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Annual Report
2075/76 (2018/19)

Government of Nepal
Nepal Agricultural Research Council
Agricultural Environment Research Division
Khumaltar, Lalitpur, Nepal
2019

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कृषि-मौसम सल्लाह सेवा बुलेटिन

साप्ताहिक बुलेटिनका संग्रह पुस्तिका (२०७६ वैशाख–असोज)

नेपाल सरकार
नेपाल कृषि अनुसन्धान परिषद्
कृषि वातावरण अनुसन्धान महाशाखा
जलवायु प्रकोप समुत्थान निर्माण आयोजना
(कृषि व्यवस्थापन सूचना प्रणाली)
खुमलटार, ललितपुर, नेपाल

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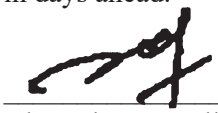
FOREWORD

Agricultural environment in Nepal is in alarming stage due to indiscriminate use of natural resources. Runoff, siltation on agricultural lands, landslide, soil erosion, haphazard use of chemicals and fertilizers, inappropriate farming practice and changes in farmer's priorities are factors for threats of agricultural environment. The country being agro-based; climate change and its impacts, vulnerabilities, consequences and adaptation has always been a topic of great concern. Mitigation of climate change, adaptation and climate friendly agricultural technology should always be the priority of the country.

The agriculture system of Nepal is highly dependent upon monsoon and weather changes. Uncertainty of weather systems is an important issue in the country. Agricultural Environment Research Division (AERD) has been working on such issues in collaboration with different organizations and stakeholders to find the solution on such issues. Efforts are being made to develop a hub for the climatic database at AERD to support Nepal Agricultural Research Council (NARC) research stations. It has been studying the various adaptive capacity of different variety of crops (rice, wheat) under elevated temperature conditions to find out adaptive variety against an exponential rise in temperature. Similarly, collection, analysis and distribution of agro-meteorological data, screening of farmer's perception on climate change, agro-met advisory bulletin (AAB) preparation and dissemination are major works. Moreover, estimation of Greenhouse Gas (GHGs) and carbon sequestration are some of the important works that are being done by AERD. Finally, the identification of new agricultural environment-related problems (pesticide residues, soil pollution, environmental pollution, etc.) is aimed in the coming year and would be the main strategy of the division in the future.

This annual report presents the detail activities and glimpse of the research activities conducted in the FY 2075/76 by the division. It is expected that the annual report will serve as a useful resource to agricultural environment related researchers, extension personnel, students and policy makers.

I am very much thankful to Mr. BP Paudel, Dr. AP Timilsina, Mr. A Sharma, Mr. R Rimal, Mr. A Gaire. Mr. HL Bhandari and Mrs. R Maharjan for their precious contribution to carry out all the activities of the Division. Also, I would like to appreciate the work of Mr. P Sah, Mrs. M Chitrakar and Mr. RK Chalise for their account, administrative and other supports. Nepal Agricultural Research Council (NARC) holds recognition for its technical and financial support. I would appreciate the constructive comments for the improvement of the report in days ahead.



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LIST OF ABBREVIATIONS

°C	Degree Centigrade
AAB	Agro-met Advisory Bulletin
AGB	Above Ground Biomass
AGTB	Above Ground Tree Biomass
AERD	Agricultural Environment Research Division
AMIS	Agriculture Management Information System
AWS	Automatic Weather Station
BGB	Below Ground Biomass
BGTB	Below Ground Tree Biomass
BRCH	Building Resilience to Climate Related Hazards
BY	Bio-mass yield
CC	Climate change
CO_2	Carbon dioxide
CO_2- C	Carbon in CO_2 form
cm	Centimetre
DAS	Days After Sowing
DBH	Diameter at Breast Height
DM	Days to maturity
EL	Ear Length
F.Y.	Fiscal Year
FS	Filled spike per spike
GHGs	Greenhouse Gases
GY	Grain yield
ha	Hectare
Hr	Hour
Kg	Kilogram
kg/ha/yr	kilogram per hectare per year
m^2	Square meter
N:P_2O_5:K_2O	Nitrogen, Phosphorous, Potash
NARC	Nepal Agricultural Research Council
OTC	Open top chamber
PH	Plant height
PPCR	Pilot Program on Climate Resilience
t/ha	ton per hectare
t/ha/yr	Ton per hectare per year
Temp.	Temperature
TGW	Thousand Grain weight
Tmax	Maximum temperature
Tmin	Minimum temperature
US	Unfilled spike per ear

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सारांश

कृषि वातावरण अनुसन्धान महाशाखाबाट वातावरण मैत्री विभिन्न अनुसन्धान र मौसम परिवर्तनका कारण बालीमा पर्न सक्ने जोखिम सम्बन्धी अध्ययन हुदै आइरहेको छ । साथै अन्य सीपमूलक कार्यक्रम, कार्वन स्थिरिकरण र कार्वन उत्सर्जन सम्बन्धी अध्ययन तथा अनुसन्धानात्मक कार्यक्रम संचालन भइरहेको छ । जलवायु परिवर्तन र यसले कृषि प्रणालीमा पार्ने असर सम्बन्धी जानकारीलाई उच्चतम प्राथमिकतामा राखि अनुसन्धान केन्द्रहरुमा स्वचालित मौसम मापन प्रणाली स्थापना गर्दै आएको छ ।

आ.व. २०७१/२०७२ देखि जलवायु समुत्थान निर्माण आयोजना (PPCR) अन्तर्गतका जिल्लाहरुमा कृषि मौसम सल्लाह सेवा बुलेटिन मार्फत कृषकहरुलाई सेवा पुर्याई रहेको छ । यस बाहेक यस महाशाखाले विभिन्न राष्ट्रिय अन्तराष्ट्रिय संघ संस्था, अनुसन्धान केन्द्र र कृषि अनुसन्धानमा संलग्न विद्यार्थीहरुलाई कृषि तथा मौसम सम्बन्धी संकलित तथ्याङ्कहरु उपलब्ध गराउदै आएको छ । यस महाशाखाबाट संचालन गरिएका अनुसन्धानात्मक अध्ययनहरुबाट आ.व. २०७५/७६ मा निम्न अनुसारका अनुसन्धान परिणामहरु प्राप्त भएका छन् :

