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WEED MANAGEMENT PERSPECTIVES FOR INDIA IN THE CHANGING AGRICULTURE SCENARIO IN THE COUNTRY

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ABSTRACT

India is the fourth largest economy in the world. Agriculture continues to be the most important sector of Indian economy providing employment and livelihood to nearly 70% of the total population. It has done well all through to feed the growing population. About 2.5 mt of additional food grains are required annually in the next 10 years to meet the demand of the growing population. This is a huge challenge as it has to come from shrinking (both in quality and quantity) land and water resources, adverse climatic and market forces, poor infrastructure, etc. The government is putting lot of thrust on agriculture in its 11th five year plan (2007-12), recognizing that agriculture growth is key to achieve the target of 9.0% growth in total GDP. The government is responding to these challenges by increasing the investment, launching several developmental schemes and providing policy support. Many of the schemes are pro-poor and pro-small holders aimed at achieving inclusive growth. One such scheme, the National Rural Employment Guarantee scheme which guarantees employment/wages to one adult in a household for 100 days in a year, has benefited millions of rural workforce. However, this has also made the labor expensive and unavailable for agricultural operations including weeding. The paper discusses the challenges and opportunities of weed management in the light of changing agricultural scenario in the country.

Keywords: Herbicide resistant crops, India, resource conservation technologies, weeds, weed management.

INTRODUCTION

Agriculture continues to be the most important sector of Indian economy, directly involving over 60% of the country's population, despite a progressive decrease in its share of total national GDP. The share has progressively decreased over the years from 48% in 1950s to the current 17%. The decreasing contribution signifies the increasing contribution by the other sectors particularly the services and manufacturing sector. Indian agriculture has by and large performed very well all through. From a net food importer until 1970s, to the present level of self sufficiency and a net exporter in certain commodities, is no mean achievement. The food production has quadrupled in the last 50 years from a mere 51 mt in 1950 to 232 mt

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in 2011. This has more than matched the three times increase in the human population from 0.36 billion to 1.02 billion during the same period. We can also boast of the huge quantity of buffer stock food grains, anywhere in the range of 40-50 mt, to tide over any adverse conditions.

The country is aiming to achieve an overall growth in the economy at over 8-9% during the 11th Five Year Plan period (2007-12). In order to achieve this, the agriculture sector has to grow at 4% or more. However, India's quest to achieve this target in agriculture has remained elusive since mid 1990's. In fact the growth was less than 1.0% during 2007-08 and 2009-10. Thanks to good harvest (with 232 mt) in 2010-11, a growth rate of 5.4% has been recorded.

The changes in productivity had a great social impact on the farming community. With increased production, income from the farms improved and with greater money to spend, new needs for farm inputs, milling, processing and marketing services occurred and spurred the local economy to growth. While the per capita consumption of food grains has shown a decline in the recent past, the demand for meat, milk, chicken, fish, eggs, fruits and vegetables is on the increase. Despite these achievements, the access to food and nutritional security, particularly in the rural areas, is cause for concern. The general well being of the people can be gauged by the fact that based on Human Development Index, the country is ranked at 122 position (of total 172 countries) during 2010.

The challenges are many. The country, with only 2.3 percent of the world's total land area, has to ensure the food security for 17.5 percent of the world's population amidst declining natural resources, erratic monsoons, climate change crisis, energy crisis, loss of bio-diversity, decreasing land holding sizes, weak extension machinery, lesser productivity from the farmlands, rising input costs, inadequate storage infrastructure and high post harvest losses, all of which ultimately pulls down the returns to the farmer-producer. There is thus a general lack of interest among the farming community, especially rural youth, in engaging with agriculture as a livelihood option and most of them are migrating to the urban areas in search of a better standard of living.

It is in this context that we have to plan to revive the agricultural sector in the country. Agriculture has to shed its old ways and embrace new ones to meet the enormous challenges it faces today. The development of innovative products, processes and concepts by entrepreneurs and private players and their integration into existing agricultural systems is the pathway to true inclusive agricultural growth. An environmentally sustainable agricultural growth

is a prerequisite for economic development in general and rural development in particular.

