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Food Security Status at different Levels and Opportunities for Course Correction in Odisha State of India

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ABSTRACT

This paper reflects the status of food security at different levels – global, country (India), and state (Odisha) based on the secondary sources of data and information. It tries to find out feasible and sustainable measures to ensure food security for all at the country and state level. Also, the paper diagnoses the relationship between food security and sustainable agriculture, exclusively. Our learning is that despite sustained economic developments, poverty reduction and targeted policy efforts, there has not been substantial progress in reducing food insecurity and malnutrition over the last decade and at all levels in terms of comparable socio-economic indicators. Food-grain production has slowly gone up, but the rising population (at country and state level) has made per capita food-grain availability lower. The paradox of food insecurity could be in the inherent flaws in the existing policies and implementation bottlenecks together with the weak public distribution system (PDS) including lack of required infrastructure to safely store and distribute food grains. Hence, to ensure food security for all, strategically designed programs need to be implemented with a strong monitoring system, creation of required rural infrastructure (roads, transport, market, communication, cold storage, grain banks, etc.), strengthening PDS, controlling rapid population growth, ensuring education for all etc.; besides developing and implementing precision agriculture technologies.

HIGHLIGHTS

- Global grain production is in decreasing trend in the last decade (2241.6 million tonnes in 2008-09 to 2121.0 million tonnes in the year 2018-19). The world's population is projected to grow from 7.7 billion in 2019 to 8.5 billion in 2030 (10% increase), and further to 9.7 billion in 2050 (26%) and to 10.9 billion in 2100 (42%). This is the major concern of food security for all.
- India at present finds itself in the midst of a paradoxical situation. Endemic mass-hunger (189.2 million people are undernourished) coexisting with the mounting food grain stocks (62 million tonnes against an annual requirement of around 20 million tonnes). Besides, there is a high decadal population growth rate of 17.7% and its population is expected to exceed that of China around 2027. This could make the food security situation more serious.
- Although the state of Odisha has been witnessing marketable surplus of cereal crops (out of 24 years, 17 and 15 years for rice and cereals, respectively), it has been placed in the category of the 'severely food insecure' regions. Here also, the population is increasing at a high decadal growth rate of 14% which if continued could aggravate the food security situation.

Keywords: Food security, precision agriculture, population, infrastructure, education

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Food security has been variously defined in economic jargons, but the widely accepted definition is one by the World Bank (1986) - "access by all people at all times to enough food for an active & healthy life". Likewise, Rome Summit on World Food Security and World Food Plan Action has mentioned in FAO's annual report on food security "The State of Food Insecurity in the World 2001" the "food security at the individual, household, national and global levels exists when all people at all times have physical and economic access to safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996; FAO, 2002). In both the definitions emphasis has been given on physical availability and economic accessibility of food to the people. It was then redefined further and Peng & Berry (2019) in their chapter titled "The Concept of Food Security" gathered it as "The State of Food Insecurity in the World 2001" by adding the social emphasis/impetus in the definition of FAO (2000). It was recognized that addressing poverty is necessary but not alone sufficient to achieve this goal (FAO, WFP and IFAD, 2012). Then at the 2009 World Summit on Food Security, the last official revision, which added the fourth dimension of stability to the concept of food security (FAO, 2009). More recently, it has been suggested that sustainability be added as a fifth dimension to encompass the long-term time dimension (Berry *et al.* 2015). Food security has several dimensions. Historically, it referred to the overall regional, national, or even global food supply and shortfalls in supply compared to requirements (Weingärtner, 2004). In recent years, because of severe disparity in the sufficiency of food intake among certain categories of population, the term has been applied at a local, household, and individual level. Food security includes four important areas like access (Sen, 1981), sufficiency, security, and sustainability (Chambers, 1989).

Food adequacy and food security could be at different levels - for an individual, household and the nation. The same are presented in the box.

Individual Food Security (IFS) refers to "access to adequate, safe and nutritious food to maintain a healthy life … without undue risk of losing access", i.e., Individual Food Adequacy (IFA) as well as the confidence that it can be maintained. Without such confidence, people take hyper cautious decisions that forfeit their chances to escape from chronic hunger. A poor person usually obtains 70 to 80 per cent of his or her calories (and most other nutritional requirements) from one or two of the world's seven main food staples. These are by far the cheapest sources of energy, and of most other nutrients. For the poor, access to these staples is the key to achieving IFS.

Household food adequacy/security (HFA/HFS) is necessary for IFA/IFS, but not sufficient, because food may be distributed among household members disproportionately to their individual needs.

National food security (NFS) refers to a nation's capacity to ensure (HFS/IFS without undue departure from other policy goals. NFS in a given year is often measured by dietary energy supplies (DES) per person, allowing for the distribution of food and needs among individuals and times; or the ratio of food imports to total exports, although food aid must be allowed for; or staple stocks (publicly controlled or likely to be marketed if prices rise) as a share of normal consumption.

Source: *The State of Food and Agriculture, 2000: Lessons from the Past 50 Years, FAO, Rome, 2000, Box 18 P.204*

Methodology

The data and information used for this paper are solely from secondary sources – articles, books, reports, conference proceedings, websites, and documents from websites/electronic sources, etc. Simple statistical central tendencies and descriptive statistics have been used for analysing data. Results have been shown in tabular form and graphically for easy understanding. The paper reviews the food security status at the global level, at a country level i.e. India, a South Asian country and at a state level i.e. Odisha, an eastern Indian state.

