NPSN 00791-805/2020/21

Annual Report

2076/077 (2019/020)

Government of Nepal
Nepal Agricultural Research Council (NARC)
Fishery Research Station, Pokhara
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Celebration of "World fisheries Day 2019" and release of Sahar (*Tor putitora*) fry in the Phewa Lake; awarenees for lake and fish conservation

Gathering of information's about the fish and fisheries activities from Jalari fisher of Begnas Lake at Fish landing site of Begnas Lake

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FOREWORD

Fishery Research Station, Pokhara was established in 1962 (2018 BS) as “Lake Development Centre” which was changed to Fisheries Development Centre (FDC) within the short period of its establishment. With the establishment of Nepal Agricultural Research Council (NARC) in 1991 (2048 BS), the name of the office changed into Agricultural Research Station (Fisheries), Pokhara and later to current name "Fishery Research Station, Begnas, Pokhara” since 14 June 2015 (31 Jestha 2072). Main purpose of the station is to develop the sustainable fisheries and improved aquaculture technology for food security, employment and income. For this purpose FRS, Pokhara has been conducting various research works on technology development for improving aquaculture and fisheries production and productivity contributing to livelihood especially those of the wetland dependent/deprived communities.

This year report briefly describes the results of different approved activities conducted during fiscal year 2076/077(2019/2020). The major works accomplished were: publications of fish seed transportation booklet and leaflet; domestication of four native ornamental fish species and among which two native ornamental fish (*Danio devario and Danio rerio*) species were bred successfully in the captive condition; nutrient profile of native fish species; stock enhancement and assessment of natural stock in lakes, mobilization of women group for conservation of indigenous fishes and supporting to supply the demand of fry/fingerlings especially for mid-hills region in Gandaki Province. Preparation of image and circular bead and mantle cavity implantation to the mussels *Lamillidens marganalis* was the major achievements of this year.

We look forward to receive constructive criticism and valuable suggestions from all concerned stakeholders, institution and personnel for improving the quality of work. The support received from all scientists, technical officers and supportive staffs of FRS, Pokhara for running mandated program is appreciated. I would like to thank all the staffs involved directly and indirectly in the research work. I would like to thanks to Ms. Sapna Chand, Ms. Sweta Nakarmi and Ms. Sunita Thapa for support in the research work during her internship work. On behalf the station, sincere thanks go to all farmers, fisher communities and fisheries cooperatives involved in fish farming for their support and providing information in technology generation process.

Md. Akbal Husen, PhD.
Station Chief
Fishery Research Station, Pokhara

ABBREVIATIONS

FAO	Food and Agriculture Organization
FRS	Fishery Research Station
FDC	Fisheries Development Centre
g	Gram
JICA	Japan International Cooperative Agency
kg	Kilogram
m^2	Square meter
mg	Milligram
mg/L	Milligram per Liter
mm	Millimeter
NARC	Nepal Agricultural Research Council
no	Number
NWFDP	Natural Water Fisheries Development Project
ppm	Parts per million
UNDP	United Nations Development Program
˚C	Degree Celsius
%	Percentage

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प्रमुख सार संक्षेप

मत्स्य अनुसन्धान केन्द्र, पोखराको स्थापना वि.सं. २०१८ सालमा "ताल विकास केन्द्र" को नाममा भएको थियो । केन्द्रको स्थापना पछि तालहरूमा मत्स्य विकास गर्ने र माछामा आश्रित समुदायको जनजीविकामा सुधार ल्याउने उद्देश्य अनुरुप फेवाताल, वेगनासताल र रुपाताल को पर्यावरण तथा जैविक विविधता संरक्षण एवं उपयोगको नीतिको आधारमा कार्यक्रमहरू संचालन भएका थिए । प्रारम्भिक चरणमा यस केन्द्रको कार्यक्रम पोखरा उपत्यकाका ताल तथा नदीमा तियारी जाल राखी संकलित माछा (आलो तथा सुकुटी बनाई) सर्बसाधारणलाई सुपथ मूल्यमा आपूर्ति गर्ने र ताल वरिपरि बस्ने निम्नआयस्तर भएका तथा फिरन्ते जीवन विताउने जलारी (पोडे) समुदायलाई तियारी जाल थाप्ने र माछा समात्ने प्रविधि सिकाई कृषकहरूको जीवनस्तरमा सुधार ल्याउने कार्यक्रम संचालन गरिएको थियो । यस प्रविधिको थालनी भएको २-३ बर्षसम्म पोखरा उपत्यकाका तालहरूमा समातिने माछाको उत्पादनमा बृद्धि पनि भयो । सो अवधिमा तालहरूमा अति दोहनका कारण समातिने माछाको उत्पादनमा ह्रास हुदै गएको हुँदा स्थानीय बजारमा बढदो माछाको माग आपुर्ति गर्न समस्या देखियो ।

तत्पश्चात नयाँ चुनौतीका लागि तालहरूमा उत्पादित प्राकृतिक आहाराको सदुपयोग गरी माछा उत्पादन बृद्धि गर्न नेपाल सरकार (तत्कालीन श्री ५ को सरकार) तथा विश्व खाद्य तथा कृषि संगठन (FAO) र संयुक्त राष्ट्र संघीय विकास कार्यक्रमको (UNDP) को संयुक्त सहयोग एवम् प्रयासमा २०३२ देखि २०३६ साल सम्म यस केन्द्रमा एकीकृत मत्स्य विकास आयोजना (Integrated Fishery and Fish Culture Development Project, NEP/73/25) लागु भएको थियो । माछा पालन प्रति कृषकहरूको बढ्दो अभिरुचिलाई दृष्टिगत गर्दै यस आयोजनाको अवधिमा फेवा, वेगनास र रुपाताल को अध्ययन गरी उत्पादकत्वको आधारमा कृषकहरूलाई वैकल्पिक आयस्रोतको रुपमा पिंजडा तथा ईन्क्लोजरमा माछा पालन कार्यको शुरुवात गरियो । यसै अवधिमा पेकिङ र एन.जी.चाउ जातका हाँस ल्याई हाँसपालन कार्यक्रम तथा विकसित डुङ्गा बनाउने प्रविधिको विकास गरी निजीक्षेत्रमा प्रविधिको हस्तान्तरण गरिएको थियो । कार्यक्रम अनुसार सरकारी तथा निजीस्तरमा विभिन्न किसिमको पिंजडाहरू तालमा राखी आर्थिक दृष्टिकोणले रोचक एवं प्रभावकारी पेशाको रुपमा माछापालन कार्यलाई अगाडि बढाइयो । फलस्वरुप पिंजडामा माछापालन प्रविधि लोकप्रिय हुन गएको छ । विकसित प्रविधिको अनुसरण तथा विस्तारण भए अनुरुप हाल अन्य सम्भावित कतिपय जलाशयहरूमा