The government is responding to these challenges by increasing the investment, launching several developmental schemes and providing policy support. Through most of these schemes the government aims to achieve inclusive growth. Many are beginning to show a positive impact. The one scheme which is much talked about is the National Rural Employment Guarantee scheme. The scheme, which was passed through an Act of the parliament, aims at enhancing the livelihood security of people in rural areas by guaranteeing 100 days of wage-employment in a year to at least one person in a family living below the poverty line. This flagship program, which cost the exchequer nearly Rs 400 billion (USD 9 billion) annually, has proved very successful and has benefited a vast number of the rural workforce (40 million households in 2010). However on the flip side, this has come under serious criticism as it has led to some negative impact on the society. Nepotism, corruption and poor implementation in some instances has resulted in misuse of funds. The flow of this 'easy money' has made people lazy and it has been alleged that people especially the youth have taken to liquor, drugs and other bad habits. However, the direct and the most significant of all effects is on the availability of the labor to perform agricultural operations. A very serious shortage of labor is reported from almost all regions including the less advanced areas. Particularly hit are the progressive states (like Punjab), which depend on migrant labor from poorer regions and plantations in the southern states, notably Kerala.

Weeds and Weed Management

Weeds continue to be an important constraint in crop production. Despite the good efforts made in research and extension in the field of weed science, the farmers continue to experience heavy losses in crop yield due to weed interference. The crop loss estimates are many and often confusing and misleading. A conservative estimate of about 10% loss would amount to a loss of about 25 mt of food grains, currently valued at approximately USD 13 billion. Losses of similar magnitude may occur in plantation crops, fruits, vegetables, grass lands, forestry and aquatic environment. The total economic losses will be much higher, if indirect effect of weeds on health, loss of biodiversity, nutrient depletion, grain quality etc is taken into consideration. The key issues relating to weed management are briefly discussed below.

Shortage of Labor

Basically, the agriculture that is practiced in India is highly labor intensive. Labor accounts for 60 % of the total cost of crop production. Weeding is predominantly done by use of manual labor.

Currently herbicides are used to a limited extent in wheat, rice, soybean and tea. Assuming a labor requirement of 20 man-days/ha for weeding, India requires a phenomenal 5 billion man-days of labor for weeding alone! That is close to 5 days of weeding for every citizen including the children! Hence any shortage of labor will impact the weed management substantially. The implementation of the National Rural Employment Guarantee scheme as described earlier has seriously impacted the availability of labor for agricultural operations. While the scheme is a boon to unemployed rural households, the farmers find it difficult to match the wages given by the government. There is pressure on the government to raise the wages further which is currently at Rs 100 per day (USD 2.2). Farmers are often forced to adopt crops (e.g sugarcane) and technologies which demand less labor.

Weeding has never been a priority operation for majority of the farmers due to a variety of reasons. The present situation of labor shortage and increase in wages will only worsen the situation. Severe crop losses due to delayed weeding are common. Farmers are beginning to think of alternatives and herbicides are the obvious choice for many. The use of herbicides is expected to grow in the near future.

Mechanization

The labor shortage has also forced farmers to go for machines in a big way. The combine harvesters which were mostly used in large farms for harvesting rice and wheat are increasingly being seen in small farms. Small and medium farmers are using these big machineries on a custom hiring basis. Even a subsistence farmer finds using harvesters and tractors more economical. The draught animals which were commonly used for land preparation and inter-cultivation operations are slowly but steadily making an exit. Increased pressure on land and the high cost of rearing the animals are the principal reasons for this shift.