- बढ्दो तापक्रमको अवस्थामा ओपन टप चेम्बर (OTC) मा डाँफे, डब्लु. के. १२०४, स्वर्गद्वारी र धौलागिरी गहुँका जातहरु लगाउँदा चेम्बरमा तापक्रम धेरै हुनाले खुल्ला फिल्डमा भन्दा गहुँ तीन दिन पहिले पाक्यो भने दाना र परालमा ०.४ र ४.१ टनले उत्पादनमा कमी आयो । गहुँको जात WK 1204 को दानाको उत्पादन सबै भन्दा बढी पाईयो ।
- चेम्बर र खुल्ला फिल्डमा लगाईएको गहुँबालीमा बिहानको ८:४५ र दिउँसोको २:४५ बजे उत्सर्जन मापन गर्दा खुल्ला फिल्डमा उत्सर्जनको मात्रा गहुँको बृद्धिको सुरुवाती समयमा बढी पाइयो जुन चेम्बर भन्दा ठीक विपरित थियो। खुल्ला फिल्डमा गहुँ लगाईएको ४५ दिनमा बिहानको समयमा (८:४५ बजे) उत्सर्जन मापन गर्दा सबै भन्दा बढी उत्सर्जन (१५७.७ मिग्रा/वर्ग मी./घण्टा) भएको पाईयो भने चेम्बरमा गहुँ लगाईएको १०८ दिनमा बिहानको समयमा (२:४५ बजे) उत्सर्जन मापन गर्दा सबै भन्दा बढी उत्सर्जन (१५७.७ मिग्रा/वर्ग मी./घण्टा) भएको पाईयो ।
- फलफूलका रुखमा कार्बन स्थिरिकरणको अध्ययनमा पन्ध्र वर्षको सत्ताईस मेकाडेमिया नटका रुखले ४४.९ टन प्रति हेक्टरका दरले कार्बन स्थिरीकरण गरेको पाईयो।
- लमजुङ्ग र नुवाकोट जिल्लाहरुमा गरिएको जलवायु परिवर्तन र त्यसको कृषिमा परेको असर सम्बन्धी सर्वेक्षणमा उक्त परिवर्तनका कारण पहिले भन्दा गर्मीयाममा अधिकतम तापक्रम बढेको पाईयो भने थोरै मात्र किसानहरु जलवायु परिवर्तन र यसले कृषिमा पारेको असरको बारेमा पूर्णरुपमा जानकार रहेको पाईयो । असिना र सुख्खालाई सबैभन्दा असर पार्ने जलवायुका घटनाहरुको रुपमा क्रमश: लमजुङ्ग र नुवाकोटका किसानले लिएको पाईयो। रासयनिक मल र नयाँ जात लगाउँदा जलवायु परिवर्तनको असरलाई कम गरि उत्पादनलाई स्थिर राख्न सकिने धारणा किसानको रहेको पाईयो । किसानलाई कृषि तथा पशु बीमा सम्बन्धि जानकारी भएपनि खाद्यान्न बालीमा भने कुनै पनि किसानले बीमा गरेको पाईएन ।

EXECUTIVE SUMMARY

Agricultural Environment Research Division (AERD) is contributing and sharing the environment friendly agricultural technologies and knowledge developed through the crop vulnerability studies and other researches. For this purpose, the division is conducting various activities like crop modelling, carbon sequestration and GHGs emission estimation studies. Realizing the importance of climate information to agricultural researcher, the division has continuously emphasized on the establishment of automatic weather stations in different research stations in collaboration with Department of Hydrology and Meteorology. The division has been providing advisory services on changing climate scenario and its effect on agricultural crops to many of its clients including researchers and organizations. The weather forecasting based weekly advisory services is one of the major notable work started under PPCR:BRCH/AIMS project to minimize the weather induced crop vulnerabilities. Apart from above mentioned services, the division is also making weather and agricultural data available for various organizations, research stations and to the students involved in agricultural researches. Following are some of the findings of researches conducted by the division last year:

* The four wheat varieties (WK1204, Swargadwari, Danphe and Dhaulagiri) grown under elevated temperature mature three days earlier with reduced average grain yield and fresh biomass yield by 0.4 t/ha and 4.1 t/ha, respectively as compared to open field conditions. Among wheat varieties, WK 1204 had highest grain yield of 4.7 t/ha followed by Dhanphe (4.5 t/ha) whereas Danphe variety produced highest fresh biomass of 16.8 t/ha followed by WK1204 (15.3 t/ha).
* The carbon emission was found higher in open field condition in early wheat growth stage than later stages as contrast under open top chamber condition. The maximum emission (157.7 mg C m^{-2} hr^{-1}) was found at measurement taken at 45 DAS (8:45 AM) in field condition. Similarly, the maximum emission (104.7 mg C m^{-2} hr^{-1}) was found at measurement taken at 108 DAS (2:45 PM) under open top chamber condition.
* Based on measurement of twenty seven Macadamia nut trees of fifteen year aged, the average above ground, below ground and total biomass per tree were found 71.3, 18.5 and 89.9 t/ha. Similarly, the total carbon stock per hectare was 44.9 t/ha in Malepatan, Kaski district condition.
* Only few farmers from Lamjung and Nuwakot districts were well known about climate change and its consequences in agriculture sectors. Majority of respondents felt increased temperature during summer season. Hailstorm and drought were ranked first climate related hazard in Lamjung and Nuwakot districts, respectively. Though farmers have expressed mix response on impact of climate change in sowing and harvesting time, they are confident that infestation of pests have increased in recent days. The use of fertilizers and new improved varieties have caused increase on major crop yield and helped to minimize negative impact of climate change. Though farmers were aware about the agriculture insurance policy, none of them have insured for food crops.

1. WORKING CONTEXT

Nepal is an agriculture based country with two third of population involved in this sector. In addition, the increasing population and food demand makes the sector of prime importance in order to become a food secured country. Global warming, spatial, temporal and weather change are becoming alarming in whole agricultural system. The database on agro-meteorological record from various stations is helpful for cause and effect studies and for explanation and prediction of production performance in a given set of environment. The agro-meteorological databases can also be helpful in crop modelling. Study on crop performance under elevated temperature conducted in open top chamber will be helpful for agricultural scientists for planning breeding programs and crop management practices.

Agricultural Greenhouse Gases (GHGs) emission is of great concern and is significantly contributing in the climate change. Agriculture has also an important role in emission of CO_2 by agricultural practices. Similarly, horticultural fruit crops help sequestrating the CO_2 in the form of trees and organic matters in soil. In this context, the division is currently monitoring CO_2 emission from crops and pasture land under different management practices in different parts of the country. The division is also trying to make inventory of carbon sequestration by different types of fruit trees. With the strategy of working in collaboration, the division is currently working together with national and international organizations in different aspects of researchable issues and weather based agro-advisory services related to climate change.

2. INTRODUCTION

The Agricultural Environment Unit was established in the F.Y. 2000 AD in Khumaltar, Lalitpur under the Directorate of Planning and Coordination, Nepal Agricultural Research Council (NARC). It was upgraded to Agricultural Environment Research Division (AERD) in the F.Y. 2013 AD. It aims to contribute in protection of the environment with secured and increased agricultural productivity for livelihood enhancement. It also aims to strengthen update and upgrade the agro-meteorological stations in NARC research stations.

