Discussion Papers

Sustainable Agriculture and Nutritional Security: Emerging Policy Options with Production Choices

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RIS
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Sustainable Agriculture and Nutritional Security: Emerging Policy Options with Production Choices

P. K. Anand*
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Abstract: The 2030 Agenda for Sustainable Development with SDGs at its core, has focus much beyond the current generation and lays the foundation to protect hopes and aspirations of the future generations. In this endeavour to bring sustainable agriculture at the centre stage, inclusion of millets and pulses can pave a way. These crops can provide solution through localisation of SDGs towards sustainable agriculture by virtue of their reduced requirement of irrigation, chemical fertilizers etc. Moreover, these can help marginal and small farmers better leading to reduced inequalities and a pathway towards Green Revolution II, having a darker shade of green compared to the Green Revolution I. Besides being sustainable, millets prove to be finest of the fine cereals, and in a way shake off the tag of 'coarse' by providing better quality nutrition. Similarly, pulses are like a super food, even though they witness periodic price volatility. Unfortunately, area and production share of millets in the cereal basket is on the declining trend that certainly needs reversal. The Minimum Support Price (MSP) and Public Distribution System (PDS) have very small components of millets and pulses in spite of high market surplus ratios of these items. A way forward for the new framework for millets and pulses should internalise sustainable interconnects on pre-farm action, on-farm interventions, post- harvest management, marketing reforms, procurement and PDS reforms all interwoven around better awareness.

Key Words: SDGs, millets, pulses, reforms, marginal and small farmers, nutrition, awareness.

Introduction

The 2030 Agenda for Sustainable Development beacons global common path to beget prosperity of all human- beings with sustainability. In fact, 17 Goals and 169 Targets at the core, called the Sustainable Development Goals (SDGs) of the 2030 Agenda, adopted by 193 countries at the 70th

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UN Summit in September 2015, have a focus much beyond the current generation, and lay the foundation to protect hopes and aspirations of the future generations. A commendable feature of the SDGs is their deep interconnectedness to harness social, economic and environmental dimensions of the development with the core objective of leaving no one behind. For instance, SDG 2 on food and nutrition security, titled, 'End hunger, achieve food security and improved nutrition through sustainable agriculture', like other SDGs, is linked to all the other SDGs. For SDG 2, when we select even a few connecting elements of other SDGs, such connects are found very deep. In brief, access to food is contingent upon ending poverty (SDG 1), better health (SDG 3), quality education (SDG 4), gender equality (SDG 5), reduced inequalities (SDG 10), access for urban vulnerable (SDG 11), peace (SDG 16), and supporting elements like drinking water and sanitation (SDG 6), energy (SDG 7), environmental dimension (SDGs 13, 14 and 15), growth (SDG 8), innovation (SDG 9) and partnerships (SDG 17).

The focus of this paper is to pave a way through growing of millets and pulses towards harnessing agricultural sustainability and achieving SDG 2. The Paper is divided into five sections- i) sustainability in agriculture, ii) millets and pulses for nutrition, iii) millets – short-term interest evicting long-term benefits, iv) reforms in MSP and PDS, and finally v) way forward.

1. Sustainability in Agriculture

1.1 No Trade-off Issues between Sustainability and Long-term Economic Growth

Apparently economic growth and sustainability seemingly compete, forcing a trade-off between the two. However, any such perceived competition at best can be valid only for a short run. In contrast for a medium and a long run, higher growth rate of consumption and production would not be materialized without ensuring sustainability. For instance, a decline in agricultural productivity, due to falling water- table in some areas, and water-logging in some others, frequently witnessed

across Punjab, is one such case, where both deficit and excess are detrimental. But it also gives a much needed hope that a fine balance can still be struck between the two through judicious water- use. Such appropriate solutions through localisation of SDGs are now much needed to attain sustainable production through restoration and enhancement of productivity emanating from prudent use of all resources.

1.2 Natural Resources becoming Binding Constraints

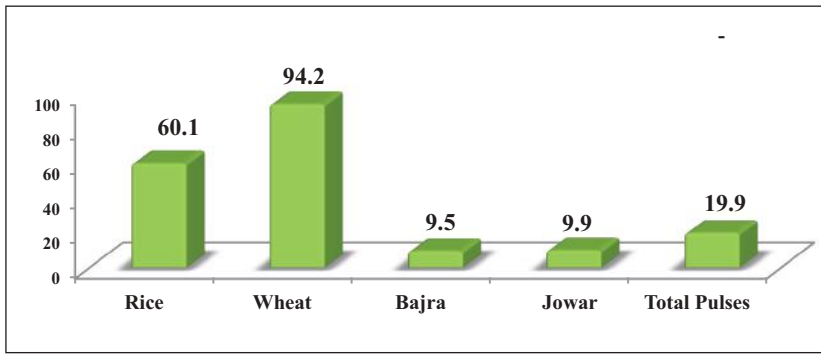
Unless an endeavor to utilise judiciously natural resources is woven around the sustainable agriculture, sooner than assumed, inadequate and inappropriate availability of water, soil, adverse climate etc. would become binding constraints. India, like other similarly placed countries, needs to place sustainability at the forefront to ensure food and nutrition security year after year. Water has already become a binding constraint in most parts of the country. One policy weakness that escalates its demand is water's next to nothing pricing. It is desirous to have a relook at how Indian farmers allocate irrigated lands and unirrigated ones among different foodgrain crops, and what can be the apt policy interventions.

1.3 Major Crops and their Irrigation Requirement

The latest available data indicate that in totality 53.1 per cent of the area under foodgrains is irrigated in India, indicating that a shade under half, is still un-irrigated[1]. Under it, wheat, a *rabi* crop, is predominantly grown in irrigated areas. Paddy needs more water compared to wheat, but as it is a *kharif* crop, it is sown in both rainfed as well as irrigated areas, by contrast, millets and pulses need relatively lesser water.

Other cereals (cereals other than paddy and wheat[2]) and pulses are grown largely in unirrigated lands. As per the Agricultural Statistics, at a Glance, 2017 out of the total cropped area under different categories, 94.2 per cent of wheat and 60.1 per cent of paddy were grown under irrigation in 2014-15. Compared to it, only 19.9 per cent of total pulses, 9.5 per cent of *bajra* and 9.9 per cent of *jowar* were irrigated[3] (Figure 1). Thus for efficient water management, low water requirement crops

Figure 1: Percentage of Area Irrigated -Major Cereals and Total Pulses (2014-15)



Source: Agricultural Statistics at a Glance, 2017.

such as pulses and other cereals are of immense potential in ensuring sustainable production.

Further the quantity of fertilizers per unit of land is interlinked with the quantum of water. At the macro level, for the country as a whole, the Agricultural Statistics of India (2016)[4] has given data on use of different fertilizers, like urea, di-ammonium phosphate (DAP), super phosphate, ammonium sulphate and other forms of N (nitrogen), P (phosphorus) and K (potassium). It further has given aggregated converted figures in terms of N, P and K, except, of course, for farmyard manure (FYM). Computation for per hectare (gross cropped) consumption of N, P, K and FYM indicates that irrigated fields need 137 per cent higher N, 112 per cent higher P and 121 per cent higher K. As far as application of FYM is concerned, though the consumption is on the higher side in irrigated fields, it is only 17 per cent higher compared to un-irrigated fields. Across the globe one can infer from a long-term study[5], covering various regions including India, that for unirrigated lands the level of application of fertilizers should not be increased indiscriminately.

Literature is surfeit with studies on the water-fertilizer interlinkages. In fact as long back as a 1983 article[6] had also quoted that 'optimal fertilizer doses for a given relative price would be higher for the

irrigated crops.' It is a fact that different cereals require varied quantum of irrigation-cum-rain water, and the technologies utilised for better harnessing of both irrigation and rain water can help reducing water requirement. In the areas where fall in groundwater table has already made inadequate availability of water a binding constraint, new technologies can be practised to efficiently utilise lower availability of water and commensurate lower requirement of chemical fertilizers to harness benefits of Green Revolution, towards which crop diversification facilitating low water demanding crops can be planned.