पनि पिंजडामा माछापालन व्यवसाय विस्तार भैरहेको छ । यस अतिरिक्त केन्द्रले स्वदेशी जातका आर्थिक दृष्टिकोणले महत्वपूर्ण मानिएका माछाहरू मध्ये सहर तथा गर्दीको प्रजनन्मा सफलता प्राप्तगरी व्यावसायिक रुपमा पालन गर्न प्रविधि विकासको लागि अध्ययन अनुसन्धान गरिरहेको छ ।

आ.व. २०४८/४९ मा नेपालमा कृषि तथा पशु विज्ञानका क्षेत्रमा प्रभावकारी अध्ययन अनुसन्धान संचालन गरी उन्नत प्रविधिको विकास गर्न नेपाल कृषि अनुसन्धान परिषद्को स्थापना भएपछि यो केन्द्र सो परिषद् अर्न्तगत संचालन हुदै आईरहेको छ । यस केन्द्रले मत्स्य एवम् जलचर उत्पादन मुलक अध्ययन अनुसन्धान खास गरी मध्यपहाडी भेगको प्राकृतिक जलाशयहरूमा मत्स्य पालन कार्य बढी प्रभावकारी बनाउन अध्ययन अनुसन्धान संचालनका साथै नदीनाला, तालतलैया, पोखरी तथा धानखेतमा माछापालन एवं जैविक विविधताको प्रवर्द्धन समेतका कार्यहरूमा आवश्यक प्राविधिक ज्ञान, सिप एवं सेवा उपलब्ध गराउन स्रोत केन्द्रका रुपमा समेत कार्य गर्दै आइरहेको छ । आ.व. २०४८/४९ देखि ६ बर्षसम्म ताल, तलैया, रिर्जभ्वायर तथा नदीनालामा मत्स्य उत्पादन गर्ने उद्देश्यले नेपाल सरकार र जापान सरकारको (JICA) अनुदान सहित संयुक्त सहयोगमा प्राकृतिक जलाशय मत्स्य विकास आयोजना (NWFDP) संचालन भएको थियो । यस आयोजना अर्न्तगत माउ माछा व्यवस्थापन तथा भुरा हुर्काउने पोखरीहरू, मत्स्य ह्याचरी, दाना घर, तालिम भवन, प्रयोगशाला, कार्यालय भवन, आदि भौतिक सुविधाहरूको विकास गरिएको थियो भने मत्स्य ब्यवसायीलाई समेत प्राविधिक सीप ज्ञान र सामग्रीमा सहयोग प्रदान गरिएको थियो ।

आयोजनाबाट प्राप्त र विकसित प्रविधि एवं साधन स्रोतहरूको सदुपयोग गरी हाल यस केन्द्रले विभिन्न जातका स्वदेशी तथा विदेशी माछाहरूमा अध्ययन अनुसन्धान, उत्पादन कार्यक्रम तथा सेवामुलक कार्यक्रम गरी सेवाग्राहीलाई सेवाटेवा दिँदै आईरहेको छ । नेपालमा कृषक/उद्यमीको बढ्दो अभिरुची भएको र भौगोलिक रुपमा पनि प्रशस्त सम्भावना रहेको चिसो पानीमा ट्राउट माछा पालन प्रविधि यस केन्द्रको प्रभाव क्षेत्रका कास्की, लमजुङ, मनाङ्ग, मुस्ताङ्ग, म्याग्दी, पर्वत, वागलुङ्ग आादि जिल्लाहरूमा विस्तार भई माछापालन कार्य संचालन भैरहेको छ ।

दृष्टिकोण (Vision)

नेपाल सरकार तथा नेपाल कृषि अनुसन्धान परिषद्को नीति अनुरुप उन्नत र दिगो मत्स्य पालन तथा व्यवस्थापन प्रविधिको विकास गरी उत्पादन तथा उत्पादकत्व अभिबृद्धि गर्दै

सर्वसाधारणलाई सुलभ रुपमा माछा/पौष्टिक आहार उपलब्ध गराउने र राष्ट्रिय अर्थतन्त्रमा योगदान पुऱ्याउने ।

मुख्य लक्ष (Mission)

दिगो मत्स्यपालन र व्यवस्थापनका माध्यमबाट पौष्टिक खाद्य सुरक्षा, रोजगारी, आयआर्जनका अवसर सिर्जना गर्ने र यस व्यवसायमा संलग्न समुदायको जीविकोपार्जनमा सुधार ल्याउन आबश्यक प्रविधि विकास एवं विस्तार गर्ने ।

उद्देश्यहरू (Objectives)

- मत्स्य उत्पादन तथा उत्पादकत्व बृद्धि गर्न उपयुक्त खालका प्रविधिको विकास गर्ने ।
- नदी, ताल, सिमसार तथा विविध जलाशयमा आश्रित समुदायको जनजीविका उत्थान एवं प्रवर्धनका लागि जलाशय संरक्षण एवं व्यवस्थापन र उपयोग सम्बन्धी उपयुक्त प्रविधिको विकास गर्ने ।
- नेपालको गण्डकी प्रदेश तथा आसपास क्षेत्रका खासगरी मध्यपहाडी जिल्लाहरूमा मत्स्य पालक कृषक तथा जलीय स्रोतमा आधारित समुदायमा माछाभुरा उपलब्ध गराउने र आबश्यक प्रविधि एवं प्राविधिक सेवाटेवा पुऱ्याउने ।

हाम्रा सेवाग्राहीहरू

- मत्स्य व्यवसायमा संलग्न कृषक समुदाय तथा उद्दमी
- जलाशयमा आश्रित गरिब, बिपन्न, भूमिहिन समुदाय जस्तैः जलारी, वोटे, माझी, मुक्त कमैया, थारु आदि समुदाय

मत्स्य अनुसन्धानको आबश्यकता

- पौष्टिक खाद्य सुरक्षाका लागि
- रोजगारी, आय आर्जन तथा जीविकोपार्जनका अवसरहरूको लागि
- मत्स्य पालन व्यवसायिकीकरणको सम्भाव्यता तथा गरिवी निवारण
- जमीन र पानीको स्रोत वीचको पर्यावरणीय संतुलन कायम राख्न

कार्यक्रमका प्रमुख क्षेत्रहरू

- पोखरी, ताल तथा रिजरभ्वाएरमा जलीय उत्पादकत्व अभिवृद्धि गर्न उपयुक्त मत्स्य पालन प्रविधिको विकास ।
- मत्स्य पालनमा प्रयोग गर्ने उद्देश्यले महत्वपुर्ण स्वदेशी माछाको घरेलुकरण एवं

