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INTRODUCTION TO THE SPECIAL ISSUE 'SEED BIOTECHNOLOGY AND EASTERN INDIA'S "NEW GREEN REVOLUTION": ISSUES AND CHALLENGES'

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During the mid 1960s India faced huge challenges of food insecurity which led to the introduction of a high input-high output production system relying on new agricultural biotechnologies, namely high yielding varieties (HYVs), particularly of rice and wheat. Development, supply and use of HYVs allowed farmers in the targeted states of the North-west and South to increase production, which allowed India to achieve food security at the national level. Yet the use of seed biotechnologies in agriculture has also been a source of controversy. The focus of agricultural research on certain food grains (most notably wheat and rice) led to a reduction in the types and varieties of food grain produced and consumed by local populations, resulting in less nutritious diets, loss of seed biodiversity, while use of chemical inputs damaged soil and the wider environment. Liberalisation in the 1990s led to further changes, such as entry of foreign (also Indian) multi-national corporations in the agricultural input sector and the development, supply and commercialisation of new seed types such as F_1 hybrid seed and genetically modified (GM) seed. The private sector focused its attention on low-volume, high-value seeds, e.g. Bt cotton, maize, pearl millet, leaving the public sector to produce and deliver high-volume seed crops e.g. groundnut and potato (Singh and Chand, 2011).

While the first Green Revolution was successful in raising yields in states with well-developed irrigation systems, it did not make much of an impact in the arid zones or rainfed states, much of Eastern India included. Statistics sourced from Bhalla and Singh (2001) serve to illustrate this point: consumption of fertiliser over the period 1962/65-1992/95 increased from 4.3 to 163.6 kg/ha in India's North-west region, and from 8.3 to 115.3 kg/ha in India's Southern region, yet in the Eastern region it rose only from 2.6 to 74.3 kg/ha (pp. 36-37). These averages hide even greater variation within regions. For example, within the Eastern region, Ranchi district's consumption of fertiliser rose from just 1.2 kg/ha in

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1962/65 to 26.1 kg/ha in 1990/93 (ibid., Annexure 1a and 1d). Furthermore, five of the 17 districts that maintained *the lowest growth* of agricultural output during the 1960s-80s were in Jharkhand (ibid., p. 124). The undulating terrain, very low area under assured irrigation, and rainfed agricultural production system of Jharkhand are often cited as reasons for this, but less discussed was the apathy of successive governments towards agricultural development.

In recent years there has been talk of a 'New Green Revolution' or an 'Ever-Green Revolution' being brought to Eastern India. In 2010-11 the Ministry of Agriculture, Government of India launched an initiative called 'Bringing Green Revolution to Eastern India' (BGREI) that covers the states of Assam, Bihar, Chhattisgarh, Jharkhand, Odisha, Eastern Uttar Pradesh (*Purvanchal*) and West Bengal. The objective of the programme was to increase the productivity of the predominantly rice-based cropping system by intensive cultivation through promotion of recommended agriculture technologies and associated practices, all of which should address the underlying constraints of different agro-climatic sub-regions (DAC, 2011). BGREI aimed to improve irrigation facilities and build on programmes like the accelerated pulses programme. Most of the activities taken up under BGREI programme were crop specific, e.g. 63 percent of total funds in 2011-12 were allocated to block-level demonstrations of rice and wheat. The strategy was to promote hybrid and HYV technologies, improve seed replacement rates (SRRs), and promote line sowing/planting, e.g. system of rice intensification (SRI) coupled with plant nutrient and plant protection technologies, e.g. bio-fertilisers (ibid.). The role of seed biotechnologies is pivotal to this 'New Green Revolution'. Moreover, the private sector is to play a central role in providing inputs to farmers, especially HYV and F_1 hybrid seed and chemical fertilisers and pesticides. This it appears that lessons learned from the repercussions of the earlier Green Revolution are not being heeded.

Expert scientific panels, such as that formed for the 'International Assessment of Agricultural Knowledge, Science and Technology for Development' (IAASTD) – to which India is a signatory – have declared that in agriculture "business as usual is no longer an option" (McIntyre, Herren, Wakhungu, & Watson, 2009, p. 3). They cite a variety of reasons for this, including growing social-economic inequities, unstable global food prices, and unsustainable use of fossil-based energy (e.g. chemical inputs). The Ministry of

Agriculture (MoA) seems to be taking such views into consideration. In addition to the promotion of industrial agriculture the MoA is simultaneously giving emphasis to agricultural techniques like SRI, Integrated Nutrient Management (INM), Integrated Pesticide Management (IPM), and training on crop rotation, as well as organic agriculture. For example, in 2012 the Government of Jharkhand's Department of Agriculture and Sugarcane Development set up the Organic Farming Authority of Jharkhand (OFAJ). Its scientists appear to celebrate Jharkhand's natural heritage of organic commodities, biodiversity, and suitable climate for organic production (Singh, 2015). In 2015 the central government launched the Paramparagat Krishi Vikas Yojana (PKVY) under which participatory guarantee system (PGS) groups can be formed to certify organic crops and vegetables for domestic sale.