2.1 Goal

- To sustain the production and productivity of agricultural system without deteriorating production factors in context of climate change.

2.2 Objectives

- Raise awareness and seek solutions for agriculture related environmental issues ensuring a sustainable agricultural development.
- Assess impact of climate change on agriculture and develop adaptation options for reducing vulnerabilities.
- Study agricultural researches and development on system perspective using modern tools like GIS, remote sensing, crop models etc.
- Support commodity programs, divisions and research stations to

develop climate resilient technologies.

- Assist NARC in preparing policy guidelines on environment friendly agriculture and climate change issues.

2.3 Strategies

- Identification and prioritization of environment related problems in agriculture.
- Develop system perspective agricultural technologies through decision support tools.
- Support NARC research stations to generate climate resilient agricultural technologies.
- Strengthen the agro-meteorological stations in NARC research stations.
- Strengthen collaboration with national and international institutions.
- Enhance capacity of different stakeholders in understanding climate change and its impact on agriculture.
- Develop farmers friendly agro-met advisory bulletin and disseminate the AAB effective manner

2.4 Current thrust areas for research

- Understand farmer's perception on climate change.
- Climatic variability of various locations and response of crop.
- Crop performance under simulated environment (e.g. elevated temperature).
- GHGs emission under different agricultural land and system.
- Carbon sequestration in agricultural, plantation and horticultural crops.
- Mineralization rate of soil organic matter under elevated temperature.
- AAB performance and efficacy under local level / farmer level.

2.5 Infrastructure and facilities

- **Automatic weather station (11):** Daily agro-meteorological data recording (Temperature, rainfall, solar radiation, relative humidity, soil temperature etc.)
- **Multi-Gas Analyzer:** Measures various GHGs
- **Open Top Chamber:** Experimentation on crops under elevated temperature
- **CO_2 Monitor:** Measures CO_2 emission from field
- **GPS meter:** Finds coordinates of different locations
- **Soil pH and moisture meter:** Measures soil pH and seed grains moisture
- **Leaf Area Index Meter**

2.6 Organization structure and human resources

The structure of this division is given in Fig 1 and detail of human resources in 2075/76 has been presented in Annex 1.

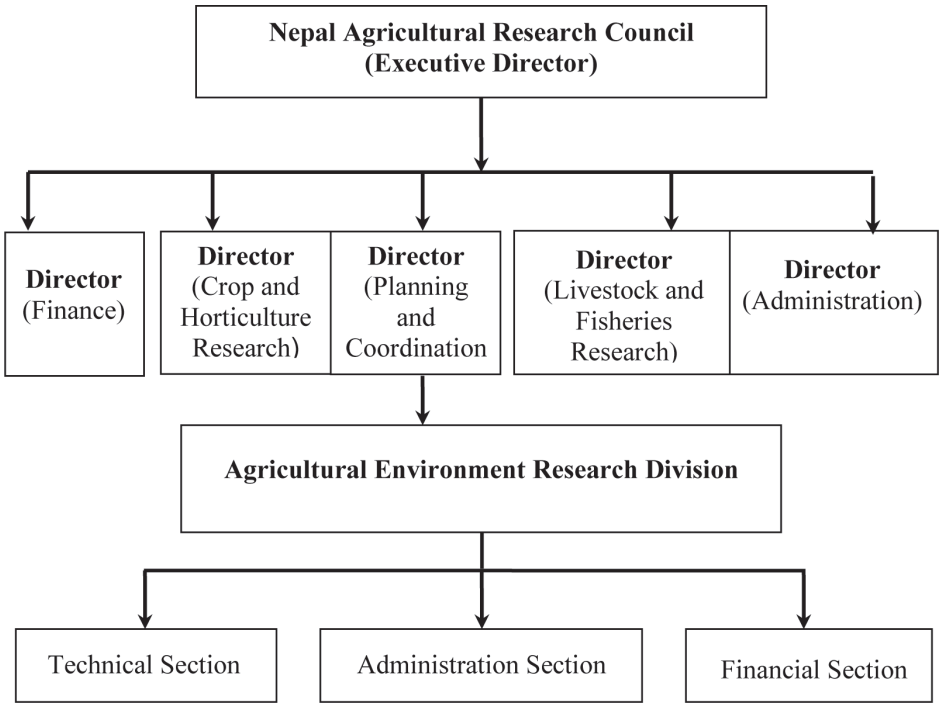

Figure 1: Organizational structure of Agricultural Environment Research

3. RESEARCH HIGHLIGHTS

3.1 Study on wheat under changing climate parameters

Air temperature is one of the important climatic parameter which impacts on crop growth, development and productivity. It imparts on soil parameters like soil moisture, mineralization rate, nutrient content etc. Plants do best under certain temperature range to perform their best in terms of production and productivity. Beyond optimum temperature, the overall physiological behaviour including photosynthesis gets negatively affected. Different species and genotypes within same species might have different optimum temperature requirement to show its full genetic potential. Air temperature also impact on amount of irrigation water requirement and incidence of insects, pests and diseases. Thus, study on effects of temperature on major crops is necessary for knowing adaptability or vulnerability of new crop varieties.

An experiment was carried out in a split plot design in three plastic chamber under irrigated condition to know the adaptability and behaviour of wheat varieties in 2075/76 at Khumaltar. Two growing conditions (Plastic chamber and Field) as main plot (factor A) and wheat varieties (Danphe, Dhaulagiri, Swargadwari and

WK 1204) as sub-plots (factor B) were carried out. The crop was sown on first week of December 2018 at Khumaltar. Seed rate was 120 kg/ha and spacing was 20 cm row to row distance. Fertilizer dose was applied at rate of 100:50:50 N: P_2O_5: K_2O kg/ha. Half of nitrogen was applied as basal and rest half applied after one month of basal dose. Irrigation in wheat field was done when as needed. The average seasonal temperature increase was about 3.85^0C in chamber than field condition (Table 1).

