Journal of Agricultural Technology 2012 Vol. 8(3): 1089-1098
Available online http://www.ijat-aatsea.com
ISSN 1686-9141

Sustainability of scientific maize cultivation practices in Uttar Pradesh, India

Km. Saroj Gupta* Gyanpur, S.R.N.

Nehru Gram Bharati University Kotwa-jamunipur, Allahabad, Uttar Pradesh, Administrative office-12, park street, New Delhi, India

Km. Saroj Gupta, Gyanpur, S.R.N. (2012) Sustainability of scientific maize cultivation practices in Uttar Pradesh, India. Journal of Agricultural Technology 8(2): 1089-1098.

Sustainability of scientific maize cultivation practices must be ensured to attain the goal of agricultural sustainability. The study was conducted in purposively selected state i.e. Uttar Pradesh. A total sample size of 80 maize farmer respondents and 20 SMS/ Experts were selected by using multi-stage random sampling technique and simple random selection procedure respectively. Data were collected by using personal interview method. The collected data were tabulated, analyzed and interpreted with the help of appropriate statistical tools. Among the practices studied in scientific maize cultivation, mean sustainability scores obtained from farmer respondents was highest for irrigation followed by application of FYM, use of HYV and application of synthetic nitrogenous fertilizer respectively. The experts perceived significantly higher sustainability in all practices.

Key words: maize cultivation, sustainability, industrial product, irrigation, sustainable agriculture.

Introduction

Estimates indicate that Indian population will require 325 million tons of food grain by 2020 AD. This demands consistent increase in production and productivity of agricultural crops. Maize has immense potential to meet food requirement of human population. It has a great significance as human food, animal feed and diversified uses in a Large number of industrial products. Adoption of improved and sustainable maize technologies holds the key to ensure both sustainability and increased maize production. Muthuran (1995) cited 14 major dimensions of sustainable agriculture as identified by M.S. Swaminathan and according to him, sustainable agricultural technology should be technologically appropriate, economically feasible and viable, environmentally sound, stable over the long run, efficient in resource use, locally adaptable, socially acceptable and sustainable, implementable in

* Corresponding author: Km. Saroj Gupta; e-mail: sarojgupta _0@yahoo.com; Sarojgupta1886@gmail.com.

existing political set-up and bureaucratic structure, culturally desirable, renewable, equitable and productive.

There is report of sustainability concerns and emerging problems in Uttar Pradesh. In Uttar Pradesh, farmers find it difficult to sustain their living standards due to small holding, less infrastructural facility, etc. Maize "The queen of cereals" is the third most important food crop in Uttar Pradesh next only to rice and wheat. Kharif maize is an important crop. Concept of cultivating the "rabi maize" was originated in this state and it is grown in a sizeable area. Uttar Pradesh account for 8.33% of the total maize area and 9.65% of total maize production in the country with an average yield of 23.74 q/ha during 2003-04. Sustainability of scientific maize cultivation practices in Uttar Pradesh had not been studied, so far. Thus, keeping in view, the importance of scientific maize cultivation practices and decreasing trend of production and productivity, the present study was undertaken, with the specific objectives given as below: to measure and compare the degree of sustainability of scientific maize cultivation practices in Uttar Pradesh, and to ascertain the perceptual difference, if any, among SMS / experts and farmers regarding various dimensions of sustainability with respect to scientific maize cultivation practices

Maize Production in India

Total maize production and maize yield per unit area in India has been affected by many different factors. Among the most important are total planted area and productivity. There is limited scope for expanding cultivated land under maize production since unused land is diminishing or is of marginal quality or just unsuitable for maize production (India Soil Survey, 1987, Muchena *et al.*, 1988). Producing higher maize yields on existing cultivated land is therefore the surest way of generating the extra maize grain required to feed the nation. To achieve this goal, a number of remedial activities must be put in place.

