CROP CULTIVATION STRATEGIES IN PUNJAB: A FOCUS ON FATEHGARH SAHIB RUPNAGAR DISTRICT, INDIA.

ABSTRACT

To study about a comparative analysis of agronomic practices by farmer at a grass root level. The study aims to understand and improve agricultural sustainability and productivity by examining the crop cultivation, soil management method of water uses, challenges and opportunities in local farming. This research has contributed to the development of more efficient and environmentally friendly farming techniques t to enhance the livelihood of farmers and promote sustainable agriculture in the districts. The study was carried 0ut under RAWE programme and as conducted by Department of University Institute of Agriculture Science (UIAS) Chandigharh University Mohali Punjab between August 2023 and September 2023. The research focused more into the practices followed by the respondent of Fatehgarh Sahib and Rupnagar in the Punjab district. The survey data is collected from the six villages like hhoti Mandauli, Rattangarh, Ramgarh Manda, Bhadwali, Bhateri and Bari Mandauli. The main crops cultivated in those areas were Paddy (100%), Wheat (98.46%), Maize (29.23%) and Sugarcane (30%). The source of irrigation is tube well and source of seed is mainly from input dealers. Almost farmers are not using recommended dose of fertilizer and Urea (100%) is excessively applied in the field. *Echinochloacrusgalli* is the major concern of the farmers almost 100%during the kharif Season in Paddy. *Phalaris minor* is the major problem of all the respondents at 100 %in rabi season. Chemical method is used by the farmers to control weeds. Average approximate yield for paddy, wheat and sugarcane were is 74.92, 53.66 and 296.6 quintals per hectare respectively. In post-harvest management, majority of the farmers sell their produce and keep few quintals for self consumption. After having interaction with farmers their agronomic practices management was sustainable and productive.

Keywords- *Agriculture; agronomic practices; cultivation; crops; yield.*

1. INTRODUCTION

Agriculture is often deemed a “national security” priority by Countries[1]. India is one of the major players in the agriculture sector worldwide and it is the primary source of livelihood for ~55% of India’s population. India has the world's largest cattle herd (buffaloes), the largest area planted for wheat, rice, and cotton, and is the largest producer of milk, pulses, and spices in the world. It is the second-largest producer of fruit, vegetables, tea, farmed fish, cotton, sugarcane, wheat, rice, cotton, and sugar. The agriculture sector in India holds the record for second-largest agricultural land in the world generating employment for about half of the country’s population. Thus, farmers become an integral part of the sector to provide us with a means of sustenance[2]. Agriculture holds a significant place in the Indian economy, with over 70% of rural households relying on it for their livelihoods. As a critical sector of the Indian economy, agriculture contributes around 17% to the total GDP and provides employment for approximately 58% of the population[3] and Agriculture is a primary source of livelihood for at least two-thirds of the working population in India. Other sectors have not been able to provide enough employment opportunities for the growing workforce(3).

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According to some scientists, agriculture was widespread in the Indian peninsula, 10000–3000 years ago, well beyond the fertile plains of the north. For example, one study reports 12 sites in the southern Indian states of Tamil Nadu, Andhra Pradesh and Karnataka providing clear evidence of agriculture of pulses *Vignaradiata* and *Macrotylomauniflorum*, millet-grasses (*Brachiariaramosa* and *Setariaverticillata*), wheats (*Triticumdicoccum*, *Triticum durum/aestivum*), barley (*Hordeumvulgare*), hyacinth bean (*Lablab purpureus*), sorghum (*Sorghum bicolor*), pearl millet (*Pennisetumglaucum*), finger millet (*Eleusinecoracana*), cotton (*Gossypium sp*.), linseed (*Linum sp*.), as well as gathered fruits of ziziphus and two cucurbitaceae[4][5].