Table 1: Average temperature of chamber and field for wheat growing period, 2075/76 (2018/19)

Treatments	Average Tmax (°C)	Average Tmin (°C)
Open field	26.1	3.3
Open Top Chamber	31.1	6.0

Table 2: Performance of wheat under open top chamber and open field, 2075/76 (2018/19)

Treatment	Days to Emer.	PH (cm)	EL	DM	Eff. T	TGW (g)	FS	US	GY (kg/ha)	BY (kg/ ha)
Growing condition										
Open top chamber	8	92.0	9.7	147	362	44.7	44.4	3.27	3999	12583
Field	11	92.2	10.1	169	397	49.5	33.8	2.42	4310	16750
Variety										
Danphe	9	97.2	9.6	159	420	42.3	43.0	2.37	4531	16833
Dhaulagiri	10	93.0	9.5	157	347	49.0	33.8	2.20	3201	12000
Swargadwari	10	88.4	10.7	157	358	52.3	39.4	3.63	4181	14500
WK 1204	9	89.9	9.7	161	394	44.7	40.1	3.17	4705	15333

Emer. = Emergence, PH=Plant height, EL= Spike length, DM=Days to maturity, Eff. T= effective tillers/m^2, TGW=1000 grain weight, FS=Filled Spike per ear, GY=Grain Yield, BY=Biomass Yield, US=Unfilled Spike per spike

Wheat sown on open top chamber three days earlier than field condition which was due to higher temperature in open top chamber. Danphe and WK 1204 took nine days to emerge compared to ten days for Dhaulagiri and Swargadwari. The plant heights under both the growing conditions were almost similar. Danphe had maximum (97.2 cm) and Swargadwari had minimum plant height (88.3 cm). Effective tillers number, spike length, test weight were lower in wheat grown under open top chamber compared to open field condition. However, filled and unfilled grains were higher under open top chamber. The average

grain yield is found higher in field condition by 4.3 t/ha than open top chamber (3.9 t/ha) as effective tillers, ear length and test weight caused higher yield under field condition. The higher temperature under open top chamber might have reduced the yield. The fresh biomass is found higher under open field condition (12.6 t/ha) as compared to open top chamber with higher fresh biomass of 16.7 t/ha. Among wheat varieties, WK 1204 produced highest grain yield of 4.7 t/ha followed by Dhanphe and Swargadwari whereas Danphe variety produced highest fresh biomass of 16.8 t/ha followed by WK1204 and Swargadwari (Table 2).

3.2 Estimation of CO_2-C emission from wheat field at different stages on field and open top chamber condition at Khumaltar

Soil CO_2 flux is the combined result of root respiration and microbial decomposition of soil organic matter (Hanson *et al* 2000). Farming practices including use of excessive fertilizers and mismanagement of natural resources has posed serious threat in contribution of CO_2 emission from soil. However, it is generally believed that CO_2 emission from the soil and CO_2 fixation by the plant during photosynthesis process is a self sustaining system and there is balance between carbon released from soil and fixed by the plant through photosynthesis. CO_2 flux from agricultural soil mainly depends on microbial activities on organic matter and a number of abiotic and biotic factors can also affect it. It generally increases with rise in temperature (Lloyd and Taylor 1994). Low level of soil moisture limits microbial and root respiration. Higher emission of CO_2 from soil depletes the organic matter content and thus reduces the soil productivity as well as fertility. So, it is necessary to monitor CO_2emission rates in different cropping pattern to formulate the plan to reduce overall agricultural emission.

Methodology

The study was carried out at Khumaltar to estimate CO2-C emission from wheat field at three different stages (45, 78 and 108 days after sowing) and two time period of same day (8:45 AM and 2:45 PM) in open top chamber and field condition. All the details on experiment are same as detailed in experiment "performance of wheat under open top chamber" in former section. Soil temperature, pH and moisture were recorded in the study. The collection of gas samples was done by Japanese closed chamber technique and finally subjected to measure with help of CO2 monitor. Soil moisture, and pH were taken by combined soil moisture and pH meter. Soil temperature was taken from 8 cm depth. The observation taken from different field categorized on the basis of standing crop in field and was analyzed accordingly.

Table 3: CO_2-C Emission from wheat field at different stages at Khumaltar, 2075/76

S.N.	Time	Days after sowing	Air Temp. (^{0}C)	C flux (mg C $m^{-2}hr^{-1}$)		Soil Temp. (^{0}C)		Soil pH		Moisture (%)	
				OTC	Field	OTC	Field	OTC	Field	OTC	Field
1	8:45 AM	45	11.0	61.9	157.7	8.2	6.1	7.0	6.4	8	8
	2:45 PM		18.9	71.1	104.9	14.4	12.3	7.1	6.3	8	8
2	8:45 AM	78	12.4	58.2	135.7	10.7	9.8	6.4	5.9	7.5	7.7
	2:45 PM		19.2	79.5	113.7	19.3	19.2	6.0	5.7	6.4	6.7
3	8:45 AM	108	14.3	74.1	51.6	11.8	11.2	6.4	6.6	7.6	7.3
	2:45 PM		17.0	104.7	84.3	13.8	13.7	5.8	6.2	7.5	7.3

The observations showed that soil carbon emission was higher from open field condition compared to open top chamber at 45 and 78 days after sowing. The emission at 2:45 PM was found higher compared to emission at 8:45 AM under chamber condition. However, the opposite the case under field condition at 45 and 78 days after sowing. However, the last measurement at 108 days was just opposite with higher carbon emission from soil under chamber than open field condition. The carbon emission was found higher in open field condition in early wheat growth stage than later stages as contrast under open top chamber condition. The maximum emission (157.7 mg C m^{-2} hr^{-1}) was found at 45 days at 8:45 AM measurement in field condition. Similarly, the maximum emission (104.7 mg C m^{-2} hr^{-1}) was found at 108 days after sowing at 2:45 PM under open top chamber condition.

It was observed that the CO_2-C emission estimation on different crop was an important study to know the crop contribution in climate change. It help to reduce the emission from soil and will be beneficial for further studies and planning of cropping pattern as well. The presence of crops and fallow land also influences carbon dioxide emission from soil. Sometimes emitted gas absorbed by crop as in photosynthesis process. Thus, emission and contribution in global warming is depend land cover and vegetation.

3.3 Carbon sequestration in fruit tree

The research works in carbon sequestration is very limited in Nepal. Only few study of atmospheric carbon sequestration on forestry is going on. While the study on fruit trees in Nepal is very limited. In this context, while reviewing the past works, there are very few and scattered research works found in the country. Carbon and its sequestration into the soil by fruit plants are very important. Above ground biomass (AGB) and below ground biomass (BGB) of the fruit trees has been considered as carbon sequestration. That increasing biomass of

trees helps to reduce carbon concentration in the atmosphere. Because, the green trees continuously absorb carbon during photosynthesis. This study has been carried out to estimate carbon balance and atmospheric carbon sequestration from fruit trees. Carbon sequestration estimation from fruit trees is an important study which helps to estimate actual contribution of horticulture in mitigating global warming. It might also be helpful for increasing the sequestration in soil and earth system by increasing fruit cultivation.

In carbon sequestration process, either CO_2 is captured from atmosphere or added in to the soil. Forestry and agriculture plays an important role in atmospheric CO_2 fixation. The horticulture, especially plantation crop contributes significantly to global CO_2 capture and offers opportunities of sequestering it into the soil, vegetation and wood products. Fruit trees help stabilize CO_2 concentration in the atmosphere by sequestrating and absorbing for long time. Atmospheric carbon gets sequestered into the soil and helps in building the soil health.

