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Agricultural system in Uttarakhand hills: With special reference to crop nutrients and irrigation strategies (Western Himalaya)

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Abstract

The present study was conducted in five districts of Garhwal Himalayan region of Uttarakhand state namely Tehri, Uttarkashi, Rudraprayag, Chamoli, Pauri and Dehradun. The study covers crops grown in the hilly areas of Uttarakhand, nutrients found in them and water conservation strategies. The crops studied were divided into three climatic zones. A total of 79 crops have been observed. These include 10 cereals/millets, 27 vegetables, 17 fruits, 11 pulses, 3 oils and 6 spice crops. Various types of nutrients (micro and macro) were observed. A comparative study of the production rate of different crops from the year 2021 to 2023 has also been observed.

Keywords: Millets, consumption, fuel-wood, house hold, nutrients

Introduction

The present research paper highlights the nutritional elements found in crops grown in Garhwal Areas. Actually crops in hilly areas of Uttarakhand are rain-fed and its production rate is determined by the rainfall in the area. Despite this, the farmers of hills focus completely on organic farming to ensure the quality and to keep traditional crops alive. From nutritional point of view, crops grown in hilly areas are highly nutritive and increase the body's immune system. Many places in the world do not have irrigation sources and crops are totally rain-fed but contribution of rain-fed agriculture from 80 percent of agricultural land to the world's food basket is 58 percent (Raju *et al*. 2008) [10].

The rain fed areas are the hot-spots of poverty, malnutrition, food insecurity, prone to severe land degradation, water security and poor social and institutional infrastructure (Rockstorm *et al.* 2007; Wani *et al.* 2007) [12, 15]. Management of natural resources at watershed scale produces multiple benefits in terms of increasing food production, improving livelihoods, protecting environment, addressing gender and equity issues along with biodiversity concerns (Sharma, 2002 and Calder *et al.* 2003) [14, 3]. Actually, the availability of nutrients in plants depends on the fertilizers present in the soil. The plants nutrition depends on the uptake and availability of macro nutrients and micro nutrients that are enclosed in the soil (Acosta-Durán *et al*., 2007) [1]. The aim of the present study is to analyze the production rate and quality of crops grown in the hilly areas of Uttarakhand. How irrigation methods can be developed in the hilly areas to increase the production rate of crops is also included.

Material and Methods

Six hill districts of Uttarakhand state *viz*. Tehri, Uttarkashi, Rudraprayag, Pauri, Chamoli and Dehradun have been selected for present investigation. A main centre was established in New Tehri town of Tehri Garhwal district and a subsidiary centre was also established in each district under the main centre. To get proper information about the agricultural system in the hills of Uttarakhand, four blocks from each district and 10 villages from each block were selected. The selected blocks and villages in different districts of Uttarakhand are as follows-

1. District Tehri Garhwal
- **Chamba:** Chhati, Nakot, Nawagar, Chamani, Phaigul, Manda, Khandkari, Dandeli, Palam and Diwara.
- **Jounpur:** Airi, Bait, Dadak, Jar gaun, Kyari, Lagrasu, Maid, Pali, Pantwari and Rauti Ki beli.
- **Pratapnagar:** Bharpur, Aabaki, Dangi, Deen goun, Banali, Garwan goun, Jewala, Koldhar, Kotga and Kuran.
- **Bhilangana:** Agar, Akhori, Bahera, Asena, Chadoli, Dalla, Gagwari, Dwari, Indrola, and Jakh.

2. District Uttarkashi
- **Bhatwari:** Aleth, Dang, Gorsali, Jokani, Kumalti, Lata, Mastari, Salu, Sukki and Purali.
- **Dunda:** Bagi, Dhareti, Jalang, Khattu khal, Majaf, Matti, Panoth, Ranari, Thati and Udri.
- **Purola:** Dharmara, Binal, Gaind, Hudoli, Math, Netri, Sunali, Thakrari, Rateri and Pora.
- **Mori:** Arakot, Begal, Dagoli, Gurari, Kamra, Monda, Osala, Rala, Sirga and Pasa.

