Preliminary synthesis of farmers' attitudes and preferences towards nutrient application in China and India

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Abstract

The International Potash Institute (IPI) has initiated the distribution of a questionnaire to several hundred farmers in villages and locations across India and in two locations in East China, and to approximately a hundred fertilizer dealers in India. The results were compiled and compared between the two countries and, in some cases, between villages of the same country.

The results show that Chinese farmers rarely avoid the annual application of nitrogen (N), phosphate (P), potash (K) and organic matter (OM), when compared with farmers in India. About 40% of farmers asked in India add K 'sometimes' or 'never', while 10% only apply 'sometimes' in China. The use of a soil test was highly varied between the various locations in India, but was very low in the two locations surveyed in China. Dependence on precipitation and the socio-economic level of farmers strongly affects the use of nutrients and consumption of services such as soil testing.

Regular contacts with extension services also varied greatly between locations in India and were quite high in China. Indian farmers appear to appreciate less the knowledge of the fertilizer dealers, mostly ranking their knowledge as poor to medium, but Chinese farmers tend to rank the dealers' knowledge as "good" and "very good".

Most farmers in the survey appreciate workshops and meetings as the best channels for receiving agronomic information, followed by TV and information sheets.

It is concluded that, in order to make the most efficient dissemination of agricultural knowledge, a site-specific knowledge transfer policy has to be tailored according to the local agronomic, social, economic and societal parameters and the needs of the region.

Introduction

Agriculture and information knowledge systems today position the farmer at the centre with research, education and advisory services surrounding him and maintaining direct links to the farmer and between themselves (Birner *et al.*, 2006). Yet, public extension and research systems compete for budget, and often research institutions have an advantage due to their higher status, better management quality and links with the global science community. This creates tension and militates against an effective two-way communication (Mureithi and Anderson, 2004). Nevertheless, Anderson *et al.* (2006) strongly advocate that the dependence of extension programs on science and technology and vice versa is very strong, i.e. the linkage effect is more important than it is among other sub-sectors. Even though in many countries, in particular in developing countries, research scientists often do not have strong incentives to interact with extension.

The economic benefit from extension work was highlighted in 1995 by the International Food Policy Research Institute, IFPRI (Rosegrant and Evenson, 1995). The authors show that public research, extension expenditures, irrigation and foreign private research each had a statistically significant, positive impact on the total factor productivity (TFP) in India from 1956 until 1987. Public sector agricultural research and extension contributed nearly 60% of TFP growth. The authors also encourage investment in these segments and indicate that, as a result of the greater complexity of post-green revolution technologies, increased investment in education and human capital is likely to have high returns.

The private sector plays an important role in extension work in developed countries. In recent years, the private sector in India (e.g. fertilizer companies; see Gahlaut, 2006) has developed sustainable activities, promotion centres and dissemination projects. Indeed, private sector and extension often have different objectives and priorities. For example, the main extension projects designed in 2001 and 2003 in the Wuhe County, Anhui Province (China) were organic farming, breeding programs, various cultivation and machinery practices, introduction of varieties, control of pest and disease and so on. Among the 20 main extension projects listed, only one was related directly to fertilization and nutrient management, entitled "testing soil nutrition and formulated fertilizer applying technology" (Mei, 2005). In this respect, there is a great challenge to create incentives and agreed programs between the private sector and extension services.

Often, a small pilot or a small component within another project, with close supervision or other additional circumstances (e.g. irrigation development, delivery of abundant subsidized inputs, or simply the small and easily-managed scale of the project) will create a perception (often justified) of success. The extension model of the small-scale pilot will then be promoted to both the donor agency management and to developing-country policymakers as worthy of scaling up to the national level. The traditional reluctance of national policymakers is temporarily overcome by the availability of abundant external funds that are provided outside of the normal budget framework (Anderson *et al.*, 2006). This principle nicely demonstrates the success of the site-specific nutrient management (SSNM) project with the private sector from the fertilizer industry (IFA, IPI and IPNI) together with the International Rice Research Institute (IRRI) and generous donor money from the Swiss Agency for Development and Cooperation (SDC), all working together for the last seven years in a project that greatly improves nutrient management of irrigated rice in Asia. The project is now at its transfer and dissemination stage in which the scientific knowledge is transferred to the extension systems and farmers in East Asian countries.