Fertilizer applications

To facilitate production of higher maize yields, it is necessary to carry out appropriate research and identify the short-term needs of the crop and long-term needs of the soil. To determine those needs, frequent soil analysis is necessary (Qurush, 1990). Once the needs are identified, it is possible to use fertilizers in a balanced way (or better ratio) to achieve the highest returns from the expensive inputs. Loss of fertilizers, input by way of leaching and P-fixation can be reduced in two ways: first through enriching the soil in organic matter which increases the cation exchange capacity and reduces leaching; second through applying fertilizers particularly N and K in split doses rather than a single dose (Taja and Zaag, 1991). Another beneficial strategy is the use of a combination of fertilizing techniques with green manure fallow plus stable manure, or compost plus modest quantities of chemical fertilizers (Smaling, 1990; Smaling *et al*. 1992). Crop rotation, based on the inclusion of polyannual legumes, should be included in the management practices as the system maintains soil fertility (Caporali and Onnis, 1992).

Weed Control

The only solution to the losses due to weeds is better weed management. Good weed management does not only involve timely weeding of individual fields and crops during the critical stages of crop growth, it also involves keeping the whole field clean and ensuring that a minimum of weed seed is allowed to come to maturity. The smallholder farmers have to rely on improved hand tools and occasionally animal-drawn implements because other alternatives such as herbicides and heavy machinery are too expensive (Aggarwal *et al*. 1992).

Technology transfer

Major effort must be made to transfer modern technology through education, training and raising the levels of knowledge of the smallholder farmers. More farmers should be involved in the development of new research packages since they usually understand better the possible impacts of new technologies on their farming systems. The center of research action should be on the farmers' farms while the farmers should be important players in research activities. This approach is likely to benefit the farmers more compared to the situation where the researchers concentrate their research in the research station.

Conventional ploughing operations have to be carried out at the appropriate time depending on the environmental conditions of the farm. Tillage operations should be carried out in such a way that sufficient crop residues are left on the land to decompose and maintain organic matter balance unless other forms of manure from outside are added.

Liming

Soil analysis should be carried out to determine requirements to facilitate the application of optimum quantities and avoid over liming. Another alternative should be the introduction of acid tolerant maize varieties.

Insect and disease control

Maize protection from the menace of insects and diseases can be achieved through several methods. Where the use of chemicals seems to be the only way of solving an immediate plant protection problem, pesticides should be used within the context of integrated pest control to increase their efficiency and minimize unwanted side effects such as: pest resurgence pest resistance to pesticides destruction of natural enemies, beneficial insects and non-target species persistence residual problems and hazards. To minimize yield reduction due to pests and diseases, it is important to incorporate pest and disease tolerance features as a high objective in maize breeding program. Crop rotation can be practiced to control pests and diseases (Brust and King, 1994).

Materials and methods

The study was conducted in two progressive districts of Uttar Pradesh Patna and Begusarai (purposively selected). Two blocks from each selected district; and from each block, two villages; and from each village, 10 Farmers were selected by using multi-stage random sampling technique, thereby constituting a sample size of 80 farmer respondents. Those farmers growing maize were considered as respondents. Twenty SMS/ experts working in the study area were also selected using simple random selection procedure. Technologies recommended by scientists of particular region become scientific practice, when it is in regular use by farmers. Based on review of literature and experts' advice four important scientific maize cultivation practices, namely; use of high yielding varieties (HYV), application of farm yard manure (FYM), application of synthetic nitrogenous fertilizer and irrigation were selected. Degree of sustainability of selected scientific maize cultivation practices was operational zed as the perceived extent up to which selected practices were technologically appropriate, economically viable, environmentally sound, socio-culturally compatible, and stable over long period of time, efficient in resource use, productive, locally adaptable, and equitable and government policy in favor of its implementation. A suitable sustainability index was developed to measure extent of sustainability of selected practices. Index was developed by using ten dimensions and twenty-two indicators of sustainability. Responses were taken from both farmers as well as expert respondents on three-point continuum, i.e., agree undecided and not agree. Score two (2) for agree, one (1) for undecided and zero (0) for not agree were given. Total obtained score for each selected practice was calculated. It was divided by number of respondents, which gave mean sustainability score. Dimension-wise mean sustainability scores were also calculated. For a total of ten dimensions of sustainability, the maximum possible mean score of sustainability were 44 for each of four scientific maize cultivation practices considered under the present study. Mean sustainability scores were calculated for each selected practice against all ten dimensions and twenty-two indicators and were analyzed by using ‘Z’ test.