A related argument is for raising fertilizer consumption (kg) per hectare (ha) from a lowly 150.5 of India, to 251.7 of Bangladesh, 367.6 of Egypt, and 424.4 of China. But then a lower consumption (kg) per hectare (ha) of 54.7 in Australia, 76.6 in Canada and 131.4 in the US points oppositely.[7] Whether developing countries like India can afford the path of high chemical fertilizer consumption or should the country switch over to a sustainable mix of chemical and non-chemical fertilizers; is to be pondered at.

1.5 Soil Health Cards (SHCs) for Internalizing Farmyard Manure

A rational decision for quantity of chemical fertilizers and FYM to be used can be based on the scientific soil testing recorded in Soil Heath Cards (SHCs) that is helping farmers assess field-to-field demand prior to sowing. The distribution of SHCs has widely spread, and so far, over 18.93 crore cards[8] have been issued, facilitating quantity determination of different nutrients available in the fields. Based on an SHC, decision can be made on the application of chemical fertilizers and farmyard manure for sustainable production of planned crop/s. Mishra *et al.* (2010) indicated that long-term experiments conducted with the incorporation of FYM in Karnataka, Himachal Pradesh and Jharkhand resulted in a build- up of soil organic- carbon, reporting that application of FYM alone or with fertilizers was found sustainable.[9]

Unirrigated crops lead to smaller carbon footprint per gross hectare cultivated area compared to irrigated crops. Chemical fertilizers can adversely affect fields, and chemical-laced water washed out into water-

bodies is additional burden, besides the production process of chemical fertilizers coming in the way to sustainability. A better FYM use under both the categories, in line with the SHCs, should be a policy initiative.

1.6 Marginal and Small Farmers Cultivating Other Cereals and Pulses

The SDGs stress a lot on the underlying principle that, 'no one will be left behind'. Accordingly, in the primary sector, any policy intervention or corrective action should invariably be seen from the lens of marginal and small farmers; together constituting 85.01 per cent of the total number of holdings (remaining being held by semi-medium, medium and large farmers) and cultivating 45.45 per cent of the total gross cropped area.[10] On categorising operational holdings by size, class and irrigation status, it is computed that considering number of holdings small and marginal farmers cultivate 87.9 per cent of the wholly irrigated holdings, 76.2 per cent of partially irrigated holdings and 83.8 per cent of wholly un-irrigated holdings, though area covered by them under these categories being relatively less — 51.4 per cent, 33.8 per cent and 45.2 per cent, respectively— but still it is substantial.

An analysis of the total area under cereals excluding paddy and wheat i.e. 'other cereals' (Figures 2 and 4) and pulses (Figures 3 and 5) along with farmers' status and need for sustainability computed from Agriculture Statistics, 2017, has brought out following characteristics:[11]

- **Irrigated areas:** Though marginal and small farmers by definition have smaller holdings, still they cover about 46 per cent and 32 per cent of irrigated area under other cereals and pulses, respectively.
- **Unirrigated areas**: Under other cereals and pulses, areas held by small and marginal farmers, are 39 per cent each.
- **Small holdings but large number:** It emerges that marginal and small farmers, sufficiently large in number, have substantial proportion of the national area under other cereals and pulses, in spite of lower size of their holdings.

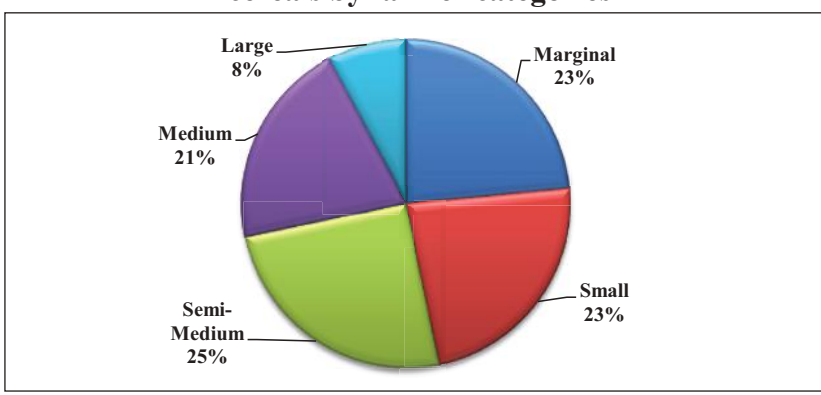
- **Rising allocation potential:** Unabated fragmentation of medium holdings, with little consolidation, would further increase area at disposal of these categories for allocation to different crops.
- **Role of other cereals and pulses:** Resultantly, role of these crops in reduction of inequalities and in national endeavour to double farmers' income is critical. Moreover, area cultivated, being a productive asset, has the potential to enhance their income crop after crop.
- **Sustainability:** Therefore, among the crops grown, other cereals and pulses merit higher coverage for achieving sustainable agricultural eco-systems.

Preceding detailed characteristics are the touchstone of any desired agronomic system towards attaining sustainable consumption of resources and production of foodgrains, internalizing social costs and benefits into private costs and benefits. Semasinghe[12], analysing private and social costs and benefits of fertilizer subsidy in Sri Lanka, pointed out that though private benefits were higher than private cost; social cost was higher than social benefits.

1.8 Pulses for Sustainability

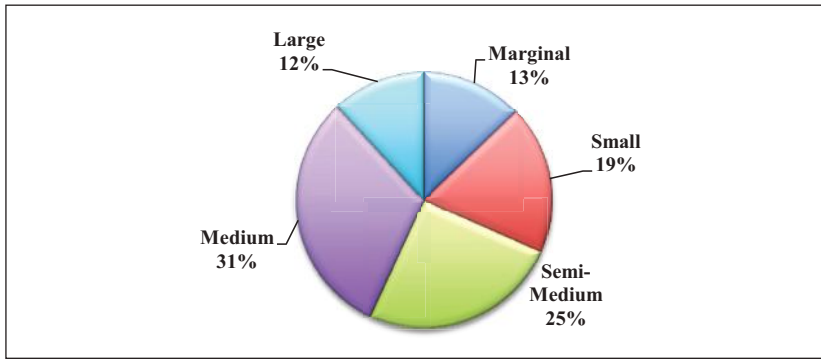
Pulses have drawn popularly known name 'legumes' from the earlier plant

Figure 2: Percent share in area under total irrigation -Other cereals by farmer categories



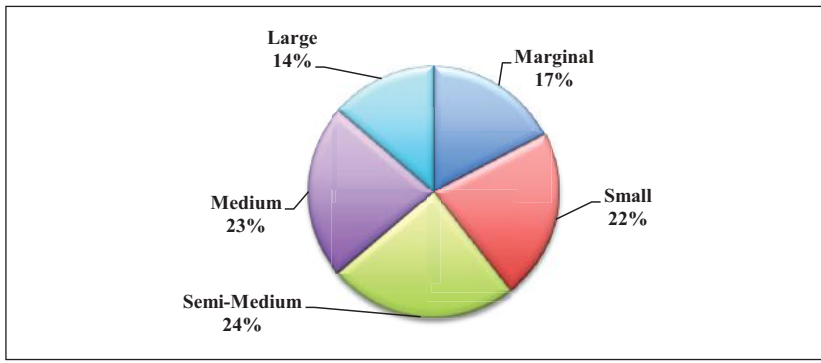
Source: Authors' Computations.

Figure 3: Per cent Share in Area under Total Irrigation- Pulses by Farmer Categories



Source: Authors' Computations.

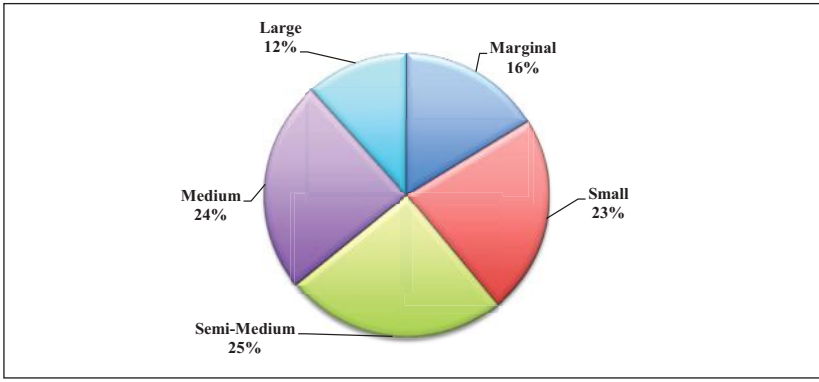
Figure 4: Per cent Share in Area under Un-irrigated other Cereals by Farmer Categories



Source: Authors' Computations.

family, called Leguminosae. Botanical standardization norm necessitating that all family names should end in 'aceae', has led to graduation of the status of the sub-family 'Fabaceae' to a full-fledged family, which covers pulses. In fact, pulses can be easily recognized by even an urban bred non-botanist through the trademark root nodules under soil and pods formed during fruiting over soil surface.