3. Pauri garhwal
- **Pabo:** Ithur, Chimoli, Buransi, Dharkot, Kola, Ladoli, Kui, Odali, Pabo and Ukal.
- **Thalisain:** Mar gaon, Koti, Daula, Sarna, Ghulekh, Jallu, Teela, Pailar, Rouli and Nagdi.
- **Pokhara:** Jajedi, Bansai, Kola, Ubot, Sileth, Pitrora, Markot, Jhalu, Dantha and Gudrinda.
- **Dugada:** Char, Boir goun, Davrana, Charekha, Budkot, Amoli, Raneth, Balli, Chandni and Dabra.

4. District Chamoli garhwal
Ghat: Hina, Gulari, Lwani, Kandai, Dhar goan, Baligwar, Bijar, Bura, Ghuni and Charbang.

Pokhari: Khanni, Dungar, Bina talla, Bhaduda, Chamsil, Girsa, Jaurasi, Kimoda, Ali and Bamoth.
Joshimath: Bampa, Ganai, Kalgoth, Lata, Noligwar, Thing, Tugasi, Sukhi, Paala and Langsi.
Dasoli: Angthala, Hat, Baunla, Irani, Bemru, Lasi, Digoli, Sroli, Ropa and Maithana.

5. District Dehradun (Only two hill blocks)
- **Chakrata:** Jadi, Pati, Salga, Thana, Nada, Lohari, Kolah, Hoda, Birpa and Astad.
- **Kalsi:** Ara, Hjta, Badhu, Kandoi, Lelta, Pata, Saradi, Malhau, Haripur and Dwina.

6. District Rudraprayag (Only three blocks)
- **Augustmuni:** Bareth, Basti, Hat, Himola, Naili, Phali, sangur, tinsoli, Chopra and Amdala.
- **Jakholi:** Basta, Dangwal gaun, Gair sera, Jaili, Kanda, Kot, Liswalta, Mosar, Palot and Srikot.
- **Ukhimath:** Daira, Chunni, Girwari gaon, Kail, Kotma, Raulek, Sari, Tausi, Syansu and Tulanga.

To collect information related to agricultural farming system and to measure the production rate of different types of crops by the year 2021-2024, five families were selected from each village and data was collected from the villagers by preparing a questionnaire. Twenty questions were asked in the questionnaire, one questionnaire was allotted to each family. The subsidiary centers were operated and controlled from the main center.
Two experts were appointed at each main and subsidiary centre. They visited each block from time to time and collected data. Data on crop production rate etc. was also collected from the agriculture and horticulture departments of each district. The information obtained from the horticulture/agriculture departments and the villagers was analyzed.

Results and Discussion
The crops grown in the hilly areas of Uttarakhand state have been divided into various zones on the basis of agro-climatic conditions; the cultivation of crops grown in the agro-climatic zones has been shown in Table 1.

Table 1: Cultivation of crops in agro-climate zone in Uttarakhand.

Agro-climatic zone	Altitude (MSL)	Climatic feature	Crop
Tarai and lower Doon	Up to 600mtr.	Humid sub-tropical climate	Cereals, vegetables, legumes, spices and fruits.
Upper Doon Bhawar and lower Shivalic	600m-1200mtr.	Sub-tropical to temperate climate	Fruits and spices.
Cold zone	1200m-2000mtr.	Temperate climate	Fruits and legumes

(State horticulture mission Govt. of Uttarakhand)

The scientific details of the crops grown in hilly areas and the nutrients found in them are presented in Table 2. The following species of crops have been observed in the present investigation- 10 cereals/millets, 27 vegetables, 17 fruits, 11 legumes, 3 oils and 6 spices.

Table 2: Crops cultivated in Uttarakhand.