Results and discussions

Among the practices studied, mean sustainability scores obtained from farmer respondents was highest in irrigation, followed by application of FYM, use of HYV and application of synthetic nitrogenous fertilizer, respectively (Table 1). The sustainability of all the selected practices was found to be perceived differentially by SMS / experts and the farmers. The experts reported higher sustainability of all practices. Mean sustainability scores obtained from experts respondents were highest in application of FYM followed by irrigation, use of HYV and application of synthetic nitrogenous fertilizer respectively.

Both farmer and experts were of the opinion that application of synthetic nitrogenous fertilizer was least sustainable among selected practices. Difference in opinion of farmers and experts was mainly due to difference in educational background coupled with their respective professional interests: experts are the technology generators/ disseminators; whereas farmers are the actual users of technology. Sustainability of application of Farm Yard Manure (FYM) maintains physical structure of soil. Farmers were applying FYM as per its availability. Table 3 revealed that application of FYM in maize cultivation was found more environmentally sound, stable and socio culturally compatible, but less equitable. Farmer and expert respondents were widely varying in their responses regarding government policy. Farmers were expecting more government support in increasing availability of FYM. But experts classified and opined that government has very limited role in increasing availability of FYM. Government is supporting application of FYM through various training programmes on integrated nutrient management (INM). Farmers should adopt improved method of composting like NADEP method, which increases amount of manure from same amount of dung. Researches should be conducted for rapid decomposition of dung, prevention of loss of nutrients in decomposition process, etc. All in all, the sustainability of use of HYV in maizecultivation was less, which might be due to less use of HYV seed, less yield, meagre profit, less suited to need and aspiration of people, less technical knowledge, lack of quality produce and lack of proper marketing facility. Thus, it would be suggested that extension agencies should impart technical knowledge about improved HYV of maize, government should ensure timely availability of HYV seed to farmers at cheaper price, and proper marketing facility should be established for improving sustainability of HYV in maize cultivation.

Sustainability of use of high yielding varieties (HYVs)

Dimension-wise analysis (Table 2) of sustainability indicates that use of HYVs was more socio-culturally compatible, technologically appropriate, stable, efficient in resource use and productive, but government support is insufficient (e.g., nonavailability of quality seed at cheaper price on right time from government agency or Beej Nigam) and less economically viable.

Table 1. Sustainability of scientific maize cultivation practices in Uttar Pradesh

Respond-Dents	**Mean Sustainability Score of Practices**			
	Use of HYV	Application of FYM	Application synthetic nitrogenous fertilizer	Irrigation
Farmers (N=80)	30.44	31.65	26.49	32.26
Experts (N=20)	31.80	34.50	28.10	33.60
Z-value	2.13*	7.87**	3.07**	2.65**

*Significant at 0.05 level of probability, ** Significant at 0.01 level of probability

Sustainability scores obtained from experts were found to be higher in most of the dimensions except socio-cultural compatibility, stability and local adaptability. Few experts were of the opinion that HYVs are not suited to needs and aspirations of few sections of the farming community. Results of dimension-wise sustainability analysis of selected scientific practices of maize cultivation have been presented below:

Sustainability of application of Farm Yard Manure (FYM)

FYM maintains physical structure of soil. Farmers were applying FYM as per its availability. Application of FYM in maize cultivation was found more environmentally sound, stable, socio-culturally compatible, productive, and technologically appropriate but less equitable, locally adaptable and economically viable.

Farmer and expert respondents were widely varying in their responses regarding government policy. Farmers were expecting more government support in increasing availability of FYM. But experts opined that government has very limited role in increasing availability of FYM. Government is supporting application of FYM through various training.

Programmes on integrated nutrient management (INM)-Farmers should adopt improved method of composting like NADEP method, which increases amount of manure from same amount of dung.