Figure 5: Per cent Share in Area Under Un-Irrigated Pulses by Farmer Categories



Source: Authors' Computations.

Sustainability is literally ingrained in genetic characteristic of biological fixation of atmospheric nitrogen in the family with the symbiotic relationship with the bacterium called rhizobium within nodules in the plant root system. Stasiak *et al.* (2016) described it as, 'Legume plants (Fabaceae) have the capacity to enter into mutualistic symbiosis with nitrogen-fixing bacteria, enabling them to grow in nitrogen-limited agricultural soils.'[13] Underscoring the role of pulses in sustainability an FAO publication states that, 'Unlike other plants, pulses carry properties that improve the soil in which they are grown and this helps other plants flourish as well'.[14] Explaining the benefits of pulses towards sustainability it further adds, 'Pulses do not require nitrogen fertilizers as it fixes its own – basically, taking it from the atmosphere and carrying it into the soil. This self-sufficiency saves the environment from greenhouse gases, a by-product of the manufacture and use of nitrogen fertilizers'.[15]

Like the strong interconnects of SDGs and their targets, such connects which promote sustainability need to be given a big thrust. In the realm of pulses and other crops grown along with or subsequently the importance of nitrogen fixation by pulses and to harness this positive externality need not to be over- emphasized. In this regard, ICAR's Indian

Institute of Pulses Research (IIPR) underscores, 'The rhizosphere can be modified by selection of suitable crop species and varieties which release root exudates (rhizodeposition), enrichment by introduction of beneficial microorganism like bio control agents and PGPRs etc., bio degradable bio stimulants and transgenic plants. Global research on this area is going on and scientists have got success in developing technology on some aspects and on other aspects research effort is being continued. Rhizosphere engineering will ultimately reduce our dependence on chemicals and help us in achieving sustainable soil health.'[16]

An IIPR study on low water requirement in growing pulses underscores that, 'Pulses are consistently being grown in harsher environments and resource limited conditions on account of comparatively low farmer's preference and less remuneration than the cereals.'[17]

Even after the lifecycle of a leguminous plant is over, it releases fixed nitrogen into the soil, which acts as an input for subsequently grown crops. And the stages undergone by the conversion of atmospheric nitrogen don't produce any harmful chemicals. By contrast it is not so in manufacturing of urea, which is extensively used as a nitrogenous fertilizer.

1.9 Pulses towards Doubling Farmers' Income

Notably, as a national policy, import of pulses can be resorted to as an exception but not as a norm. The objective of doubling farmers' income, especially of small and marginal farmers can't be attained without higher productivity of crops like pulses. Higher productivity of pulses would ensure better nutrition and also sustainability. Notably, import of pulses, among other concerns, deprives the nation of related nitrogen-fixing benefits, which could have fructified only through the domestic production of pulses.

1.10 Millets for Sustainability

Millets have many nutritional, health and environmental benefits, making them more sustainable as crops. Un-irrigated fields require lesser quantities of chemical fertilizers and thus help management of water and soil sustainability. This builds strongly a case in favour of millets, similar to that for pulses. Moreover, millets provide sizeable quantities of fodder for animals. Indian Food Consumption Tables (2017) have given a detailed account of various minerals, vitamins and micro-nutrients available in different crops, which in a way conforms strongly in favour of millets and pulses.

According to Vision 2050 of the Indian Institute of Millets Research (IIMR)[18] 'Millets are staple cereal grain and fodder crops grown by subsistence farmers in the hottest, driest regions of the Indian subcontinent where rainfed crop production is possible. Enhancing the reliability of millet grain and straw yields in such environments will contribute directly and sustainably to the alleviation of poverty and improvement of food security of farm households. Sorghum, pearl millet and small millets, are more tolerant of high temperatures than other cereals, are the ideal crops for such conditions.'

Underscoring resilience for withstanding climate change, IIMR adds that, 'Predicted climate change scenarios indicate that water shortages and shorter effective growing seasons lengths will be increasingly likely thus increasing the need for short-duration crops such as sorghum, pearl millet and small millets with enhanced drought tolerance. Development of millets will not only able to withstand such conditions but also will be able to provide a usable yield increase with resilience for poor people inhabiting drier regions.'[19]

Hariprasanna *et al.* (2014) highlighted importance of millets in achieving nutritional security 'millet cultivation is the mainstay of rainfed farming which provide livelihood to nearly 50% of the total rural workforce and sustain 60% of cattle population in India.' They added

that, 'Millets are important drought-resistant and hardy crops, and quite adaptable to a variety of agro-climatic adversities. Because of their better adaptability they play an important role in marginal agriculture followed in the semi-arid tropical regions and hilly terrains. Millets are C4 plants and hence have a very efficient photosynthetic system than the less efficient C3 plants like rice and wheat.'[20]

Millets prove to be climate - change resilient, high nutrition, sustainability enhancing crops, thus area under them should not be allowed to shrink to really boost sustainability in a comprehensive manner.

1.11 Pathway to Green Revolution II

The Indian Institute of Pulses Research (IIPR) of the ICAR, in its 'Vision 2050' document emphasized the need for dryland farming — 'There is a need for second green revolution that is more broad-based, more inclusive and more sustainable; and there is need to produce more without depleting our natural resources any further. Rainfed agriculture contribute more than 80 per cent of the pulses, oilseeds and substantial part of horticulture and animal husbandry products which plays a very important role in our economy, contributing about 60 per cent of the cropped area and 45 per cent of total agricultural produce. The second green revolution must therefore explicitly embrace dry land farming.'[21]

The IIPR document has also detailed regarding a negative externality of Green Revolution— 'Sustainability of Indian agriculture system as a whole in long run is a major concern due to consistent reduction in the soil fertility and loss of essential soil nutrients on account of exhaustive cropping systems being followed after Green Revolution. The Green Revolution in fact pushed pulses and other crops to harsher rainfed environments which led to their poor productivity, besides leading to an imbalance in soil micronutrients.'

Economic Survey 2017-18 stated that 'India ranks first, with 9.6 per cent (179.8 Mha) of the global net cropland area according to United

States Geological Survey, 2017'. Hence, India has enormous potential for crop diversification and to make farming a sustainable and profitable economic activity.

The Survey has added that the government is implementing the Crops Diversification Programme in original green revolution states, Punjab, Haryana and in Western Uttar Pradesh, to diversify paddy area towards lesser water requiring crops.

The Survey has highlighted likely benefits to farmers such as diversification would help in mitigating the risks faced by farmers in terms of price shocks and production/harvest losses.[22]

It is relevant here to mention that promotion of intercropping of pulses can bring back the benefits of nitrogen- fixing legumes to Green Revolution areas making them sustainable and profitable for farmers. It would help in expanding Green Revolution areas and overall sustainability so that when the national production increases, there remain no pockets in which production falls averting any ecosystem turning non-sustainable. Obviously with increasing need and awareness for sustainability, Green Revolution II would have to have a darker shade of green as compared to Green Revolution I.

It is not being suggested that pulses and millets replace paddy and wheat but a check on the trend of diminishing area under millets should be arrested to restore a sustainable balance. Crop rotation, intercropping, higher productivity and better utilisation of certain degraded lands which can support agriculture should be surveyed and wherever possible production of millets and pulses should be increased so that the representative food basket has these crops besides rice, wheat, etc.

'The National Mission for Sustainable Agriculture, which is one of the eight missions under our National Action Plan on Climate Change, also seeks to devise appropriate adaptation and mitigation strategies for ensuring food security, enhancing livelihood opportunities and contributing to economic stability at the national level.'[23]

Therefore, it is imperative that the still eluding Green Revolution II should address squarely these concerns, and accordingly the reformed policies are the need of the hour to boost production of millets and pulses for the national food basket.