अनुवांशिक स्रोत संरक्षण ।

- विभिन्न प्राकृतिक जलाशयमा उपयुक्त खालका मत्स्य पालन प्रविधि विकास एवं सुधार ।
- प्राकृतिक जलाशयमा जलचरहरूको घनत्व, मत्स्य व्यवस्थापन, माछाको पोषण तथा रोगव्याधी अनुसन्धान ।
- ताल, रिजरभ्वाएर, घोल जस्ता सिमसारको संरक्षण र दिगो उपयोगको लागि सह-व्यवस्थापनका नमूना प्रणाली अनुसन्धान ।

क्रियाकलापहरू

- मत्स्य पालनमा उपयोगी माछाहरूको आनुवांशिकी सुधार गरी उत्तम गुण भएका माछाहरूको प्रजनन् ।
- साना किसानहरूको लागि कम लागत बढी उत्पादन लिने र लघु मत्स्य पालन व्यवशायका लागि उपयुक्त माछाका जात तथा प्रविधिको विकास ।
- उत्पादकत्व बढाउने खालका स्थान सुहाउदो मत्स्य पालन प्रविधि विकास र परिमार्जन ।
- न्यानो पानीमा सघन माछा पालन प्रविधिको विकास गर्न व्यवसायिक खेतीका लागि उपयुक्त स्वदेशी तथा विदेशी माछाहरूको मत्स्य विज्ञान, जीवनचक्र, आनुवांशिक मत्स्य पोषण, रोग तथा परजिवि सम्बन्धि अध्ययन अनुसन्धान ।
- मत्स्य पालन प्रविधिको सामाजिक, आर्थिक तथा वातावरणीय प्रभाव अध्ययन ।
- प्राकृतिक जलाशयहरूको संरक्षण र दिगो उपयोगको लागि जलीय वातावरणको जैविक, भौतिक तथा रसायनिक गुणहरूको सर्वेक्षण/अध्ययन ।
- प्राकृतिक जलाशयहरूमा स्थानीय समुदायहरूको सहभागितामा स्वदेशी माछाहरूको प्रजनन्स्थल संरक्षण, सम्वर्द्धन तथा संख्या अभिबृद्धि गर्ने ।
- अनुसन्धानबाट विकसित प्रविधि परिमार्जनका लागि कृषकको थलोमा वाह्य अनुसन्धान ।
- मत्स्यपालनमा संलग्न व्यवसायीहरूलाई प्राविधिक ज्ञान, तालिम तथा सेवा टेवा ।

आ.व. २०७६/७७ मा प्राप्त मुख्य मुख्य उपलब्धीहरू:

मत्स्य अनुसन्धान केन्द्र पोखराले जलाशयको उत्पादकत्व बृद्धि, आय आर्जन, जीविकोपार्जनमा सुधार, गरिवी न्यूनिकरणमा सहयोग पुग्ने विभिन्न अनुसन्धान कार्यक्रम संचालन गर्नुका साथै मत्स्य पालनमा संलग्न मध्य पहाडी क्षेत्रका कृषकहरूलाई प्राविधिक ज्ञान तथा सेवा टेवा सम्बन्धी कार्यक्रम गर्दै आईरहेको छ । यस आ.व. २०७६/७७ मा तालहरूको भौतिक तथा रासायनिक गुणहरूको अध्ययन, पोखरी तथा पिंजडाको उत्पादकत्व बृद्धि, ट्राउट तथा पोखरीको स्थल छनौट, तालहरूको जलाशयको घनत्व व्यवस्थापन, विषयगत तालिम, महिलाहरूको सहभागितामा तालहरूको जैविक विविधता संरक्षणका साथै कृषकहरूको आवश्यकतालाई ध्यानमा राखी श्रोत विउ उत्पादन तथा वितरण सम्बन्धी कार्य गरी निम्नअनुसार उपलब्धी हासिल भएको थियो ।

कमन कार्प पोखराको भाले र भैरहवाको पोथी विचको क्रस, पोखरा लाईन र भैरहवा लाईनको वृद्धि दरको अनुसन्धानको नतिजा अनुसार क्रसको वृद्धि दर राम्रो पाईएको छ । कमनकार्प र सिल्भर कार्प जातका शुद्ध नश्लका हुर्कौला भुराहरू टैगिंग गरेर मत्स्य विकास केन्द्र भण्डारा र श्री न्यु मुखिया मत्स्य प्रजनन् फार्म शहिद नगर-४, धनुषा, ह्याचरीमा हस्तातरण गरियो । शुद्ध नश्लका कमनकार्प ५००० गोटा भुराहरू हुर्किसकेका छन् ।

सहर माछाको दानामा ५% देखि ७.५% प्रोबायोटिक मिसाई खुवाऊदा सहरको वृद्धि प्रोबायोटिक न मिसाईएको दाना भन्दा बढी भएको पाइएको छ । मालुंगे सहर (Tor tor) सहर कालिगण्डकी मत्स्य ह्याचरी बाट ल्याई यस केन्द्रमा माऊ सम्म हुर्काउनको लागी व्यस्थापन भईरहेको छ ।

गुँदे, न्युरेनी, खास्टे, कमल पोखरी र दिपांग तालहरूको स्थलगत निरिक्षण गरि तालहरूको व्यस्थापन र माछाको उत्पादन सम्बन्धि अन्तरक्रिया कार्यक्रम सम्पन गरियो । प्रत्येक तालहरूको संरक्षण र माछा उत्पादन र संरक्षणको लागि सुक्षाव दिईयो ।

फेवा, बेगनास र रुपा तालहरूको मुहान, मध्य भाग र निकासको पिन्धको माटोको प्रिक्षन गर्दा रुपातालको माटोमा पोषक तत्वहरू (नाईट्रोजन र फस्फोरस र अर्गानिक पदार्थ) फेवा र बेगनास तालको तुलनामा बढी मात्रामा पाइएको छ । विश्व मत्स्य दिवस र माछाको महोत्स्य अवसरमा फेवा र बेगनासतालमा २५००० सहर र गर्दिको भुराहरू छाडिएका छन् ।

दैनिक माछाको तथायंक अनुसार चन्दा नामा र सिंघी माछा फेवा तालमा पहिलो पटक देखा परेका छन । दैनिक माछाको तथ्यांकअनुसार गएको आ.व. मा क्रमसः फेवा, बेगनास र रुपा तालबाट ४३.०१, २६.५९ र ५५.६३ मेट्रिक टन माछाको उत्त्पादन भएको थियो । क्लोरोफिल ए (Chlorophyll a) को आधारमा हाल फेवाताल मेजोट्रोफिक (mesotrophic) बाट युट्रोफिक (eutrophic) हुने अवस्थामा, बेगनासताल ओलिगोट्रोफिक (oligotrophic) र

मेजोट्रोफिक (mesotrophic) को विचको अवस्थामा र रुपाताल युट्रोफिक (eutrophic) को अवस्थामा रहेको पाईयो ।