Study was carried out on Macadamia nut in Horticulture Research Station, Malepatan, Kaski in 2075/06/02. In this study, carbon stock was estimated by calculating Above Ground Tree Biomass (AGTB) and Below Ground Tree Biomass (BGTB). A total number of twenty five trees were taken under observations. The trees were fifteen years old. The diameter at breast height (DBH) was measured at 1.3 m height above the ground level and plant height was calculated using angle measured by clinometers. Since plants were spaced at 5x5 m^2, 400 plants were on one hectare area.

Table 4: Carbon Sequestration study on Macadamia nut, 2075/76 (2018/19)

S.No	DBH (m)	Height (m)	AGB (t/ ha)	BGB (t/ha)	Total biomass (t/ha)	C Stock (t/ha)
1	0.5	6.4	40.6	10.6	51.2	25.6
2	0.6	9.4	72.6	18.9	91.5	45.8
3	0.4	8.1	29.7	7.7	37.5	18.7
4	0.8	8.3	121.6	31.6	153.2	76.6
5	0.5	6.0	41.7	10.8	52.5	26.3
6	0.7	8.9	114.9	29.9	144.8	72.4
7	0.5	8.3	61.5	16.0	77.5	38.8
8	0.8	10.0	143.2	37.2	180.5	90.2
9	0.5	8.5	61.1	15.9	77.0	38.5
10	0.6	9.1	86.0	22.4	108.3	54.2
11	0.7	8.5	91.5	23.8	115.3	57.7
12	0.8	7.2	117.3	30.5	147.8	73.9
13	0.4	6.4	30.4	7.9	38.2	19.1
14	0.4	7.6	27.1	7.0	34.1	17.1
15	0.4	7.3	29.0	7.5	36.5	18.2

S.No	DBH (m)	Height (m)	AGB (t/ha)	BGB (t/ha)	Total biomass (t/ha)	C Stock (t/ha)
17	0.4	8.0	36.0	9.3	45.3	22.7
18	0.7	10.0	127.8	33.2	161.0	80.5
20	0.7	9.0	99.4	25.8	125.3	62.6
21	0.6	8.2	84.9	22.1	107.0	53.5
22	0.4	6.8	23.7	6.2	29.8	14.9
23	0.4	6.3	19.6	5.1	24.7	12.4
24	0.5	8.7	66.0	17.2	83.2	41.6
25	0.7	7.9	103.7	27.0	130.7	65.4
26	0.6	9.2	94.6	24.6	119.2	59.6
27	0.5	9.3	59.2	15.4	74.6	37.3
Average			71.3	18.5	89.9	44.9

The averaged above ground, below ground and total biomass calculated based on per tree basis was found 71.3, 18.5 and 89.9 t/ha. Similarly, the total carbon stock per hectare was 44.9 t/ha (Table 4). It is necessary to study further with different ages and locations macadamia tree to reach to proper conclusion.

3.4 Weather vulnerability assessment in farmers' perspective

Weather vulnerability and its impact on Nepalese agriculture is a matter of increasing concern especially in the context of climate change. Various effects in agriculture as a result of climate change and weather variability are being observed in most of the part of country presently. Impacts are not only on crop productivity, but threats are also on environment and human health as well. There are reports time and again from many places about such vulnerabilities induced by weather change on agriculture. Effects are more serious and intense in rural areas than in urban. It is very important to know farmers' knowledge level and coping mechanism to such climate change/weather variability effects. This will help to design and implement programs more efficiently and more appropriately. With this view, a survey was conducted in Nuwakot and Lamjung district in 2075/76.

Lamjung

A total number of thirty-seven farmers were interviewed in Dhuseni and Marsangdi area of Sundar Bazar Municipality out of which seventeen were female. The respondents ranged from 20-30 to 70-80 age group (Table 5). Thirteen respondents were high school educated followed by literate (ten) (Table 6). The majority of farmer's sole earning source was agriculture (ten) followed by agriculture and business combined (sixteen). The annual income ranged from less than one lakh to five to ten lakhs per annum. Most of the farmers had one to five ropani cultivated land. Only sixteen farmers were growing food sufficient for them from agriculture. Farmer's were getting seed, fertilizer, and pesticides

on a timely basis as indicated by thirty-five, sixteen and twenty-one farmers. The maize seed from previous season crop was the major source of seed for next season though few farmers use seed purchased from agro-vet (one farmer) and government (one farmer).

Table 5: Frequency of the age group of the respondents

Age group	Frequency	
	Lamjung	Nuwakot
20-30	8	4
30-40	7	17
40-50	2	9
50-60	5	12
60-70	3	6
70-80	3	3
80-90	0	1

Table 6: Frequency of respondent's education level

Education level	Frequency
	Lamjung
Illiterate	5
Literate	10
High school	13
University degree	0

Personal communication is a major source of technical information followed by mass media like radio and Television. Eight farmers were using mass media followed by two farmers getting information from any organization as a single source. Most of the farmers were unaware of climate change and its implications/ effects on people's livelihood (Table 7). Only four farmers responded that they have received weather/climate-related information during the last two years.

Table 7: Degree of clarity about climate change and its implications/effects on people's livelihood

Degree of clarity	Frequency	
	Lamjung	Nuwakot
More clearly	2	0
Clearly	5	0
A little bit	10	27
Do not know	11	25

Twenty-one farmers have experienced climate-related crises though sometimes they know the consequences but the exact meaning of climate-related crisis. Hail storm was ranked the first as a climate-related crisis by twenty-one farmers followed by drought (fourteen farmers) and dry spells (thirteen farmers).

The majority of farmers felt hot summer climate (nineteen farmers) and similar winter (eighteen farmers) in these days compared to the last ten years (Table 8).

Table 8: Frequency of the respondent's perception on change in seasonal air temperature compared to last ten years

	Lamjung			**Nuwakot**		
	Hotter	**Colder**	**Same**	**Hotter**	**Colder**	**Same**
Summer	19	4	5	45	0	7
Winter	3	7	18	6	35	11

Farmers felt decreased summer rainfall amount (nineteen respondents), rainfall extreme events (sixteen respondents) and number of rainy days (thirteen farmers). Though the majority of farmers felt similar onset and withdrawal of monsoon, ten farmers felt onset of monsoon was being late and a similar number of farmers felt the early withdrawal of monsoon compared to ten years before. The consensus on summer longer dry spells and similar fog characteristics was strong as supported by seventeen and twenty-six farmers, respectively. Though twelve farmers felt no change in water availability during summer, thirteen farmers responded to decreased water availability for farming than ten years before. Except for one response for an increase in winter rainfall amount and rainy days, all respondents felt either decreased or same winter rainfall amount, rainy days and extreme events. The majority of farmers have experienced the same onset and withdrawal of winter rainfall, fog characteristics. Eleven farmers experienced decreased water availability during winter time (Table 9).