1.12 Excess Water Proving Counterproductive

Like any other crop, excess watering is counterproductive for pulses too. But as pulses need lesser water, the threshold of 'excess' reaches with relatively lesser quantity of water, unless rains completely fail.

Analysing this issue, the Directorate of Pulses Development, Bhopal, recommendation for situations when winter rains elude gram (*kala chana* – dark -brown chickpea) is that, 'Under assured irrigation, one irrigation each at maximum branching and pod development resulted in 25-70 per cent increase in yield in absence of winter rain.' And it warns against counterproductive ill-timed irrigation, 'In no case, irrigation should be given earlier than four weeks after sowing and during active flowering because earlier situation is harmful for maximum 'N' fixation as the Rhizobial bacteria work only in aerobic conditions and later, excess irrigation may reverse the crop again to vegetative phase with severe depression in yield due to ultimately shorter reproductive phase.'[24]

The Directorate also warns against excessive irrigation to pigeonpea (*arhar*) 'In no case, irrigation should be given earlier than four weeks after sowing and during active flowering because earlier situation is harmful for maximum 'N' fixation as the Rhizobial bacteria work only in aerobic conditions and later, excess irrigation may reverse the crop again to vegetative phase with severe depression in yield due to ultimately shorter reproductive phase one or two irrigations may be needed. A pre-requisite for the success of *arhar* is proper drainage. *Ridge planting* is effective in areas where *sub-surface drainage is poor*. This provides enough aeration for the roots during the period of excess rainfall. During rainy season, water should not stand anywhere in the field.'[25] Excessive irrigation is already adversely affecting many tracts of land in Punjab where farmers need to be nudged to adapt more sustainable cropping patterns.

Even if one doesn't take into account the relatively high prices of pulses, the current procurement mechanisms which are loaded in favour of wheat and paddy, once rationalized would make pulses and millets economically more viable, environmentally more sustainable and socially more acceptable to meet nutritional needs. It is a fact that pulses and millets don't necessarily compete with paddy and wheat at each turf but can make farming itself more viable by raising them on the lands where wheat and paddy cannot be grown.

2. Millets and Pulses for Nutrition

2.1 Millets - 'Coarse' is the Finest of the Fine and Better for Health

The importance of coarse- grains has been well projected in the Annual Report of the FCI which aptly states— 'India is a member of the IGC an inter governmental forum of exporting and importing countries for co-operation in wheat and coarse grain matters which was previously known as International Wheat Council up to 1995.'[26] Thus in addition to being sustainable, millets have proven to be finest of the fine cereals; shaking off the tag of 'coarse' by providing better nutrition.

It is also argued that millets do not attract pests; and majority of the millets are not affected by storage pests; thus, the use of pesticides is not mandated in the cultivation of millets.[27]

Apart from many nutritional qualities, millets also possess a number of characteristics vital for health. Various epidemiological studies[28] have shown that consumption of millets reduces risk of heart diseases, protects from diabetes, improves digestive system, lowers risk of cancer, detoxifies body, increases immunity for respiratory health, increases energy levels and improves muscular and neural systems besides being protective against several degenerative diseases such as metabolic syndrome and Parkinson's disease. McKeown (2002)[29] reiterated that, 'Regular consumption of whole grain cereals and their products have shown in epidemiological studies that they can protect against risk of Diabetes mellitus, gastrointestinal diseases and cardiovascular risks'. It

is further argued that if stored properly millets can be preserved well for two years or beyond.[30]

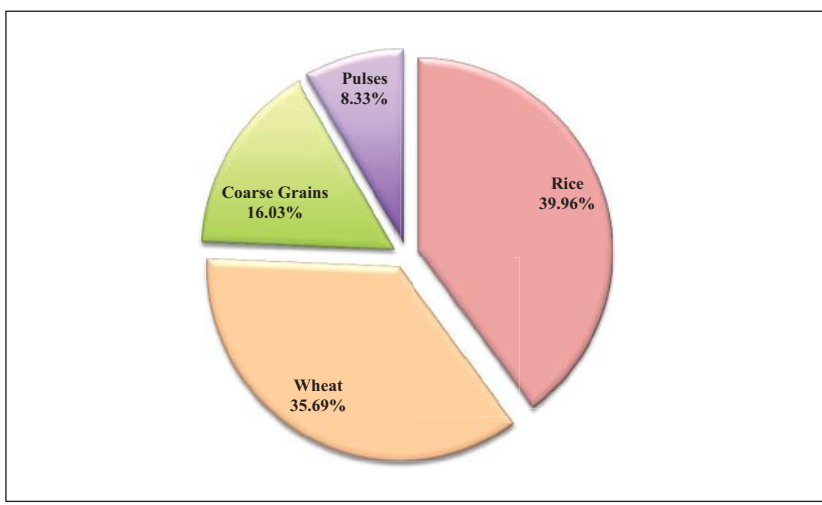
Hariprasanna *et al*. (2014) elaborating health benefits of millets pointed out that, "A majority of millet grains contain higher protein, fibre, calcium, and minerals than the widely consumed rice and wheat, and hence now often being regarded as 'Nutri-cereals'."[31]

In the light of all above, it is felt that once the nutritional and other qualities of millets are taken into consideration, the nomenclature like 'Pearl' millet is more apt than the often used one 'Coarse'.

2.2 Crop Production Shares and Dispersal Across Kharif and Rabi Seasons

In the context of total foodgrains production, the Figure 6 shows that the proportion of coarse-grains and pulses is quite significant in the Indian foodgrains basket, being around 16.0 and 8.3 per cent, respectively.

Figure 6: Foodgrain Production in 2016-17



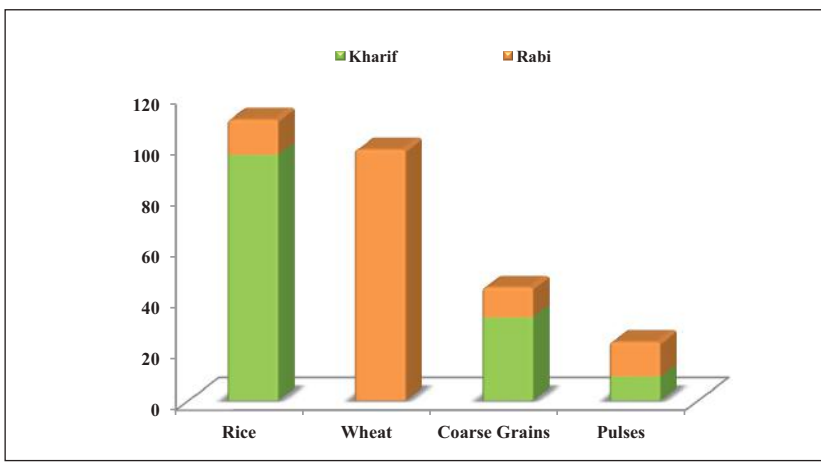
Source: Agricultural Statistics of India, 2016.

Coarse cereals are widely dispersed over seasons; as 26 per cent of these are produced during *Rabi* and remaining 74 per cent during *Kharif* (Figure 7). This would especially help marginal and small farmers and vulnerable consumers in keeping supply lines open more than once a year. Compared to millets, only 12.5 per cent of rice is produced in *Rabi,* while wheat is hardly produced in *Kharif*. Relatively, 59 per cent of pulses are produced in *rabi* and remaining 41 per cent in *kharif*. Thus, pulses and coarse- cereals are relatively better spread over two major cropping seasons in the country and better suited to suffice year-round nutritional needs of the people.