Table 2. Dimension-wise sustainability of use of HYVs

S. No. Dimensions of Sustainability	Maximum possible sustainability score	Uttar Pradesh	
		Farmers (N=80)	Experts (N=20)
1.Technological appropriability	6	5.65	5.70
2. Economic viability	6	3.12	4.00
3. Environmental soundness	4	2.39	2.50
4. Socio-cultural compatibility	4	3.93	3.80
5. Stability	4	3.23	3.20
6. Resource-use-efficiency	4	3.11	3.40
7. Productivity	4	3.05	3.10
8. Local adaptability	4	2.53	2.50
9. Equity	4	2.46	2.50
10. Government policy	4	0.98	1.10
Overall	44	30 .44	31.80

Researches should be conducted for rapid decomposition of dung, prevention of loss of nutrients in decomposition process, etc.

Sustainability of application of synthetic nitrogenous fertilizer

Dimension-wise analysis presented in Table 4 showed that application of synthetic nitrogenous fertilizer in maize cultivation was more socio-culturally compatible, technologically appropriate, productive and economically viable, but less environmentally sound and equitable. Farmers were using fertilizer without soil test. They were applying higher dose of urea for getting same yield level. Indiscriminate use of fertilizer making this practice less environmentally sounds. Differences in the opinions of farmers and expert respondents were mainly on utilization efficiency of urea, risk involved

Table 3. Dimension-wise sustainability of application of FYM

S. No. Dimensions of Sustainability	Maximum possible sustainability score	Uttar Pradesh	
		Farmers (N=80)	Experts (N=20)
1.Technological appropriability	6	5.16	5.30
2. Economic viability	6	3.60	3.70
3. Environmental soundness	4	3.96	4.00
4. Socio-cultural compatibility	4	3.82	3.80
5. Stability	4	4.00	4.00
6. Resource-use-efficiency	4	3.09	3.30
7. Productivity	4	3.65	3.70
8. Local adaptability	4	2.11	2.00
9. Equity	4	1.63	1.90
10. Government policy	4	0.63	2.80
Overall	44	31.65	34.50

Sustainability of irrigation

Generally, kharif maize cultivation is rained but rabi maize is irrigated. Dimension-wise analysis indicated that irrigation in maize cultivation satisfies most of the dimensions of sustainability. It was found more socio-culturally compatible, stable and technologically appropriate. It was found to be less equitable. It indicates that irrigation facility is not available to all farmers. Both farmer and expert respondents stated regarding lack of government support for establishing irrigation infrastructure, like, canal irrigation, electricity operated pump-sets, etc. It is suggested that irrigation at critical stages of crop growth must be ensured in all seasons for getting higher yield and improving sustainability of irrigation as well as overall maize cultivation. Of HYV and application of synthetic nitrogenous fertilizer, respectively, whereas, mean sustainability scores obtained from expert respondents was highest in application of FYM, followed by irrigation, use of HYVs and application of synthetic nitrogenous fertilizer respectively. The sustainability of all the selected practices was found to be perceived differentially by SMS / experts and the farmers. The experts reported higher sustainability of practices. Timely availability of quality seed, use of vermicompost, reduction in cost of irrigation and govt. control on supply, quality and cost of fertilizer were the important suggestions as given by the farmers to improve sustainability regarding use of HYV, FYM, irrigation and synthetic nitrogenous fertilizer, respectively