S. No.	Botanical name	Family	Local name	Nutrients present
		Cereals/Millets		
1.	*Echinochloa colona* (L.)	Poaceae	Jhangora	Ca, Mg, K, Na, P, Fe, Zn.
2.	*Eleusine coracana* (L.)	Poaceae	Kodu	Ca, Mg, K, P, Fe, Cu, Zn, Mn, Fiber, Phenolic compounds.
3.	*Fagopyrum esculantum* (Syn.)	Polygonaceae	Ogal	Ca, Mg, K, P, Na, Fe, Zn, Fe.
4.	*Hordeum vulgare* (L.)	Poaceae	Jou	Ca, Mg. P, Carbohydrate, Protein, Fat, Fiber and Ash.
5.	*Oryza sativa* (L.)	Poaceae	Chaval	Ca, Mg, K, and Vit. B & E, Carbohydrate.
6.	*Panicum miliaceum* (L.)	Poaceae	China	Ca, Mg, K, P, Na, Zn.
7.	*Pennisetum typhoids* (Burm.) Stapf. & hubbard	Poaceae	Bajru	Ca, Mg, K, Cu, P, Mn, Protein, Fat and Fiber.
8.	*Setaria italica* (L.)	Poaceae	Kouni	Carbohydrate, protein, P, Ca, Zn, Na, Fe and phytochemicals
9.	*Triticum aestivum* (L.)	Poaceae	Gehun	Ca, Mg, K, P, Na, Carbohydrate, Protein, and Fiber.
10.	*Zea mays* (L.)	Poaceae	Makai	Ca, Mg, K, Protein, Fiber, Fat and Vit. A, B & E.