2.3 Protein Content Glycemic Index and Nutritional Value

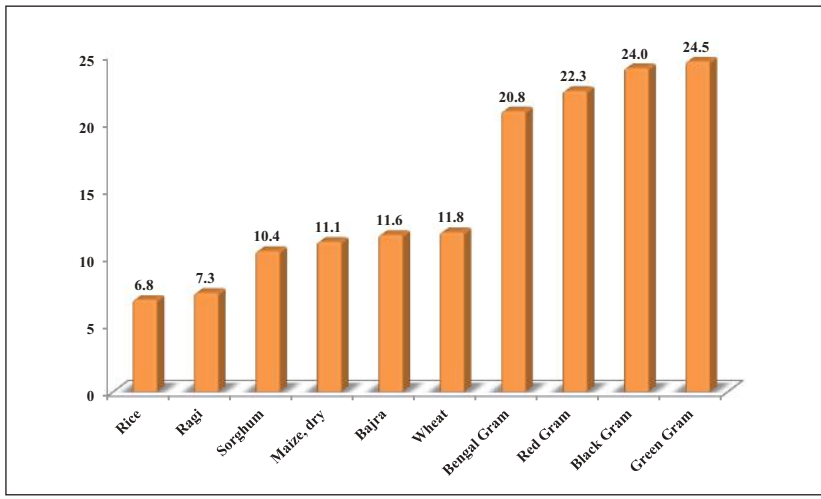
It is important to have a glance at the intrinsic qualities like nutritive values of various crops. Protein content (per cent weight by weight) is high in pulses; 24.5 in greengram (*moong dal)*, 24.0 in blackgram (*urad dal*), 22.3 in redgram (pigeonpea-*arhar*/*tur*), and 20.8 in Bengalgram (*safed chana* - white/beige chickpea), (Figure 8)**;** much higher than in cereals.

Figure 7: Foodgrain Production in 2016-17 (million tonnes)



Source: Agricltural Statistics of India, 2016.

Figure 8: Percentage of Protein in different Food Items (per 100 gm)



Source: NIN.

It is not being advised that pulses should substitute cereals, but they should supplement them to increase intake of protein. It has been emphasized by McDermott *et al.* that proteins in pulses and cereals are complementary.[32]

Moreover, with changing food habits and life style, diseases like diabetes are catching- up fast. To avert diabetes, food items like millets and pulses are found ideal, especially, compared to polished white rice. It is relevant to add, 'Foods with a low glycemic index are considered to be healthier because they produce a lower and slower rise in blood glucose. This affects how much insulin the body has to produce during the metabolism of the food sugars, and ultimately affects how much fat is stored in the body. As a group, pulses (peas, chickpeas and lentils) and legumes (beans) have low glycemic indexes because of the type of carbohydrates (sugars) they contain'.[33] Millets, being rich in important vitamins *viz*., thiamine, riboflavin, folic acid and niacin, are equally important. Further, *jowar* and *bajra* possess high fibre and minerals like

iron and manganese. Moreover, *jowar*, like oats, contains no gluten, thus it can be utilised for preparation of gluten-free diets. Further, a report on 'Nutritional and Health Benefits of Millets'[34] by Indian Institute of Millet Research (IIMR) of ICAR argues that millets are comparable to rice and wheat in certain other minerals as well as fatty acids.

Highlighting importance of pulses, an FAO publication states — 'Amongst the praises of pulses are their vast geographical range, high nutritional value and low water requirements, their unique ability to self-fertilize, (adding necessary nitrogen to farm land and improving crops along the way), along with maintaining their health benefits over a long shelf life. All these reasons, make pulses an uncompromising enemy of hunger and malnutrition worldwide.'[35] It adds further that, 'Pulses are a genuine *superfood* for the future.'[36] It is very true that to effectively fight high burden of undernutrition, pulses definitely would meet twin criteria of nutrition and sustainability.

'Vision 2050' of the IIPR endorses crucial role of pulses in addressing undernutrition: 'A balanced approach including judicious use of natural resources, protecting soil microflora and lesser application of chemical pesticides and fertilizer are needed to sustain the ecosystem. Pulses improve soil health by enriching nitrogen status, long-term fertility and sustainability of the cropping systems. Therefore, their inclusion in cereal-based cropping systems contributes to soil fertility by enriching organic nitrogen, reducing the demand of chemical fertilizers, enhancing soil microflora as well as supplement protein diet for large population of the country suffering from protein malnutrition or *hidden hunger*'[37].

McDermott *et al.* (2017) reiterated: 'There is a considerable market opportunity for pulses to be incorporated into complementary foods for young children. Another food processing demand that can be met with pulses is in the area of nutritionally complete foods to prevent and treat undernutrition in humanitarian emergencies.'

2.4 Price Volatility of Pulses - A Major Constraint

In spite of many benefits from pulses, periodically witnessed price volatility comes in the way of their steady promotion, and also leads to uncertainty in decision-making of farmers, consumers and governments. Supply -side fluctuations of pulses clubbed with relatively inelastic demand lead to high price volatility. And it is compounded further by the following: India being a sizeable producer thus not leaving much scope for imports[38]; high level of coefficient of correlation between Indian production and other supplier countries production owing to *El Nino*[39] effect; inelastic nature of the sown area of individual pulses,; low levels of substitution across pulses owing to localized tastes and preferences; specific pulses largely grown in one season a year; and high dependence of *kharif* pulses on monsoon, as they are largely rainfed.

2.5 Millets to Supplement not to Supplant

While millets have many nutritional advantages but a diet restricted only to *bajra* (pearl millet) or ragi (fingermillet) as the cereal is not advised, as it would be devoid of some attributes of other cereals. As a caution against Iodine Deficiency Disease (IDD) it is notable through an NIN report, '….another factor responsible for IDD is presence of goitrogens in diets, which are known to interfere with iodine metabolism at various levels, from absorption of iodine to synthesis and utilisation of thyroxin. Some of these goitrogens are thiocyanates, iso-thiocyantes, thio-oxazolidone, flavanoids, disulphides, phenols, phthalates, biphenyles, lithium etc. Certain varieties of foods such as *jowar*, fingermillet, tapioca, cabbage, cauliflower, mustard seeds and groundnuts are known to have goitrogens in significant quantities.'[40]

2.6 Tackling Undernutrition and Doubling Farmers' Income:

As per NHFS 4 Report, the prevalence of stunting, wasting and underweight among children under five years of age is 38.4, 21.0 and 35.7 per cent respectively in India. Regarding availing of ICDS benefits NFHS 4 further states that the provision of food supplements is most

likely being used by 48 per cent children. Authors' computations for children in the age group 3 to 6 years, based on Census and UNDESA age-population data also lead to a similar level of coverage. Accordingly, if these children are given nutritional items including preparations from millets and pulses (of course alongwith rice/wheat based preparations) with vegetables and items like milk on regular basis their nutritional deficiencies can be overcome. This will help in reducing undernutrition of about half the children in this age group. In addition awareness and dedicated efforts to cover remaining children can no more be delayed in order to substantially reduce undernutrition well before 2030.

The Volume VI of the 'Report of the Committee on Doubling Farmers' Income', is dedicated to 'Strategies for Sustainability in Agriculture' analysing different aspects to achieve sustainability. It points out, 'Recently, the cropping patterns in rainfed areas are witnessing shift to mono-cropping, particularly to rainfed cotton replacing pulses, millets, oilseeds crops.'[41] Stressing on the importance of nutritious cereals/millets, it further recommends that, 'For rainfed area nutritious cereals/millets are suggested where rainfall is less than 500 mm a year'[42].

Nutrition and sustainability driven framework clubbed with policies like procurement and PDS can help in promoting millets while ensuring better income to farmers through them and other crops.

3. Millets – Short-term Interest Evicting Long-term Benefits

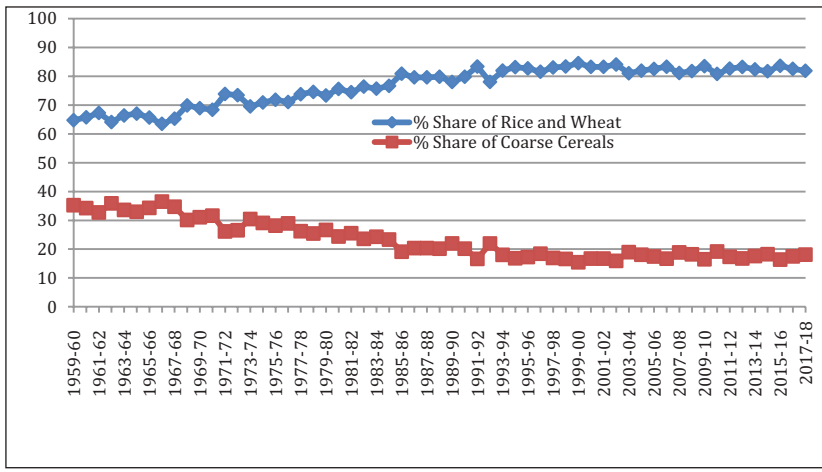
This section covers how short-term interests, especially financial interests, are evicting millets from the mainstream of the cropping systems; ignoring their long-term nutritional and other benefits.

