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Potato production for nutritional security and doubling farmers' income

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Abstract

India is predominantly an agriculture-based country in which agriculture and allied activities contribute about 17% to the country's GVA and provide employment to about 55% of the population. Unfortunately, majority of the farming communities in the country still living a hard life and get very less remuneration for their hard work. After independence, the policies for agricultural development mainly focussed on increasing agricultural production and ensuring food security. However, the strategies for raising the income of farmers had not been given much emphasis by the policy makers and the government. The Government of India had set a policy target of doubling farmers' income by 2022. Potato is the third most important food crop, after rice and wheat. It provides more food, more calories in a shorter period and lesser land area than many other main crops. It is a highly nutritious crop, containing carbohydrates, minerals, vitamins, proteins and high-quality dietary fibre, thus will play a significant role in food and nutrition security for the ever-increasing Indian population. The demand of potato and its products is rising at a faster rate. It has a very high potential in doubling farmers' income as it could be used for table purpose (as vegetables), seed purpose and processing purpose. The farmers' income could be doubled by increasing the potato productivity, decreasing the cost of cultivation, ensuring remunerative price for the produce and reducing the harvest and post-harvest losses through various strategies and practices.

Keywords: Potato, doubling farmers' income, nutrients, nutritional security

Introduction

Potato (*Solanum tuberosum* L.) is the third most important food crops after rice and wheat in term of human consumption. During 2008, potato was designated as "Food for Future" by FAO, to reflect its importance as a world food crop to address future global food and nutrition security and poverty alleviation (FAO, 2008) [3]. It is a highly nutritious crop, containing carbohydrates, minerals, vitamins, proteins and high-quality dietary fibre. Because of the beneficial role of potato in food and nutrition security, most of the people in several European and Latin American countries consume potato as a staple food. However, its consumption in India is still very low. According to FAOSTAT data, potato consumption per capita in India reached an all-time high of 25.5 kg in 2017 (FAOSTAT 2020) [4], which is very low when compared with other countries. For example, in Belarus, Ukraine and Latvia, the per capita consumption of potato was 178 kg, 131 kg and 124 kg, respectively during the same period. Due to increase in population, changes in lifestyle and economy, it is estimated that by the year 2050, India would require about 125 million t of potato from an area of 3.62 million ha (CPRI, 2015) [7]. Therefore, there is a wide scope to increase potato consumption and production in the country. India ranks second after China with a production and productivity of 51.31 million MT and 24.00 t/ha, respectively, covering an area of 2.14 million ha (DAC&FW, 2019) [9]. Potato plays a very important role in Indian agriculture as it alone contributes about 21% of the total vegetable area and 28% of total vegetable production of India (DAC&FW, 2018) [8].

Nutritional Value and Health Benefits of Potato

Potato is the world's most popular vegetable because most people find its taste appealing, it is a satisfying comfort food, and it is inexpensive and readily available year-round (Jansky *et al.*, 2019) [12]. It has a more favourable overall nutrient-to-price ratio than many other crops (Drewnowski, 2013) [10]. It is becoming recognized as a functional food not only for the general consumer but also for athletes, who demand nutrient-dense, high quality carbohydrates (Kanter and Elkin, 2019) [13]. People in under developed countries, who are unable to afford high-energy diets such as meat and milk products, use potatoes as their prime source of nutrient energy (Zaheer and Akhtar, 2016) [22].

Potato is a highly nutritious, tasty, easily digestible, wholesome food crop and is approximately containing about 79 percent water and 20 percent dry matter content and other health beneficial ingredients such as protein, high-quality dietary fibre, vitamin (ascorbic acid), potassium, magnesium etc (Table 1). 100 g of raw potato provides about 77 kcal of energy. It is an important part in athletes' diet, since the energy produced through potato gets stored as glycogen in muscle and liver and functions as a readily available energy during prolonged, strenuous exercise (Singh *et al.*, 2020) [18]. Carbohydrates in potato is mostly found in the form of starch. On an average, raw potato contains 15 percent of starch on fresh weight basis. It provides most of the energy supplied by the potato. Sucrose, fructose and glucose are the main sugars in potato. Potatoes are gluten free, thus they are key sources of nutrient dense carbohydrates in the diets of those with celiac disease and/or gluten sensitivity (Beals, 2019) [2]. Potato is a very good source of high-quality protein. Average protein content is approximately 2.05 g in a 100 g fresh potato. Potatoes have a relatively high biological value (BV)