Vegetables				
1.	*Abelmoschus esculentus* (L.)	Malvaceae	Bhindi	Ca, Mg, K, P, Vit. E & K, Fibers, Folate and Niacin.
2.	*Allium cepa* (L.)	Amaryllidaceae	Piyaz	Ca, Mg, P, K, S, Folate and Vit. B.
3.	*Allium sativum* (L.)	Amaryllidaceae	Lahsun	Ca, Mg, K, P, Mn, Zn, and Vit. K.
4.	*Amaranthus caudatus* (L.)	Amaranthaceae	Marshu	Ca, Mg, K, Na, Fe, P, Mn, Zn and Multi Vit.
5.	*Amaranthus viridis* (L.)	Amaranthaceae	Marshu	Ca, Mg, K, Na, Fe, P, Zn and Multi Vit.
6.	*Brassica juncea* (L.)	Brassicaceae	Rai	Ca, Na, Cu, Fe, P, Protein, Vit. A,B_6,C,E,K, Fiber and Fat.
7.	*Brassica oleracea* (L.)	Brassicaceae	Gobhi	Na, K, P, Fe Mg and Vit. B_6, D.
8.	*Brassica oleracea* (L.)	Brassicaceae	Bandgobi	Ca, Mg, Na, K, Fe, Vit. B_6, and Fiber.
9.	*Capsicum annum (L.)*	Solanaceae	Shimla Mirch	Ca, Mg, K, Na, Vit. B_6 and Fiber.
10.	*Colocasia esculanta* (L.)	Araceae	Kuchain	Ca, Mg, K, P, Fe, K and Starch, Protein, Fat, Fiber, Vit. A and Folate.
11.	*Cucumis sativus* (L).	Cucurbitaceae	Kheera	Ca, Mg, Fe, Protein, Energy, Rivoflavin and Thiamin.
12.	*Cucurbita maxima Duch.*	Cucurbitaceae	Kaddu	**Ca,** Mg, K, **P, Zn, Fe and Silicon.**
13.	*Cyclanthera pedata* (L.) Schr.	Cucurbitaceae	Mitha karela	Ca, Mg, K, P, Zn, Vit. B and fibre.
14.	*Daucus carota* (L.)	Apiaceae	Gajar	Ca, Mg, K, P, Cu, Fe, Mn, Zn, Vit. A, B, (Phylloquinone), B6, E K and Biotin.
15.	*Lagenaria siceraria (Mol.) Standl.*	Cucurbitaceae	Lauki	Ca, Mg, K, P, Fe, Mn, Protein, Fiber and selenium.
16.	*Luffa acutangula* (L.)	Cucurbitaceae	Kali tori	Ca, Mg, K, P, Cu, Fe, Vit. A, B, K and fiber.
17.	*Luffa cylindrical* (L.)		Ghia tori	Ca, Mg, K, P, Fe, Vit. A, B and fiber.
18.	*Lycopersicon esculentum* Mill.	Solanaceae	Tamatar	Ca, Mg, K, P, Fe, Mn and Zn and Vit.C.
19.	*Momordica charantia* (L.)	Cucurbitaceae	Karela	Ca, Mg, K, P, Fe, Zn, Calories, Fiber, Vit. A,C and Folate.
20.	*Raphanus sativus* (L.)	Brassicaceae	Muli	Ca, K, Mg, Cu, Fiber and Folate.
21.	*Solanum melongena* (L.)	Solanaceae	Bhatta	Ca, Na, Mg, K, Cu, Mn, Fe, Zn and Vit. B, K.
22.	*Solanum tuberosum* (L.)	Solanaceae	Aalu	Carbohydrate.
23.	*Spinaceae oleraceae* (L.)	Chenopodiaceae	Palak	Ca, Mg, K, P, Cu, Fe, Vit. A, B, K and fiber.
24.	*Trichosanthes anguina* (L.)	Cucurbitaceae	Chichenda	Ca, Mg, K, P and Alkaloids, Tannins, Flavonoids, Carbohydrate and Aminoacids.
25.	*Trichosanthes dioica* (L.)	Cucurbitaceae	Parwal	Ca, Mg, Na, K, Cu, S, Vit., Tannins, Saponins, Alkaloids, Glycosides, Flavonoids, Steroids, Pentacyclic and Triterpenes.
26,	*Trigonella foenum- raecum* (L.)	Leguminaceae	Methi	Ca, Mg, K, P, Cu, Mn, Vit. A, B, K and fiber.
27.	*Zingiber officinale* (L.)	Zingiberaceae	Adrak	Ca, Mg, Na, K and Zn, P.
Fruits				
1.	*Citrus aurantifolia* (Christm.)	Rutaceae	Kaghzi nimbu	Ca, Na, Mg, K, P and Vit. C.
2.	*Citrus lemon* (L.) Burm.f.	Rutaceae	Nimbu	Ca, Na, Mg, K, and Vit. C.
3.	*Citrus reticulata* Blanco	Rutaceae	Narangi	Ca, Na, K, Calories, Carbohydrates, Fiber, Sugars and Vit. B & C.
4.	*Citrus sinensis* (L)	Rutaceae	Malta	Ca, Mg, Na, K, Riboflavin, Thiamin and Vit.C, A.
5.	*Citrus maxima (Burm.)*	Rutaceae	Khatain	Ca, K, Na, Mg, P and Vit.C
6.	*Emblica officinalis* (L.)	Euphorbiaceae	Amla	Ca, Na, Mg, K, P and Vit. C.
7.	*Juglans regia* (L.)	Juglandaceae	Akhrot	Co, P, Mn, folic acid, Vit. B6 & E, Calories, protein, carbohydrate, fiber and fat.
8.	*Mangifera indica*	Anacardiaceae	Aam	Ca, Mg, K, P, Calories, Protein, Carbohydrate, Sugar, fiber, Vit. A & C, Beta carotene, lutein, zeaxanthin and folate.
9.	*Musa paradisiaca* (L.)	Musaceae	Kela	Ca, K, Na, Cu, Zn, Fe, Vit. A, B, E, calories, carbohydrate and sugars.
10.	*Prunus domestica* (L.)	Rosaceae	Plum	Ca, Mg, K, P, Mn, Cu, Zn, Fe, Fiber, carbohydrate, Vit. A,B,C,E,K, Carbohydrates, Sugars and Folate.
11.	*Prunus americaa* (L.)	Rosaceae	Khubani	Ca, Mg, K, P, Mn, Vit. A,C,K, Carbohydrate and Fiber.
12.	*Prunus amygdalus* Bath.	Rosaceae	Badam	Ca, Mg, K, P, Cu, Vit. D and protein.
13.	*Prunus persica* (L.) Batsch	Rosaceae	Aru	Ca, Mg, K, P, Cu, Mn, Zn, Fe, Fiber, carbohydrate, and Vit. A,B,C,E,K.
14.	*Psidium guajawa* (L.)	Myrataceae	Amrood	Ca, Mg, K, P, Mn, Cu, Vit. A, B, K and fiber.
15.	*Pyrus communis* (L.)	Rosaceae	Nashpati	Ca, Mg, K, P, Cu, Calories, Carbohydrates, Fiber and Vitamin B, C, K.
16.	*Pyrus malus* (L.)	Rosaceae	Seb	Ca, Mg, K, P, Mn, Cu, Fe, Calories, Carbohydrates, Fiber and Vitamin C, K.
17.	*Vitis vinifera* (L.)	Vitaceae	Angoor	Ca, Mg, K, P, Cu, Fe, Vit. A, B, C and carbohydrate.
Pulses (Legumes)				
1.	*Cajanus cajan (L.)*	Fabaceae	Tor	Ca, K, Mg, Na, P, proteins, vit.B6 and fiber.
2.	*Cicer arietinum* (L.)	Fabaceae	Channa	Ca, Mg, K, Na, P, proteins.
3.	*Dolichos biflorus* (L.)	Fabaceae	Gahat	Ca, Mg, K, Na, P, proteins.
4.	*Dolichos lablab* (L.)	Fabaceae	Sem	Ca, Mg, Na, Mn, P, proteins and Fiber,
5.	*Glycine max* (L.)	Fabaceae	Bhatt	Ca, Mg, K, P, Na, Fe, proteins.
6.	*Lens culinaris* (L.)	Leguminaceae	Massor	Ca, Mg, K, P, proteins.
7.	*Phaseolus mungo Roxb.*	Fabaceae	Urd	Ca, Na, Mg, K, P, proteins.
8.	*Phaseolus vulgaris* (L.)	Fabaceae	Chemi	Ca, Mg, K, P, Na, proteins.
9.	*Pisum sativum* (L.)	Fabaceae	Matter	Ca, Mg, Na, K, Fe, proteins.
10.	*Vicia faba* (L.)	Fabaceae	Sinchiyuna	Ca, Mg, Na, K, P, proteins.
11.	*Vigna sinensis* (L.)	Fabaceae	Sunta	Ca, Mg, Na, proteins.
Oil				
1.	*Brassica campestris (L.)*	Brassicaceae	Sarson	Ca, Mg, Na, Fe, P, Cu, Vit. A, B_6, C, E, K, Fiber, Protein and Fat.
2.	*Perilla frutescencs* L.	Labiatae	Bhangjira	Ca, Mg, Mn, Fe, P, Cu, Zn, chromium and Protein.