3.1 Shrinking Production Share of Millets

The trend of production of rice, wheat and coarse- cereals clearly illustrates that coarse- cereals are being steadily evicted from the Indian cereal basket (Figure 9). Unfortunately, this eviction has been happening silently. In many regions retention of a sizeable share of coarse- grains

is becoming the need for the maintenance of the biodiversity. But as the scenario is, one can realize that they have already disappeared from many of the fields; thus lesser diversification and in some cases monoculture of paddy and wheat only remains.

Figure 9: Percentage Share in Production of Cereals



The share of coarse -grains in the national cereal basket has fallen (Figure 9) from over 35.26 per cent in 1959-60 to 18.1 per cent in 2017-18, i.e. less than half the share of what it was 58 years earlier.

3.2 Shrinking Areas under Millets

One of the key reason is the forces leading to reduction in the area under coarse- grains from 44.96 million hectares in 1960-61 to 24.77 million hectares in 2016-17. In terms of the share of area under cereals during the period, reduction was from 48.85 per cent to 25.13 per cent.

Given the valuable nature of millets for sustainable agricultural growth, nutritional value and affordability, this trend needs to be reversed promptly.

4. Reforms in MSP and PDS

4.1 MSP System Needs Reforms

The declaration of Minimum Support Price (MSP) and ensuing Public Distribution System (PDS) are very important tools which can promote sustainability and provision of nutritive food items.

The production story of pulses in India is relatively better than of millets. Pulses production achieved a record level[43] of 25.23 million MT in 2017-18, one of the factors that pushed pulses production has been the Government decision to create a buffer stock of pulses; to implement which the FCI started procurement from *mandies* at the market price through auctions, through utilisation of funds provided under the 'Price Stabilization Fund' of the Ministry of Agriculture and Farmers' Welfare.[44] Still, MSP system needs major reforms as millets and pulses have not been given much focus under it.

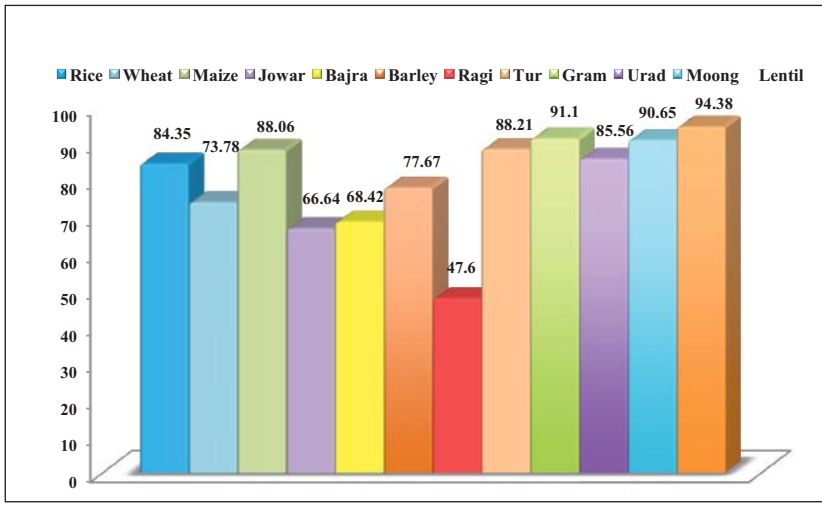
Highlighting this shortcoming, the Department of Food boldly admits that, 'MSPs are announced for 23 commodities, but effectively price support operates primarily in wheat and rice and that too in selected States.'[45]

4.2 Adequate Surplus of Millets to Justify Procurement

Howsoever critical own-farm produce of these crops may be for domestic consumption for certain sections of marginal and small farmers, still at the macro-economic level, most of these crops have sizeable marketable surplus (Figure 10). Low level of procurement of coarse- grains is often wrongly justified on the ground that they are mostly grown for subsistence farming by marginal and small farmers. In reality, except ragi having a shade under half, other crops have higher marketable surplus (Figure 11), *jowar* and *bajra* have over two-thirds and pulses over 85 per cent.

In spite of high marketable surplus ratio, the low level of procurement (Figure 11**)** is not justified. Procurement of coarse-grains has been widely fluctuating and of late, it became abysmally low and

Figure 10: Market Surplus Ratio (MSR) of various food items in 2014-15



Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation.

had fallen to below one lakh metric tonnes in 2016-17 and 2017-18. This presents a sorry state of coarse- grains; being treated as poor cousins of paddy and wheat by the procurement machinery.

In line with the poor level of procurement of coarse- grains, their proportion in the stock of cereals has also been insignificant (Figure 12).

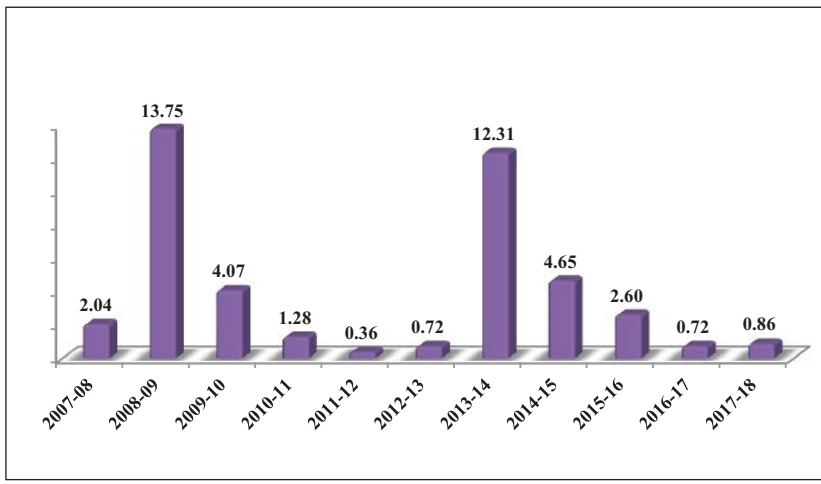
4.3 Analysis of marginal substitution with millets in procurement:

It is beneficial to marginally restore proportion of millets in food basket. One may compute the marginal financial implications of procurement of say, an additional one lac quintal of millets in place of a corresponding quantity of paddy[46] and wheat under PDS. Here the marginal procurement can be computed in proportion to the production of various millets against reduced procurement of paddy and wheat[47]. It is estimated that financial outgo would reduce by around one-twelfth of the procurement cost of corresponding quantities of paddy and wheat, implying financial gains to the exchequer. In addition, central issue price (CIP) charged

to the consumers being lower for millets, would also lead to financial gains to them to the tune of around four-fifth of the financial gains to the exchequer.

Basic objective of this analysis is not to make any financial gains but to promote nutritional gains for the consumers. The actual quantities to be modified can be decided as per local tastes and preferences while generating awareness about related nutrition related facts. To accomplish it local food items prepared from a mixture of rice/wheat with millets, alongwith pulses and vegetables, can help improve nutritional standards

Figure 11: Procurement of Coarse-grains (lakh Tonnes)

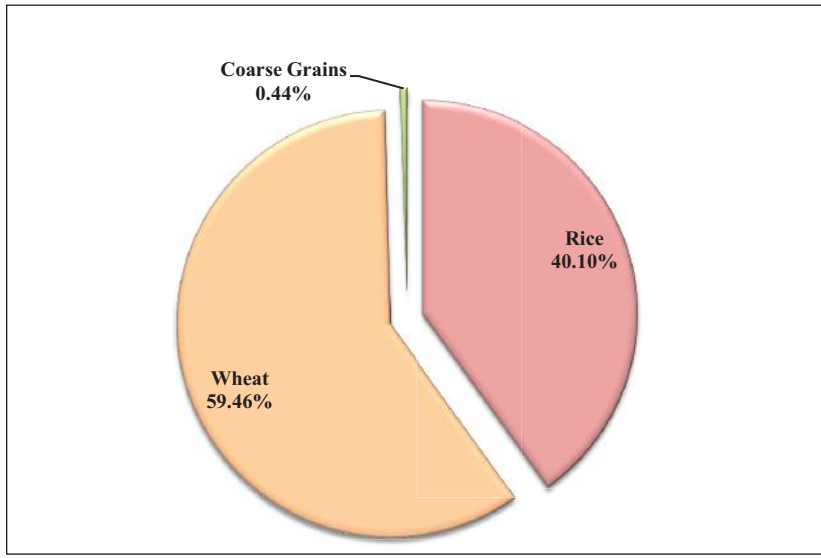


Source: Agriculture Statistics and Food Grain Bulletin, Jan 2019.

among the population serviced through various channels including ICDS, MDM, Community kitchens, retail marketing involving private sector, etc.

