Agriculture Update
Volume 8 | Issue 3 | August, 2013 | 504-508

A Case Study

Cultivation of traditional crops : an overlooked answer

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ARTICLE CHRONICLE :
Received:
02.03.2013;
Accepted:
15.07.2013

SUMMARY : Dryland agriculture constitutes over 60 per cent of total Indian agriculture and serves as a vital source of food for the country's rural poor (MINI, 2010). For thousands of years, people in the arid regions of India have been cultivating millets, sorghum and upland rice varieties that have evolved to be adapted in the water-limited environments. These crops provided a source of security for the people who cultivated them. The diversity of traditional crops maintained soil health, required few external inputs, spread the risk associated with weather events, and provided for multiple securities other than meeting caloric requirements.

How to cite this article : Kumar, Prasann (2013). Cultivation of traditional crops : an overlooked answer. *Agric. Update*, **8**(3): 504-508.

KEY WORDS :
Agriculture, Direct, Risk, Traditional crops

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BACKGROUND AND OBJECTIVES

Cultivation of endemic crops, especially the coarse grains, is today in decline. In the last few decades, the most significant grains of the arid regions – millets, sorghum and upland rice have been replaced with modern seed varieties. Influencing farmer's decisions about what crops to grow are economic policies that have provided incentives for commercial crops cultivation, formal and informal extension services that praised the attributes of modern seed packages and a fabricated social stigma that labels traditional crops as an inferior alternative to the scientific seeds of today. The most dramatic departure from traditional crops can be seen immediately after the "Green Revolution" with the promotion of the new high yielding varieties of rice and wheat. By 1990, 70 per cent of all rice and wheat grown in developing countries were high yielding varieties (IFPRI, 2002). In India, the expansion of new crops undermined native production and led to a 44 per cent reduction in land area being cultivated with millets between 1966 and 2006 (Basavaraj *et al*, 2010). Inorganic fertilizers and pesticide use increased significantly during this period. Expansion of irrigation systems, chemical inputs and high yielding seed varieties helped to double crop yields (IFPRI, 2002). For this reason, the technological package was heralded as the solution for food security in India.

Crop yields have since stabilized and the negative externalities of the technologically centered strategy of achieving food security are starting to materialize. Nutrient pollution from excessive fertilizer application, mining of groundwater, declining soil health and exaggeration of regional inequalities can all be attributed to the dogma of the "Green Revolution". The traditional crops of the region have fallen from prominence and farmers have been left with a dependence on chemical inputs and diminishing yield returns (IFPRI, 2002).

Yield increase of "Green Revolution" was profound and should not be understated. The jump in productivity spurred growth in both the national economy and the rural non-farm economy. Yet the accomplishments are incomplete; the strategy promoted under the "Green Revolution" has not sufficed in meeting the dual goals of achieving food security and maintaining environmental integrity. This paper investigates the characteristics of endemic food crops and advocates for their incorporation into solutions focused on food security. Using land

races of millets and rice as the paradigm case of underutilized traditional crops, the advantages of these local food species will be explored. Traditional crops do not just represent calories; they are an important component of local cultures and can serve as a mechanism for communities to re-establish control over their food choices. Food sovereignty and revival of traditional practices can offer multiple livelihood securities to rural communities, empower the citizens and enhance the lives of individuals physically and socially.

Nutritional superiority :

The sub-continent is endowed with a variety of millets species, including sorghum, pearl millet, finger millet, foxtail millet, barnyard millet and others. When compared against the wheat and rice varietals that promoted in India, millets are shown to have the capacity to help meet not just the caloric and nutritional requirements of Indians. Most millet land races contain more fibre than rice and wheat. Some varieties contain nearly 50 times as much. Additionally, native millet varieties contain double the calcium content as their rice counterparts and finger millet boasts more than 30 times the amount (MINA, 2006). Anaemia, associated with iron deficiency, has become one of most serious deficiencies in India. Want of iron can be mitigated with the cultivation of millets, especially promotion of the pearl millet and barnyard millet varieties. Compared against the average iron content of rice and wheat species, 0.7 mg and 5.3 mg, respectively, it is apparent that promotion of these native cultivars would help address this national problem (MINA, 2010). Another organic compound that millets are endowed with it is beta-carotene, a necessary precursor to vitamin A adsorption and fixation. These millet species have the capacity to mitigate micronutrient deficiencies while providing the calories needed for the population. Table 1 shows the comparisons of some millets against rice and wheat .