Conclusion

Among the practices studied in scientific maize cultivation, mean sustainability scores was highest in irrigation, followed by application of FYM, use of HYV and application of synthetic nitrogenous fertilizer, respectively, whereas, mean sustainability scores obtained from expert respondents was highest in application of FYM, followed by irrigation, use of HYVs and application of synthetic nitrogenous fertilizer respectively. The sustainability of all the selected practices was found to be perceived differentially by SMS / experts and the farmers. The experts reported higher sustainability of practices. Timely availability of quality seed, use of vermicompost, reduction in cost of irrigation and govt. control on supply, quality and cost of fertilizer were the important suggestions as given by the farmers to improve sustainability regarding use of HYV, FYM, irrigation and synthetic nitrogenous fertilizer, respectively. The formulation of a strategy to pursue sustainable maize production in India is indispensable mainly because of the scarcity of good agricultural land and rapid population growth. Unfortunately, the majority of farmers will not be able to provide adequate inputs in order to increase the current yields and to sustain higher yields. Increasing maize production in India can be approached both at farm and national levels. At the farm level, a number of important measures are necessary: execution of early and better land preparation, timely planting, planting of the most appropriate maize varieties, proper fertilization, efficient weeding and improved control of pests and diseases while family labor should be used effectively to carry out weeding operations. At the national level, several interventions are essential: enhancing the productivity of fragile, marginal land ecosystems through improving the existing maize varieties to facilitate the expansion of maize production in marginal land areas, breeding germplasm varieties that are acid-tolerant and utilize phosphorus more efficiently, devising techniques to improve rainwater utilization and developing effective residue management practices. Other interventions include: intensification of research to determine the appropriate types and quantities of fertilizers, manures and agricultural lime for different soils and climatic conditions of the country; boosting of agricultural extension services to promote efficient weeding practices particularly by family labor; increasing agricultural credit facilities to enable farmers purchase the necessary inputs, and put in place maize price policies that encourage farmers to increase maize production on a sustainable basis.

References

Anonymous (2005-06). Directorate of Economics& Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India.

Anonymous (Circa 2005). Site: www.mssrf.com. Issued by M.S. Swaminathan Research Foundation.

Swaminathan, M.S. (1995). Dimension of sustainable agriculture cited by Muthuraman, P. towards Sustainable Agriculture: Dimensions and Components. Employment News 20: 34.

Muthuraman, P. (1995). www.mssrf.com: M.S. Swaminathan Research. Toward Sustainable Agriculture: Dimensions and Components. Employment News 20:34.

Ahmed, A. S. H., Khan, M. D. Mia and M. A. Shahid (1983) Sonar Bangla Sonar Fashal: Bhutta, Bangladesh

Agricultural Research Institute, Regional Agricultural Research Station, Jamalpur

BARI (1980). Agro economic Study on On-Farm Maize Trials in Bangladesh. BARI, Joydebpur, Gazipur.

BARI (1988). Annual Report 1987-88. On-Farm Research Division, BARI, Joydebpur, Gazipur.

BBS (2002). Statistical Year Book of Bangladesh 2002. Bangladesh Bureau of Statistics, Ministry of Planning,

Government of the Peoples Republic of Bangladesh, Dhaka, Bangladesh.

BBS (2003). Statistical Year Book of Bangladesh 2003. Bangladesh Bureau of Statistics, Ministry of Planning.

Government of the Peoples Republic of Bangladesh, Dhaka, Bangladesh.

C.D.P. (1992). Crop Diversification Program Technology Nirdeshika. Published by Ministry of Agriculture.

Duloy, J. H. (1959). Resource allocation and f fitted production function. Australian Journal of Agricultural Economics 3:2.

Farrel, M. J. (1957). The Measurement of Production Efficiency, Journal of Royal Statistical Society, Series A 120:250-290.

Haque, A. and Mahfuzul, B. (1996). An Agribusiness Study of Winter Maize System in Some Selected Areas of Bangladesh. Unpublished M.S. Thesis. Department of Agricultural Economics, Bangladesh Agricultural University.

Hossain, M.M. (1990) An Economic analysis of Maize Cultivation in Saturia Upazila of Manikgonj District.Unpublished Master Degree Thesis. Department of Agricultural Economics, Bangladesh Agricultural University.

Russel, D.G. (1983). Resource Allocation in Agricultural Research Using Socio-economic Evaluation and Mathematical Models. Canadian Journal of Agricultural Economics 23:29-52.

Shahidullah, M, M.A. Rahim, M. A.Aziz and A. K. M. Hafizur Rahman (1995). Trial on Potato Intercropped With Maize and Khira, OFRD, BARI, Bogra, Research Report, 1994-95.

Yamane, T. (1973). Statistics- An Introductory Analysis, Asyana Gakuin University, Tokyo, Harper International Edition.

(Published in May 2012)