While pulses are being utilised under *anganwadis* and MDM all over the country, certain states are including recipies made from a mixture

Figure 12: Stock in Central Pool : Rice, Wheat and Coarse Grains (Jan 2019)



Source: Food Grain Bulletin, Department of Food and Public Distribution, Jan 2019.

of cereals including millets. Moreover, in the Community Kitchens periodic option of a dish based on a mix of cereals including millets is also being undertaken—for example in the *Annapurna Rasoi* in Rajasthan.

5. Way Forward

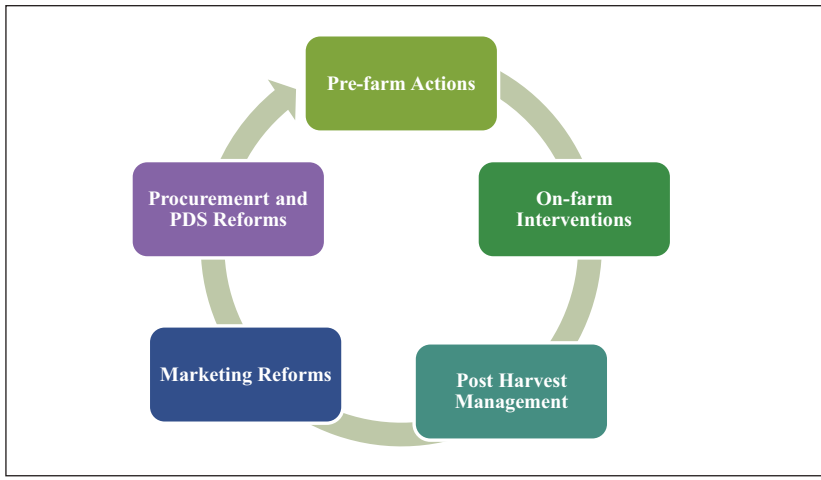
There is a need to revisit present policy and implementation mechanism and to create a new framework for promoting cultivation of millets and pulses. Such a suggested course needs to internalize sustainable interconnects as represented in Figure 13.

5.1 Pre-farm Actions

5.1.1 R&D push and Supply chain of seeds

Keeping in view sustainability and nutritive value of millets and pulses, R&D for improving their productivity, enhancing resilience to face droughts and reduction in crop duration of some varieties are the

Figure 13: Sustainable Interconnects



Source: Authors' representation.

major focus areas. It is all the more enjoined upon India to push R&D, especially of pulses, as a sizeable portion of their global production takes place in India; and their demand is increasing faster than cereals. Increase in genetic potential of millets and pulses through experiments and innovations as part of the larger R&D policy needs to be promoted. New strains should be developed to adapt to climate change, especially rise in global temperature by over 1.5 or 2 degree Celsius from the pre-industrialization era. Innovations to develop short- duration varieties especially of pulses, allowing farmers to raise these along with other crops over the year can reintroduce many of the pulses/millets.

Moreover, production of better seeds for millets and pulses, should be undertaken in a mission-mode. Unabated supply chain of breeder seeds into certified seeds through intervening stages is to be ensured. Seed certification management should be made more credible and effective. As crop insurance management has a stake in quality of inputs, involvement of agronomists and experts can make this mechanism synergic and also more efficient.

5.1.2 *Institutional Architecture and Genetic Diversity*

Institutional mechanisms need to be re-oriented to ensure proper linkages between policy- making on the one hand and outcomes of research activities/studies undertaken by the ICAR-led institutions on the other hand to meet aspirations of millets and pulses growing farmers to raise productivity, reduce input costs and minimize adversities. Scientists should be incentivized for such an applied research to benefit farmers in the long run and to enhance sustainability; for instance through development of climate-smart varieties.

In line with SDG Target 2.5 focus should be on conservation of genetic diversity to ensure adequate material to withstand adverse forces. Some of the specific research issues which should be addressed through R&D are: enhanced germplasm, resistance to multiple adversities, breeding for higher nutrient- use efficiency, early maturity, better suitability to inter-cropping through higher complementarity in utilisation of inputs etc.

5.1.3 *Soil Health Cards (SHCs) as a decision-taking Tool*

Of late, commendable work has been carried out through Soil Health Cards (SHCs); in which field soil is tested and farmers are informed about N, P, K, micronutrients' status of the soil. There is a need to prepare cropping options for different kinds of combinations of soil nutrient levels, so that the farmer can go for the most productive option among the technically feasible options. The farmers should also be provided comparative information on feasible crop rotations with and without millets and pulses so that they are sensitized better towards positive externalities of these crops to be internalized in taking sowing decisions. To give a broader idea to farmers and farmers' association, backing region/state specific Soil Maps should also be developed and made available. It is also important to ensure timely and adequate availability of finance through Kisan Credit Cards, and of fertilizers/ FYM/micronutrients at the local level at the right time.

5.1.4 *Changed Psyche towards much Needed Self-Sufficiency*

In addition, India has the potential to become a hub of supplies of various millets, especially to meet demands of the developing/LDCs during low rainfall/drought years. In addition, in a long-run, the nation needs to be self-sufficient in production of pulses for diverse yet inter-linked reasons like sustainability, nutritive value, doubling of farmers' income, saving on foreign reserves etc.

5.2 On-Farm Interventions

- Millets and pulses are cost-effective crops, needing less water and fertilizers. They should be raised in larger areas as an inter-crop or as a catch crop.
- Better crop rotation and inter-cropping to diversify production and to raise incomes should be an integral part of crop management.
- Water conservation through drip and sprinkler irrigation, matching needs of different intercrops, can help in saving water and also inputs like fertilizers, which are dependent on quantum and mode of watering undertaken. Moreover, pulses being legume crops, nitrogen fixation by them leads to lowering of demand for urea for not only of pulse crops but also of the other succeeding crops.
- Importantly, millets are hardy crops, requiring lesser quantity of pesticides. While encouraging millets and pulses, integrated pest management (IPM), matching crop varieties, previous pest management led residual pesticides in soil, water conservation techniques used should be utilised in a comprehensive and scientific decision taking manner to minimize damage to soil helping it regain its organic nature.

5.3 Post-harvest Management and Food -Processing

Reduction of harvest losses through better timing and technology, while harvesting millets and pulses as well as fodder, should be evolved and adopted.

- Scientific storage can help harnessing full shelf- life and in retention of nutritive value of millets and pulses.
- Harvesting, threshing, transportation, storage, milling/polishing and packing etc. should be integrated and should not be adding excessively to cost.
- Food processing of a higher proportion produced, including mied dishes can help in a big way.

5.4 Marketing Reforms

- Real- time information sharing can help farmers in overcoming asymmetric information and increasing revenue and reducing input costs.
- Choice of selection of a consumer should be made available to the farmer. If he so desires, the option of direct sale without utilising services of an APMC should be provided.
- Benefits of e-marketing should be made available for pulses and millets also.

5.5 Procurement and PDS Reforms

- One can recall with the help of the Annual Reports of the Department of Food and Public Distribution, the Central Issue Prices (CIPs) under the TPDS were reduced drastically under the NFSA 2013 mandate to Rs 3, 2 and 1 per kg, respectively, for rice, wheat and coarse-grains. Under the erstwhile TPDS, rates even for BPL families were Rs 5.65, 4.15 and 3.00 per kg, respectively, for common rice, wheat and coarse-grains. Only under Antyodya Anna Yojana, the cost was Rs 3, 2 and 1.50 per kg, respectively, for common rice, wheat and coarse-grains. For APL households, cost was at Rs 7.95 (Grade 'A' rice Rs 8.30), Rs 6.10 and Rs 4.50 respectively.[48]
- The NFSA 2013 stipulated Cost Issue Prices (CIPs) of rice, wheat and coarse-grains at Rs 3, Rs 2 and Re 1 per kg, respectively. It allowed CIPs to be enhanced after three years of the commencement of the

Act; not exceeding thee MSPs. Even if the rates are increased keeping in view the average CPI increase of 16 per cent over the first three years to approximate Rs 3.50, Rs 2.30 and Rs 1.15; these would still be much lower to MSPs. Such an increase would lead to rates much lesser than already charged prior to the NFSA promulgation.