Environmental benefits :

Millets require minuscule amount of water. The rainfall needed for sorghum, pearl millet and finger millet is less than 30 per cent that of rice. To produce one kilogram of conventional rice, 4000 litres of water are needed to irrigate the plant and suppress weeds (MINA, 2006). The fact that millets and sorghum can survive on just rainfall and an amount as little as 500 mm in some varieties (Cleveland, 2006), indicates that these plants will be crucial in ensuing climatic changes and shifts in water availability. Millets, unlike modern seed packages encouraged today, do not require chemical fertilizers. Interestingly, it has been shown that in dryland conditions millets grow better in the absence of fertilizers (MINA, 2010). To enhance the soil and replace bio-available nutrients, the farmers have utilized growth promoters such as Panchagavya and the enriched organic matter product of vermicompost instead of purchasing chemical substitutes. Most crops grown in large monocultures need to be sprayed regularly with chemicals to prevent loss to pests. Because there are few known pests of millets, no pesticides are needed for protection. Resistance to pests is maintained post-harvest, when many other crops need to be protected against spoil and pests. In millet systems, farmers are not burdened by the extraneous and sizeable cost of chemical inputs. This is positive not only for the household economies, but also beneficial to long-term soil health and environmental quality.

Best adapted for climate change :

Global climate change portends less rain, more heat and reduced water availability. Shifts in resource availability will have dramatic impacts on the current agriculture system. Perturbations to the current heat regime will have serious impacts on wheat, a thermally sensitive crop that India produced a record 86,870,000 tons of last year (Mundi Index, 2011). Slight increase of 2-3 degree will jeopardize the productivity of the crop. Changes in water availability will have the largest implications on the current agricultural system. While water conscious methods of rice cultivation, such as the System for Rice Intensification, exist and are

Table 1: Nutritional content of different crops

Crops	Nutritional content				
	Protein (g)	Fibre (g)	Minerals (g)	Iron (mg)	Calcium (mg)
Pearl millet	10.6	1.3	2.3	16.9	38
Finger millet	7.3	3.6	2.7	3.9	344
Foxtail millet	12.3	8	3.3	2.8	31
Proso millet	12.5	2.2	1.9	0.8	14
Kodo millet	8.3	9	2.6	0.5	27
Little millet	7.7	7.6	1.5	9.3	17
Barnyard millet	11.2	10.1	4.4	15.2	11
Rice	6.8	0.2	0.6	0.7	10
Wheat	11.8	1.2	1.5	5.3	41

Source: Millets: Future of Food and Farming. Millet Network of India. Deccan Development Society(2006)

gaining popularity, most rice that was observed on our tour was flooded and grown in a water intensive manner. Coincidentally, rice cultivation creates a positive feedback loop with climate change. The anaerobic aquatic environment generates methane, a potent greenhouse gas that has the capacity to trap 20 times more heat in the atmosphere than CO_2 (Schmid *et al.,* 2007). Agricultural practices that are conscious of water usage need to be implemented and scaled up. One such method of adhering to water shortage is to advocate for traditional crop varieties. Not only do these plants require the least amount of water input, they are the best suited for the soils that will be impacted and marginalized in a changing climate.