3.	*Sesamum indicum* L.	Pedaliaceae	Til	Ca, Mg, Mn, Zn, protein, vit.E and fiber
		Spices		
1.	*Capsicum frutesence* (L.)	Solanaceae	Lal mirch	Mg, K, Ca, P, Vit. K, folate, choline and fiber.
2.	*Cleome viscose* (L.)	Cleomaceae	Jakhiya	Ca, Mg, K, P.
3.	*Coriandrum sativum* (L.)	Apiaceae	Dhania	Ca, P, K, Mn, Choline, beta carotene, beta crypoxanthin, lutein, Zeaxanthin, Folate, Ash.
4.	*Curcuma domestica Valn., Bull. Jrd.*	Zingiberaceae	Haldi	Mg, K, Mn, Zn, P, Calories, vit. E, Cu and Fiber.
5.	*Eltaria cadamomum* (L.) Maton	Zingiberaceae	Badi Elaychi	Ca, Mg, Zn, Fe, fiber, calories.
6.	*Ginziber officinale*	Zingiberaceae	Aaddu	Na, Ca, K, P and Zn.

Most of the crops grown in hills of Uttarakhand are rain-fed due to lack of irrigation facilities. It is observed that only rice and wheat crops are irrigated in the hills of Uttarakhand, all other crops are rain-fed. Maize has the lowest average rain fed area at 17 hectares, and millets have the highest at 208 hectares. The average land area (hectares) where irrigated and rain fed crops are grown (cereals and millets) is described in Figure 1.