सुर्राक्षित माछा भुरा ढुवानीको पुस्तिका र लिफलेट प्रकाशन भएको छ । यसको अनुसार ल्वाङको तेल माछाको जात अनुसार ५-७ माईक्रो लिटर प्रति लिटर पानिमा मिसाई माछा भुरा ढुवानी गर्न सकिन्छ । बिगहेड कार्प माछामा ल्वाङको तेलको मात्रा निर्धारण गर्ने Induction and recovery test को डाटाको विश्लेषण अनुसार ल्वाङको तेलको मात्रा ०.५ मि. लिटर/लिटर पानीमा माछाको सर्जिकल बेहोस तिन मिनट भित्र देखियो ।

यस केन्द्रमा पाईएका सिपि (Mussels) *Lamellidens marginalis* को बाहिरी आवरणको धुलो प्रयोग गरि बनाईएको इमेज र गोलाकार विड Pearl Culture को बिधि अनुसार ६०-८० ग्रामको ५०० गोटा सिपिमा इनोकुलेट गरी ६ महिना पालिएको पोखरीमा अध्यन अनुसन्धानको नतिजा अनुसार ईमेज विड implant गरि पोखरीमा पालन गरिएकोमा ईमेज विड्मा एक पातलो प्रतको पर्ल देखियो । यसको नतिजा अनुसार कम्तिमा १२-१८ महिना पाल्नु पर्ने देखिएको छ र १०० ग्राम भन्दा माथिको सीपीको प्रयोग गरिनुपर्ने देखिन्छ । सानो साइजको सिपिमा राम्रो पर्लको निर्माण हुन् सकेको छैन । नेपालमा पाईने सबै सिपि सानो साईजको छ ।

स्थानीय माछा संकलन गरि पौष्टिक मात्रा अध्यनको लागी बेगनास तालबाट ९ गोटा स्थानीय प्रजातिको माछा संकलन गरि प्रयोगशालामा विश्लेषण गरिएको छ । यसको नतिजा अनुसार चुच्चे बाममा प्रोटिनको मात्रा, भित्ते माछामा क्याल्सियमको मात्रा, भोटि माछामा फस्फोरुसको मात्रा र दुंगे बाममा आईरणको मात्रा बढी मात्रामा पाईएको छ ।

ह्याचालिंग देखि फ्राई साइजको भुरा हुर्काउनको लागि ग्रास कार्प ह्याच्लिंग्को घनत्व ४० लाखरहेका दरमा पोखरीमा पाल्दा ३०% सम्म बाच्ने दर पाइयो ।

चार जातको स्थानीय रंगिन माछा बेगनासताल र सिचाईको नहरबाट संकलन गरी घरेलुकरण गरियो । यी चार मध्ये दुई जातको रंगिन माछाले प्रजनन गर्न सफल भयो ।

एक थरि रंगिन माछाको दाना र पाँच थरि कार्पको दानाको कम्पोजिसन तयार गरी परीक्षण गरियो । कमन कार्प माछाको विद्धि दरको प्रिक्षणमा सोया चोकर र तोरीको पिना हालेको (माछाको सिध्रा नहालेको) को कम्पोजिसनमा माछाको सिध्रा ५% र १०% हालेको कम्पोजिसन भन्दा राम्रो पाईयो ।

पोखरी र रेस्वेमा माछापालनको लागि सम्भावना अध्यन गरि ४ वटा किसानहरू लाई सर सल्लाह दिईयो । केन्द्रको प्राविधिक सहयोगमा कास्की र मनांग जिल्लामा कृषक स्तरमा ट्राउट माछा पालन तथा प्रजननको लागि माउ व्यस्थापनको सहयोग गरियो ।

यस आर्थिक वर्षमा विभिन्न जातहरूको २३ लाख १८ हजार १ सय ४३ गोटा फ्राई भुरा र १० लाख ह्याचालिंग विक्री गरियो ।

EXECUTIVE SUMMARY

As the mandate of Fishery Research Station, Pokhara it is generating various technologies of aquaculture and fisheries on the basis of conducting research works for increasing productivity of water resources, income generation, livelihood enhancement, poverty reduction and providing technical and support services to the fisher community in mid-hill region. This station had completed the targeted 8 research projects, 1 outreach program and 1 seed production program as well as 2 research projects conducted by Kali Gandaki Fish Hatchery during this fiscal year (2076/77). It was expected that the findings obtained would be useful and applicable for farmers and stakeholders. Major activities accomplished in FY 2076/77 are summarized below:

An experiment was conducted in the ponds of FRS, Begnas to compare the growth of common carp cross line (Bhairahwa F× Pokhara M**)** with pure line of Bhairahwa and Pokhara. The results showed that cross line have found significantly higher ($p<0.05$) growth in comparison to Bhairwa line and Pokhara line.

The pureline of common carp and silver carp weighing about 100 gm and in 100 number with tagging was send to private hatchery in new Mukhiya farm Nanupatti, Dhanusha and Government Fish farm Bhandra for making future brood. 5,000 of common carp fry of pure line are rearing in ponds (<5 g).

Probiotics incorporation in feed was found effective for the growth of sahar.The results showed that 5% to 7.5 % incorporation of probiotics in feed have better growth results. The sahar reached to mean weight±Sd, 85.01±10.3g in 240 days culture period in the 7.5% incorporation of probiotics in feed.

Interaction meeting in each lake of Pokhara valley were completed with the active involvement of members and chairman of each lakes management committees. The improvement of fish yield and conservation of native fish species through management of Lake Environment was recommended for each lake.On the basis of $chlorophyll_a$ concentration, status of Phewa Lake fluctuated between mesotrophic- eutrophic condition while Begnas Lake fluctuated between oligo-mesotrophic and Rupa is in eutrophic condition. On the basis of transparency Khaste lake is categorized to eutrophic. Total fish harvested from three lakes of Pokhara valley was 125.23 metric ton. Fish harvested from Phewa Begnas and Rupa lakes were 43.01, 26.59 and 55.63, metric

ton respectively. The fish catch was peaked in the month of December in each lake. Twenty native and eight exotic fish species have been found in the catches of lakes of Pokhara Valley. For improvement native stock, 25000 of Sahar, Gardi were released in the lakes on the occasion "world fisheries day 2019".

Four native ornamental fish species were collected from Begnas lake and irrigation canal. The domesticated native fish are**:** *Puntius sophore, Danio devario, Danio rerio, Puntius conchonius*. Among these domesticated fish species *Danio devario* and *Danio rerio* were propagated successfully in the captive condition.

Six composition of feed formulation one for ornamental fish and five for carp were formulated and tested. Three feed formulation (No shrimp, 5% shrimp, and 10% shrimp) iso-protein was tested on the pure line common carp. The growth of pure line common carp was higher in feed composition without shrimp but the growth was not found significant difference between feed composition ($p>0.05$). It suggests that the feed formulation based on plant protein could be an option to replace the shrimp.