Scientific success is not a guarantee for adoption of a new technology. In Indonesia, where SSNM technology was introduced, half of the farmers in Garut village in Bali (n=25) did not know the benefit of 'balanced fertilization', and in other villages, a large number of farmers was not familiar with the relationship between balanced fertilization and pest-disease occurrence (Djatiharti *et al.*, 2006). The use of the 'leaf color chart' (LCC) is another example of the SSNM technology that requires further concerted effort to achieve adoption: only 24, 4 and 8% of the farmers adopted the use of LCC, even though it was an integral part of integrated crop management (ICM) and has an acknowledged record of success (Djatiharti *et al.*, 2006).

In order to create and maintain an efficient dissemination strategy for transferring the knowledge of 'balanced fertilization', IPI has created a questionnaire for farmers and dealers. IPI conducted this survey among hundreds of farmers and dealers in China and India during the period 2004 – 2007. The results of this survey may assist in adopting specific strategies for dissemination to farmers.

The survey

Locations of the survey

The survey covered 10 locations in India (Table 1) and two locations in China. It included 350 farmers and 105 dealers in India, and 125 farmers in China. Locations were in North, West and South India, and in East China. In China, the survey was conducted on farms around the city of Changsha (Province of Hunan) and the city of Yuyao (Zhejiang Province).

Table 1. Locations where the survey was conducted in India.

State	Locations of survey
Haryana	Gurgaon, Rewari
Uttar Pradesh	Meerut, Sahajahanpur
Uttrakhand	Pantnagar
Madhya Pradesh	Indore
Punjab	Gurdaspur
Jammu & Kashmir	Jammu[1]
Kerala	Kottayam[1]
Maharashtra	Kolhapur[1]

[1] In these locations, dealers were responding to a similar set of questions, with additional queries targeted to dealers only

Farm size

Half of the farmers in India had 1-2 ha of cultivated land, 27% had 0.1-1 ha and 22% had less than 0.1 ha. Most of the Chinese farmers (81%) had 0.1-1 ha.

Main crops

The major crops grown in the survey plots are shown in Table 2.

Results from the survey and discussion

In order to learn more and receive first-hand information on the farmers' practices and preferences, we asked them a series of questions in a written form. This took place during or following meetings with large groups over discussion or a visit to various demonstration plots. To ease the replies and its analysis, no free text questions were asked.

Table 2. Main crops (>70% of land) grown in the survey plots in India and China.

Crops grown (rate)	India								China	
	Pantnagar	Sahajahanpur-1	Sahajahanpur-2	Indore	Gurdaspur	Gurgaon	Meerut	Rewari	Changsha	Yuyao[1]
	N=30	N=23	N=22	N=94	N=40	N=41	N=52	N=72	N=95	N=30
1	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Rice	Peanut
2	Rice	Rice	Rice	Soybean	Rice	Pearl millet	Rice	Pearl millet	Soybean	Tea
3		Vegetables	Vegetables	Maize					Vegetables	Vegetables

[1] The crops grown in Yuyao are very different from the other locations, with farmers in the survey putting 30% of their land to peanuts

Table 3 describes farmers' attitude toward the frequency of application of N, P and K fertilizers and OM.

Nitrogen

The vast majority of farmers in India (53.6-96.0%) and many more in China (98.3-100%) use N every year (Table 3). Nitrogen application is relatively low in three regions in India: only 53.6% of the farmers asked in Indore apply N every year, and about 10.0% do not apply N at all. A possible reason for this is that the main crop in this region is soybean. The relatively low level of N application in Rewari (73.3%) is explained by the fact that Rewari is highly dependant on rainfed agriculture, and thus fertilizer application varies according to actual rainfall. Meerut (63% answered 'every year') is another example of low application of N, but we have no observations to explain this phenomenon.