RESULTS AND DISCUSSION

Food Security and Sustainable Agriculture

Human life has many essential requirements, and perhaps the most fundamental physical needs are air, water, and food. Out of these, food is our concern as we consider it the subject of agriculture. Our food production programmes at present seem to be largely determined by market forces and economic considerations. If we have to solve our food security and

nutrition problems, food production policy must have a sustainable agriculture and nutritional orientation. In order to achieve adequacy of food production, scientific, safe, and ecologically sound agricultural practices are needed. The green revolution has also led to some imbalances because it was solely directed to wheat and rice, to the relative neglect of pulses, oilseeds and millets and vegetables. The per capita availability of pulses, an important source of lysine, riboflavin, and folic acid, has now declined significantly. Millets, which were the main staple of the rural poor, have now been practically displaced by wheat and rice. Pulses and millets are important food items that could have provided much needed micronutrients. Ever rising import of edible oils is again adding increasing burden to the national exchequer. Horticulture is also not receiving adequate attention, resulting in that much gains with regard to production of vegetables. Moreover, nearly a third of vegetables and fruits produced continue to perish. The diets of the poor continue to be imbalanced and deficient in nutrients. Diversification of household diets is necessary, and a national food production policy must be the aim for the achievement of balanced production and availability of a range of basic essential foods. The production of pulses and vegetables and fruits must now be augmented. The challenge before agricultural scientists is to ensure balanced, sustainable, and ecologically sound agricultural development suitable to supply the requirements of micronutrients and macro nutrients (Gopalan, 2001). Further, there is a relation between agriculture and the availability and quality of the other two fundamental elements, air, and water. In a very real sense, none of these issues can be examined in isolation.

The rate of increasing production and growing needs have therefore been in somewhat balance over the past four decades. The gains in food production are a consequence of several factors. For one, some marginal lands, formerly unused or underused for agriculture have been taken up for cultivation. The principal reason for the impressive gains in food production, however, has been the introduction of new varieties of grains and the associated management practices that accompany the new strains.

The economic element of agriculture relates to individuals as well as to the local community and the broader national society. If the system does not make economic sense, if farming is not profitable, and if basic needs are not provided, the food system becomes unsustainable. Society at large also requires that sustainable practices which have a sound economic basis.

Agriculture is a time and labour-intensive occupation. Where the resource base is deficient, the demands for long hours and heavy physical work can be especially severe. It is, therefore, an essential requirement for human well-beings that requirements for being a successful farmer are not as harsh as to preclude opportunities for education, recreation, and relaxation. This applies to all the members of the farm family as well as the rural community as a whole. Government policies across landscapes and scale have so far have encouraged productivity at the expense of other factors, including a need to provide facilities and opportunities for all in the rural community. One consequence is consolidation of land and resources in the hands of a small proportion of the total population, leaving many people with small and marginal holdings (world ~ 90%, India ~ 86% and Odisha ~ 93%) or even no land at all. For sustainability in any setting, sustainable agriculture must consider and bring together sound practices in the environmental, economic, and social arena.

Sustainable agriculture is the activity of growing food and fibre in productive and economically efficient manner, using practices that maintain or enhance the quality of the local and surrounding environment- soil, water, air, and all living things. It is also sustainable in supporting the health and quality of life of individual farmers, their families, and the communities as a whole. Sustainable agriculture encompasses the elements of productivity, profitability, conservation, safety, and the environment. Sustainable agriculture means not only the withdrawal of three things - synthetic chemicals, hybrids/ genetically modified seeds, and heavy agricultural implements but also application of multi culture, intercropping, use of farmyard manure, mulching and integrated pest management. Recognizing that agriculture is a process of food and fibre production

as well as a way of life, the categories are chosen so as to reflect its various dimensions – productivity, stability, efficiency, durability, compatibility, and equity (Talukder *et al.* 2017).

Sustainable agriculture includes economically viable system that reduces use of the off- farm inputs such as chemical fertilizers and pesticides and relies more on on-farm resources (Vanloon, 2005). In order to be sustainable, agriculture needs to be technologically feasible, economically viable, socially acceptable, and environmentally sound. Moreover, sustainability in agriculture can be achieved broadly through efficient management of natural resource base and integrated approaches to crop management. At all levels, we find fallow lands. India accounts for 88.3% (19.7 m ha) of South Asia's total rice- fallows (22.3 m ha). Rice-fallows spread in the states of Chhattisgarh (4.1 m ha) and Odisha (1.6 m ha) covering 51 % and 21 % of rice-fallow areas in eastern India (Gumma *et el.* 2016). This needs to be brought into cropland by appropriate interventions like utilisation of residual soil moisture, development of irrigation infrastructure and their management and maintenance strategy, water management practices, targeting landscape specific suitable crops etc. Mishra (2005) found agricultural production can only be sustained on a long-term basis if the resource base like land, water, and forest on which it is based are not degraded.

The recurring incidence of flood and drought are the major causes of crop failure, income volatility and persistent poverty among small and marginal farmers (Mottaleb *et al.* 2015). Mostly, exposure to these stresses is high due to poor access to irrigation and flood control infrastructure in developing countries (Pingali *et al.* 2019). The impact of flood is more severe than drought. It is not only affecting crop production, but impacting the livelihoods of people, livestock, infrastructure damages household properties etc. (Douglas *et al.* 2008). It is projected that climate extreme events will increase, such as the timing of onset of monsoon, intensity of rainfall, and frequency of flood (Khan *et al.* 2009). This will adversely affect agricultural production and food security in the regions where poverty and food insecurity are already very common (Mackill *et al.* 2012).

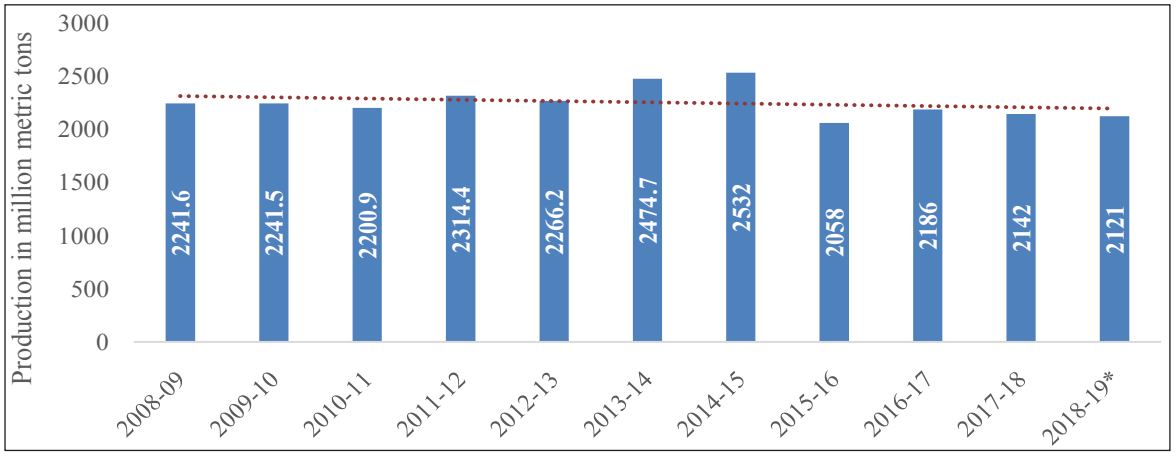
It is observed that a rice production environment in India is very sensitive to climatic fluctuations (Duncan *et al.* 2017). For example, one-third of the cultivable area is flood-prone (Ranuzzi & Srivastava, 2012).