India adopted significant policy reforms focused on the goal of food grain self-sufficiency. This ushered in India's Green Revolution. It began with the decision to adopt superior yielding, disease resistant wheat varieties in combination with better farming knowledge to improve productivity. The state of Punjab led India's green revolution and earned the distinction of being the country's breadbasket[6]. The Green Revolution yielded great economic prosperity during its early years. In Punjab, where it was first introduced, the Green Revolution led to significant increases in the state's agricultural output, supporting India's overall economy. By 1970, Punjab was producing 70% of the country's total food grains,(7)and farmers' incomes were increasing by over[7]. Punjab's prosperity following the Green Revolution became a model to which other states aspired to reach(8). Agronomical practices are directly proportional to the yield of the crop. In order to obtain good yield farmers must follow best agronomical practices according to the season and agro-climatic

zone. These practices vary from region to region. There are 6 agroclimatic zones in Punjab. Fatehgarh Sahib and Rupnagar district comes nder the Undulating plain zone, where temperatures are cold, humid to sub-humid, and semi-arid to humid. Rainfall varies between 165mm to 1000 mm. The soil of this area is suitable to grow vegetables, wheat, maize, paddy, sugarcane, and sorghum among other crops. [9].

Farmers were interviewed according to the RAWE programme about the basic agronomic practices which they followed from sowing to harvesting in this region. We also observed the changes in agronomic practices, the respondent adopted the combined methods for the better yields, they try to follow both the traditional as well as the modern methods. By this they put a step towards enhancing agricultural sustainability and productivity. The main objectives of the research are to examine the current agronomic practices at a grass root level followed in the region, to facilitate the sharing of knowledge and best practice among local farmers, exploring opportunities and challenges for improvement in the agronomic practices and enhancing agricultural sustainability and productivity.

2. MATERIALS AND METHOD

Fig.1. The location of the region where the survey was conducted

Fig. 2. Shows the satellite map view of the six mentioned villages

The research was conducted in the Chamkaur Sahib tehsil of Rupnagar district and Bassi Pathana tehsil of Fatehgarh Sahib district in Punjab, India. A total of 130 farmers were interviewed randomly from six selected villages: Chhoti Mandauli, Rattangarh, Ramgarh Manda, Bhadwali, Bhateri, and Bari Mandauli. Figure (1) depicts the survey region's location, while Figure (2) provides a satellite map view of the mentioned villages[12][13]. Individual data collection from respondents was carried out using a meticulously designed questionnaire covering socio profiles, agronomic practices, and year-round plant protection.The data collection occurred through personal interviews, maintaining an appropriate sequence. The aim of the survey was the gather basic information about agricultural production. Upon collecting the data, every piece of information underwent assessment, analysis, and presentation through appropriate analytical methods such as figures, tables, percentages, ratios, averages, and graphical representations like column charts and doughnut charts.

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2.1 Farmers per village:

A sum of 130 participants were surveyed, with 15 respondents from Chhoti Mandauli, 25 from Rattangarh, and 20 each from Ramgarh Manda and Bhadwali. Additionally, 25 participants were interviewed from both Bhateri and Bari Mandauli.

Table 1. Illustrating the overall count of farmers in each village.

Sr.no	Village	Overall farmer	Ratio
1	ChhotiMandauli	15	12
2	Rattangarh	25	19
3	Ramgarh Manda	20	16
4	Bhadwali	20	15
5	Bhateri	25	19
6	Bari Mandauli	25	19

3. RESULTS AND DISCUSSION

Agronomic practices represent crucial techniques and methods employed in agriculture to enhance crop production and efficiently manage farming systems. These practices encompass a broad spectrum of activities, including soil management, crop selection, planting, cultivation, irrigation, pest and disease control, and harvesting. The implementation of agronomic practices varies across different villages, influenced by the types of crops grown and local conditions. Based on interviews with respondents, various agronomic practices were observed during the kharif season, involving crops such as paddy, maize, cauliflower, fodder crop chari, and oilseed soybean. In the rabi season, wheat, mustard, and fodder crop berseem were cultivated. Paddy and wheat were the predominant crops, while fodder crops were grown by those engaged in livestock practices. Maize was cultivated on a small scale for personal and cattle consumption, whereas sugarcane cultivation occurred at a commercial level. Soybean crops were specifically cultivated in the village of Bari Mandauli.