The difference between the Indian and the Chinese farmers is very clear and shows that the latter are applying N, P, K and OM in a more frequent manner (Table 3, Figure 1). A possible reason for this is the higher crop index in Changsha, better returns for the product, less dependence on rainfall and higher level of agricultural knowledge.

Phosphorous

The application of P in India is less frequent compared to N, and the percentage of farmers replying 'never' to P application is 0-22.1%, the highest being in Meerut district, India. In the two locations from China (Changsha and Yuyao), no farmer answered that they "never" applied P.

Potash

The frequency of K application in India is lower than that of N and P, and the percentage of farmers replying 'never' to the question 'I apply potash' varies between 7.4 to as high as 64.9% (Table 3). In three regions in India (Pantnagar, Sahajahanpur-1 and 2) and in both locations in China, farmers always apply K, either every year or less frequently. Farmers in Gurgaon district displayed the lowest rate of K application: only 18.9% apply

Table 3. Farmers' practice concerning regular application of N, P, K and OM (% of farmers).

Farmers' practice	India								China	
	Pantnagar	Sahajahanpur-1	Sahajahanpur-2	Indore	Gurdaspur	Gurgaon	Meerut	Rewari	Changsha	Yuyao
	N=30	N=23	N=22	N=94	N=40	N=41	N=52	N=72	N=95	N=30
'I apply nitrogen' (%)										
Every year	96.0	91.0	77.3	53.6	75.9	81.1	63.0	73.3	100.0	98.3
Every 2 years	4.0	4.5	4.5	9.5	10.3	10.8	15.2	14.7	0	0
Sometimes	0	4.5	18.2	27.4	13.8	5.4	15.2	9.3	0	1.7
Never	0	0	0	9.5	0	2.7	6.6	2.7	0	0
'I apply phosphorus' (%)										
Every year	84.0	87.0	65.2	50.0	37.9	80.6	59.7	68.2	100.0	98.3
Every 2 years	4.0	13.0	4.3	15.2	10.3	8.3	6.6	10.6	0	0
Sometimes	8.0	0	26.1	30.4	41.4	5.6	11.6	13.6	0	1.7
Never	4.0	0	4.4	4.4	10.4	5.5	22.1	7.6	0	0
'I apply potash' (%)										
Every year	84.6	79.2	81.8	39.3	40.7	18.9	63.5	32.6	100.0	94.0
Every 2 years	0	8.3	4.6	15.7	11.1	5.4	5.8	13.9	0	0
Sometimes	15.4	12.5	13.6	29.3	40.7	10.8	15.4	16.3	0	6.0
Never	0	0	0	15.7	7.4	64.9	15.3	37.2	0	0
'I apply organic manure' (%)										
Every year	76.9	45.8	40.9	64.4	23.5	37.5	54.2	72.1	86.3	18.7
Every 2 years	0	45.9	40.9	18.4	35.3	2.5	37.5	22.9	0	15.6
Sometimes	23.1	8.3	18.2	12.6	35.3	20.0	6.2	3.3	13.7	65.6
Never	0	0	0	4.6	5.9	40.0	2.1	1.6	0	0

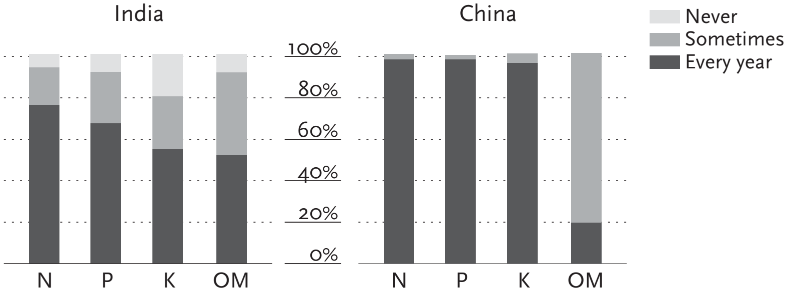

Figure 1. Farmers' practice for application of N, P, K and OM in India and China (average of 374 and 125 farmers in India and China, respectively).