Several improved and sustainable crop and resource management practices have been developed under the framework of sustainable intensification to sustain or improve the productivity and profitability while rationalizing resource use and reducing environmental externalities by drawing on the principles of conservation agriculture (CA) and precision management (Kumar *et al.* 2018; Jat *et al.* 2020; Sidhu *et al.* 2019). Such technologies include dry direct-seeded rice, zero tillage (ZT) wheat, high yielding shorter-duration rice varieties which not only reduce irrigation requirement by reducing field duration but also create longer turn around period between two crops which facilitates in sustainable rice residue management, and deploying water-saving technologies such as laser land levelling, AWD, and micro-irrigation systems like drip and sprinkler systems (Bhullar *et al.* 2018; Kumar *et al.* 2018; Kumar & Ladha, 2011; Jat *et al.* 2020; Sidhu *et al.* 2019). The promotion and adoption of such technologies will ensue higher crop production and bring food security for all.

In the developing world, significant progress has occurred in the availability of food for human consumption during the last three decades. Yet, substantial number of world's population faces food scarcity, hunger, and deprivation. In India, actions taken since mid-sixties have eliminated famine conditions, reduced poverty, and improved both energy and nutrition intake per capita. However, still substantial number of populations who belongs to poor households faces chronic as well as seasonal food insecurity. Legislature, executive as well as judiciary are constantly engaged to see that the food security situation specifically relating to vulnerable groups is improved in a sustainable manner.

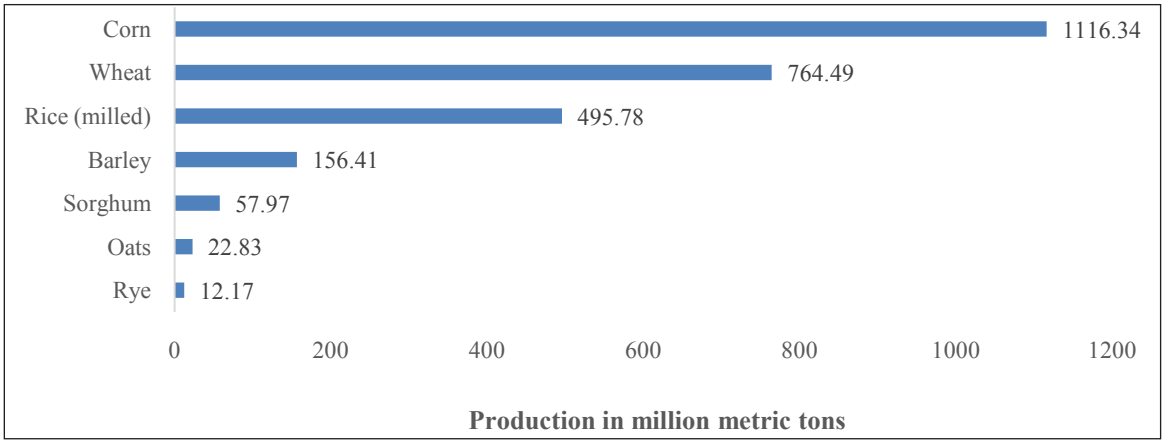
Food Security- World Status

Achieving global food security whilst reconciling demands on the environment is the greatest challenge faced by mankind. By 2050, at least 9 billion people will need food, and increasing incomes and urbanization will inevitably lead to dietary change.



Source: *Authors computation from (Shahbandeh, 2019)*

Fig. 1: Global grain production

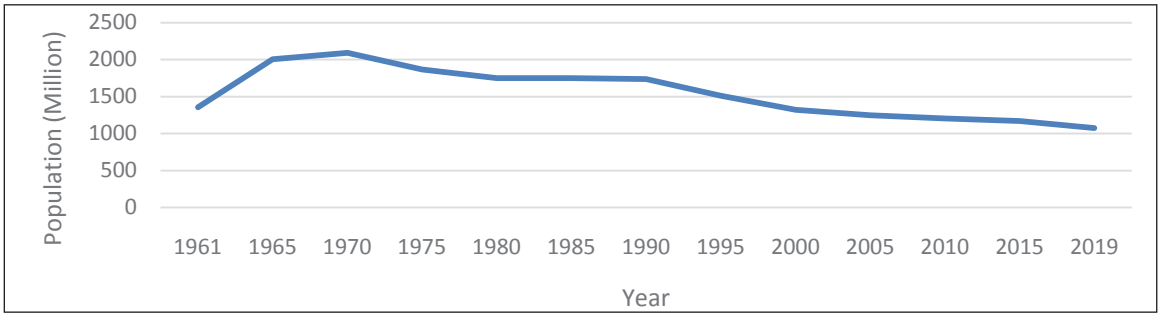


Source: *Authors computation from (Shahbandeh, 2020)*

Fig. 2: Total global grain production in 2018-19 by crop type

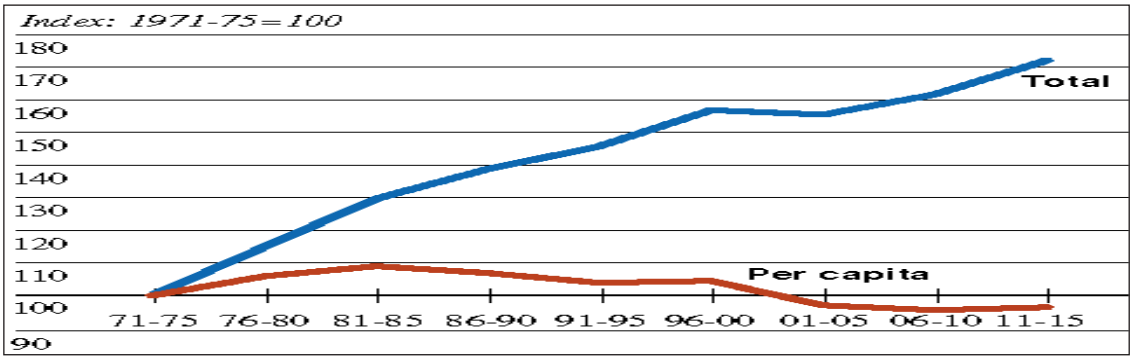
Global crop production has expanded threefold over the past 50 years, largely through higher yields per unit of land and crop intensification. But the global grain production has not achieved an increasing trend in last decade (Fig. 1), the total global grain production in crop years 2008-2009 to 2017-2018 and also a forecast for 2018-2019.