3.1 Crops grown by the farmers

Table 2. Representing crops grown by the farmers

Sr.no	Crops	Chhoti Mandauli (n=15)	Rattangarh (n=25	Ramgarh Manda (n=20)	Bhadwali (n=20)	Bhateri (n=25)	Bari Mandauli (n=25)	Overall percantage (N=130)
1	Paddy	15	25	20	20	25	25	130(100)
2	Wheat	15	25	20	19	25	24	128(98.46)
3	Maize	2	7	6	5	10	8	38(29.23)
4	Sugarcane	5	8	8	5	6	7	39(30)
5	Berseem	6	5	9	8	4	9	41(31.53)
6	Chari	2	3	5	6	3	5	24(18.46)
7	Vegetables	1	6	1	3	4	7	22(16.92)

As evident from the provided Table 2, farmers adopt various crop cultivation practices in each season. Paddy is cultivated by almost all farmers (100%), and wheat is grown in fields across nearly all villages (98%). Maize and sugarcane are grown by 29.23% and 30% of farmers, respectively. Additionally, fodder crops, specifically berseem (31%) and chari (19%), are cultivated for livestock. Finally, a portion of farmers (17%) engages in vegetable cultivation, predominantly growing potatoes and cauliflower.

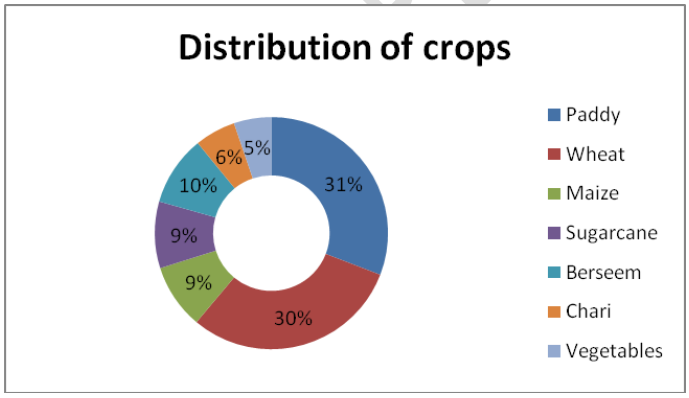

Fig.3. Depicts distribution of crops grown by villagers.

3.2 Crop varieties

3.2.1 Paddy

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As the respondents, Paddy stands as the major crop cultivated in the fertile fields of Punjab. This staple plays a vital. Farmers typically engage in two main varieties of rice i.e Basmati and non-basmati. The variety mostly grown in the selected villages are PR121, PR126, PR110 and Basmati 1121. Among these varieties PR126 is almost grown approx 96 percentage of the farmer while other varieties approximately PR121(21%), PR110(14%) and few of them cultivate Basmati 1121 (12.30%) among villages.

Seed rate: 20-25 kg seed per hectare

Sr.no	Paddy Variety	Chhoti Mandauli (n=15)	Rattangarh (n=25	Ramgarh Manda (n=20)	Bhadwali (n=20)	Bhateri (n=25)	Bari Mandauli (n=25)	Overall percentage (N=130)
1	PR126	15	24	20	19	22	23	125(96.15)
2	PR121	5	6	4	2	3	7	27(20.76)
3	PR110	3	-	5	3	3	4	18(13.84)
4	Basmati 1121	1	4	2	-	6	3	16(12.30)

Table 3. Representing paddy varieties grown by the respondents

3.2.2 Wheat

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Following the interviews, it was discovered that the predominant wheat varieties cultivated in the chosen villages are PBW550 (Badwal), PBW677, DWS777, and DWS222. PBW550 is the most extensively grown, accounting for around 71% of farmers, while the distribution of other varieties is approximately PBW677 (20%), DWS777 (14.61%), DWS222 (10.76%). Additionally, farmers across villages sow other varieties (7.6%) apart from the mentioned ones.

Seed rate: 100 kg/ha

Table 4. Representing Wheat varieties grown by the respondents

Sr.no	Wheat Variety	Chhoti Mandauli (n=15)	Rattangarh (n=25	Ramgarh Manda (n=20)	Bhadwali (n=20)	Bhateri (n=25)	Bari Mandauli (n=25)	Overall percentage (N=130)
1	PBW550	10	18	16	11	20	17	92(70.76)
2	PBW677	6	5	4	2	3	6	26(20)
3	DWS777	3	2	4	2	3	5	19(14.61)
4	DWS222	1	3	2	-	5	3	14(10.76)
5	Other Varieties	2	1	-	-	4	2	10(7.6)

3.3 Source of seed

The majority of participating farmers purchased cultivation seeds from input dealers in Morinda, the nearest town market, while a few opted to utilize their own seeds.

3.4 Time of Sowing

Mostly Crops that are sown paddy in the month of June-July and wheat in the month of that November-December.

