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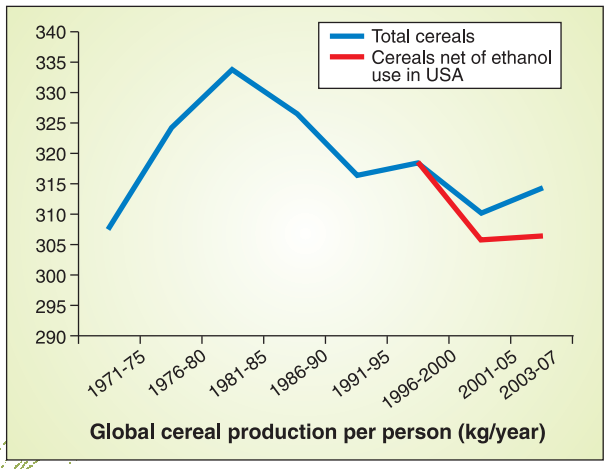
Agricultural Economics, Marketing and Statistics

AGRICULTURAL ECONOMICS AND MARKETING

Global food crisis: causes, severity and outlook: Global food prices have witnessed unprecedented surge after mid-2007, which has caused worldwide concern. The main factors for escalation in food prices were categorized as a result of (a) increase in price of crude oil, (b) supplies did not keep pace with demand for many years, and (c) diversion of grain for liquid bio-fuel. Long-term trend revealed that cereal production increased at a faster rate than population in the initial years of Green Revolution, which is reversed since 1980s. The growth rate in cereals turned out to be lower than the growth rate in population. Though there was some improvement in per caput availability of cereals during 2003–2007, this increase was not available in food due to diversion of foodgrains for bio-fuel. When total production is netted out for quantity of corn used for bio-fuel in the USA then per caput production reduced to 307 kg, which is the lowest during any five years period since 1971. This shows that the shortage of staple food has been building for several years and it became quite large and serious in the recent years.



Global cereal production per person (kg/year)

Shift in dietary pattern towards meat product particularly in China and India, and population growth in India contributed to surge in prices of staple food. Precautionary measures like export bans and rationing in various countries exacerbated the price increase. Long-term trends indicate high and rising prices in future over base period price of 2005. High food prices are seen as an opportunity in some quarters to improve income of farmers and to stimulate food production. Such an increase in production, contingent upon high prices, would keep food out of reach of a large segment of population. Therefore, due attention is to be given to agriculture sector to deal with the harsh reality of high food prices and its effects on poverty.

Economic and ecological benefits of system of rice intensification: Being the important ingredient of food basket of the common people, the declining productivity and per caput availability is a major policy concern in agriculture. System of rice intensification (SRI) increases production, reduces yield gap and ensures the household food security. To quantify the benefits of SRI and compare its performances with that of conventional practice of rice cultivation, a detailed survey was conducted among the 58 carefully selected SRI farmers in four districts of Tamil Nadu representing distinctive features of irrigation system. As the average farm size of over 90% farmers in Tamil Nadu is less than 1.4 ha, producing more food from less land and other inputs has become a necessity for their livelihood. A perception survey the farmers' motivation revealed that most of the farmers were aware of SRI method of cultivation and they have perfected the major principles. The series of field demonstrations and supply of

Fertilizer growth, imbalances and subsidies: trends and implications

Imbalance in fertilizer use, accompanied by serious slowdown after 1991-92 and growth and structure of fertilizer subsidies are the major concerns of fertilizer sector in the country. Empirical evidence revealed that imbalance in use of N, P and K has persisted for a long time at country level as well as in different states. Total fertilizer use in India declined from 18.49 million tonnes to 16.32 million tonnes during 1999-00 to 2003-04, and it was one of the factors for slowdown in agricultural growth during this period. Fertilizer production in India has remained almost stagnant for a decade now. This can adversely affect fertilizer use in the country as dependence on import has already exceeded 35% of fertilizer used in the country. Moreover, imports are now costlier than domestic production net of subsidies. There is a need to expand fertilizer production capacity in the country by encouraging investments and improving efficiency in this sector.