Zero tillage, Direct-seeding and Conservation Tillage

A rice-wheat cropping systems occupies about 18 million ha in Asia, of which 13.5 mha are in the Indo-Gangetic Plains (IGP) of Bangladesh, India, Nepal, and Pakistan and feeds about 1.3 billion people (20% of the world population). To ensure food security in Asia, it is imperative to identify rice production systems that require less irrigation water input than the conventional transplanted rice. In recent years, the major emphasis in the rice-wheat system has been on alternative resource conservation technologies (RCTs) for both rice and wheat to reduce the cost of cultivation and energy consumption, to sustain productivity, and to increase the profit margin of farmers. Zero tillage in wheat crop in rice-wheat system in the north western

Indo-Gangetic Plains has become popular and is practiced over 2.1 mha area. A change in rice establishment method from traditional manual transplanting of seedlings to direct-seeding has occurred in many Asian countries in the last two decades in response to rising production costs, especially for labor and water. Direct-seeded rice needs only 34% of the total labor requirement and saves 29% of the total cost of the transplanted crop. At research farms, the direct seeding of rice has been shown to do as well as transplanted rice provided the weeds are effectively controlled. The spread of the technology has been restricted amongst other factors, because of absence of effective herbicides for weed control in direct-seeded rice. Despite the demonstrated advantages of conservation tillage, the technology is yet to take off. Availability and accessibility to the proper machinery is the limiting factor. Large scale demonstrations and government support will be needed to make the technology popular.

Herbicide Resistant Crops

Bt-cotton is the only GM crop that has been approved for commercial cultivation in India. The technology whose introduction was opposed tooth and nail by some of the civil society organizations, has found phenomenal acceptance by the farmers. Introduced in 2002, it is presently grown over 9.0 mha (86% of the total) area, by over 5.6 million farmers, including small and medium, with a production of 5.61 mt. In the past nine years, India has greatly diversified deployment of Bt genes and genotypes which are well adapted to the different agro-ecological zones. About a thousand hybrids and one variety belonging to six different types (events) of Bt-cotton are available to the farmers. The technology has resulted in 40-60% reduction in pesticide use with 50-130% increase in farmers' profit and a significant increase in employment opportunities, particularly to women. This should be proof enough to silence the critics.

However, other crops/ traits have not been so lucky! Attempts to commercialize Bt-brinjal failed in 2009. Caught between scientists/experts on one side and the NGOs on the other side, the government chose to put the proceedings on hold. The herbicide resistant soybean, cotton and maize have been under controlled trials for a couple of years now. Given the way things are progressing, they are not expected to be approved by the government in the next 2-3 years. There is this old theory that any technology which replaces labor should not be encouraged. Unfortunately despite the description given above, a few NGOs think that labor in India is cheap and plentiful! There can not be a bigger contradiction than this. Some of the so-called guardians of the environment and the well being of the society opine that HRCs not only deprive rural poor of their livelihood, but also deprive them of the opportunity to eat nutrient-rich weeds (as

green vegetables) which grow in association with crop plants, and their cattle the 'quality' fodder. They recommend 'growing' of weeds in the crop fields, ignorant of the fact that weeds compete with crops and reduce yields significantly.

Herbicide-resistant crops have the potential to improve the efficiency of weed management and facilitate adoption of resource conservation technologies (RCTs). However, several important risks associated with HRCs should be examined before their widespread adoption is permitted. The greatest risk is the potential for transfer of the gene conferring the HR trait to related wild and weedy relatives. This could lead to increased weediness or invasiveness. While this may not pose a danger in crops such as maize or soybean, it could be very important in rice where India, being the centre of origin for rice, has wide genetic diversity in the country.

India is planning to replace the rules under the Environment Protection Act with a Biotechnology Regulatory Authority of India (BRAI) Act. This when approved is expected to give fast-track approvals for GMOs.