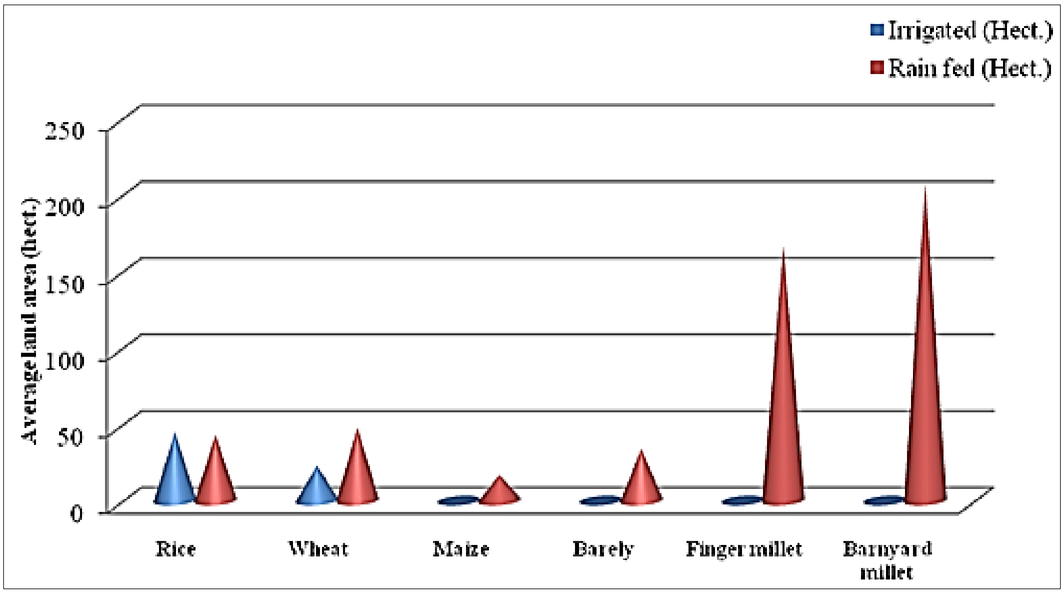

Fig 1: Av. land area (hect.) where irrigated and rain fed crops cultivated (cereals and millets).

The total agricultural land area (hectares) under fruits and vegetables where rain-fed and irrigated crops are grown is shown in Figure 2. Potato, tomato, capsicum and pea crops are irrigated and rain-fed, while other crops are completely dependent on rainwater.

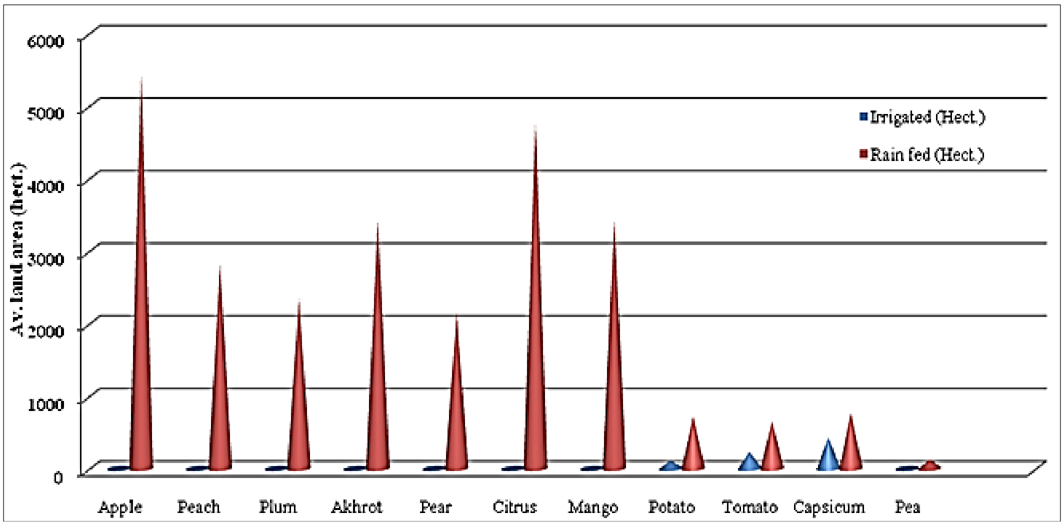

Fig 2: Av. area of farming land (hect.) where rain fed and irrigated crops cultivated (fruits and vegetables).

The average production rate per hectare and the total average production rate of different crops from the year 2021 to 2023 are shown in Figure 3. The highest average production rate of 19864 quintals per hectare was recorded in rice crop. After which an average production rate of 19084 quintals was recorded in legumes crops. The lowest average production of 541 quintals in 3 years was recorded in barley crop. The total average production rate of all crops was also recorded. The highest average production rate of 32345 quintals was recorded in wheat, while the lowest production of 231 quintals was recorded in barley crop and 738 quintals in pear crop.