In crop year 2017-2018, a total of approximately 2142 million metric tons of grain were produced worldwide against 10 years back (year 2008-09) production of 2241.6 million metric tons. The most important grain was corn, based on a production amount of about 1050 million metric tons in the year 2016-17 (Shahbandeh, 2019) which increased to 1116.34 million metric tons during 2018-19. Fig. 2 also shows the worldwide production of grain in 2018-19, sorted by type. In that year, Worldwide production came to about 764.5, 495.8, 156.4, 57.9, 22.8 and 12.2 million metric tons of wheat, milled rice, barley, sorghum, oats, and rye, respectively (Shahbandeh, 2020). The three primary factors that affected recent increases in world crop production are (i) increased cropland and rangeland area (15% contribution in 1961–1999); (ii) increased yield per unit area (78% contribution); and (iii) greater cropping intensity (7% percent contribution) (FAO, 2003; FAO 2006).



Source: *Authors computation from (United Nations, 2019)*

Fig. 3: World population since 1961



Sources: *International food policy research institute, Oct. 1999, US Bureau of the census and CIA*

Fig. 4: Global per capita grain production: 1971-2015

Global per capita food supply rose from about 2200 kcal/day in the early 1960s to over 2800 kcal/day by 2009. At 3370 kcal/person/day, Europe currently has the highest average per capita food supply. Cereals occupy more than half of the world's harvested area and are the most important food source for human consumption.

Of the 2.3 billion tonnes of cereals produced each year, 1 billion are destined for human consumption, 750 million tonnes are used as animal feed and 500 million tonnes are either processed by industry, used as seed, or wasted (FAO, 2013).

At global level although grain production is growing at a good race, but so far, no corresponding fall in world population (The World Bank, 2019) (Fig. 3) and even there is rising trend of population in some countries making per capita grain availability lower and lower (Fig. 4). Again, the world's population is projected to grow from 7.7 billion in 2019 to 8.5 billion in 2030 (10% increase), and further to 9.7 billion in 2050 (26%) and to 10.9 billion in 2100 (42%) (United Nations, 2019). This is the major concern of food security for all.

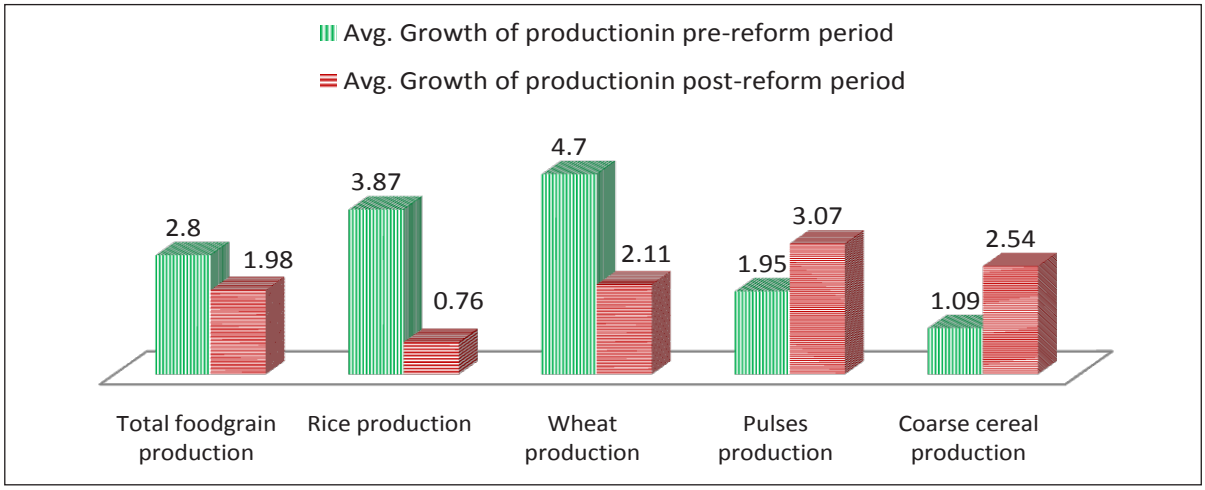
Food Security- India Status

India at present finds itself in the midst of a paradoxical situation: endemic mass-hunger coexisting with the mounting food grain stocks. The food grain stocks available with the Food Corporation of India (FCI) stand at an all-time high of 62 million tonnes against an annual requirement of around 20 million tonnes for ensuring food security. Still, according to FAO estimates in 'The State of Food Security and Nutrition in the World, 2020 report, 189.2 million people are undernourished in India. By this measure, 14% of the population is undernourished in India. The Global Hunger Index 2019 ranks India at 102 out of 117 countries (FAO, IFAD, UNICEF, WFP and WHO, 2020). The estimates

show that while 27.8% of India's population suffered from moderate or severe food insecurity in 2014-16, the proportion rose to 31.6% in 2017-19. The number of food insecure people grew from 42.65 crore in 2014-16 to 48.86 crore in 2017-19. India accounted for 22% of the global burden of food insecurity, the highest for any country, in 2017-19. It is also noteworthy that while the prevalence of moderate to severe food insecurity increased in India by 3.7 percentage points during this period, it fell by 0.5 percentage points in the rest of South Asia (Bansal, 2020). From 330 million in 1947 to 1.32 billion today; India's population has increased by almost 3.8 times. In this period, India's food grain production increased from 50MT (1951) to 257 MT in current year. During this period, production of wheat gone up by 15 times, rice by five times, maize by 14 times, milk by 8 times and so on (GKToday, 2015). The result is in front of all of us. Today, India is not only self-sufficient but also a net exporter of food grains and the largest exporter of rice in the world. The key to such a glaring achievement revolves around scientific endeavour, sound policies, good governance and above all hard work and devotion of farming community at large. Major credit goes to the Indian farmers, who took the risk of adopting new technologies. From 1970-71 to the end of the 1990s, the production of food grains has grown up by 2.80 per cent annually whereas the growth rate of food grains for the period of 1991-92 to 2008-09 was 1.98 per cent comparatively lesser than the previous period (Ahmad & Haseen, 2012). If we analyse, pre-reform and post-reform crop production (Fig. 5), in case of rice and wheat pre-reform was better than post-reform period. Whereas the production of pulses and coarse grain during post-reform is better. This indicates the crop diversification (witching from main cereals to pulses and coarse cereals) has occurred in terms of foodgrain production. This is a positive indication so far as nutritional security is concerned.