K every year, 16.2% apply sometimes and every second year, but 64.9% answered 'never' to the question 'I apply K every…'. This is the highest rank for 'never' application we received in this survey.

Another contrasting figure is the low use of soil test services reported by the farmers in Gurgaon (Table 4): only 27%, the lowest rank in all the sites across India, use laboratory soil testing facilities. Since Gurgaon is close to Delhi, with a good logistic infrastructure, the reason for this is obviously not related to a reliable supply of K. Gurgaon region has light textured soils, the soils are poor in fertility and rainfall is quite low. Farming is mostly rainfed, and the predominant crops in the Kharif season are pearl millet and cluster bean, followed by wheat and mustard in the Rabi season. Yields are generally not high and if rains are not adequate, farmers tend to apply low levels of fertilizers. The area in Gurgaon where our survey was conducted is characterized as a low socio-economic level area, which reflects the low education level, the large number of children per family, a high level of drop-out from school and the large extent of disease born by unhygienic conditions. With such a social structure and conditions, the agricultural performance is also poor. We thus assume that this low socio-economical level is the main reason for the low level of farmers' knowledge as well as the low level of technical support from extension and others, as reflected by the low level of soil test laboratory use. Interestingly, Shen *et al.* (2005) showed that there is a good correlation between per capita net income of rural households and N surplus and K deficit in soils of China. The authors conclude that the level of economic development plays an important role in nutrient balances of various agro-ecosystems.

To overcome the low level of K application in Haryana, near the Gurgaon area, IPI initiated a demonstration program in 2001, where numerous field trials with excellent agronomic results for K application in pearl-millet, wheat and mustard were demonstrated to farmers (Yadav *et al.*, 2005). The impact of this activity can be observed in some locations with a relatively higher demand for K.

Table 4. Percent of farmers using soil test laboratories and farmers maintaining contact with extension and private sector in India and China.

Location	I use soil test laboratory		I have regular contacts with extension and private sector	
	Yes	No	Yes	No
India (%)				
Pantnagar	36.4	63.6	90.9	9.1
Sahajahanpur-1	95.4	4.6	100.0	0.0
Sahajahanpur-2	54.5	45.5	85.0	15.0
Indore	53.7	46.3	60.9	39.1
Gurdaspur	62.5	37.5	74.3	25.7
Gurgaon	27.3	72.7	35.3	64.7
Meerut	40.0	60.0	58.7	41.3
Rewari	52.4	47.6	71.2	28.8
China (%)				
Changsha	11.5	88.5	69.5	30.5
Yuyao	17.0	83.0	58.0	42.0

Organic manure

The application of organic manure appears to be well accepted by the Indian farmers. Unlike very similar results for N, P and K application in China obtained in the two locations surveyed, the farmers of Yuyao apply organic manure at a relatively low frequency (Table 3). Most of the farmers in Yuyao (65.6%) apply organic manure 'sometimes', the highest rank among all locations in India and China. A possible reason for this is the quite different crops and crop rotations in Yuyao (peanut, tea and vegetables; Table 2).

In conclusion, farmers are much more 'dedicated' to precise, frequent N application than to P and K application. Crops and irrigation facilities or, alternatively, dependence on rainfall also largely affect the practice of nutrient application. We also assume that agricultural knowledge gaps, sometimes induced by poor socio-economic levels, affect the application of K more than that of N and P.

Soil testing in the laboratory and contacts with extension and the private sector

In order to assess the farmers' attitude towards the use of soil tests, and to learn of their links with extension and advisors from the private sector, we asked the questions listed in Table 4.