Prices of all the three major nutrients relative to price index of crop sector followed a big decline during 1983-84 to 1990-91. There was no significant decline in real prices of fertilizer after this. Subsidies on fertlizer very steeply increased in the recent years but this has not helped in raising domestic production of fertilizer. Among states, fertilizer subsidy per hectare of net cultivated area varies from Rs 393 in Rajasthan to Rs 3,167 in Punjab. Fertilizer subsidy as per cent of value of crop output showed that Punjab and Haryana receive highest benefit from fertilizer subsidy closely followed by Andhra Pradesh.

Assesment of effect of fertilizer subsidy on food security by estimating impact of reduction in subsidy on foodgrain production revealed that complete withdrawal of subsidies on fertilizer is likely to decrease foodgrains production by close to 9%.

Domestic production and import of fertilizer ('000 tonnes), 1990–91 to 2007–08

Year	N		P		K		NPK import	Import share (%) in total consumption
	Production	Import	Production	Import	Import	Production		
1990–91	6,993	412	2,051	1,016	1,326	9,044	2,754	23.3
1999–00	10,873	856	3,448	1,534	1,774	14,321	4,164	22.5
2000–01	10,943	164	3,734	437	1,594	14,677	2,194	13.0
2001–02	10,690	283	3,837	494	1,697	14,527	2,474	14.6
2002–03	10,508	135	3,908	228	1,568	14,415	1,932	11.8
2003–04	10,557	205	3,627	372	1,553	14,183	2,129	13.1
2004–05	11,305	413	4,038	307	2,058	15,343	2,779	15.3
2005–06	11,333	1,390	4,203	1,145	2,764	15,536	5,299	25.4
2006–07	11,525	2,704	4,440	1,373	2,076	15,965	6,153	27.8
2007–08	10,903	3,708	3,714	1,391	2,668	14,617	7,767	34.7

Impact of removal of fertilizer subsidy on foodgrains production

Particulars	Dimension
Elasticity of foodgrains with respect to fertilizer	0.2056
Elasticity of fertilizer use with respect to real price of fertilizer	–0.6159
Elasticity of foodgrains production with respect to real price of fertilizer	–0.1266
Weighted price of NPK 2004-05 (Rs/kg NPK)	12.5
Fertilizer subsidy in 2004-05 (Rs crore)	15,879
Fertilizer use 2004-05 (thousand tonnes)	18,398
Subsidy (per kg NPK)	8.63
Increase in fertilizer price due to removal of subsidy (%)	69.04
Impact of removal of fertilizer subsidy on foodgrains output (%)	–8.74

subsidized equipment facilitated the adoption. The innovative practice has several bio-physical benefits, namely increase in productivity, input saving and conservation of precious water resources. The results showed that the return to SRI is high ranging from Rs 14,875/ha to Rs 17,629/ha across the districts as compared to corresponding figure of Rs 9,263 to Rs 14,564 under conventional practices. Higher return is attributed to increase in production as well as substantial reduction in cost of cultivation. The most impressive is the savings in water (22–39%) and seed (92%) contributing to distinctive benefit-cost ratio of SRI. The organic supplementation due to compost, green manure and weed incorporation, enhanced soil microbial activities and aeration, use of solar energy and time saving owing to early transplantation, are some of the uncommon advantages of SRI. The gains due to women labour in specialized operations such as transplanting, harvesting and weedings indicate gender equity. The SRI provides opportunity for employment of the idle family labour in *rabi* season. The novelty is that SRI research outcome is inexpensive as the innovation is farmer invented and invariant to any variety, need not be new and

All India crop group wise growth in production (%)