of 90 compared with other key plant sources of protein, for examples, soybean with a BV of 84 and beans with a BV of 73 (McGill *et al.*, 2013) [15]. Egg protein has a biological value of 100 and is considered the reference protein. Potatoes contain all nine essential amino acids and, thus, are a "complete" protein (Woolfe, 1987) [21]. Potatoes contain very little quantity of fat. The average fat content of potato is only 0.1% on fresh weight basis which is lower than major cereals like rice, wheat, maize and sorghum. Nearly, 60-80 percent of the fatty acid content in potato is composed of unsaturated fatty acids, and linoleic acid is the predominant among them (Singh *et al.*, 2020) [18]. The high content of unsaturated fatty acids increases the nutritive value of the fat present in potato. When eaten without added fat, potato is good for weight conscious people because of its low energy density. However, when fat is added to the fried or processed potato products, it becomes rich in energy and may cause obesity (Singh *et al.*, 2020) [18]. There is no evidence to suggest that potatoes need to be excluded from a weight management diet (Randolph *et al.*, 2014) [17].

Table 1: Nutritional value of potato (per 100 g, raw potato with flesh and skin)

Sl. No.	Name	Amount
1	Water	79.25 g
2	Energy	77 kcal
3	Carbohydrate	17.49 g
4	Protein	2.05 g
5	Total lipid (fat)	0.09 g
6	Dietary fiber	2.1 g
7	Sugars	0.82 g
8	Starch	15.29 g
9	Calcium	12 mg
10	Iron	0.81 mg
11	Magnesium	23 mg
12	Phosphorus	57 mg
13	Potassium	425 mg
14	Sodium	6 mg
15	Manganese	0.153 mg
16	Vitamin C	19.7 mg

Data source: USDA, 2020

Potatoes contain a variety of essential vitamins and minerals. Potato is the excellent source of vitamin C as it contains about 20 mg per 100 g tuber, which is higher than other vegetables like carrots, onion and pumpkin. When consumed in sufficient quantity potatoes can meet the vitamin C requirements of a person (Singh *et al.*, 2020) [18]. It is an important source of thiamine, niacin and pyridoxine and its derivatives (vitamin B6 group). It also contains pantothenic acid (vitamin B5), riboflavin and folic acid (USDA, 2020) [20]. It is a good source of phosphorous as it contains 57 mg Phosphorus per 100 g fresh potato. It is also a good source of other important minerals like iron, magnesium, copper, manganese, molybdenum and chromium (USDA, 2020) [20], which play important roles in human health.

In addition to vitamins and minerals, tubers also contain dietary fibre and other small molecules, many of which are phytonutrients like polyphenols, flavonols, anthocyanins, phenolic acids, carotenoids, polyamines, glycoalkaloids, tocopherols and sesquiterpenes (USDA, 2020) [20]. Dietary fibre content in potato tuber is about 2 g/100g fresh weight. These dietary fibres help in lowering cholesterol levels. Glycoalkaloids are produced in potatoes during germination and serve to protect the tuber from pathogens, insects, parasites and predators (Friedman, 2006) [11]. It contains nearly 5 mg solanine per 100 g fresh weight which is far

lesser than the safety limit of 20 mg/100 g (Singh *et al.*, 2020) [18]. Thus, glycoalkaloids content of potato is so low that it is not even perceptible by taste. Moreover, most of the glycoalkaloids (80%) are found in outer layers of the potato skins (i.e., the periderm, cortex, and outer phloem) which can be easily removed. Similar to other plant phytonutrients, glycoalkaloids not only have toxic effects but also beneficial effects including cholesterol lowering, anti-inflammatory, antiallergic anti-bacterial, antiproliferative and antipyretic effects (Friedman, 2006) [11].

Potential of Potato for Doubling Farmer's Income

Potato has a very high potential in doubling farmers' income as it can be used for table purpose (as vegetables), seed purpose and processing purpose. Potatoes provide more food, quicker and on lesser land area than any other major crops. In India, potato is mostly grown (about 85%) in Indo-Gangetic plains for short duration (about 90 days). Thus, it could be well adjusted in various cropping systems. With a projected population increase of 19% by 2050 and to be the world most populous country by 2024 (United Nations, 2017) [19], the demand for potato and its products will be rising at a faster rate and by the year 2050, India would require about 125 million t of potato (CPRI, 2015) [7]. Several options may be available for increasing incomes of potato growers. Some of

them are increasing the potato productivity, decreasing cost of potato production, ensuring remunerative price for the

produce and reducing harvest and post-harvest losses (Figure 1).