The overall message coming from the Ministry of Agriculture is unclear. Calls to increase the use of hybrid and high yielding seed varieties with associated chemical inputs avoid addressing the reality that intensive fertilizer use ruins soil and wipes out the wild leafy vegetables and fish that the poor previously harvested from their rice fields. Such usage has a high carbon footprint too. There is a notable silence on the fate of traditional varieties of rice and other crops, many of which are said by farmers to perform as well as improved varieties if and when they receive sufficient water. These varieties are rapidly disappearing from the fields (in-situ conservation), while some varieties' seed are being stored by institutions (ex situ conservation) that allow private companies to access the germplasm, develop new seeds, and later sell it back to the farmers making a profit while doing so. These are just a few of the reasons why the issue of seed biotechnology is so controversial. We find the debate polarised between most agricultural scientists on the one hand, and civil society groups and social scientists on the other.

To take the debate on agriculture in Eastern Indian forward, in this special issue of JJDMS we asked contributors to address research questions related to seed biotechnology, for example, 'how a Green Revolution based on industrial agriculture can coincide with the development of organic agriculture', or 'how the seed of traditional varieties can be preserved while increasing seed replacement rates'. This thematic issue contains six articles. The first by R. P. Singh, Ashok Kumar and S. K. Pal of Birsa Agricultural University sets the scene by examining the prevalence, productivity and protection of

traditional varieties vis-à-vis modern varieties of rice, wheat and maize. The agricultural scientists justify the need to increase yields by comparing national yield to show how the Eastern region lags behind. Among other highlights, their analysis shows that traditional varieties yield comparatively well under irrigated conditions. The authors discuss the many factors that have led to the continued use of traditional varieties of seed in Eastern India, such as the lack of progress in provision of irrigation, lack of availability of improved seed, and poor nutritional value of improved or modern varieties. The authors also discuss India's various legislations to protect traditional varieties and farmers, and some of the efforts made by governmental institutions to protect and preserve seeds.

The second article by Abhijit Mohanty and Ranjit Sahu discusses how Agragamee, a civil society organisation working in Odisha's tribal belt, has helped farmers set up seed cum grain banks (SCGBs) to promote and conserve traditional varieties (landraces) of rice and millet. Given that Odisha is a secondary centre of origin of rice, and that numerous traditional varieties are being lost each and every year due to the promotion of modern varieties, this is a pressing task. The authors argue that while ex situ preservation of seeds is necessary as a back-up, of equal importance is the in situ conservation of landraces, because it is through farmer-led seed multiplication that farmers can retain control over their way of life while producing healthy, nutritious food. More importantly, in situ conservation via use of SCGBs allows crops to adapt and evolve to cope with the changing climatic conditions; something they claim ex situ conservation does not facilitate.

In the third article, Birsa Agricultural University's scientists R. P. Singh and S. Singh present their thoughts on the question of how seed replacement rates (SRRs) can be improved in Jharkhand. They opine that only by increasing SRRs can production, hence food security be assured. Their focus is on the major crops: rice, wheat, maize, pulses and oilseed. All barring pulses have average yields far below the national average. The scientists share the rolling seed plan they themselves prepared for the Department of Agriculture and Sugarcane Development, Government of Jharkhand and discuss some of the shortcomings of current seed research and production arrangements, e.g. that new varieties are unavailable to farmers, and that seed conversion rates (from breeder to certified seed) are pathetically low, terming this a 'national wastage'. Among other recommendations, they advocate strengthening of farmer managed seed systems.

The fourth article by Sanjay Kumar and Sanjay K. Singh, from Society for Promotion of Wastelands Development (SPWD), Ranchi, is a study that examines the neglected secondary characteristics of rice. Their argument begins with a claim that agricultural scientists are overly obsessed with yield to the neglect of the many other important facets of crops, such as their nutritional content and taste, storability of food, and the quality and nutritional value of straw. They remind us of the intrinsic nature of plants, their capacity to reproduce, which has been exploited for millennia to help human civilisation develop. To profit from a seed, its reproduction cycle has to blocked so that markets can be captured, which is what has happened through the development of modern hybrid seeds. Their data and analysis, though having limitations, confirms the findings of other studies of small and marginal farmers, namely that hybrid yields are not as high as promised. Traditional rice varieties have many important facets that are worth saving, and a policy of enhancing production through hybrids alone will not be self-sustaining.

The fifth article, by three practitioners working at SPWD Ranchi, Udaipur and Delhi respectively, argues that the government's continued attack on shifting cultivators is leading to a loss of agro-biodiversity and an increase in the food insecurity of Particularly Vulnerable Tribal Groups (PVTGs). Sharat Singh, Jagdish K. Purohit and Amita Bhaduri give two examples, of the Kondh in Odisha and the Baiga in Chhattisgarh. The Forest Right Act, 2006 is hugely important for PVTGs, as the Forest department has in the past caused them a lot of trouble. Their study highlights the rich mix of crops and vegetables grown on shifting cultivated plots, emphasising how much this contributes to the well-being of the people. The authors suggest that shifting cultivation plays (and can play) an important role in strengthening the resilience of communities to climatic changes.

Finally, the sixth article by Joe K. W. Hill gives an overview of organic agriculture in India, claiming that it has a long way to go. Up-scaling the area under organic production, creating demand for the produce especially in urban markets, and linking producers with consumers are all ongoing struggles for the proponents of organic farming, namely civil society groups. One system of certification, known as participatory guarantee system (PGS), offers hope for those small and marginal farmers who believe in and practice organic farming. PGS is low cost, involves

little paperwork, and helps farmers to build their skills and access domestic markets. A case study from West Bengal highlights the challenges facing an NGO that has worked for decades to promote organic farming and to support organic farmers. The central government scheme, PKVY, is a welcome step for organic farming in India; however further research is needed to understand how large PGS groups will function.

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