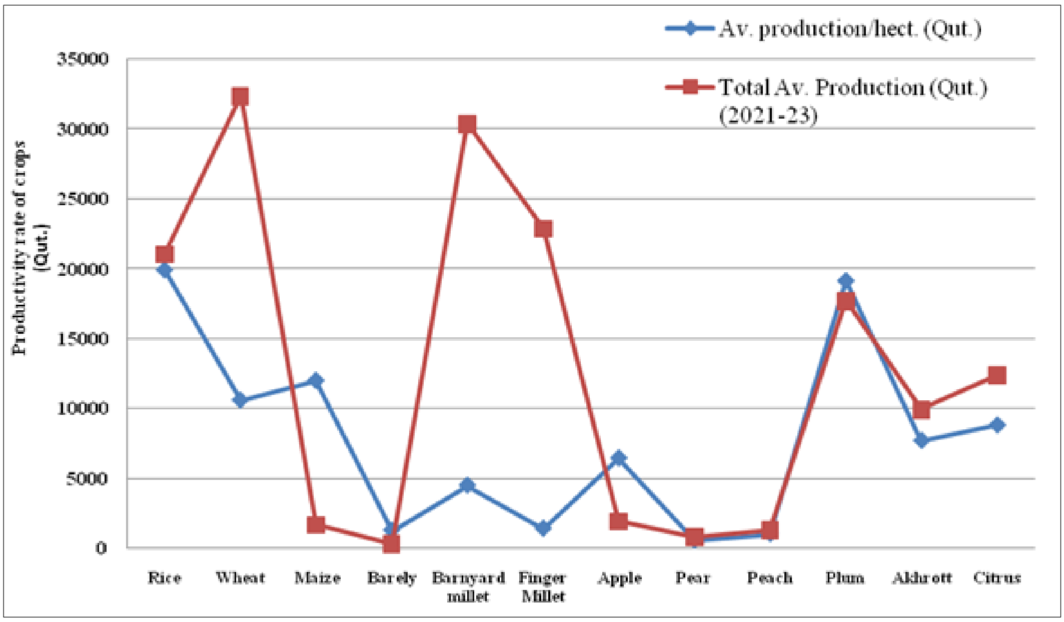

Fig 3: Av. production of various crops (Qut./het.) during 2021-223.

Table 3: Sources of irrigation in the hills of Uttarakhand state.

S. No	Sources	Description
1	Rain Water harvesting	It is underground as well as open. Water used for irrigation and domestic purposes.
2	Canal (Nahar)	It is originate from water sources, found in high mountain areas and carry water from the reservoir to the fields.
3	Dhara	It is called traditional water resources; water is supplied directly from the groundwater source with the help of pipes. Earlier people used to make these pipes from bamboo trees.
4	Nawn	It is a type of water storage structure, which has a huge capacity of water storage. A special channel is separated from the tank for users to wash clothes or take a bath.
5	Percolation Tank	Percolation tank is an artificially created surface water body, submerging in its reservoir a highly permeable land.
6	Check Bunds	Check bunds are constructed in hilly areas to collect rain water. So that the water has more time to seep underground. These are important measures to conserve and protect water quality in the watershed.
7	Polythene Tank	A polythene water tank is a container for storing water. Polythene water tanks are mainly used for drinking water and agricultural irrigation.
8	Spring (Diggi)	Diggi is a deep stoned pit, which is dug where water percolates naturally from the earth surface.
9	Collection pit	A small pit is digging in the ground beneath the tap or any flowing water, so that water gets collected in it without flowing freely and to restrain wastage of water.
10	Pond (Chaals)	These are reservoirs are natural or man-made and water used for irrigation of crops and drinking water.
11	Tank	Cemented tanks are constructed to store water from different sources. This water is used for irrigation and other purposes.
12	Planting pit	Planting pits are a very simple form of free-standing water harvesting structure.

