were Rs. 565 (BPL); 730 (APL) and Rs. 415 (BPL); 510 (APL) respectively and an amount of Rs. 7,615 crores totally mobilized through the distribution. In the base scenario it was found that an amount Rs. 11,674 crores was absorbed in the entire process of procurement till distribution, which accounted for 51 per cent of the total food subsidy and the expenditure on procurement of foodgrains, was also not recovered (Table 5).

In scenario I, procurement at the recommended level so as to keep the stocks just at the normative level showed a cut in the subsidy level to an extent of 75 per cent compared to the base scenario. An amount of Rs. 500 crores will be saved through the normative level of procurement and adding only 2.50 million tonnes of foodgrains to the existing stock, which needs only an amount of Rs.896 crores for managing the stock. In addition to the present level of issues prices with the reduced level of subsidy, this decision may be able to recover the expenditure incurred in procurement of the foodgrains. Scenario II is with a small change i.e. the procurement at the CACP recommended price (no revision of MSP) and others similar to the scenario I. This policy decision would be able to save an amount of Rs. 200 crores and with a marginal cut in the subsidy. From the scenarios I and II it is evident that the revision and hike in the MSP over the CACP recommendation require only a few hundred crores, which contribute smaller proportion in the total food subsidy. But the level of

procurement, offtake and CIPs (distribution at 50 and 75 per cent of the economics cost to the BPL and APL consumers) are the major factors determine the level of subsidy. Simulation result for total subsidy does not fall in the confidence interval due to multiplication of random number with lesser procurement level and no rise in MSP are greatly emphasized than in scenario I.

Scenario III is perfect by decision where procurement at the recommended level, no rise in MSP and zero food subsidies. This may result in huge rise in CIPs of foodgrains as PDS would try to mobilize an amount of Rs. 10,223 crores to recover the economic costs involved in the process. This gives rise to the average issue price to Rs 745 and 903 for rice and wheat respectively. Differential pricing can be done for the people living BPL and APL with different combinations. Scenario IV is pragmatic where the present level of procurement at revised MSP and increased offtake but leaving the normative buffer stock may bring a reduction in the inventory cost to half of the present level and the grains may distributed at the existing CIPs without any change. An important point to note here is that with the existing subsidy level, increased level of offtake may lead to the recovery of the expenditure on procurement at the same time the consumers' welfare may be unaffected.

*Table 5. Simulation results for changing level of procurement, rise in minimum support price and subsidy in India*

Scenarios	Commodity	Procurement (Rs. Crores)	Additional cost in revising MSP (Rs.Crores)	Off- take (MT)	Added stock (MT)	Inventory cost (Rs crores)	Revenue through Distribution @ CIP (Rs. Crores)	Subsidy (Rs. Crores)
Base	Paddy	14848	-	7.40	18.2	11406.20	4785.03	6621.20
	Wheat	19764	810.00	6.10	26.3	7073.52	2830.50	5053.00
	Total	34612	810.00	13.50	44.5	18479.72	7615.53	11674.20
I	Paddy	4649.11	-	7.40	0.62	385.66	4791.50	243.27
	Wheat	4878.01	199.91	6.10	1.90	510.22	2821.25	2766.90
	Total	9527.12	199.91	13.50	2.52	895.88	7612.75	3010.17
II	Paddy	4678.09	-	7.40	0.62	385.66	4791.50	243.27
	Wheat	4649.11	-	6.10	1.90	510.22	2821.25	2367.06
	Total	9327.20	-	13.50	2.51	895.88	7612.75	2610.34
III	Paddy	4649.11	-	7.40	0.62	385.66	5034.77	-
	Wheat	4678.09	-	6.10	1.90	510.22	5188.31	-
	Total	9327.20	-	13.50	2.52	895.88	10223.08	-
IV	Paddy	13338.72 <sup>NS</sup>	-	14.60	8.40	5261.51	9452.07 <sup>NS</sup>	9148.16
	Wheat	20133.43	825.14	24.61	8.40	2259.87	11380.10	11838.34
	Total	33472.15	825.14	39.20	16.80	7521.38	20832.17	20986.50

Results are significant at 1 per cent level except for the paddy procurement and distribution in Scenario IV.

Scenarios:

I: Procurement for the normative level of stock

II: Procurement for the normative level of stock and no increase in MSP

III: Procurement for normative level of stock, no increase in MSP and subsidy is abolished

IV: Procurement at base level and increase offtake leaving the nominal stock

## **5. Discussion and Policy Implications**

Having achieved self-sufficiency in production the National Policy on foodgrains stock and distribution will not be successful unless the suitable strategic changes are to be implemented in the system. MSP recommended by CACP should be followed during the procurement of the foodgrains. Methodology for calculating MSP by CACP may cover only the variable costs of the farmers and should not be meant to cover their entire production costs. A food security buffer stock of 10 – 14 million tonnes would be adequate. FCI should not procure all that is offered by the farmers but only to maintain an optimum level of buffer stock. The FCI can maintain a minimum level of buffer stock and then undertake open market operations within a prescribed price band. One of the recommended options is that FCI could also play a role in the international market for food grains by resorting to imports when stock levels are low and exporting food grains when there are surplus stocks. With this option the government can avoid costs associated with buffer stock operations such as procurement, storage, transportation and handling of grains. But the export of subsidized foodgrains is highly criticized.