From the available statistics, it can be easily observed that there has been always an irregularity (ups and downs) in the performance of food grains production in both the periods, pre-reform as well as post reform. No definite/conclusive prediction is possible in case of the growth rate of food grains production. In financial year 2019, India produced over 285 million metric tons of food grains. The third advance estimate for 2020 indicated a rise in production, with a gradual increase over the decade. Food grains included a variety of cereals and pulses. In that year, the daily per capita availability for food-grain amounted to 491 grams (Statista Research Department, 2020).

The present scenario is that there is more supply of cereals than the actual demand but in case of pulses and



Source: *Authors computation*

Fig. 5: Average growth rate of food grain production in India: Pre vs. Post reform period

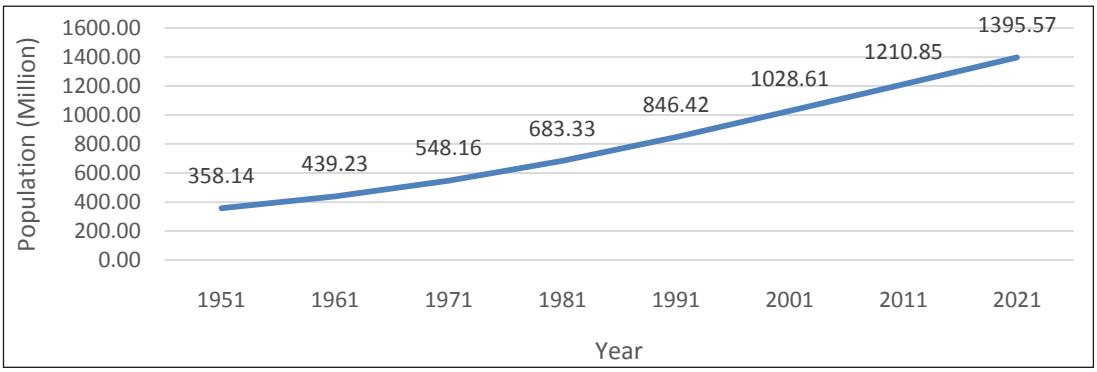
oilseeds, supply is less than the demand. A negative gap indicates that the demand of the commodity is more than its supply, and this implies a deficit of the commodity in future (Table 1).

Table 1: Supply-Demand gap for selected food items

Food Items	Gap (Supply – Demand) in million tons		
	2011	2021	2026
Rice	1.26	8.98	9.13
Wheat	21.21	27.33	32.04
Total cereals	21.19	-2.94	-16.97
Pulses	-8.05	-24.92	-39.41

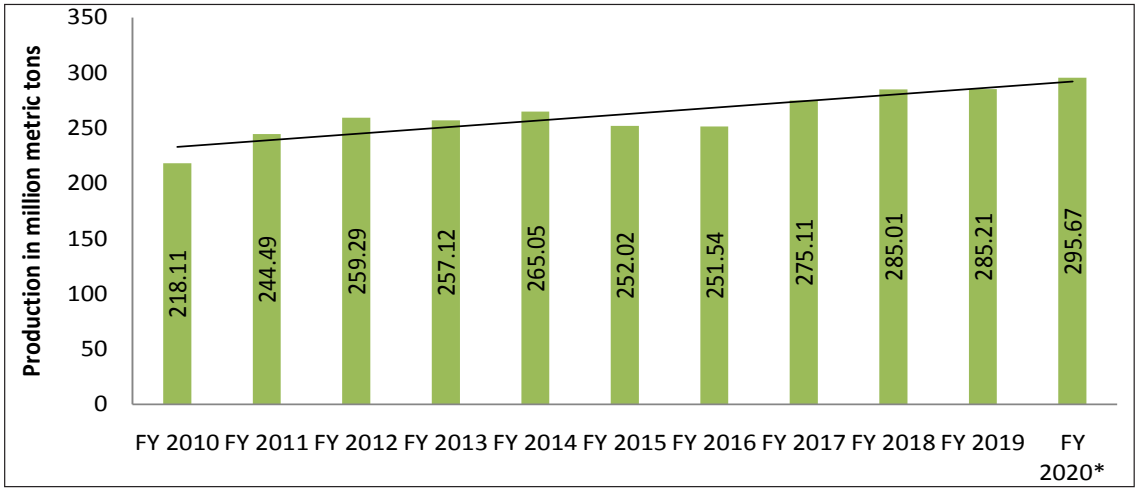
The gap between supply and demand is narrowing down over the years for all the food items. The supply-demand gap for total cereals was 21.19 million tonnes in 2011 is expected to be projected at -16.96 million tonnes in 2026 (Mittal, 2008).

The population in India is continuously increasing at a very high rate (Fig. 6) and at decadal population growth rate of 17.7% (2001-2011 Census). The population of India is expected to exceed that of China around 2027 as per World Population Prospects 2019 Report (United Nations, 2019). Within 40 years, it has more than doubled but increase in food grain production is very slow (Fig. 7) (MOSPI, 2016 & Statista, 2021). This is resulting in per capita food grain availability as very critical.



Source: *Authors computation from census*

Fig. 6: Population growth in India



Source: *Authors computation from (MOSPI, 2016 & Statista, 2021)*

Fig. 7: Average growth rate of food grain production in India during last ten years

Moreover, despite sustained economic growth, poverty reduction and centrally backed targeted policy efforts, India has made less progress in reducing malnutrition over the last decade than have other countries with comparable socio-economic indicators. The paradox lies in the inherent flaws in the existing policies and implementation bottlenecks.