Water is conserved by various methods to overcome water scarcity in hills of Uttarakhand. Diggi, Dhara, Chal and Nahar etc. are the common sources for irrigation. Traditional step-based irrigation systems produce good crops. But climate change is having a bad impact on crop production in the hills of Uttarakhand. It is important to use water and nitrogen fertilizer in a timely and appropriate manner. However, to optimize water use in production and quality, there is a need to detect water stress in crops in real time (Han *et al*. 2018) [5]. Apart from irrigation, compost is also another problem. The presence of good nutrients in any crop depends on the soil conditions and fertilizers. Despite this, timely irrigation and proper fertilizers is also a part of higher yield and improved quality. But due to limited irrigation sources in the hilly areas and crops being rain-based, many times the amount of nutrients becomes unbalanced, and then it directly affects economy of local peoples. On the other hand, surplus use of fertilizers possibly will lead to the accumulation of heavy metal which is also a cause of distraction for crop (Hayyat *et al*., 2020) [6].

The percentage of nutrients such as iron, zinc, calcium, potassium, etc. in wheat, rice and various types of fruits also depends on the good quality of fertilizers. Due to their dietary importance, grain iron and zinc are also components of rice grain quality. Nutrients are essential for growth, which protects us from various types of diseases and due to lack of nutrients in crops people suffer from malnutrition. More than 3 billion people worldwide suffer from Fe and Zn deficiency (Graham *et al*., 2001) [4]. Moreover, their number is expected to increase in future (Byrnes and Bumb, 1998) [2].

In hilly areas, people do not use chemical fertilizers in crops. Application of proper fertilizers at regular intervals in crops also balances the content of various nutrients. Excessive use of chemical fertilizers damages soil structure, mineral cycles, microbial flora, plants and food chains, which may perhaps cause genetic mutations in future generations (Rai *et al*. 2015) [11]. Rice and wheat are a common part of the diet in the hilly areas. Therefore, it is important to have plenty of nutrients in both these crops to avoid malnutrition. Sufficient nitrogen supply can help increase head rice recovery with a significant reduction in grain protein, grain antioxidant capacity grain anthocyanin (Yamuangmorn *et al*., 2018) [17] and kernel chalkiness. However, N improves protein concentration in Maize and cereals (Zhang *et al*., 2020) [18]. With increasing proportion of grain nutrient content allocated to the endosperm, grain iron and zinc in the endosperm increases, however, endospermic iron and zinc may decrease if nutrients are allocated to the alveolar layer (Senchai *et al*., 2016) [13]. People in the hilly areas of Uttarakhand are very poor and depend on cultivated crops due to lack of industrial establishments. Low production and poor quality of crops are the main causes of malnutrition for the people living here. Much of the land in hilly areas has become barren due to the lack of water resources. Water is becoming a scarce resource for food production as a result of global population growth, and this situation is worsened by climate change (Molden 2007) [9]. Water is conserved and used on a small scale for domestic and irrigation purposes. Nutrition deficiency also reduces the production rate of fruiting crops in hills. The most disappointing thing is that there is no proper supply of water along with fertilizers. The overall result of the deficiency of nutrients during fruit development is due to the low concentration of nutrients during fruit development (Kaur *et al*. 2020) [7]. The production of traditional crops in the hilly areas is also negligible, whereas traditional crops have the highest amount of nutrients. Its effect is also being seen on other crops across the country. Maize production in India is lower than the global average, which is affected by various biotic and abiotic stresses (Yadav *et al*. 2016) [16]. Overall, this shows that timely care of crops and proper fertilization are important for best quality and higher yields. Crop residues, which contain abundant organic carbon and mineral nutrients, are important sources of organic matter that can be returned to soil for nutrient recycling and for improving soil physical, chemical, and biological properties (Kumar and Goh, 2000) [8].

Conclusion

There is a trend of growing traditional crops in hilly areas since civilization, but the problem is water, due to which the production is negligible. Therefore, people are regularly migrating from hilly areas. Water has become a problem that is hampering the development of hills. A study was done on the nutrients found in the crops grown in hilly areas and their irrigation methods. The study showed that the crops that are sown have the highest amount of nutrients, but due to lack of proper management of rainwater, it affects crop production. Keeping in mind the production rate of crops, the government should provide an improved variety of seeds to the farmers; along with this, a concrete policy should be made for water conservation. So that crops can grow easily even in places with less water and give more production and people of that area can become economically strong and all the hilly areas can develop.

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