Mantle cavity image bead implantation were done in 500 mussels. Six months results showed that mussels have developed shining coating on the implanted beads. The preliminary results showed that the mussels used for pearl farming should be above 100 gm size. The implanted mussels should be reared for 12-15 months in the ponds with high density of plankton. Further trials should be carried out to find the image pearl for commercial use.

Nine native fish species samples were collected from Begnas Lake to know the nutrients level in these species. Sample were prepared and proximate analysis: moisture (%), crude fat (%), crude protein (%), total ash (%) and mineral analysis (iron, calcium and phosphorus) were analysed in the laboratory**.** The results showed that nutrients contents were varied in each species. Comparatively, high amount of crude protein was found in the *Mastacembelus armatus,* calcium was found in the *Puntius conchonius,* phosphorus was found in the *Channa striatus* and iron was found in the *Xenotodon cancilla.*

In the FY 2076/77, one trout farm and three carp feasibility study was completed.

This year 2318143 number of fry and fingerlings and 10 lac of hatchlings of different fish species were distributed to farmers for nursing and fish production in pond culture, cage fish culture, rice-fish culture etc.

1. WORKING CONTEXT

Mission

Develop appropriate improved technology that would enable to increase fish yield per unit area from improved fisheries and aquaculture techniques.

Challenges/issues

- Trophic status of Lakes is changing: Assessment of aquatic environment and biodiversity is necessary.
- Increase the productivity of natural water: Stock enhancement program could be promoted in different natural waters. The existing stocking density in Lakes of Pokhara Valley should be increased to enhance productivity with promotion of native species.
- The productivity of Silver carp and Bighead carp is characterized by low productivity: Use of supplementary feeding in different combination of fish species is necessary to sustain cage aquaculture.
- Human encroachment on aquatic environment and aquatic biodiversity: breeding ground of some species reported to destroyed/disturbed.
- Invasion of some alien species: need to be assess.
- Climate change impact: Coping with appropriate technology/management practices.
- The fish catch/production from open water stocking is limited/hindered. Need of introduction and improvement of fishing gear as well as improved and best management techniques to increased production.
- Expansion of aquaculture in potential areas of mid-hill districts is slow.
- The growth potential from pond aquaculture of carps seems steady: need strategy to change gradually from extensive production to semi-intensive and intensive farming methods in all aquaculture system.

Research needs in capture fisheries

- Studying production, dominant catch trends, species composition and
- Ecological status
- The fish production from open water stocking is limited: Develop suitable, eco-friendly and responsible harvesting technology (fishing gear) as well as improved management techniques to increased production.
- Pilot-scale testing of appropriate management models for improving fisheries in reservoirs, lakes and flood plain wetlands.Study the impact of human encroachment on aquatic biodiversity
- Technologies for utilization of fish by-catch

- Develop climate change action plan ensuring to minimize negative impacts and exploit new opportunities.

Research needs in aquaculture

- Diversification in aquaculture by bringing more potential species and varied culture systems.
- Breeding and culture of high value native and exotic fishes.
- Developing sustainable aquaculture technologies for open water culture
- Fish health management, immuno-prophylaxis and therapeutic against common diseases.
- Ornamental fish culture, breeding and farming of indigenous and exotic species.
- Low production from natural fed cage culture: Need use of feeding strategies and species composition.
- Up-scaling of breeding and culture technologies for potential coldwater fish species.
- Up-scaling pen and cage culture technology in reservoirs and wetlands.
- Development of fish nutrition, feed and feeding technology for all aspects of aquaculture and culture of live feed organisms.
- Develop technique to increase survival of fry/fingerlings and round the year supply of seed.
- Genetic improvement in existing fish species for growth and disease resistance.
- Minimize post-harvest losses and effective utilization of fishing waste.
- Develop the appropriate value chain mechanism and marketing network.
- Development of technology of pearl culture, mussel's culture.

Thematic Area of Fisheries Science

- Aquatic genetic resources, conservation, evaluation and utilization
- Fish resources improvement and maintenance
- Aquatic resources management
- Aquaculture and fisheries management
- Fish nutrition and health management
- Fish breeding, genetics and biotechnology
- Post production management and value addition
- Hatchery management and source seed production
- Climate change, impact assessment and mitigation
- Technology verification, communication and promotion
- Socio economic, market and policy research
- Participatory approach in natural resources/wetlands management

2. INTRODUCTION

2.1 Introduction

- This station was established in 1962 as “Lake Development Centre" which was changed the name as Fisheries Development Center in late 1960s.
- In 1975 an “Integrated Fishery and Fish Culture Development Project (NEP/73/25)" was implemented under FAO/UNDP cooperation.
- Later recognized as “Agriculture Research Station (Fisheries), Pokhara in 1993 under Nepal Agricultural Research Council (NARC). Currently from 2071/72 named as “Fishery Research Station, Pokhara.
- Functioning as “Lake Fisheries Research Station” for aquatic and fisheries resources conservation and proper utilization.
- Facilitated in expansion of cage fish culture and open water fisheries management in Nepal.
- Technical/resource support and services to pond/cage/raceway aquaculture farmers and fishers.

2.2 Goal

Enhancement of fisheries/aquaculture contribution to livelihoods, especially those of the wetland dependent rural poor through increased production and productivity.

2.3 Objective

- Development of appropriate aquaculture technologies for improving production and productivity.
- Development of appropriate inland water management and resource conservation technologies for supporting wetland dependent community.
- Appropriate delivery of technical and resource services to the farmers/fishers community in western Nepal.

2.4 Strategies

- Aquaculture technology generation for poverty reduction and increased water productivity according to NARC policy guidelines.
- Domestication of native fish species for use in aquaculture and genetic resource conservation.
- Development/improvement of aquaculture technologies suitable for various natural water resources.
- Research on fish stock improvement, nutrition and health of aquaculture species.

- Research on modality of co-management of wetlands for sustainable conservation and utilization.

2.5 Current thrust area for research

- Selective breeding to improve the stock performance of aquaculture species.
- Development of small-scale and low level-input based fish farming for ultra-poor community.
- Productivity assessment of pond /cage/enclosure/ raceway/rice field to identify appropriate technology recommendation domain.
- Implementation of research, more specifically in fish nutrition, physiology, genetics and pathology for developing intensive warm freshwater fish farming systems for commercially important native and exotic fish.
- Environmental, social and economical impact of aquaculture technologies and fish farming system.
- Water environment/water chemistry survey to optimize the utilization of natural productivity of water resources into fish production.
- Participatory fish stock enhancement for vulnerable native fish species in target water body.
- Demonstration of fisheries co-management in lakes, rivers and streams.
- On farm testing and verification of generated technology and scientific information in farmer's field.
- Technical support to coldwater aquaculture in potential areas.
- Development of technology of pearl culture.