Crop group	1970-71 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-00	1996-97 to 2005-06
Cereals	2.66	2.89	2.24	0.13
Pulses	–0.01	1.54	0.84	–0.20
Oilseeds	1.11	5.15	1.92	0.64
Sugarcane	2.26	2.19	2.74	3.67
Cotton	2.61	2.57	2.68	2.40
Horticulture	2.88	2.64	5.84	3.12
Condiments and spices	2.90	4.71	4.97	4.25
Fruits and vegetables	2.88	2.27	6.00	2.91
All crops	1.79	2.03	3.02	1.66

modern input-intensive technology. The estimates of technical efficiency also clearly showed that SRI is more efficient (both in technical efficiency and economic efficiency). Therefore, appropriate strategy for upscaling the adoption is a *sine-qua-non* to achieve national as well as household food security. The successful models of SRI promotion have emerged, which need to be integrated for generalizing the practice. In the changing scenario, given the general acceptance of the practice and willingness to accept, the needed preparedness for implementation of the policy to scale up the adoption will go a long way.

Progress and potential of horticulture in India: The study examined patterns, trends and successes of diversification towards horticulture since 1970–71 at national and state level. Productivity and progress of horticulture was compared with other major crop groups. First output of horticulture, both condiments and spices and fruits and vegetables, increased at much faster rate as compared to growth rate of total crops sector during all the decades since 1970–71. Second, the growth rate in horticulture group was higher than all other crop groups except cereals and oilseeds during 1980–81 to 1989–90. Horticulture production increased by about 2.9% per year during 1970s when annual growth rate of total crop sector was 1.8%. There was some setback to growth rate of fruits and vegetables during 1980s, however, growth rate in condiments and spices accelerated to 4.7%.

The main factor underlying diversification in favour of fruits and vegetables was higher returns relative to other crop groups, and the difference in productivity between horticulture and other crops widened during 1980–81 to 2000–01. During 1980–81 to 2005–06 share of fruits and vegetables in total cropped area of the country increased from 2.8 to 4.9% and their share in crop output increased from 15.95% to 25.61%. There is some slowdown in productivity growth of all crop groups after 2000–01 but the change is negative for fruits and

Livestock sector composition and factors affecting its growth

Supply side as well as demand side factors of livestock sector showed that it possesses large potential for growth. Growth rate of livestock output slowed down from 2000-01 to 2005-06, which is a matter of serious concern. Data revealed that livestock sector growth can be accelerated by improving feeding, quality and composition of livestock, veterinary facilities, output marketing, and institutional interventions. The sector requires increased allocation of public resources and support to accelerate growth to achieve the targeted growth during the XI Five Year Plan. If the factors affecting livestock sector increase at the same rate as experienced during 1992-93 to 2004-05, output of livestock sector is likely to experience growth rate of 3.83%. To achieve targeted growth rate of 6% in livestock output, progress in livestock infrastructure, institutional efforts and availability of livestock feed is required to be accelerated by about 50%

Achieving targeted growth of XI Plan for livestock output

Source of growth/ factor	Elasticity of output	Scenario I		Scenario II		Scenario III	
		Factor growth rate	Output growth rate	Factor growth rate	Output growth rate	Factor growth rate	Output growth rate
In-milk bovine,%	0.413	0.96	0.40	1.51	0.62	0.96	0.40
Artificial inseminations done (-3)	0.237	5.38	1.28	8.43	2.00	5.38	1.28
Veterinary institutions (-1)	0.074	2.20	0.16	3.44	0.26	4.40	0.33
Surfaced road length (-2)	0.108	2.51	0.27	3.93	0.42	5.02	0.54
Per caput income	0.213	4.40	0.93	6.89	1.46	7.50	1.59
Membership of dairy cooperatives	0.116	4.15	0.48	6.50	0.76	8.30	0.97
Fodder area	0.113	2.65	0.30	4.15	0.47	2.65	0.30
Total			**3.83**		**6.00**		**5.40**

Figures in parentheses indicate lag period.

vegetables. The decline in productivity of fruits and vegetables needs to be addressed. Maharashtra maintained more than 5.5% growth rate and Andhra Pradesh showed acceleration in growth rate from 4 to about 5% between 1990s and 2000s. Last six years showed rapid progress in production of fruits and vegetables in Gujarat, Himachal Pradesh and Chhattisgarh, exceeding 10% annual rate of increase. Growth rate turned out to be either negative or very low in Asom, Karnataka, Rajasthan, West Bengal and Uttarakhand.