Table 5. Representing time of sowing of crops by the farmers

Sr.no	crops	Time of sowing
1	Paddy	June- July
2	Maize	June to July till August
3	wheat	November-December
4	Sugarcane	October- November

3.5 Method of Sowing

Farmers of villages are using different method of sowing for different crops like, broadcasting, transplanting, drilling and furrow method. As per the survey, 80 percentage farmers are broadcasting method (for wheat, barseem etc) 68 percentage farmers are using transplanting method (for rice), 48 percentage farmers are using ridge & furrow method (sugarcane and vegetables like potato, cauliflower) and only 36 percentage farmers are using other method like dibbling, drilling etc.

Table 6. Illustrating the technique employed by the respondents for crop sowing.

Sr.no	crops	Sowing methods
1	Paddy	Broadcasting or transplanting
2	Wheat	Broadcasting or drilling like by seed drill or super seeder
3	Maize	Dibbling or drilling
4	Sugarcane	Ridge and furrow

3.6 Land preparation

a) Ninety percentage of the respondent farmer used tractors to plough the land and the rest 10% used bullocks.

b) For crops ploughing of land is done 3-4 times.

Table 7. Method of ploughing

Sr.no	Method of ploughing	Percentage
1	Animal Drawn plough	10
2	Machine drawn plough	90

Small-scale farmers with land holdings up to 2 hectares employ animal-drawn ploughs, while marginal and large-scale farmers, possessing land holdings exceeding 4 hectares, opt for machine-drawn ploughs.

3.7 Seed Treatment

Most of the farmers were not treat their seeds. Small farmers, which have less land holdings and less knowledge treat the seeds by dipping it in normal water for a day. Marginal and big farmer treat seeds with chemical or used Hybrid seed. Seed treatment diminishes the risk of soil-borne diseases and pests, consequently promoting early germination.

.3.8 Irrigation

Table 8. Irrigation method and schedule of irrigation

Crops	Method of irrigation	No. of irrigation	Stage / DAS
Paddy	Tubewell	6 to 25 times(regular)	At the interval of 20 DAS

Wheat	Tubewell	4-6 times	20-21DAS
Miaze	Tubewell	4-5 times	10-15 DAS
Sugarcane	Tubewell	8 -10times	45-55DAS

3.9 Fertilizer

In the case of organic manure, most of the farmers used cow dung (gobar) and one or two of use green leaf manure. It is environment friendly, gives higher yield and contains high nutrient valve. In case of inorganic fertilizer, all respondents used Urea, Diammonium phosphate (DAP) and Murate of potash (MOP).

3.10 Fertilizer Dose of N:P:K

From the insights gained through interviews with respondents, it was observed that the majority of farmers utilize inorganic fertilizers such as Urea, DOP, and MOP (refer to Table 9). Organic farming, on the other hand, leans towards the preference of cow dung. Employing a combination of inorganic and organic fertilizers proves beneficial in sustaining soil health and fertility. However, it was noted that farmers lacked awareness of the recommended fertilizer application doses, resulting in environmental imbalances. There was limited usage of MOP by farmers in their fields. For instance, the recommended dose for paddy crops is 125N: 30P: 30K[10], and for wheat, it is 120N: 60P: 40K[11]. Urea emerged as the most relied-upon fertilizer, potentially posing a risk of increasing soil pH. Although this may yield high outputs, it also has the potential to harm the soil, leading to soil degradation.

3.11 Weed Observed

Table 9: Weed found in major crops

Sr,no	crops	Major weeds	Ratio
1	Paddy	*Echinochloacrusgalli*	100
		Cyperusrotundus	80
2	Wheat	*Phalaris minor*	100
		Avenaludoviciana	80
3	Cauliflower	*Amaranthusviridis*	30
		Hook. F.	
		Chenopodium album L	40
4	Sugarcane	Cyperusrotundus	60
		Amaranthusviridis	45

5	Maize	*Eleusineindica*	34

As all the farmers face major problem in weeds in their fields through out the season, we can clearly see (table 9). *Phalaris minor* is the major problem of all the respondents (100%). According to them this weed shows resistance towards most of the chemicals used to eradicate or eliminate this weed. It reduces the yield upto a significant level. The primary worry for farmers arises during the Rabi season, particularly concerning wheat crops, akin to how Echinochloa crusgalli poses a significant concern for almost all farmers (100%) during the Kharif season in paddy fields. In sugarcane cultivation, approximately 60% of the fields exhibit the presence of Cyperus rotundus weed. Additionally, Eleusine indica weed is observed in maize crops, accounting for around 34%. To manage these weeds, farmers resort to chemical methods, employing pre-emergence herbicides like pendimethalin and post-emergence herbicide such as butachlor.