Alien Invasive Weeds

India has been a fertile field for invasion by exotic weeds. *Parthenium hysterophorus*, water hyacinth, *Mikania micrantha*, *Phalaris minor* are a few of the many invasive weeds that have been introduced into the country over the years. The problem has only increased with globalization and free trade policies. The Indian government imported about 6.2 MT of wheat from 10 countries between 2006 and 2007 for public distribution and it was believed that several exotic weeds have gained entry as contaminants. A National Invasive Weed Surveillance (NIWS) Programme was launched by the government in 2008, to detect the establishment of these regulated weeds. Extensive surveys and rigorous monitoring led to detection of five quarantine weeds in several parts of the country. They are: *Cenchrus tribuloides*, *Solanum carolinense*, *Cynoglossum officinale*, *Ambrosia trifida* and *Viola arvensis*. Now we must do everything possible to contain their spread and try to eradicate them, if possible.

The Role of Herbicides

Compared globally, the pesticide market in India is small. It is about USD 1 billion, compared to USD 33 billion world market. The overall pesticide consumption is also very low at 362 g/ha, the bulk of which are insecticides (67%). The share of herbicides is nearly 20% and is growing. Although the herbicides have been in use for over 3 decades, use has increased only recently. Wheat, rice, soybean and sugarcane are the major crops with approximate share of 28, 20, 9 and 7% respectively. With the labour shortage looming large, the demand for herbicides is expected to grow substantially. The lack of

awareness about herbicides amongst farmers and the technical competence of the extension personnel are going to be the major challenges for the scientific community to deal with. Extensive awareness-raising activities for farmers and trainings and workshops for extension personnel will be urgently needed. With the increased use of herbicides, the issues such as herbicide residues in soil, water and food, resistance to herbicides in weeds, etc would come into prominence and we should be geared up to tackle them.

Weed Science Research in India

India has one of the largest national agricultural research systems (NARS) in the world, with over 100 research institutes under the administrative control of the Indian Council of Agricultural Research (ICAR) and over 50 State Agricultural Universities. India also has the distinction of having an independent national research institute dedicated to weed science research. Established in 1989 at Jabalpur in central India, the centre has been recently upgraded to Directorate of Weed Science Research (DWSR). DWSR is engaged in basic and strategic research. It also coordinates the applied and location-specific research carried out at 22 coordinating units located at different parts of the country. DWSR has been successful in bringing awareness about the importance of weeds and weed management in enhancing crop productivity and sustainability. A lot more, however, is expected from this nodal centre in the years to come.

CONCLUSIONS

There is a greater recognition of weed science research in India now than before. Although the advantages of herbicides were known earlier, their popularity and adoption by the farmers was limited due to a variety of reasons. The increased urbanization, higher income and more importantly the implementation of the National Rural Employment Guarantee scheme which guarantees employment/wages to one adult in a household for 100 days in a year have put tremendous pressure on availability of labor to agricultural operations including weeding. While it is a boon to the vast majority of the rural poor, it is advisable to implement the scheme during agriculturally lean periods, so that the labor supply during the peak agricultural season is not affected. Due to higher wages and unavailability of labor, herbicides may now find greater acceptance by the farmers.

Herbicide industry and weed scientists have a greater responsibility in educating the farmers and the extension staff on judicious and sustainable use of herbicides. Integrating HRC technology (expected to be available sooner or later in the country) with resource conservation tillage strategies will benefit the farmers in a big way. If handled appropriately, this will address production,

profitability and sustainability issues in crop production. The research related to herbicides must go beyond herbicide screening to application techniques, enhancing herbicide efficiency and integrating with ecological methods of weed management. The basic research on weed biology and ecology which has been largely ignored until now needs encouragement, as the results of such studies lay the foundation for integrated weed management strategies. Agronomists should not consider weed science as their sole domain. Scientists from related disciplines must be encouraged to undertake collaborative research. This will give greater dividends. There needs to be greater interaction with international bodies and weed scientists from around the world. Going by the past record, Indian weed scientists have greater difficulty in participation at international meetings and seminars for various reasons. However, in the era of Internet, this can be overcome, albeit to some extent. This is also the era of social networking. It is high time our weed scientists started interacting with peers residing outside the country and working on collaborative research programs. Our scientists should start taking advantage of the ICTs for building their own competence, sharing knowledge and ultimately to serve the farming community.

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