Supply, demand and trade of fish in India: The fish production in India has increased rapidly, nearly tripling from 2.44 million tonnes in 1980 to about 6.87 million tonnes in 2008. Domestic demand for fish in India is growing rapidly. The expansion of demand to match supply has to be a priority concern in the light of resource degradation, weak public support and investment, and potential worsening inequities in the global trade.

The income elasticities vary substantially across fish species by income group. But at the aggregate level for all the households, income elasticities range with narrow difference 1.61 for shrimp/ prawn to 1.66 for molluscs. Income elasticities for all the fish groups consistently fall with an increase in per caput expenditure (income) level of the household above the poverty line. None of the groups under study became an inferior good at the highest income quartile. This indicates that even a very rapid increase in aggregate per caput income in the projected period, fish consumption is not likely to turn an inferior good in India. The results revealed that when total income increases, people tend to spend more on fish, and relatively less on other types of meat.

Inland fish supply analysis revealed that supply of Indian major carps will increase significantly with time. The input demand and fish supply are sensitive to their own prices, suggesting that Indian fish producer responds to price changes in an effective manner. Price instruments along with technological policy are likely to be quite effective in fish supply. The increase in supply will make the fish available to the consumers at a cheaper price, which will increase the fish consumption in their food basket. Domestic demand for fish under the baseline scenario is likely to grow at an annual rate of 2.5% between 2000 and 2020. Highest growth in demand is projected for IMC (3.98%), followed by other freshwater fish (3.96%), and pelagic low value and demersal low value (2.0% each). Between 2000 and 2020 consumer demand for shrimp would decline at an annual rate of –1.97%, followed by demersal high value (–1.43%) and molluscs (–1.14%).

Fish production by production environment is projected for two decades using year 2000 as the base year. Total fresh fish output growth is projected slightly above 3%. The aquaculture output is expected to expand with higher growth about 4% per annum as compared to capture output which is likely to grow at about 2% per annum. Thus, aquaculture would expand faster than the capture.

Farmers' perception on Agriculture Debt Waiver and Debt Relief Scheme 2008: Agriculture Debt Waiver and Debt Relief Scheme 2008 (ADWDRS) was announced in budget speech of the Finance Minister in the 2008. Under this scheme, the Government of India provided a debt relief to the tune of about Rs 71,000 crore to small and marginal farmers. The main aim was to provide fresh loans to farmers who have become defaulters to the banks due to reasons beyond their control, so that they could restart their farming or economic activity. To study the implications of the scheme on farmers, a survey was conducted in the villages of Mahendergarh, Hisar and Karnal districts of Haryana during October–December 2008. Farm household level data were collected using a specially designed and pre-tested schedule to study the opinion of the farmers on the scheme. The response of the beneficiary and non-beneficiary farmers from the selected districts of Haryana regarding effects and their perception on the scheme are summarized here.