2.6 Infrastructure and facilities

The station has infrastructure and facilities available in different places has been provided in **Annex 1**.

2.7 Organization structure and human resource

This station has 44 approved post of different level staffs. Currently 14 post are only fulfilled. Name of employees with their post and organization structure of this station are provided in **Annex 2.1 and 2.2.**

3. RESEARCH HIGHLIGHTS

3.1 GENETIC IMPROVEMENT OF CARP STOCKS FOR QUALITY FISH SEED PRODUCTION

Poor reproductive performance, retarded growth and morphological deformities of hatchery produced fish seeds experienced by farmers claimed to be due to poor brood stock management and inbreeding depression. Replacement of deteriorated stock and/or genetic improvement of farmed species is necessary to increased fish production in Nepal. Considering this planned breeding program was initiated through introduction of improved strain of common carp, Chinese carp and inter location crossing of common carp.

3.1.1 Maintenance of Pure Line of re-introduced carps

Pure line (improve strain) stock of common carp and Chinese carp had been maintained in ponds. These stock of fish were provided with regular fertilization and feeding at 3-4% of their biomass. Occasional replacement of water was done to maintain the water quality. Different species of fish of varying weight size were stocked in ponds for next breeding season (Table 1).

Table 1: Pureline brood maintained at Begnas and Phewa Ponds.

Fish species	No	Average size(kg)
Common carp	98	1.5-2.3
Silver carp	68	1.5-2.1
Grass carp	17	1.5-2.1
Bighead carp	35	1.5-2.0

3.1.2 Production of Foundation Seed

Sexually matured brood fish of common carp were segregated and maintained separately in well prepared ponds before breeding season. The fish were fed daily with 25% CP feed. During breeding season in late March and April month selected brood fish were given ovolin hormone @ 0.4 mg/kg to stimulate spawning. The breeding results is provided in the Table 2.

Table 2: Breeding summary of pure line common carp

Total no of male used	10 (avg. size 2-2.3 kg)
Total no of female used	18 (avg. size 1.5-2 kg)
Fertility %	60
Hatchability %	51
Hatchling production (no)	400,000

Likewise, silver carp pure line was maintained in separate pond and fed with 25% CP feed. Pond is fertilized with Urea, DAP and compost as standard protocol to maintain plankton level in pond. Breeding of silver carp was done in last week of May. Hormone ovolin was used for stimulate spawning of fish. The produced fry were nursed in ponds and kept for PIT tag to distribute in private hatchery for further propagation. Breeding details are given in the Table 3.

Table 3: Breeding summary of pure line Silver carp

Species: Silver carp	
Breeding parameters	
Female (No. wt kg)	3(av.size2-2.1kg)
Male (No. wt kg)	5(av.size2-2.1kg)
Total No. of egg	1,50,000
Fertility %	78%
Hatching %	74%
Hatchling No.	86,580

3.1.3 Comparison of Multi-Trait (Reproduction, Growth, Shape and FCR) of Pure Line and Existing Stocks of Carp

Comparative growth of common carp cross line, and pure line of Bhairwa line and Pokhara line at Begnas

An experiment was conducted in ponds at Begnas to compare growth of common carp cross line (Bhairahwa F× Pokhara M**)** with pure line of Bhairwa and Pokhara .The stocking size was 5.1 ± 0.65g and stocked at the rate of 1.5 fish/m^2. 25% CP pellet feed was used at the rate of 3 % of body weight. The experiment was done in the earthen pons of 50 m^2. Water quality parameters were measured. The results showed that cross line have found significantly higher ($p<0.05$) growth in comparison to Bhairwa line and Pokhara line (Fig.1).

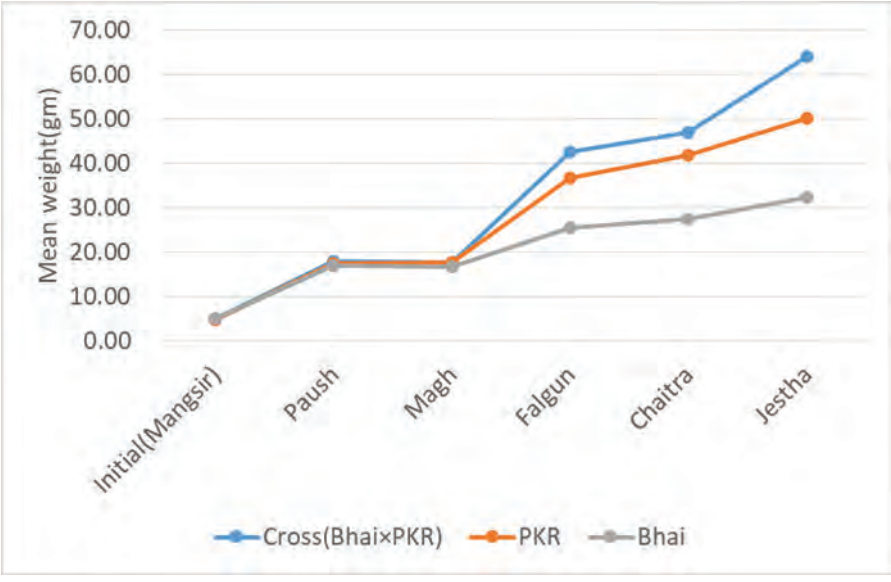


Fig. 1: Growth of common carp cross Bhairwa line and Pokhara line at Begnas

3.1.4 Selective Breeding of Common carp

Inter location crossing of existing brood stock of common carp were performed with broods of different eco location in order to improve genetic quality. The crossing made were between Bhairahwa Female F× Pokhara Male.Standard practice was adopted to maintain different cross line breed and breeding protocol. Fry produced from these crossing lines were reared separately further selection.

3.1.5 Monitoring the performance of foundation seed in private hatchery

The pureline of common carp and silver carp weighing about 100 gm and in 100 number with tagging was send to private hatchery, new Mukhiya farm Nanupatti, Dhanusha. The pureline of common carp and silver carp weighing about 100 gm and in 100 number with tagging was send to Government Fish farm Bhandra for making future brood.

5,000 of common carp fry of pure line are rearing in ponds (<5 g). Tagging will be done after achieving size of over 25 g. The tagged fish will be provided to selected private fish hatchery to multiply and maintain genetic line. Their performance in terms of growth and fecundity will be monitored after sexual maturity in upcoming breeding season.