3.12 Harvesting Method

Based on the gathered data, a majority of farmers opt for combine harvesters when harvesting cereal crops such as wheat and paddy (refer to Table 11). This mechanical approach proves efficient as it saves time and eliminates the need for manual labor. Approximately 90% of respondents utilize combine harvesters for wheat and paddy crops, while only 10% opt for manual harvesting. For paddy crops, farmers often choose manual harvesting, especially for varieties like Basmati, 1121 (PB 1121), Pusa basmati, etc., where the grains are long and thin, aiming to prevent any damage to the grains. Manual harvesting is also preferred for maize crops. In the case of sugarcane, the majority of farmers favor manual harvesting.

Table 10. Represting the methods of harvesrting adoped by farmers

Crop	Harvesting technique
Paddy	Combine and harvester/ manually
Wheat	combiner and harvester
Maize	manually
Sugarcane	manually

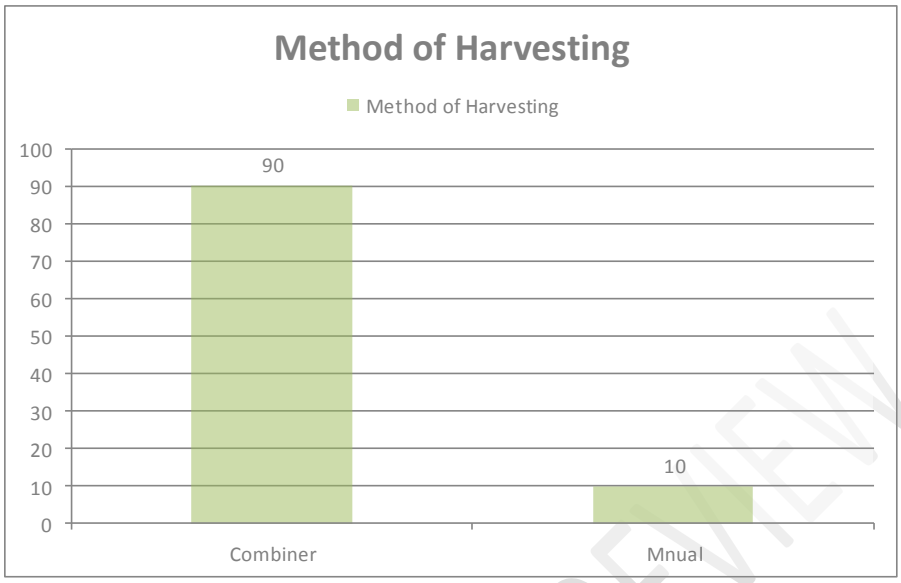

Fig.4. Harvesting technique utilized by farmers

3. 13 Yield Record

The yield is a crucial economic aspect of any crop, evident in the average yield of paddy at 74.92 quintals per hectare and wheat at 53.66 quintals per hectare (see Table 11). For sugarcane, the average yield stands at 296.6 quintals per hectare. Badhwali achieved the highest paddy production among the six villages with 77.5 quintals per hectare, while Rattangarh recorded the lowest at 72.5 quintals per hectare. In wheat production, Bhateri had the highest yield at 56 quintals per hectare, and Rattangarh had the lowest at 50 quintals per hectare. For sugarcane, Rattangarh exhibited the highest productivity at 310 quintals per hectare, while Chhoti Mandauli had the lowest production yield at 280 quintals per hectare.

Table 11. Yields (qtl/ha) of cereals crops per villages

Sr.no	Village	Paddy	Wheat	Sugarcane
1	Chhoti Mandauli	74.5	55	280
2	Rattangarh	72.5	50	310
3	Ramgarh Manda	74	52	290
4	Badhwali	77.5	49	-
5	Bhateri	76	56	300
6	Bari Mandauli	75	54	303
Overall (average/ha)		74.92	53.66	296.6