Food Security- Odisha Status

In the context of Odisha, a combination of economic, social, ecological, and institutional factors contributes to food security. A high level of income poverty, a large tribal population living in remote areas with poor connectivity, and periodic recurrence of drought and floods (sometimes simultaneously in different parts of the state) give rise to food insecurity and its negative impacts. Despite a comfortable food availability situation in the state, food insecurity is chronic. The state has been placed in the category of the 'severely food insecure' regions. One-third of the total districts of Odisha are 'extremely food insecure', emphasizing the severity of the situation (CES, 2011; Mohapatra, 2018). A comprehensive measure of food access, considering several direct and indirect indicators, places Odisha in the category of 'very low' food access (WFP & IHD, 2008). This is mainly due to poor entitlement on account of high incidence of poverty, inadequate employment opportunities in lean seasons, and poor economic access to public distribution of subsidised food grains. Taking into account food availability, food access, and food absorption, represented by 19 indicators, Odisha has been put in the category of 'severely food insecure' regions. It has been pointed out that severe food insecurity in Odisha is primarily due to the presence of a vulnerable rural population with poor livelihood access or livelihood susceptible to natural disasters. Lack of safe drinking water, proper health infrastructure, poor rural infrastructure, and low female literacy are also featuring of severely food insecure states like Odisha. Thus, lack of basic amenities due to inadequate governance in the social sectors reinforces the severely food insecure status of the state.

Table 2 shows details of production of rice, other cereals, pulses, and total food-grains from 1970-71to 2019-20 in Odisha. In total food-grain estimation, paddy has been mentioned and not the milled rice; all have increased over the time.

Table 2: Production of rice, total cereals, pulses and food grains (million tonnes) from 1970-71 to 2019-20 in Odisha

Year	Rice	Total cereals	Total pulses	Total food grains
1970-71	4.10	4.40	0.47	4.86
1971-72	3.62	3.96	0.39	4.35
1972-73	3.98	4.37	0.49	4.86
1973-74	4.40	4.80	0.47	5.27
1974-75	3.17	3.54	0.43	3.97
1975-76	4.53	5.04	0.53	5.57
1976-77	3.22	3.67	0.41	4.08
1977-78	4.32	4.88	0.68	5.56
1978-79	4.40	4.97	0.79	5.76
1979-80	2.92	3.31	0.57	3.88
1980-81	4.30	5.09	0.89	5.98
1981-82	3.85	4.49	1.06	5.55
1982-83	2.99	3.75	0.93	4.68
1983-84	5.12	5.94	1.06	7.00
1984-85	4.17	4.76	0.86	5.62
1985-86	5.23	5.87	1.09	6.96
1986-87	4.83	5.33	1.05	6.38
1987-88	3.47	4.04	1.01	5.05
1988-89	5.30	5.89	1.11	7.00
1989-90	6.28	6.86	1.12	7.97
1990-91	5.28	5.86	1.17	7.03
1991-92	6.66	7.14	1.13	8.27
1992-93	5.39	5.84	1.06	6.90
1993-94	6.62	7.10	1.11	8.22
1994-95	6.35	6.83	1.16	7.99
1995-96	6.23	6.73	1.19	7.92
1996-97	4.44	4.78	0.57	5.35
1997-98	6.21	6.60	0.71	7.31
1998-99	5.39	5.77	0.61	6.38
1999-00	5.19	5.61	0.65	6.27
2000-01	4.61	5.03	0.51	5.53
2001-02	7.15	7.54	0.70	8.23
2002-03	3.24	3.59	0.46	4.04

Year	Rice	Total cereals	Total pulses	Total food grains
2003-04	6.73	7.11	0.62	7.74
2004-05	6.54	6.96	0.62	7.59
2005-06	6.96	7.43	0.79	8.22
2006-07	6.93	7.43	0.87	8.30
2007-08	7.66	8.35	0.91	9.25
2008-09	6.92	7.64	0.99	8.63
2009-10	7.02	7.74	0.96	8.71
2010-11	6.93	7.77	1.00	8.77
2011-12	5.90	6.70	0.92	7.62
2012-13	9.50	10.36	1.04	11.40
2013-14	7.61	8.57	1.06	9.63
2014-15	9.85	10.77	1.06	11.82
2015-16	5.88	6.69	0.94	7.63
2016-17	9.79	10.68	1.00	11.68
2017-18	6.55	7.41	1.08	8.48
2018-19	7.73	8.62	1.05	9.67
2019-20	9.64	10.53	1.04	11.57

Source: *Data extracted and analysed from "Five decades of Odisha Agriculture Statistics, 2020" Directorate of Agriculture and Food Production, Government of Odisha.*

The 23-year trend of total food-grain production in Odisha is both increasing and encouraging. It has been doubled in last two decades. In 2017-18, it was 11.86 million metric tons. Mohapatra (2018) has discussed marketable surplus or deficit of 'rice, cereals, pulses and oilseeds' in Odisha over a 20-year period (1994-95 to 2013-14). We have added backward and forward year data and presented the food grain production in Odisha (DAFP, 2020) with its trend line through the Fig. 8 (Yr. 1970-71 to 2019-20) which reflects the same trend.