Traditional rice varieties :

During our tour through, the southern states we heard numerous complaints about the lack choice when purchasing rice. One man challenged us to find more than two varieties distributed in town. India boasts over 200,000 native rice varieties, the richest biodiversity of any country (Rajukkannu *et al.,* 2009). Branding of modern seeds as superior to endemic options by seed companies, government extension agencies and market forces have undermined the traditional diversity present in the area. The high yielding varieties were true to their name but their cultivation was not appropriate in all places, including areas where irrigation schemes were not implemented and where native varieties thrive. Rice varieties have yet to be engineered that can compete with native land race's native adaptation to coastal saline conditions, deep water, and dry upland conditions (Rajukkannu *et al.,* 2009). Some local varieties have inherent resistance against diseases and pests. Certain native varieties had distinct cultural values and were used in special ceremonies. Many were grown for their special aroma and flavour. Some traditional rice variety's stalks were used to thatch roofs. The replacements for these local varieties do not produce the same additional uses. Perhaps the strongest argument for high yielding varieties use is the fact that the new varietals are capable of producing a much larger crop and thus the farmers realize a much greater return on their time and money. In terms of strict yield, that is normally true. But when yield is calculated as production of grain per unit of inputs of water and fertilizers, most of the local land races have better yields. Using the metric of output per unit of nitrogen fertilizer, land races are clearly superior (Rajukkannu *et al.,* 2009). The new high yielding varieties are touted as being a more economically viable decision for small farmers. However, when considering the cost of seeds and the cost of external inputs needed, this is not the case. Table 2 shows one economic analysis of modern versus traditional varieties.

Promotion of endemic crops on a local and national level :

The traditional crops that have sustained the Indian people for the past centuries still have an important role to play in India's future. Policies, initiated locally or implemented nationally, are needed that will ensure natural resource conservation practices and plan for impending changes associated with climate change. Local crops and varieties offer one aspect of that comprehensive plan. Food insecurity, malnourishment, and environmental degradation can be addressed with native varietals. These crops can serve as an empowerment mechanism and have positive social implications for rural society. Revival of traditional knowledge and systems has become a popular topic in the last decade and numerous organizations have advocated for tools that preserve cultural and biological diversity. Non-governmental organizations have had an instrumental part in devising mechanisms and interventions that preserve both the genetic and cultural diversity of India. Successful project implementations that serve the community and protect the natural resources should be evaluated as a template for possible replication throughout India.

The alternative public distribution system :

One national programme that could be modified to curtail the dependence on modern seeds and the industrial agriculture complex is the Public Distribution System (PDS). This programme distributes food at a subsidized price to the poor while providing a price support to the farmers cultivating the crops, the government has chosen namely rice, wheat and non-edibles such as cotton and oilseeds. Maintenance of one of the world's largest welfare institutions is not cheap; food subsidies and administrative costs of running the PDS comprised over 3 per cent of total government spending in 2000. Despite the magnitude of government resources

Table 2 : Economic analysis of traditional versus modern varieties

Particulars	Traditional varieties	Conventional varieties
Total expenditure for cultivating 1 acre (1 USD = Rs. 49)	Rs. 4,800	Rs. 9,800
Yield of produce - Grain (kg)	1,000 kg @ Rs. 8/kg = Rs. 8,000	1,500 kg @ Rs. 8/kg =Rs. 12,000
Yield of produce- Straw (kg)	1,200 kg @ Rs. 1/kg = Rs. 1,200	1,850 kg @ Rs. 1/kg =Rs.1,850
Total returns per acre	Rs. 9,200	Rs. 13,850
Net profit per acre (Total returns - Total expenditure)	Rs. 4,400	Rs. 4,050