Approximately 50% of the Indian farmers that participated in the survey use soil test laboratories (Table 4). The low level of soil test usage in Gurgaon (27.3%) is again explained by the high dependence on rainfall and the poor socio-economic structure. In contrast, the very high level of soil tests in Sahajahanpur-1 could be due to the fact that the farmers in the survey area are in the vicinity of Shriram's sugar-mill Haryali Bazar (a shopping mall for farmers' needs run by Shriram fertilizers) that has been very active and instrumental in promoting the orderly, systematic use of soil tests.

In China, the high fertilizer application rates do not rely on soil tests: only 11-17% of the farmers in the survey reported the use of this service.

Most of the farmers in both India and China did have regular contacts with extension and private sector (Table 4). It is again the Gurgaon region that has relatively low levels of contact (only 35.3% said 'yes' to maintaining regular contact with extension and private sector).

Ranking the knowledge of the fertilizer dealers

In order to learn more of the interface between farmers and their dealers, we asked the farmers to rank the knowledge of the dealers they work with (Table 5). The reply to this question may also relate to the status of the dealers in the eyes of the farmers.

Table 5. Ranking the knowledge of the fertilizer dealer by farmers in India and China.

Location	Ranking the knowledge of the fertilizer dealer				
	Poor	Low	Medium	Good	Very good
India (%)					
Pantnagar	0	0	21	10	69
Sahajahanpur-1	0	5	37	10	48
Sahajahanpur-2	42	33	17	0	8
Indore	35	29	14	13	9
Gurdaspur	50	0	34	8	8
Gurgaon	60	0	40	0	0
Meerut	40	7	27	3	23
Rewari	18	40	24	0	18
China (%)					
Changsha	0	6	7	75	12
Yuyao	0	0	30	44	26

In general, the farmers participating in this survey in India showed considerable less appreciation of the knowledge of their fertilizer dealers, whilst in the two locations monitored in China, it appears that the general ranking is between 'medium' to 'good'. Only farmers in Pantnagar and Sahajahanpur-1 (India) ranked their dealers positively. In all other locations of the survey in India, more than 50% of the farmers ranked the knowledge of their dealers as 'poor' or 'low'. As in other questions of this survey, farmers in Gurgaon have the highest negative rank towards the knowledge of their dealers, and 60% of the farmers answered that the knowledge level of their dealers is 'poor'.

These results pose a question over the role fertilizer dealers may play in promoting the use of 'balanced fertilization' practices. In addition, the status of the Indian dealers in most of the regions where the survey was carried out needs to be addressed.

Ranking farmers' preference for receiving agricultural information

In order to better evaluate the means IPI needs to use for the dissemination of 'balanced fertilization', farmers in the survey group were asked their opinion of the effectiveness of various agricultural information delivery channels. Their replies were graded into 4 categories: low, medium, high and very high (Table 6).

Table 6. Preferred communication channel for farmers in India and China for receiving agricultural information.

Location	Preference for receiving agricultural information						
	Information sheet	Workshops & meetings	TV	Radio	Experimental demo plots	Dealers	Successful neighbour
India (%)							
Pantnagar	High	High	Low	Low	Medium	High	Low
Sahajahan pur-1	Low	Very high	Medium	Medium	Medium	Medium	Medium
Sahajahan pur-2	Medium	High	Low	Medium	Low	Low	High
Indore	Medium	Medium	High	Low	Medium	Low	High
Gurdaspur	Medium	Medium	High	Medium	Low	Low	Medium
Gurgaon	Medium	Medium	High	High	Medium	Low	Medium
Meerut	Medium	High	Medium	Medium	Medium	Medium	Low
Rewari	Medium	High	High	High	Medium	Low	Medium
China (%)							
Changsha	Low	Very high	High	Low	Very high	Medium	Low
Yuyao	High	Medium	High	Low	Medium	High	Medium