Only one farmer has indicated a change in cropping patterns under irrigated conditions. Only seven farmers have used modern ploughing machines rather than traditional plough. Similarly, seven farmers have changed local maize variety with new improved varieties like Arun, Rampur Composite and Manakamana. Only four farmers indicated that they have cultivated hybrid maize as well. Two farmers responded delayed sowing of maize by two weeks. Three farmers experienced delayed harvesting of maize by one to two weeks. Thirteen farmers have indicated the amount of FYM application changed in these days, however, only four farmers have used less amount of FYM on maize than ten years before because of less number of livestock. The increase in the FYM amount was due to the increase in a number of livestock rearing.

Table 9: Perception on various weather events in Lamjung and Nuwakot

Particulars	Summer rainfall (Monsoon; Jun -Sept)			Winter rainfall (Dec-Feb)		
	Increase	**Decrease**	**Same**	**Increase**	**Decrease**	**Same**
Rainfall amount	2	19	7	1	12	13
Rainy days	1	16	11	1	11	14
Rainfall extreme event	8	13	7	0	11	17
	Early	**Late**	**No change**	**Early**	**Late**	**No change**
Onset of rainfall	2	10	16	1	2	25
Withdrawal of rainfall	10	3	15	3	0	25
	Longer	**Shorter**	**Same**	**Longer**	**Shorter**	**Same**
Dry spells	17	2	9	21	0	7
Other Events	**Increase**	**Decrease**	**Same**	**Increase**	**Decrease**	**Same**
Fog Characteristics	1	1	26	2	0	26
Impact on water table/availability						
Water availability	3	13	12	0	11	17

Note: *Figures in bracket are for Nuwakot district*

The infestation of weed (nineteen respondents), diseases (sixteen respondents) and insect (twenty-one respondents) on maize has increased in recent years. The weed-like *banmara*, *Kaligandha* are new for maize field. However, farmers have not applied any kind of pesticides. Twenty-five farmers have responded that they have experienced loss in maize due to bad weather like limited rainfall, hailstorm, wind, etc. The loss was mainly due to the hail storm. Nineteen respondents indicated that the loss was even more than seventy percent. Eighteen farmers have indicated that they are harvesting higher grain yield as compared to before. The increase was up to 60 kg per ropani maize cultivation. The use of fertilizers and new improved varieties has caused this increment in maize yield. Famer's did not have any complain about change in the quality of maize yield due to bad weather. Eleven farmers were aware of insurance policy for a crop like maize. However, none of them have insured yet. Thirteen farmers responded that the government current policy was not working for farmers to benefit to reduce the climate change impact.

Nuwakot

A total of fifty-two households were included in the survey. Twenty-seven were female and twenty-five were male. The survey areas were Aabutar, Bogatitol, Dharampani, Mahamandal, Pathpani. Rice-based in irrigated and maize/millet-based cropping patterns in non irrigated condition were dominant in survey areas. Some farmers have indicated that they were sowing mustard instead of

wheat in some years in irrigated land due to drought, otherwise, farmers were using the same cropping patterns in both irrigated and rainfed areas. Two farmers indicated two weeks earlier transplanting of rice and twelve indicated delayed transplanting by one to two weeks. Similarly, four farmers have experienced earlier harvesting of rice by one to two weeks and nine respondents observed delayed harvesting by three weeks. Moreover, three farmers indicated that millet sowing/ transplanting being earlier by one to three weeks and twenty responded late sowing/transplanting. Only one farmer responded one week earlier harvesting whereas nineteen respondents experienced one to two weeks delayed harvesting. The sowing of wheat was delayed by one to three weeks (two respondents) and delayed by five weeks (five respondents). In addition, the harvesting was delayed by one to two weeks (five respondents) and was done earlier by one week (one respondent). The farmer did not experience any changes in sowing and harvesting time. Farmer's have observed production change in rice (twenty respondents), wheat (four respondents), maize (33 respondents) and millet (eleven respondents). Only three farmers indicated the negative change in rice production. There were no changes in the frequency of irrigation and irrigation sources. The diseases, insect and weed increment was felt by forty-one, forty and thirty-five farmers on their rice, maize, wheat, and millet field, respectively.

Twenty-seven farmers knew a little bit about climate change and its implications/ effects on people's livelihood and twenty-five indicated that they were unaware of it. The drought was ranked number one climatic events as indicated by twenty-six farmers followed by dry spells (sixteen farmers). Twenty-one farmers experienced delayed winter start by one to five weeks opposed to eight who viewed early start one to three weeks in recent years compared to ten years back. However, the majority of respondents (twenty-three) viewed the early start of summer by one to six weeks opposed to six respondents who experienced a delayed start of summer. Thirty-five experienced colder and six experienced hotter winter. Forty-five have consensus on summer being hotter and remaining felt no change in summer temperature (Table 8). Except two respondents, all of them felt a decreased number of rainy days during monsoon and winter. Forty-five observed the late onset of rainfall and only two observed early onsets of rainfall in recent years. Similarly, a long dry spell was observed by forty-six respondents (Table 9). Very few households were using improved varieties to cope with negative impact of climate change. Ten households were using short duration, five households using drought-resistant, and fourteen farmers using hybrid varieties. Similarly, sixteen farmers were using the higher amount of fertilizer than before as climate impact adaptation strategies. Only five farmers viewed that they have increased the amount of pesticide application and five of them responded pesticide application depends on the severity. Twenty households have shifted on vegetable production instead of rice and wheat. Only six farmers were used to discuss climate change-related issues. The respondents want to discuss on climate change and its impact on disease occurrence, irrigation requirement change, and health hazard issues.

4. TECHNOLOGY TRANSFER AND SERVICES

Services

The division made available of meteorological data to various stakeholders including research stations, students and other concerned organization. Technical information regarding agri-environment and its importance on agricultural productivity and its impacts in agriculture was provided to various concern stakeholders.

Publications

Besides the annual report publication of division, has been published (Annex 4).

Information through media

Various interviews related to climate change and its impact on Nepalese agriculture were broadcasted/published on various media

5. VISITS

Visit of students from Academic institutions regarding meteorological and climate change impact information on agriculture sectors.

6. OTHER ACTIVITIES

Participation in different training and workshop by different personals from the division is given in Annex 5.

7. BUDGET AND EXPENDITURE

The total annual budget and expenditure of the division for regular as well as special projects are provided in details in from Annex 6 to Annex 9. Revenue generated from various activities and Beruju status of the division is provided in Annex 10 and Annex 11, respectively.

8. KEY PROBLEMS

- Insufficient technical human resources to represent different disciplines.