Source: Rajukkannu *et al*., 2009

dedicated to food distribution and the claim of self-sufficiency in food grain production, most subsidies fail to serve the population living below the poverty line. Instead of encouraging a high input, low diversity approach to food security, could the Government of India not amend its policies to incorporate coarse grains such as millets, and devolve some authority to the local areas. The Deccan Development Society has developed a system that addresses that exact question. Headquartered in Andhra Pradesh, the Deccan Developmental Society (DDS) addresses issues of sustainable rural livelihoods and food security based on the principles of natural resource management and bio-diversity conservation at the local level. One of their most successful programmes serves as a surrogate to the PDS. Labeled the Alternative Public Distribution System, control of the community's food grain production, procurement, storage, and distribution is vested in women from the lowest social caste. These women have organized into self-help groups, referred to as *Sanghams* and brought fallow marginalized lands under the plow and have worked to improve existing soil conditions. The *Sanghams* have successfully lobbied the government for a one-time award of money, which is, in turn, loaned out to farmers looking to improve their lands in an environmentally friendly way utilizing traditional seed varieties. Such improvements include the purchase of manure as fertilizer, trenching, and plowing the land. After harvests, the loans would be paid back in the form of grains to village committees who store it and manage Community Grain Funds (CGFs). Grains are later sold at a subsidized price to families that the community has identified as being the most vulnerable and needy. The revenue generated by selling grains is later used to fund additional loans to farmers, bringing more fallow land into cultivation (Srinivas and Thaha, 2006). All grains stored and distributed via the APDS are traditional grains. The women did not plant newly developed high-yield seeds but rather the same varieties that farmers in the region have adapted over several centuries. This programme conserves not just the genetic diversity of the region, but also the traditional knowledge associated with the different crops. It also serves as an empowerment mechanism for the entire community, especially the Dalit women who were once hostage to the high prices of scientific varieties. Other aspects of the APDS include an eco-employment initiative that is focused on providing a constant source of labour and bringing fallowed lands under cultivation while upgrading existing plots via natural resource management works. Additionally, a land lease programme targets landless and marginal farmers and organizes them to collectively work on leased land to grow food for their households.

Keystone agriculture :

Another organization taking measures to preserve traditional crops is the Keystone Foundation, based in the Nilgiris Mountains. Similar to the approach taken by DDS, a strategy that Keystone is promoting is the re-vitalization of seed banks. Seed banks serve as a depository for local seeds including grains, grams, greens, oilseeds and vegetable seeds. Stored in chemical free manner, seeds are loaned to farmers who are obligated to return twice the volume of seeds after harvest. Those farmers are trained in crop varietal purification techniques and seed selection processes, strengthening the communities' important role in food sovereignty. Seed banks have been successfully established in six villages. Training on compost and bio- input preparation is also offered, strengthening the local component of food production system and reducing the proportion of income spent on agricultural supplements. Keystone has also been instrumental in reviving the role of the Mannukaran/Gowda in rural society. This societal figure is similar to a modern day extension agent, providing knowledge about soil fertility and composition, disease and pest management, and selection of feed varieties. This farmer visits all the fields and is integral to the collection of good quality local seeds. The Mannukaran stores seed for future harvests and makes offerings to the deities in exchange for favourable weather and yields. Recent introduction of new seed varieties and various government schemes have undermined the role of the Mannukaran. Communities who have seen the role of the Mannukaran restored have taken great pride in the inseparable revival of traditional knowledge, religion and connection to the land.

Conclusion:

Traditional crops and indigenous knowledge were overlooked in the strategies promoted during the Green Revolution era. Now that the shortcomings of a strategy dependent on foreign inputs have become evident, renewed emphasis has been put into local varieties and traditional agricultural systems. Investigation of native land races reveals that native species can minimize the environmental harm due to minimal input requirements and can better satisfy the nutritional needs of the rural populace than the commercial wheat and rice varieties. Because of their native adaptation to the local conditions, native varieties are often better poised to face the impending challenges of climate change, namely water scarcity and preserve the genetic and cultural diversity of the region.

More modern agricultural practices, such as use of fertilizers, pesticides, irrigation, and genetically altered seeds have made significant impacts of agricultural productivity in India. However, use of these technologies, even those practices that have been designed to minimize impacts and usage, are not appropriate everywhere. This paper does not advocate for an overhaul of conventional agriculture, but rather offers an alternative solution that can be instituted

in tandem with more modern agricultural systems. Especially for rural rain-fed areas, traditional crops offer a source of security economically and can lead to community empowerment and social change.

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