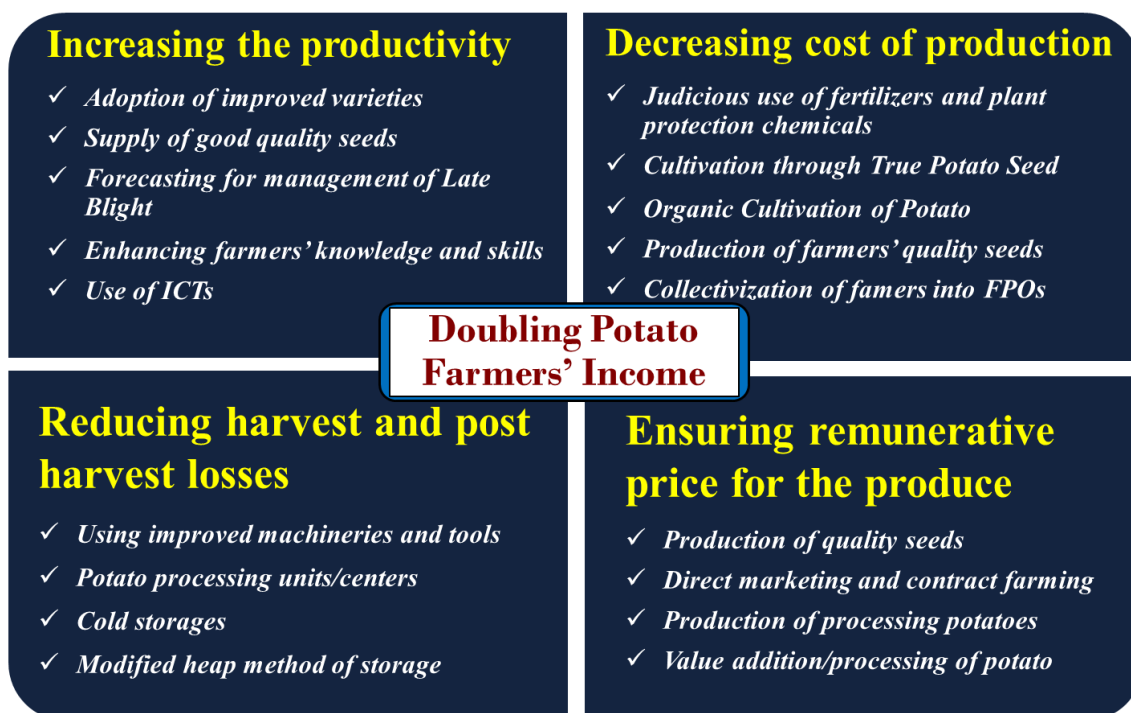


Fig 1: Strategies for doubling potato farmers' income (Source: Authors' compilation)

Increasing the productivity

In potato cultivation, productivity can be increased by adopting various technologies and strategies like adoption of improved varieties, suitable potato-based cropping systems and good quality seeds, forecasting for management of late blight and enhancing farmers' knowledge and skill through use of ICTs and other extension methods. So far, ICAR-Central Potato Research Institute (CPRI) has developed 68 potato varieties for different agro-climatic regions of the country (Luthra *et al.*, 2020) [14]. Farmers should be made aware about the improved varieties and government and research institute should ensure regular supply of good quality seeds to the farmers. The cropping system varies with different agro-ecological zones; best cropping systems for different regions should be selected and popularised among the farmers for achieving higher and sustainable productivity. Farmers should be provided with timely and accurate information (e.g., forecasting using Indo- Blightcast model developed by CPRI) regarding occurrence of late blight in advance to enable them to apply fungicides timely, effectively and efficiently. Other ICT tools like potato growing season descriptor, potato pest manager, nutrient recommendation, potato variety, potato weed manager, etc. developed by CPRI, should be made aware among extension functionaries and farmers for enhancing their knowledge and decision making in agriculture.

Decreasing cost of production

Cost of potato cultivation can be decreased by judicious use of fertilizers and plant protection chemicals, use of True Potato Seed (TPS), organic cultivation, production of farmers' quality seeds and collectivization of famers into FPOs. Fertilizers and plant protection chemicals account for about 20-30% of the total cost of cultivation (CPRI, 2020) [6], therefore, awareness programmes regarding adverse effects and judicious use of inorganic chemicals should be organized

in order to control excess use of fertilizers and pesticides. Seed potato is the most expensive potato input which account about 25-30% of the total cost of cultivation. Potato production through TPS not only reduces the production cost, but also increases the net profit of the farmers. The government should also encourage and train farmers to grow their own good quality seeds. Organic potato cultivation not only fetch premium prices but also reduces the cost of cultivation to a large extent. Collectivization of farmers into producers' organisations help them, especially marginal and small farmers, to sell their produces in bulk at a price higher than when sold individually, and hired machineries/tools and purchased production inputs in bulk at lower prices.