9. WAY FORWARD

- Expansion of climate change research activities to other research stations.
- Establishment of Environment Unit in each Regional Agricultural Research Stations and commodity program of NARC.
- Strengthening research stations in terms of manpower and laboratory to conduct research related to climate change.
- Installation of Automatic Weather Station (AWS) in different research stations for agro-meteorological database and to support the researches.
- Coordination with different organizations to provide agro-met advisory based on weather forecasting for agriculture use.

10. REFERENCES

Hensen *et al*., 2000. Global Warming in the Twenty first century: An alternative scenario. Proc. Natl. Acad. Sci.

LIoyd and Taylor, 1994. On the Temperature Dependence on Soil Respiration, Functional Ecology, Vol. 8, No. 3, (June, 1994), pp 315-323.

11. ANNEXES

Annex 1. Human Resources, 2075/76 (2018/19)

S.N.	Name of the Staff	Designation	Remarks
1	Mr. Ghanashyam Malla	Senior Scientist (S-4)	
2	Mr Bishnu Prasad Paudel	Senior Scientist (S-3)	
3	Dr. Amit Prasad Timilsina	Scientist (S-1)	Deputed from HCRP
4	Mr. Alok Sharma	Technical Officer (T-6)	On study leave
5	Mr. Prabhat Sah	Account Officer (A-6)	
6	Mrs. Mandira Chitrakar	Admin. Officer (A-6)	
7	Mr. Rameshwar Rimal	Technical Officer (T-6)	
8	Mr. Achyut Gairhe	Technical Officer (T-6)	PPCR/BRCH/AMIS
9	Mr. Hem Lal Bhandari	Technician (T-5)	
10	Mr. Raj Kumar Chalise	Driver	Deputed from NASRI
11	Mrs Reena Maharzan	Lower Technician	

Annex 2. Summary of Progress of NARC Research Projects and Activities, 2075/76 (2018/19)

Project code number	Name of project/activity	Project/ Activity Leader	End Year	Major progress/achievements
32970002	**Vulnerability of climate change in agriculture**	**G Malla**	**Continuous**	
Activity 1	Collection, analysis and dissemination of agro-meteorological database of various locations of Nepal	R Rimal	,,	Meteorological database of 11 stations of NARC collected and analysed (Average precipitation, max and min temp).
Activity 2	Weather vulnerability assessment in farmers perspective	B P Paudel	,,	Survey conducted in Nuwakot and Lamjung districts. Majority of farmers' perception was that summer is becoming hot.
Activity 3	Crop management study under changing climatic parameters	G Malla	,,	Among the varieties, higher temperature resulted lower grain yield. WK1204 produced highest grain yield of 4.7 ton/ha.
Activity 4	Estimation of GHGs emission from pasture agricultural land and livestock sectors	H Bhandari		The carbon emission was found higher in open field condition in early wheat growth stage than later stages as contrast under open top chamber condition.
Activity 5	Estimation of atmospheric C sequestration by fruit plants and in orchard	G Malla	,,	Fifteen years old Macadamia nut sequestrated total carbon of 44.9 t/ha Malepatan, Kaski district.
32900001	**FMP/AOE 329**	**Division Chief**	**Time bound**	**Activities accomplished**
Activity 1	Farm security	Division Chief		Farm security well maintained.
Activity 2	Research support (admin Lab services, etc)	,,	,,	All research supports made available as per requirements.
Activity 3	Annual Report Publication	B.P.Paudel	,,	100 units of Annual Report was Published.

Annex 3. Summary progress of special research projects and activities, 2075/76 (2018/19)

Name of project /activity	Project/ Activity Leader	Begin Year	End Year	Major progress /achievements
PPCR HELVETAS	D Bhandari	2014	2019	Publication of Weekly Agro-met based advisory bulletin for 25 Districts (Jhapa, Morang, Sankhuwsabha, Dhankuta, Sunsari, Saptari, Siraha, Dolakha, Mahottari, Kavrepalanchoke, Bara, Dhading, Chitawan, Kaski, Mustang, Palpa, Rupandehi, Rukum, Dang, Banke, Surkhet, Jumla, Kailali, Doti and Darchula). Four drought tolerant rice varieties were distributed to validate climate resilient technologies. A training program to farmers was conducted in Udaypur and Okhaldhunga districts on agro-met advisory bulletin.

Annex 4. Publications, 2075/76 (2018/2019)

SN	Title of publication	Type	Language	Author	No. of copies
1.	Annual Report 2073/74 (2016/17). Agricultural Environment Research Division, Khumaltar, Lalitpur, Nepal	Report	English	Agricultural Environment Research Division, Khumaltar	100
2.	कृषि मौसम सल्लाह सेवा वुलेटिन	सँग्रह पुस्तिका	नेपाली	विषय विशेषज्ञ समूह	

Annex 5. Training/workshop/seminar attended by staff, 2075/76 (2018/19)

SN	Name of staff	Position	Name of Training/seminar/workshop	Duration	Place/Country	Organizer
1.	Mr. Ghanshyam Malla	S. Scientist (S4)	Interaction with ILRI Scientist and to introduce NARC Scientist With the activities of ILRI in South Asian Region	15-19 Feb, 2018	India	CSIP-Nepal
2.	Mr. Bishnu P Paudel	S. Scientist (S3)	Summer School for Officers (Agriculture) 2019	4-10 Dec, 2019	Nepal	CHD, NARC
3.	Mr. Bishnu P Paudel	S. Scientist (S3)	Training and Workshop on Experimental Design Statistical Procedure Using R	20-24 May, 2018	Nepal	SSD
4.	Dr. Amit P Timalsina	Scientist (S1)	Crop Modelling Training	25-29 June, 2018	Nepal	PPCR
5.	Mr. Ghanshyam Malla	Scientist (S4)	Consultation meeting and exposure visit	4-7 March, 2019	Bangladesh	ORD
6.	Dr. Amit P Timilsina	Scientist (S1)	Consultation meeting and exposure visit	10-13 March, 2019	Bangladesh	ORD

Annex 6. Regular annual budget and expenditure,(NARC) 2075/76 (2018/19)