3.2 EXPLORATION OF CULTURE POTENTIAL OF INDIGENOUS FISH SPECIES (SAHAR, GARDI)

Nepal possesses abundant water resources in which 230 fish species are reported to occur. Among these some native species, such as sahar (*Tor putitora,* Tor tor), Katle (*Acrossochilus hexagonolepis*), Asala (*Schizothorax* spp), *Clarias batrachus*, fresh water eel (*Mastacembalus armatus*) and Gardi (*Labeo dero*) etc. has considered potential species which could be develop as aquaculture species. Preliminary study on growth potential of sahar and gardi in mono and polyculture system observed in captive environment in different ecological regions provides the opportunity to include this species in current aquaculture setting of the country. However, sustainable inclusion of sahar and gardi in aquaculture could be assured by the development of a suitable breeding and rearing technology.

3.2.1 Brood Management of Sahar and Gardi

About 28 no of female averaging 3-4 kg sizes and 48 no of male brood fish averaging 2-3 kg sizes of sahar were stocked and managing in ponds. Similarly about 50 pairs of brood fish of gardi are also maintaining and reared in ponds. Brood fish were fed with 30 % CP feed @ 3% body weight /day. Water quality check and maintenance have been done regularly. Application of fertilizer done regular as required on the basis of water quality. Water exchange in ponds was done as per necessary. The maximum and minimum water temperature ranged from 14^{o}C to 31^{o}C during management period this year. The monthly water temperatures recorded from ponds at Begnas are provided in Table 4, Figure 2.

Table 4: Monthly water temperatures (^{o}C) recorded from Begnas ponds during year 2076/77

	Pond water Temperature °C		
	Average	**Minimun**	**Maximum**
Shrawan	28.7	27	30
Bhadra	28.7	28	29
Ashoj	28.3	26	29
Kartik	23.7	21	27
Mangsir	19.1	17	21
Poush	15.5	14	17
Magh	15.6	15	17
Falgun	19.4	17	21
Chaitra	22.4	21	25
Baisakh	24.7	23	26
Jestha	27.8	24	30
Asar	28.6	27	30

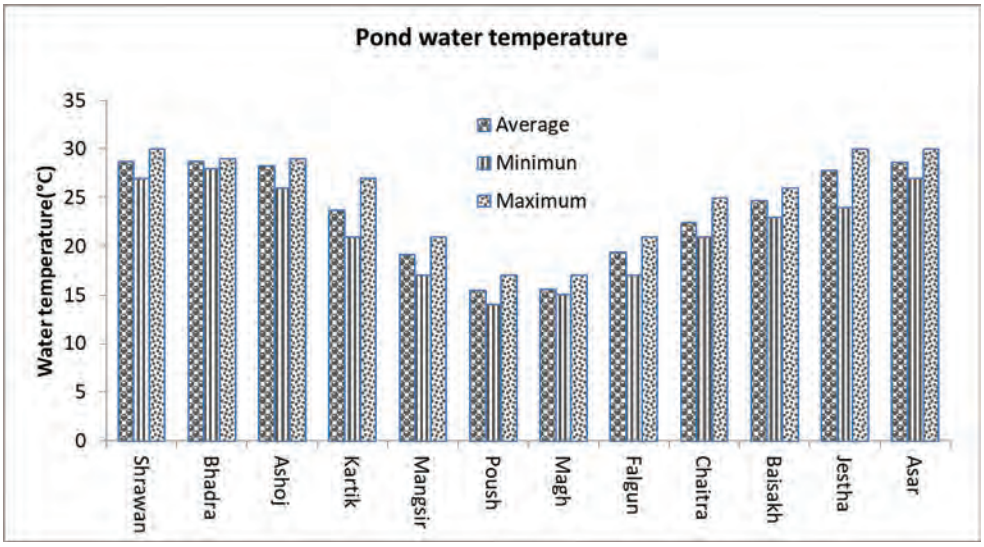


Fig.2: Monthly variation of pond water at FRS office

Table 5: Water quality parameters of brood ponds of Sahar and Gardi

Parameter	Range
Transparency (cm)	25-30
Temperature(^{0}C)	29.5-30.5
Dissolved oxygen (mg/L)	6.8-7.4
pH	8.3
Total alkalinity(mg/L)	38-41
Total Hardness(mg/L)	60-65
PO_4 (mg/L)	1.20-1.46
NO_2 (mg/L)	0.02-0.05
NO_3 (mg/L)	0.02-0.05
NH_3 (mg/L)	0.01-0.02
Chlorophylla (µg/litre)	5.45-5.5

3.2.2 Seasonal Spawning Performance of Indigenous Fishes

Brood fish of sahar were checked time to time for maturity condition by pressing the abdomen. This year only 4 female fish averaging size of 1.9 kg-3.2 kg were stripped out while 10 fishes were found in over ripped condition during different time period in breeding season. Eggs were stripped out from fully matured female fish. The milt was collected from male fish and fertilization was done immediately by mixing eggs and milt. The swollen eggs were incubated in hatching trays with running water. The

incubation temperature ranged from 21 °C to 21.3 °C. The average fertility ranged from 95.0% to 94.0% with hatching rate of 90% to 91%. Although month of Sep-Oct and March-April was considered for sahar breeding, this year most of the fishes were found to develop gonad for stripping during month of March-April. The breeding performance data of sahar are provided in **Table 6.**

Table 6: Breeding performance of indigenous fish species Sahar in FRS, Pokhara during 2076-77.

Breeding parameters	Date 2076/12/07	Date 2076/12/27
Fish species	Sahar	Sahar
Female (No. wt kg)	2(4.5kg)	2(3.6kg)
Male (No. wt kg)	4(3.6 kg)	4(4.2 kg)
Water temperature(^{0}C)	21.1°C	21.3°C
Total weight of egg	328 gm	250 gm
Fertility %	95%	94%
Hatching %	91%	90%
Hatchling No.	10000	9000

3.2.3 Hatchling Nursing and Fry Rearing of Sahar

The fry of sahar produced during breeding season were stocked in well prepared ponds. Sahar hatchlings were stocked at 10 million/ha. Stocked fry were initially fed with micro feed (43% CP) and later with farm made mass feed (25% CP) daily. Ponds were frequently fertilized with 20 kg Urea and 20 kg DAP/ha for plankton availability. About 2356 fry of different size ranging from 1g to 15 g were sold to different stakeholders till Ashad.

3.2.4 Effect of probiotics on growth and yield of Sahar (Fingerlings to grow out)

The use of probiotics in feed for fish and its inclusion in intensive aquaculture to promote healthy gut is growing. Probiotics have been used in aquaculture.to increase the growth of cultivated species. The need for sustainable aquaculture has promoted research into the use of probiotics on aquatic organisms. The initial interest was focused on their use as growth promoters and to improve the health of animals; however, new areas have been found, such as their effect on reproduction or stress tolerance. Post pelleting spraying in oil or water is the best option method for now to use in feed of fish.