It was observed that ADWDRS did not affect the social harmony in the village and provided benefit to farmers who are not having sufficient income. Beneficiary farmers (87%) reported that they had planned to repay the loan before the announcement of the scheme. Mere 4% of the beneficiary farmers and 20% of the non-beneficiary farmers opined that there will be decreasing tendency towards non institutional loans. The reason is that formal lending institutions would be now more cautious in processing the loan

Changes in fish supply by production environment by 2020

Production environment	Production ('000 tonnes)		Change in production		% share in total	
	2000	2020	Quantity ('000 tonnes)	Per cent	2000	2020
Aquaculture	2,849.5	6,215.2	3,365.8	71.4	52.0	60.9
Capture	2,632.1	3,982.6	1,350.5	28.6	48.0	39.1
Total	5,481.6	10,197.8	4,716.3	100.0	100.0	100.0

Perceptions of selected farmers in Haryana on Agriculture Debt Waiver and Debt Relief Scheme 2008

Response	Beneficiary (%)	Non-beneficiary (%)
Non institutional loans should be waived off	97	97
Planned to repay before announcement	87	-
Encouraging people towards defaulting	38	99
Decreasing tendency towards non-institutional loans	4	20
Availed similar facilities in the past	1	2
Needed incentives for non-defaulters	100	100
Effects on social harmony of the village	1	0
Socio-economic changes in the family	4	0

applications for defaulters. Both category of farmers felt that the scheme should not be discriminatory and incentives should have been provided to the non-defaulters also.

STATISTICS

The database for the Hindi module of expert system on wheat crop management was designed that accepts UNICODE for the support of Hindi language. The variety selection module is now available in Hindi. The system displays varieties through state and zone map with the Hindi interface.

A β-version of Statistical Package for Animal Breeding (SPAB 2.1) was developed. The package is quite useful for animal breeders for estimation of genetic parameters and for formulating sound breeding strategies and selection processes. All the available programs have been grouped into 11 modules.

The new additions in SPAB 2.1 are:

- Application of Sanders correction and calculation of repeatability
- Estimation of heritability for threshold traits
- Recurrent selection and reciprocal recurrent selection
- Genetic advance in closed and open nucleus breeding schemes
- Testing the homogeneity of variance-covariance matrices (Likelihood ratio test)
- D-square analysis (Oblique axis and Iterative mini-max)
- Simulation of sib data
- Bootstrapping for estimation of standard error of genetic parameters
- Skillings and Mack non-parametric test.

Design Resources Server (www.iasri.res.in/design) developed to popularize and disseminate research in design of experiments among experimenters and research statisticians, used across 656 cities of 83 countries across the globe. It has been strengthened by adding the following material/ links:

- Modules for generation of simplex centroid designs and simplex lattice designs for experiments with mixtures that are quite useful for the experiments where a fixed quantity of inputs (may be same dose of fertilizer, same quantity of irrigation water or same dose of insecticide or pesticide etc.) are applied as a combination of two or more ingredients.
- Modules for online generation of randomized layout of factorial completely randomized designs and factorial randomized complete block designs.
- The facility of generation of field book for data entry has also been created for completely randomized designs, randomized complete block designs both for single and multi-factor experiments and Latin square designs for single factor experiments. The field book can be created as a comma separated value (csv) file or a text file.
- SAS and SPSS steps/ codes for (i) fitting non-linear models using SAS and SPSS on the sub-link non-linear models, and

Knowledge data warehouse for agricultural research

In Knowledge data warehouse for agricultural research, data mart related to crops were redesigned and 3 techniques of future projections, i.e., growth models, trend models and auto-regressive models were incorporated in on-line decision support system. The data marts also include derived parameters such as Cropping intensity index, Pesticides per cropping intensity, Pesticides per '000 irrigated area, Productivity, N ratio, P ratio, K ratio, Fertilizer intensity, Irrigation intensity. Multidimensional model of the census data related to household amenities was designed. On-line Analytical Processing (OLAP) cubes for the Census data (2001) were for all states were published. Thematic maps of productivity of various crops were digitized based on historical data using GIS software. Attempts were also made to calculate crop diversification index at state level. Further, data mart of crops, livestock and fisheries sectors was also updated.

(ii) performing cluster analysis for dimension reduction of the data.

– On the link Design for Factorial Experiments, a sub-link on Block Designs with Factorial Structure giving a bibliography on the subject as well as catalogue of three factor designs having orthogonal factorial structure with balance and permitting estimation of main effects with full efficiency and two factor interactions with controlled efficiency was uploaded.