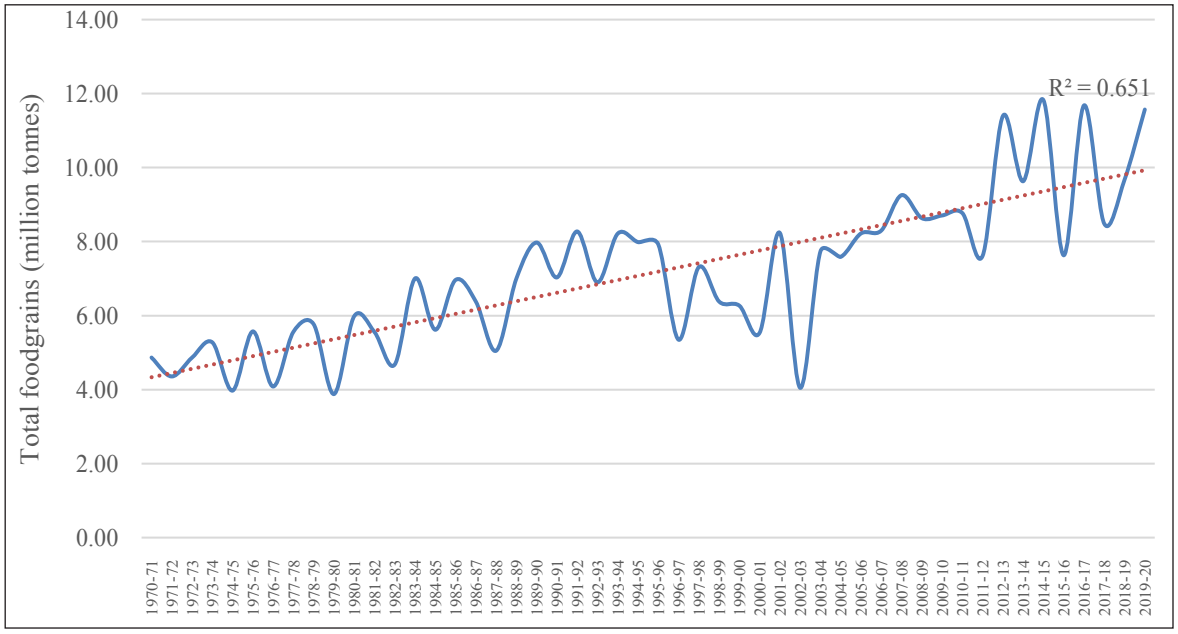
Food-grain availability and requirement (marketable surplus and deficit) as an indicator of food security, reveals that out of 24 years (1994-95 to 2017-18), number of surplus years for rice, cereals, pulses, and oilseeds were 17, 15, 2 and 0 years, respectively. After 1995-96, there is no surplus in pulses. Oilseed is always in marketable deficit status (Fig. 9).

So far as population of Odisha is concerned, it is also increasing at a very high rate of decadal growth rate of 14%. In 1951, the population of Odisha was 14.64 million which reached to 47.65 million in 2020 (Government of Odisha, 2012 & Census Population Data, 2021). This is adversely affecting per capita food grain availability and it is also the main reason behind food insecurity in Odisha.

Measures to bring food security for all

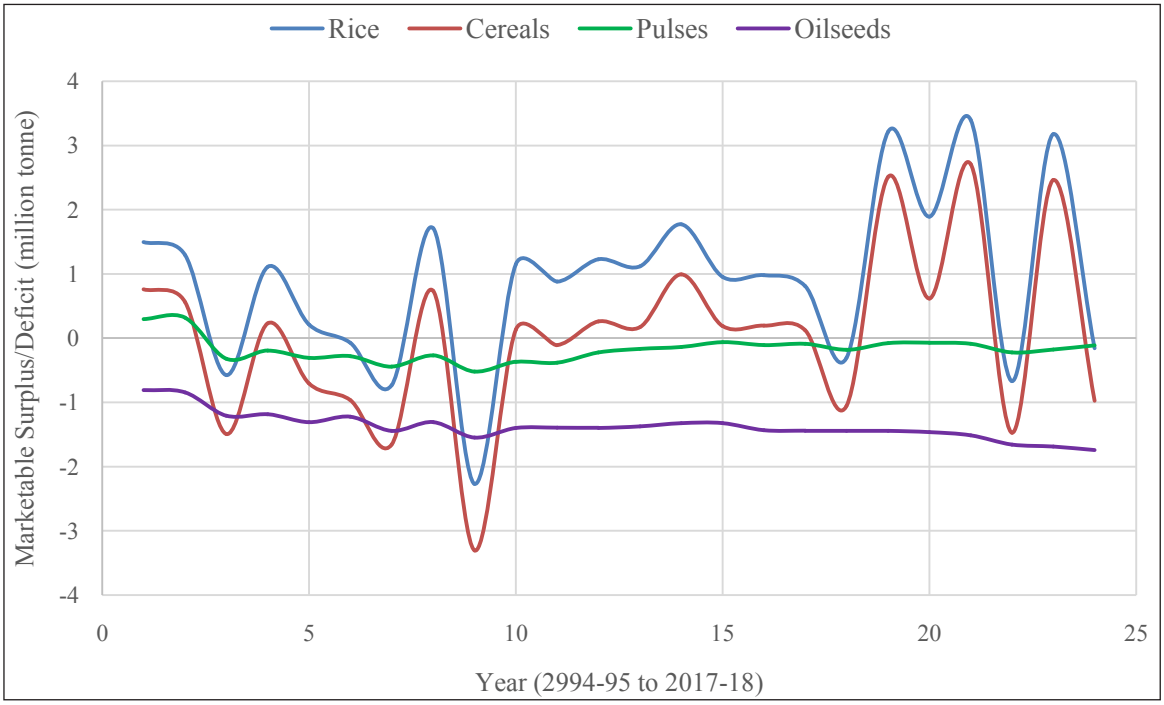
From the above updates and discussions, we reckon that there are opportunities for course correction in food security status. We will be discussing here about various potential indicators of food security at the country (India) and the state (Odisha) level.

We notice promotion and adoption of advanced and sustainable agriculture practices along with population control as the foremost measure to ensure per capita food grain availability as per requirement for food and nutritional security. For the first part i.e., agricultural development sustainable intensification, diversification, and water management technologies (Bhullar *et al.* 2018; Kumar *et al.* 2018; Kumar & Ladha, 2011; Jat *et al.* 2020; Sidhu *et al.* 2019), climate-smart crops and infrastructure development to control natural disasters like flood (Pingali *et al.* 2019) and fallow management (Gumma *et al.* 2016; Mohapatra, 2016), the productivity of agriculture produce has to be further increased consistently. Sustainable agriculture (Sharma, 2009; Kalamkar, 2009), reforms relating to supply side factors in agriculture like public investment, credit, technology, land, and water management etc. (Dev, 2009), and institutional innovation (Das & Mishra, 2010), etc. need to be properly planned and implemented. For all these, both supply and demand side issues need to be addressed in a holistic approach with feasible interventions. This could cover (i) bridging farmers' knowledge gap (strengthening extension system though dissemination of well-designed agro-economic advisories, outreach materials, and demonstrations, hands-on training, exposures, etc.); (ii) geo-spatial targeting of landscapes and suitable crops (including climate smart verities); (iii) promoting associated technologies (preferably farm mechanisation based - seed drill sown direct seeded rice, mechanical transplanting of rice, line sowing of non-rice crops, mechanical weeding, combine