- For the year 2017-18, MSPs for rice (taking conversion factor of 3/2 for paddy), wheat and coarse-grains were Rs 23.25 per kg, Rs 17.35 per kg, respectively, and Rs. 19.00 for ragi, Rs. 17.00 for jowar and Rs. 14.25 for bajra and maize. The MSP of coarse- grains being near the level of that for wheat, their low CIP of Re. 1 per kg gives an impression that these are 'cheap' or 'inferior' or 'low-standard' or a 'poor man's' cereals, but from the angle of sustainability, nutrition etc. they are certainly not. Therefore, there is a need for higher procurement of millets and their introduction in the distribution of MDM/ICDS hot-cooked meals in the form of dishes mixed with other cereals.

Understanding importance and great potential of millets towards food and nutritional security and climate resistance and with their anti-diabetic properties, low glycemic index properties, government has declared *Jowar, Bajra, Ragi* and little millets like *Kutki, Kodo, Sawa, Kangni* and *Cheena* as 'Nutri-Cereals'. And to give further boost to 'Nutri-Cereals' government has created a sub -mission on these by dividing National Food Security Mission (NFSM) – Coarse Cereals into two components: NFSM (*Makka* and *Jau*) and Sub Mission on Nutri-Cereals. Further, it has accepted to include millets in PDS across the country. Moreover, the year 2018 was declared as 'National Year of Millets'.[49] Concrete and prompt action points are required to fructify the intent of the policy.

An analysis of the provision related to 'Distribution and Disposal of Coarse- grains Overview'[50] revealed a number of impediments in the procurement of coarse- grains, which along with suggested course of action, are as follows.

- There is a provision that a state should obtain prior approval of Government of India before procuring coarse- grains. This provision needs to be removed as it is totally against the spirit of assured procurement at the MSP, and Mission statement of FCI encompassing 'Efficient procurement at Minimum Support Price (MSP)'.
- Madhya Pradesh had launched a scheme *akin* to Price Deficiency Payment (PDP) called *Bhavantar Bhugtan Yojana* for eight crops covering *urad, moong* and *tuar*. Under the scheme, a modal rate is fixed for a *mandi* for the select crop. If the selling rate in *mandi* is below or equal to the modal rate, government credits the difference in amount based on MSP minus modal rate. However, if the selling rate in the *mandi* is above modal rate but below MSP, the amount credited is based on MSP minus selling price. Importantly, if procurement and distribution of pulses under PDS are streamlined farmers would be motivated to grow a higher quantity of pulses as the bulk demand generated by PDS would raise the market price and keep it above MSPs for different pulses.
- An issue raised may be that the FCI requires a procurement plan in advance to organize procurement of coarse-cereals. However, the need is in a way similar to the provision under the MGNREGA to submit a labour budget to Ministry of Rural Development, which doesn't hinder engagement of job-card holders. Similarly, to procure millets if a realistic procurement plan is sent to the Ministry of Food a month after *kharif / rabi* sowing is over, it should suffice. But the need to obtain prior approval should definitely be dispensed forthwith.
- There is a condition imposed on states to keep in mind that procured quantity of coarse -cereals is to be used for distribution under the TPDS within the procuring state. This is a very harsh condition, and should be removed forthwith.
- There is a provision that the FCI may ask a state to provide a stock of coarse -grains for making supply to other state(s) at the provisional acquisition cost approved by the FPD. This provision is quite uncertain in nature, as during sowing season, coarse grain

producing farmers have no idea about post-harvest likely inter-state procurement demand. To make this demand channel- effective, the FCI should collect coarse grain - wise likely demands from states deficient in coarse-grains and convey it to surplus states.

- Presently, a state is expected to dispose of the balance quantity of coarse-grains in the open market, after joint checking of the quality of stocks by a team of the FCI and stakeholders. This condition ties the hands of the states as there can be situations of sales below the economic cost. Thus there is a need for a credible commitment from the FCI to reimburse any shortfall in revenue generated.
- There is a helpful provision that wherever required FCI may engage Small Farmers' Agri-Business Consortium (SFAC) as its agency for procurement of coarse- grains for which payments are directly made to farmers. This provision needs to be invoked by timely laying down minimum procurement targets during *kharif* and *rabi* for different coarse-grains.

Government has approved 'Integrated Management of Public Distribution System (IM-PDS)' as a Central Sector Scheme (CSS) for implementation during 2018-19 and 2019-20. This should be implemented intensively to stop leakages through de-duplication and identification of fake/ghost ration cards. The funds saved through this effort can be utilised towards better coverage, portability under PDS as well as in prompt introduction of pulses and millets to diversify PDS basket from wheat and rice across the country.

5.6 Inclusion of Pulses in the PDS while pushing Millets

Though pulses are currently included in a few states in the PDS, they need to be covered in all states/UTs giving consumers option to go for this superfood, while millets need a push under PDS. To increase consumption of pulses and millets, the following steps should be undertaken.

- Locally grown pulses should be procured and distributed to all households covered under the PDS. In the pulses deficit States, FCI and NAFED and other State Agencies should provide pulses meeting

local tastes through procurement from other states, preferably the nearby ones.

- To promote consumption of higher quantity, under the PDS, pulses maybe distributed by charging only MSP. Therefore, all costs above MSP like transportation, grading, packing should be subsidized and borne by the Central and State Governments in agreed proportions say, on 50:50 basis. Notably, presently some States are already distributing pulses by entirely bearing such costs. While actually pricing pulses, instead of keeping the marked price at MSP, such costs though may be charged, but subsidy element may be provided in the form of a matching free extra quantity. For example if MSP of a pulse is Rs 40 per kg and subsidy computed owing to transportation, grading, packing is its 25 per cent, the pulse can be given in 1.25 kg packets by charging full cost of only 1 kg i.e. Rs 50 to promote higher quantity of consumption.
- While steering procurement of millets and pulses under the PDS system, proximity of production and consumption areas should be harnessed towards which ICDS and MDM consumption needs are to be taken into account. Thus, while matching with the consumption preferences of local people, this can provide a sustainable push enhancing nutrition security.

5.7 Creation of Awareness

Awareness, being the key, can help a lot in disseminating information about worth of nutritive items. So far as millets and pulses are concerned they are storehouse of protein, fibre, minerals and micronutrients. While pulses are a very rich source of protein, *jowar* and *bajra* are also of fibre and minerals like iron and manganese. Moreover, *jowar* like oats, contains no gluten, making it valuable for the preparation of gluten-free diets. Additionally, glycemic index of pulses and millets is low, making these more suitable diets in case of diabetics whose number is on a rise, especially in urban areas. There is a need to popularize consumption of millets and pulses through electronic and other media like pamphlets,

leaflets and posters. One can also organize various daily Nutrition and Health Programmes such as *'Poshan aur Swasthya'* in local and regional languages using various e-media platforms.

Further, awareness can be created by educating people through dissemination of information regarding different recipes of millets and pulses; and many other preparations by mixing them with other cereals like wheat/rice for recipes like idli, dosa, porridge or uttapam and other ready-to-cook/popped or flaked items/packed snacks based on millets and pulses. These can be popularized through on-site demonstrations in exhibitions etc.

Increased demand through better nutritional awareness can be easily met through increased supply; shifting both demand and supply curves outwards. Higher income of coarse -grains and pulses growing farmers would also raise their own demand for vegetables and fruits. Resultantly, the average food basket would become more diversified and nutritive though inclusion of coarse- grains, besides rice and wheat, along with pulses, vegetables and fruits etc.

The increased procurement in turn would demand higher production of millets and pulses. In fact, while removing the aforesaid bottlenecks, the central government may provide funds for transportation of millets and pulses both within and across states to promote further acquisition of coarse -grains.

The changes proposed above in policies and other interventions can no longer be postponed as food and nutrition security, doubling of farmers' income etc., can be achieved only through a well- planned sustainable ecosystem.

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