For efficient designing of experiments for crop sequence experiments, a method of construction of block designs having orthogonal factorial structure (OFS) with balance was obtained in which all main effects are balanced in the sense that these are estimated with full efficiency. A catalogue of designs for three-factor factorial experiments having OFS and balance was prepared.

A procedure of simultaneous optimization of several ingredients for complete/incomplete multi-response experiments useful in food processing experiments was developed.

In the experimental situations, wherein experimental units are required to perform a series of tasks one after another under various experimental conditions and the conditions are altered from one session to another—for such experimental situations, two classes of nested designs involving sequences of treatments with same number of experimental periods and units have been obtained. The precision of estimation of direct and residual effects is more with the design having more number of levels of the nested factor.

Estimates of extent of farming practices, resources and activities with energy use were obtained using 59th round survey (2003) data. The estimates of total land possessed per farmer household (FHH) averaged over seasons (*Kharif* and *Rabi*) in different kinds of farming ranged between 0.008 ha and 1.238 ha for all-India and 0.011 ha – 0.894 ha in North Eastern Hilly (NEH) region. Estimated seasonal variations of these lands per FHH for all-India and NEH region ranged between 0.002ha and 0.381 ha and 0 ha and 0.320 ha, respectively. Fertilizers, organic manure, pesticides and veterinary services were available within the village to 6–93% FHHs, while improved seeds were not available to FHHs even within the reasonable distance (5 km) in most of the states. Percentages of FHHs using fire-wood for cooking, animal power for ploughing and harvesting and electricity for lighting, irrigation and threshing as main sources of energy in different states ranged from 20.6% (Punjab) to 92.1% (Rajasthan), 13.7% (Orissa) to 90.1% (Jharkhand) and 15.6% (Bihar)) to 94.5% (Punjab) respectively.

Methodology for obtaining surplus rain thresholds useful in developing rainfall-insurance programmes was developed and illustrated by analyzing data for Akola, Jhansi and Kheda districts of Maharashtra, Uttar Pradesh and Gujarat respectively. The chances of crossing these thresholds, appropriate rainfall distribution during the crop season is required for crop insurance. Various methods for estimation of parameters of generalized lambda distribution (GLD) were studied. The goodness of fit is examined by several methods. As an illustration, the probability density function of monthly rainfall data for Asom and Meghalaya meteorological subdivision showed that the method of maximum likelihood performed the best. For multimodal rainfall data, methodology of fitting mixture of distributions to 'body' and 'tail' using statistical learning theory is demonstrated. Three estimators of extreme value index are computed to fit the theoretical tail distribution to the rainfall data. "Structural risk minimization procedure" is applied to fit the 'body' of the rainfall distribution. As an illustration, the probability distribution of monthly rainfall data for Orissa meteorological subdivision is obtained by combined body-tail estimation method, and it is shown that Hill's method performed the best.

For computational analysis of SNPs at functional elements of rice genome, the genomic coordinates of functional elements were obtained and stored in database. A web page was developed for Agricultural Bioinformatics Lab (ABL) wherein links are provided to bioinformatics tools, local BLAST, etc. *BioPerl* and *.cgi* scripts are written for sequence alignment and filtering of BLAST report. SNPs along with their flanking sequences are collected and processed in a format suitable for populating database. Online local BLAST was developed to locate and quantify blocks of similarity between query sequence and database sequences. ❑

Estimation of mushroom production

Sampling methodology for estimation of production of mushroom was developed. This methodology would be time and resource efficient. In a pilot study the productivity of mushroom as estimated from data obtained through stratified two-stage random sampling was 4.46 kg/tray with 1.2% standard error. The productivity based on complete enumeration was 4.94 kg/tray. The magnitudes of standard errors and the closeness of the two figures indicated that the random sample survey based approach appears to be suitable for estimating production of mushroom.