Source: *Data extracted and analysed from "Five decades of Odisha Agriculture Statistics, 2020" Directorate of Agriculture and Food Production, Government of Odisha*

Fig. 8: Production of food grains (million tonnes) from 1970-71 to 2019-20 in Odisha



Source: *Authos computation from various issue of agriculture statistics, Govt. of Odisha*

Fig. 9: Marketable Surplus/Deficit (million tons) of Crops from 1994-95 to 2017-18 in Odisha

harvesting, or mechanised harvesting followed by mechanised threshing, etc.) with tailored agronomy; (iv) mainstreaming innovating models and service economy like custom hiring services (Mohapatra, Baruah, & Yamano, 2014), rice nursery enterprise (Mohapatra, Veettil, Panneerselvam, & Singh, 2019), small farmers large field (SFLF) (Mohanty, Baruah, Mohapatra, & Veettil, 2018), farmer interest group (FIG) (TNAU, 2016), etc. and (v) aligning with existing schemes/programs or framing new ones, including policy reforms, etc. Moreover, emphasis on reducing the cost of production instead of enhancing the price of agriculture commodities (but farmers should be guaranteed remunerative prices) have become necessary and inevitable. This may be achieved by reducing the prices of agricultural inputs (Srivastava, Chand, & Singh, 2017), offering agriculture credits at lower interest rates, building warehouses at village or block level, forming groups, enabling collective bargaining, adopting various resource-conserving and climate-resilient technologies, and improving farmers' access to market information and enterprise development (Mohapatra *et al.* 2020). However, unless the high growth of population is controlled as we know there is limited arable land and with a potential/ saturated crop productivity level; ensuring food security would be very difficult. Increased production of food alone will not solve the world's food security problem (DFID, 2004). Projections from the International Food Policy and Research Institute (IFPRI) suggest that slower population growth could significantly lower malnutrition along with increased agricultural productivity, economic growth and investment in health and education (Rosegrant, Paisner, Meijer, & Witcover, 2001). Many publications also support this. Population growth needs to be restricted (Pawlak & Kołodziejczak, 2020; Askew, 2017; PAI, 2011) to get rid of food crisis. Suitable population control policies, implementation strategies with mass awareness programs, etc. to strategically communicate the benefits of population control in the country like India.

After getting required food grain production, it's highly desirable to make this accessible and affordable by all the needy people. Here, public distribution system (PDS) plays a vital role in making so. However, Kumbhar (2012) has explained that the paradox of food insecurity (FI) with plenty of food has been found in Odisha too. He reported that entitlement failure rather than Food Availability declines the detrimental factor of food deprivation in Odisha. Public support through PDS could have reduced food insecurity but its poor designing, implementation and functioning left the poor in the cold. He found, PDS provides only around 11 percent of the monthly per capita consumption to the surveyed households. Tripathy *et al.* (2004) revealed from primary data that there are many reasons of weak PDS such as money available but food supply not regular, food available but no money with the people to buy, poor quality of food grains, ration shops not opening regularly and ration (BPL) cards being in the possession of dealers or moneylenders as collateral. All these causes contributed substantially to limit access of vulnerable population to food. One of their suggestion was to transfer the PDS responsibilities to Panchayati Raj Institutions (PRIs) with better capacity building at PRI levels is likely to improve effectiveness of the food distribution to poor. There is huge scope for improvisation over current PDS and we see its high time to work on timely procurement, safe storage, quick transport, enhancing purchasing power through employment schemes for poor, etc. and targeting of needy people/area and required rations.

Road infrastructure/transport, information, communication etc. equally plays a vital role in successfully reaching the developmental programs including food security schemes/programs at remote areas as it is not practical for everyone to locate close to the urban centres (Mohapatra, 2020) and Food Security Atlas of Rural Odisha, 2008 also reveals rural connectivity is poor in most food insecure districts of the state (WFP & IHD, 2008). To make this happen, Mehta *et al.* (2003) recommended strategic allocation of resources and development of rural infrastructure that are needed to correct any imbalances. Turley & Uzsoki (2019) rightly observed financing infrastructure, including roads, storage, and localized energy grids, will help provide food security for the millions of people living in hunger worldwide.

Mohapatra (2020) revealed that for sustainable food

security and poverty free society, education plays a vital and crucial role in any type of economy (developed and underdeveloped) along with factors like agriculture, income, assets etc. Tilak (2002) also has suggested that education enables people to earn or increase their earnings so far as to get out of poverty trap. Educational systems, both at the micro and macro-level, have an important role in supporting social upward mobility. Education in all its forms, is one of the most important factors in breaking the vicious circle of intergenerational transmission of poverty and food security (Mihai et al., 2015; Mohapatra, 2020). Moreover, adequate, and easy access to secondary education and vocational education and training, in varying combinations of general and vocational education or in separate programmes of acceptable quality is necessary for the new entrants to the work force for rural transformation, but these are lacking seriously (UNESCO & INRULED, 2012) which need to be focussed through appropriate education policy which would potentially guarantee job and hence income and food.

CONCLUSION

Despite sustained economic development, poverty reduction, and centrally backed targeted policy efforts, there has been less progress in reducing malnutrition and food insecurity over the last decade and at all levels (World, India, and Odisha) based on comparable socio-economic indicators. Although food-grain production has gone up, the rising population has made per capita food-grain availability lower. This induces intervention on sustainable agriculture and most importantly on population control. The paradox of food insecurity could be in the inherent flaws in the existing policies and implementation bottlenecks together with the weak public distribution system (PDS) including lack of required infrastructure to store and distribute food-grain. The other factors responsible for food insecurity are poor education system, rural connectivity, income, assets holding etc. We agree with Mohapatra (2016) that, effective implementation and monitoring of ongoing and upcoming schemes and projects have to be strictly undertaken. We suggest properly designed implementation strategy, strong monitoring of related programs/projects, creation of required rural infrastructure (roads, transport, markets and communication, and cold storage and grain banks), strengthening PDS, controlling rapid population growth, educating everyone to safeguard food security for all in future.

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