In general, the ranking varies greatly from location to location. For example, TV was ranked 'low' in Pantnagar but 'high' in many other locations (Table 6). Attending workshops and meetings appears to be the most preferred channel for agricultural dissemination, as it scored 'very high' and 'high' in six locations, and not even a single 'low' rank. TV was also highly preferred as a channel of acquiring agricultural knowledge and scored 'high' in six of the ten locations. Dealers were the least preferred channel for this purpose, and scored 'low' in five locations. The use of information sheets is received by farmers in a very moderate way, and it appears that they prefer face to face means such as workshops and meetings. Between the two media channels, TV is much preferred over radio.

No significant differences were found between the India and the Chinese farmers in this survey.

Dealers' response

Fertilizer dealers are probably the closest circle around farmers as they often meet, trade, discuss and share information with the farmers. In order to better understand the dealers' opinions regarding their business environment and the interface with the farmers and extension workers, we launched a similar survey in 2007 with similar and different questions. Dealers from Jammu (Jammu and Kashmir; n=33), Kolhapur (Maharashtra; n=43) and Kottayam (Kerala; n=29) were selected for this purpose.

Asked "what is the dealer's most urgent problem", dealers from North (Jammu), Central (Kolhapur) and South India (Kottayam) replied similarly, and indicated that the reliable supply of fertilizers is the most pressing problem they face (Table 7). Reliable supply is highly relevant to dissemination of knowledge: we face many situations where, following the completion of a field experiment or demonstration plots, farmers are convinced of the value of potash and willing to purchase it. A year of no potash availability at the market damages the results and simply impairs the willingness of the farmer to adopt the experiment's different nutrient management techniques.

Storage capacities and the number of clients do not appear to be a serious limitation, but cash flow and the financial arrangements with the suppliers seem to be another constraint.

Asked "what is your attitude towards extension workers", the dealers across the three locations were very clear, and the vast majority (80%) had a positive approach, seeing the extension worker as a "friend/advisor" rather than "controller/invader" (Table 7). This finding shows that the interface between dealers and extension workers may be of positive value.

Table 7. Dealers approach to management and financial issues and attitude towards extension workers (total 105 dealers).

Location / issue	Jammu	Kolhapur	Kottayam
	N=33	N=43	N=29
Dealer's most urgent problem is: (%)			
Reliable supply	42	34	38
Own storage capacity	6	16	0
Cash flow / financial arrangements with suppliers	21	32	31
Not enough customers	6	5	16
Too limited variety of products	25	13	15
What is your attitude towards extension workers? (%)			
Friend / advisor	79	81	89
Controller / invader	7	5	4
Neutral	14	14	7

Conclusion

This survey clearly demonstrates that farmers surveyed in China were applying N, P and K much more frequently than those surveyed in India, and this is especially true for K. The reason for this is not better soil testing procedures in China, but probably the differences in cropping systems, location of the villages and, thus, the income that can be generated by the farmers. In India, it was demonstrated that the lack of irrigation facilities and the total dependence on erratic precipitation leads presumably to a lower socio-economic status, with less income generated and, thus, lower frequency of fertilizer application.

The two groups surveyed, farmers and dealers, felt positive towards extension workers. This provides an opportunity for empowering extension workers so that they can assist farmers' decisions: we also found that dealers, especially according to the survey in India, did not enjoy the appreciation of farmers as a source of agricultural information and, thus, cannot replace the role of extension workers.

There is a large variety of channels for disseminating agricultural information, and its ranking by farmers varies from location to location. However, we assume that attending workshops and meetings (with resourceful extension and/or private sector workers) is more appreciated by the farmers, in addition to mass media such as TV and radio.

In general, we found a large variation in the opinions of the farmers towards the questions we asked, both in India and China. We conclude that establishing a process in which the physical and societal conditions are assessed is vital for conducting a successful dissemination process of agricultural information.

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