Ensuring remunerative price for the produce

Better income for farmers can be ensured through production of quality seeds, direct marketing and contract farming, production of processing potatoes and value addition of potato. The market rate of potato seeds is very much higher than the table potatoes. Therefore, efforts should be made to train the progressive farmers, NGO members, youths, etc for production of quality seeds. Direct marketing and contract farming enable farmers to sell their produce directly to the consumers/contracting firms without the involvement of the middlemen, thus enable farmers to get remunerative prices. Many processing varieties like *Kufri Chipsona 1*, *Kufri Chipsona 4*, *Kufri Frysona*, *Lady Rosetta*, FC1, etc. have been procured by many MNCs like McCain, PepsiCo, etc for processing of chips, French fry and other processed products, at higher prices. In India, the demand for processing quality potatoes is expected to rise to 25 million t during the year 2050 (CPRI, 2015) [6]. As per CPRI Vision 2050, the pattern of Indian potato industry suggests that the demand for processing potatoes is expected to rise rapidly over next 40 years for French fries (11.6% CAGR) followed by potato flakes/powder (7.6%) and potato chips (4.5%). The export of

fresh potato and processed products from India is also increasing at a significant rate (Table 2). Thus, farmers need to be motivated and trained to cultivate processing potatoes for selling at higher price. Potatoes can be processed into various forms such as chips, French fries, dehydrated products

(dehydrated chips, dice or cubes, papads, flakes, granules and flour) potato starch, cookies, etc. Farmers and organized sectors like SHGs, NGO members, etc may be motivated to take up the processing business for improving their income.

Table 2: Potato export from India during 2003-04 to 2017-18

Year	Fresh potatoes (t)	Potato seeds (t)	Frozen steam potato (t)	Dried potatoes (t)	Flour, meal & powder (t)	Flakes, granules & pellets (t)	Potato starch (t)	Total
2003-04	67740	5201	2849	426	401	17	0	76634
2004-05	65996	6657	3034	227	397	122	0	76433
2005-06	74534	3844	7815	1396	2053	142	0	89784
2006-07	89025	3159	7952	277	2088	610	9	103120
2007-08	78451	3176	7690	101	2486	1600	49	93553
2008-09	184961	11429	15529	6459	1319	292	57	220046
2009-10	94088	2311	7433	851	1910	242	45	106880
2010-11	185953	12109	24995	1700	2321	1004	83	228166
2011-12	193086	5669	36539	999	5344	1963	301	243900
2012-13	163186	1843	14297	5697	5197	898	61	191180
2013-14	220926	1734	33038	3503	7797	2186	1473	270657
2014-15	373932	834	334	97	19013	1034	1086	396330
2015-16	279650	818	3304	231	3101	1770	1738	290612
2016-17	396341	1147	1026	3263	3293	2324	2733	410126
2017-18	395748	4175	1117	368	8914	2802	320	413444
Compound Annual Growth Rate (CAGR) of potato export during 2003-04 to 2017-18								
CAGR (%)	15.0	-10.1	-8.3	4.5	20.6	30.0	53.4	14.1

Source: APEDA Agri Exchange, 2020

Reducing harvest and post-harvest losses

On an average, the harvest and post-harvest losses in potato is about 20 percent of the total production (CPRI, 2018) ^[5]. Harvesting, sorting/grading, transportation, storage at wholesaler and retailer levels are the main operations and channels where losses were found to be high. Many types of machineries like diggers, graders, seed treatment machines and handling machineries/tools have been developed, which significantly reduce harvesting and post-harvest losses of potatoes. Farmers have to be made aware about these machines and their skills have to be improved for operation of these machineries. Potato processing centers need to be established in every major potato producing areas/blocks, so that farmers can sell their produce to the processing centers at higher prices. Similarly, cold storages have to be established in every major potato producing block in the district in order to reduce post-harvest losses as well as transportation cost. CPRI Shimla has modified the traditional heap storage of farmers. The cost of this modified heap method is low and could be easily afford by farmers and work efficiently for 2-3 months (Mehta *et al.*, 2007) ^[16]. Potato farmers need to be made aware about these improved heap storages.

Conclusion

Potato is a very important crop to fight against food and nutritional security and poverty India. It is an excellent source of carbohydrates, dietary fiber, vitamin C, vitamin B, potassium, magnesium, iron and many other important elements. In Europe and other developed countries, potato is consumed as a staple food. Recently, China also made potato as one of the staple food crops in order to fight against food and nutritional security. Potatoes provide more food, more calories in lesser time and lesser area than any other major crops. Keeping in view the burgeoning population, shrinking cultivable land, increasing number of farmers who want to quit farming, poverty, hunger and malnutrition problems, potato is a better alternative to deal with the situations. Due to misconception about potato, the per capita consumption of

potato in India is very less, only about 25 kg per year. People should be made aware of the nutritional value of potatoes through mass media and other awareness programmes. Potato is a potential crop for doubling farmers' income. The government and policy makers should formulate and implement proper production and marketing strategies to ensure sustainable and higher production and remunerative prices for the farmers.

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