Table 12. Fertilizer dose of N:P:K applied by farmers in Kg/hectares

Sr.no	Fertilizers	Chhoti Mandauli (n=15)	Rattangarh (n=25)	Ramgarh Manda (n=20)	Bhadwali (n=20)	Bhateri (n=25)	Bari Mandauli (n=25)	Overall Kg/ha	Recommnded dose
Paddy									
1	Urea	330	305	300	320	312	300	311.16	125
2	DAP	175	190	180	200	157	165	177.83	30
3	MOP	-	-	-	-	-	-	-	30
Wheat									
1	Urea	300	285	310	315	275	300	297.5	120
2	DAP	215	190	180	200	187	225	199.5	60
3	MOP	-	-	-	-	-	-		40

*Overall kilogram per hectare data represents the mean value of fertilizers applied

4.CONCLUSION

Based on the survey data, Paddy and wheat are the predominant and stable crops in the surveyed regions, with maize, sugarcane, cauliflower, potato, and fodder crops like chari and berseem also popular among farmers for livestock. PR-126 and PBW550 varieties are preferred by over 90% of farmers. Land preparation involves mechanical methods such as tractors, disc harrows, and levelers to control weed germination. Flood irrigation from tube wells is the primary method for Paddy and wheat. Farmers often use inorganic fertilizers, mainly Urea and DAP, at non-recommended doses, leading to soil imbalance. Cow dung is the sole source of organic fertilizer. The major weeds, Echinochloa crusgalli in Paddy and Phalaris minor in wheat, are controlled using chemical methods. Harvesting is mostly done by combine harvesters (90%). The average yields are 74.92 quintals per hectare for paddy, 53.66 quintals per hectare for wheat, and 296.6 quintals per hectare for sugarcane. Challenges include farmers' lack of awareness of tools like the leaf color chart for Paddy crops and the need for proper cropping rotation to manage pest and disease issues. Soil testing, weather forecasting, and informed crop choices are crucial for preventing economic losses and ensuring high production.

REFERENCES

1. Beckman, J., & Countryman, M. A. (2021). The Importance of Agriculture in the Economy: Impacts from COVID-19. American Journal of Agricultural Economics, 103(5), 1595-1611.

2. India Brand Equity Foundation (IBEF). (2021). Indian Agriculture and Allied Industries Industry Report. Retrieved from https://www.ibef.org/industry/agriculture-india.aspx

3. "Contribution of Agriculture in GDP Report" (2023). Retrieved from https://testbook.com/articles/contribution-of-agriculture-in-gdp

4. Fuller, Korisettar, Ravi; Venkatasubbaiah, P.C.; Jones, Martink.; et al. (2004). "Early Plant Domestications in Southern India: Some Preliminary Archaeobotanical Results." Vegetation History and Archaeobotany, 13(2), 115–129. doi:10.1007/s00334-004-0036-9. S2CID 8108444. Archived PDF. Retrieved 22 December 2011.

5. Tamboli, A., & Nene, Y. (Year). "Science in India with Special Reference to Agriculture." Agri History. Archived PDF. Retrieved Day Month Year.

6. The Government of Punjab. (2004). Human Development Report 2004, Punjab. Archived PDF. Retrieved 9 August 2011. Section: "The Green Revolution," pp. 17–20.

7. Sandhu, Jashandeep Singh. "Green Revolution: A Case Study of Punjab." Proceedings of the Indian History Congress; 2014, 75, 1192–1199. Accessed via JSTOR.

8. Shiva, Vandana. (1991). The Violence of the Green Revolution: Third World Agriculture, Ecology, and Politics. Zed. ISBN 0-86232-964-7. OCLC 24740968.

9. Agnihotri Chaba, Anuj. (2021). "Punjab's Six Agroclimatic Zones Might Hold Key to Diversification ConundrumC Indian Express.

10. PAU (Punjab Agricultural University). (2022). "Package of Practices for Kharif Season." Available at: PAU Website. https://www.pau.edu/content/ccil/ pf/pp_kharif.pdf

11. PAU (Punjab Agricultural University). (2022). "Package of Practices for Rabi Season." Available at: PAU Website. https://www.pau.edu/content/ccil/ pf/pp_rabi.pdf

12. Mukherjee, J. (2010). "Location of the Study Area: Rupnagar, Punjab, India." Available at https://www.researchgate.net/figure/Location-of-the-Study-area-Rupnagar-Punjab-India_fig1_258885321

13. Anonymous. (Year). "Chamkaur Sahib, Rupnagar, Punjab, India." Available at VillageInfo. https://villageinfo.in/punjab/rupnagar/chamkaursahib.html