Budget Code	Budget heads	Annual Budget	Expenses	Balance
21* **	**Staff expenses**			
21111	Basic Salary	5535000	4737414.50	797585.50
21113	Allowance	240000.0	240000.0	0.0
21119	Other allowance	60000.0	0.0	60000.0
21121	Cloth	100000.0	100000.0	0.0
22* **	**Operational and Administrative expenses**			
22111	Water and electricity	42000.0	23283.60	18716.40
22112	Communication	150000.0	62490.0	87510.0
22211	Fuel vehicle	500000.0	341303.14	158696.86
22212	Operation maintenance	1150000.0	844197.05	305802.95
22213	Insurance	50000.0	43708.20	6291.80
22311	Office expenditure	600000.0	594351.30	5648.70
22314	Fuel others	40000.0	5850/0	34150.0
22321	Existing Assets Maintenance	300000.0	294560.04	5439.96
22412	Other service	555000.0	67800.0	487200.0
22521	Production materials/ Service expenditure	1080000.0	864285.0	215715.0
22611	Monitoring evaluation	100000.0	10000.0	90000.0
22612	Travel expenses	1233000.0	875189.0	357811.0
22711	Contingency	210000.0	209085	915.0
	Total	**11945000.0**	**9313516.83**	**2631483.17**
29* **	**Capital expenses**			
29231	Capital Improvement	0.0	0.0	0.0
29311	Furniture and Fixers	100000.0	99892.94	107.06
29411	Vehicle	0.0	0.0	0.0
29511	Machinery and Equip	0.0	0.0	0.0
	Total	**100000.0**	**99892.94**	**107.06**
	Grand Total	**12045000.0**	**9413409.77**	**2631590.23**

Annex 7. Special project (PPCR/BRCH/AMIS-NARC Project) Budget and expenditure, 2075/76 (2018/19)

Budget Code	Budget heads	Annual Budget		Expenses		Balance
		Gov. Nepal	IDA	Govt. Nepal	IDA	
2100	**Labour Expenses**					
21111	Basic Salary	5000	531000		488779.15	47220.8
21113	Allowance		24000		24000	0
21119	Other Allowance	104000	1670000	100215	1630685	43100
21121	Cloth					
2200	**Operational Expenses**					
22111	Water and electricity					
22112	Communication					
22122	Other Rent					
22211	Fuel vehicle	55000	128000	31540.82	128000	23459.1
22212	Operation maintenance	57000	58000	12222	54629	48149
22311	Office expenditure	5000	85000	5000	83212	1788
22313	Publications (Books and others)					
22411	Service and consultant					
22412	Other service					
22511	Staff training					
22512	Workshop (skill, people, awareness)					
22521	Production materials/ Service expenditure	7000	494000	0	0	501000
22522	Program expenditure					
22611	Monitoring evaluation		170000		100000	70000
22612	Travel Expenses					
22711	Contingency	13000	247000	12765	247000	235
	Total	**246000**	**3407000**	**166742.82**	**2751305.15**	**734952**
2900	**Capital Expenses**					
29311	Furniture and fixtures					
29411	Vehicle					
29511	Machinery &equipment	975000	6525000	862940	6525000	112060
29611	Construction					
29612	Capital improvement					
29712	Software Expenses					
	Total	**975000**	**6525000**	**862940**	**6525000**	**112060**
	Grand Total	**1221000**	**9932000**	**1029682.8**	**9276305.15**	**847012**

Annex 8. Special project: Food and Agriculture Organization (FAO) Project budget and expenditure, 2075/76 (2018/19)

Budget Code	Budget heads	Annual Budget	Expenses	Balance
2100	**Labour Expenses**			
21111	Basic Salary	0.0	0.0	0.0
21113	Allowance	0.0	0.0	0.0
21119	Other Allowance	1484315.0	1469195.0	15120.0
21121	Cloth			
2200	**Operational Expenses**			
22111	Water and electricity	0.0	0.0	0.0
22112	Communication	25000.0	14560.0	10440.0
22122	Other Rent	0.0	0.0	0.0
22211	Fuel vehicle	0.0	0.0	0.0
22212	Operation maintenance	0.0	0.0	0.0
22311	Office expenditure	98000.0	97954.0	46.0
22314	Fuel others			
22411	Service and consultant			
22412	Other service			
22511	Staff training			
22512	Workshop (skill, people awareness)			
22522	Program expenditure			
22611	Monitoring evaluation			
22612	Travel Expenses	151000.0	109405.0	41595.0
22711	Contingency	102300.0	101775.0	525.0
2900	**Capital Expenses**			
29311	Furniture and fixtures			
29411	Vehicle			
29511	Machinery &equipment Vehicles			
29611	Construction			
29612	Capital improvement			
29712	Software Expenses			
	Total	**1860615.0**	**1792889.0**	**67726.0**

Annex 9. Special project (Prayas- HELVETAS) Project budget and expenditure, 2075/76 (2018/19)

Budget Code	Budget heads	Annual Budget	Expenses	Balance
2100	**Labour Expenses**			
21111	Basic Salary	0.00	0.00	0.00
21113	Allowance	0.00	0.00	0.00
21119	Other Allowance	0.00	0.00	0.00
21121	Cloth			
2200	**Operational Expenses**			
22111	Water and electricity	0.00	0.00	0.00
22112	Communication	13500.00	0.00	7500.00
22122	Other Rent	175000.00	219945.00	132.00
22211	Fuel vehicle	157500.00	10280.00	97020.00
22212	Operation maintenance	0.00	0.00	0.00
22311	Office expenditure	145000.00	77497.00	67503.00
22314	Fuel others			
22411	Service and consultant			
22412	Other service			
22511	Staff training			
22521	Production materials	130000.00	398381.00	11600.00
22521	Production, Labour	95500.00	27401.00	18099.00
22512	Workshop (skill, people awareness)	300000.00	150000.00	0.00
22522	Program expenditure			
22611	Monitoring evaluation	165000.00	14200.00	100000.00
22612	Travel Expenses	655000.00	515794.00	44206.00
22711	Contingency	76500.00	70980.00	0.00
2900	**Capital Expenses**	0.00	0.00	0.00
29311	Furniture and fixtures			
29411	Vehicle			
29511	Machinery &equipment Vehicles			
29611	Construction			
29612	Capital improvement			
29712	Software Expenses			
	Total	**1915000.00**	**1484478.00**	**346060.00**

Annex 10. Revenue status, 2075/76 (2018/19) (*In Nepalese Rupees*)

Source	Total	Remarks
Administration Income	9000.00	
Research materials	2550.00	
Grand Total	**11550.00**	

Annex 11. Beruju status, 2075/76 (2018/19) (*In Nepalese Rupees*)

Beruju	Amount	Remarks
Beruju till last year	0	
Beruju cleared this FY	0	0
Remaining Beruju	0	

NPSN : 00635-450/2017/18

कृषि-मौसम सल्लाह सेवा बुलेटिन

साप्ताहिक बुलेटिनका संग्रह पुस्तिका (२०७२ असार–चैत्र)

नेपाल सरकार
नेपाल कृषि अनुसन्धान परिषद्

कृषि वातावरण अनुसन्धान महाशाखा

जलवायु प्रकोप समुत्थान निर्माण आयोजना

(कृषि व्यवस्थापन सूचना प्रणाली)

खुमलटार, ललितपुर, नेपाल

Bung: Traditional way of potato farming (Bung) in Okhaldhunga district

Training on Agro-met Advisory service at Gaighat, Udaypur