The government has to recognise the complementary role that private storage can play in stabilizing prices. Monopoly food procurement must be ended by allowing private agencies along with state procurement agencies to operate in all parts of the country. The restriction on private food grain trade must be lifted and the bias against them removed so that competitive forces can have freer play in reducing intermediation costs. In particular the constraints and restrictions on entry of modern food procurement, transport, processing and distribution companies must be removed so that the benefits of modern management practices like silo storage, logistics and large scale processing can flourish. Private sector participation in this sector may be sought and encouraged through measures such as Build-Own-Operate-Transfer, Build-Own-Lease-Transfer, Build-Own-Operate, Lease-Develop-Operate, and Joint ventures etc.

Food stamp system can be tried in urban food markets and infrastructurally developed rural areas. Food credit cards with built-in identification for the target card holders (smart card technology), which can serve better than food stamps. It can serve as a single multi use card in banking, transportation, driving license, health care and physical access to work places.

A massive food-for-work public works programme to generate and maintain infrastructure, this would have had many positive effects upon the economy. It provides a tremendous opportunity to create rural infrastructure apart from generating employment for the poorest of the poor (Dev and Ranade 1997, Patnaik 2000 and Jayathi Ghosh 2003). Other welfare schemes like Mid – Day – Meal – Scheme, Wheat Based Nutrition Programme (WBNP), Annapurna Scheme, Sampoorna Gramin Rozgar Yojna, World Food Programme (WFP) and distributing foodgrains to poor students hostels, welfare institutions helped to improve offtake thus a reduction in the level of added stocks.

Recently it was decided that Food Corporation of India (FCI) will be handling much lower level of stocks from the year 2004, which will bring down its inventory holding cost. During the year 2004 total foodgrain stocks in the Central pool were 32.28 million tonnes, comprising 12.25 million tonnes of rice, 19.39 million tonnes of wheat and 0.64 million tonnes of coarse grains. At these levels, stocks were not only less than half of what they were on two years ago when they touched a peak of 64.83 million tonnes but have also dipped to a six-year low (The Hindu, 2004). Without tinkering with the issue price of grains sold through the public distribution system (PDS), Government of India has cut Rs 2,000 crore in the budgeted food subsidy for 2004-05 over the figure projected in the beginning of 2004. This is despite there being no increase in the PDS issue price and rationalisation of the existing unlimited grain procurement regime.

**APPENDIX – I**  
**Confidence intervals for the simulation results**

Particulars	Scenario	Commodity	Mean	SD	Confidence Interval		
					Left tail	Actual	Right tail
Procurement (Rs.Crores)	I to III	Paddy	4649.11	670.61	3268.34	4872.00	6029.88
		Wheat	4878.01	704.88	3426.68	5124.00	6329.34
	IV	Paddy	13338.72	704.06	11889.08	14848.00	14788.36
		Wheat	20133.43	669.25	18755.46	19764.00	21511.40
Additional cost in revising MSP (Rs.Crores)	I	Wheat	199.92	28.89	140.44	210.00	259.40
	IV	Wheat	825.14	28.85	765.74	810.00	884.54
Offtake (MT)	IV	Paddy	14.60	1.15	12.23	16.20	16.97
		Wheat	24.61	1.15	22.24	24.00	26.98
Added Stock (MT)	I to III	Paddy	0.62	1.16	0.10	1.00	3.01
		Wheat	1.90	1.16	0.25	2.30	4.29
Inventory cost (Rs.Crores)	I to III	Paddy	385.66	724.23	100.00	632.63	1876.83
		Wheat	510.22	310.84	150.00	613.68	1150.23
Revenue through Distribution @ CIP (Rs.Crores)	III	Paddy	5034.77	1394.84	2162.83	5504.63	7906.71
		Wheat	5188.31	986.83	3156.46	5527.68	7220.16
	IV	Paddy	9452.07	533.81	8352.97	11137.00	10551.17
		Wheat	11380.10	747.14	9841.76	11100.00	12918.44
Subsidy (Rs. Crores)	I	Paddy	243.27	1394.84	125.00	719.61	3115.21
	IV	Paddy	9148.16	199.10	8738.22	8972.50	9558.10
	I	Wheat	2766.90	1044.61	616.08	3117.20	4917.72
	II	Wheat	2367.06	986.83	335.21	2697.20	4398.91
	IV	Wheat	11838.34	77.89	11677.97	11734.90	11998.71

$$\text{Confidence interval: } \text{Mean} - \frac{SD}{\sqrt{N}} t_{\alpha/2, N-1} \leq \text{Actual} \leq \text{Mean} + \frac{SD}{\sqrt{N}} t_{\alpha/2, N-1}$$

Where N is number of replications = 5 and  $t_{0.005, 4} = 4.604$



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