An experiment was conducted in the raceway to study the effect of probiotics on growth and yield of Sahar. Sahar was stocked at the rate of 1 fish/m^2. The stocking weight of Sahar was 25.3± 10.8. The probiotics incoprporation into feed were at the rate of 5%, 7.5% and 10%. The results showed that 5% to 7.5 % incorporation of probiotics in feed have better growth results. The sahar reached to 85.01±10.3g in 240 days culture period in 7.5% incorporation of probiotics in feed(Fig.3). Probiotics incorporation in feed was found effective for growth of sahar.

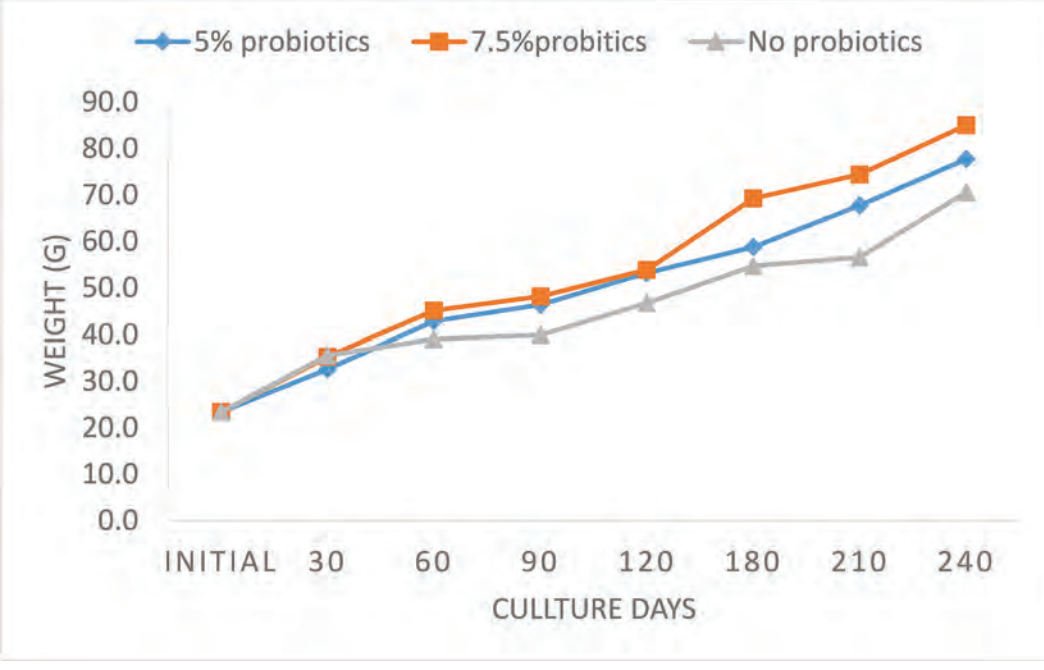


Fig. 3: Growth of Sahar in different doses of probiotics

3.2.5 Effect of probiotics on growth and yield of Gardi: fry to fingerlings

An experiment was conducted in the hapa (1m×1m×1m) fixed in the pond (Fig.4) The fish was stocked at the rate of 10 fish in each cages. Fish were fed 30% CP feed at the rate of 3% of body weight as the treatment 1: Probiotics 1.5 gm/kg feed;treatment2: Probiotics 2.0 gm/kg feed; Treatment3;Probiotics 2.5 gm/kg feed; Treatment 4: without probiotics. The results showed that 1.5 gm/kg feed was found better than other treatment (Fig.5). Further study will be carried out in the next year.

Fig. 4: Experimental unit of Gardi growth trial in different doses of probiotics.

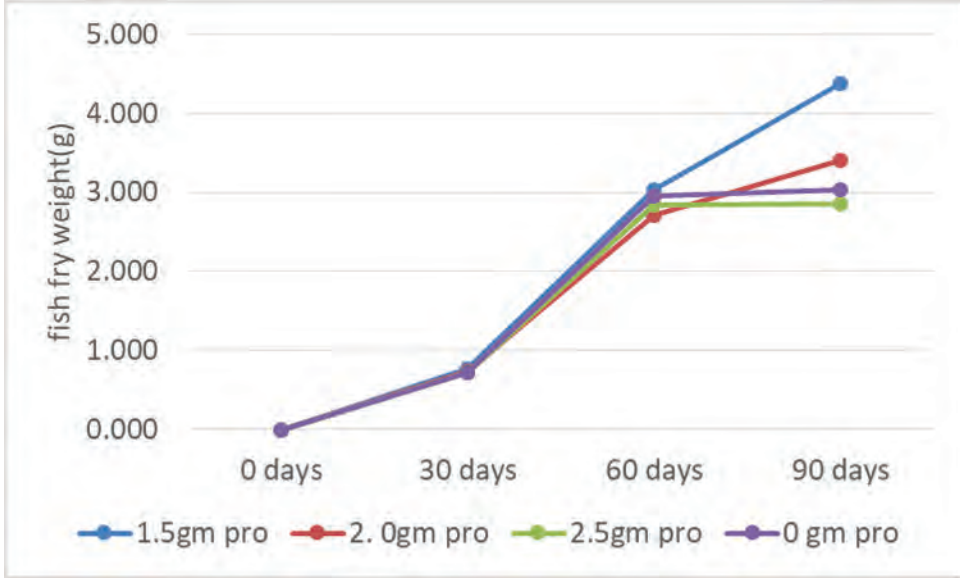


Fig. 5: Growth of Gardi in different doses of probiotics

3.3 FISH YIELD ENHANCEMENT OF OPEN WATER (LAKE and RESERVOIR) FISHERIES THROUGH FISH STOCK MANAGEMENT WITH COMMUNITY PARTICIPATION

The effectiveness of lake and reservoir fisheries (culture-based fisheries) varies widely between locations. The potential production of culture-based fisheries is strongly linked to ecosystem productivity. Presently, Lakes of Pokhara Valley are facing environmental problems posing threat to the sustainability of the lake resources including declining proportion of important native fishes from the lake have been encountered for sustainable lake fisheries and other resource management in the lake. This could be improved through improved management, stock enhancement and increasing the skill of local fishermen for benefit of community involved in fishing profession.

3.3.1 Strengthen capacity of Fisher Community for Open Water Fisheries Management and Sustainable Use

Interaction meeting in each lake of Pokhara valley were done with the member and chairman of lakes committees. For the improvement of fish yield and conservation of native fish species recommendations for each lake was provided.

In Phewa and Begnas Lakes**,** mostly traditional man and women fishers known as *Pode* or *Jalari,* while in Rupa Lake many ethnic groups such as *Kami, Damai, Sarki, Magar, Gurung, Chhetri* and *Bradmin* including *Pode* are engaged in lake fisheries for their livelihood. These fisher groups were sensitized through organizing meetings at station, participation in farmers' monthly meeting for conservation and wise utilization of aquatic resources. Farmers were provided with technical support to run fish hatchery in Rupa Lake. Advised/suggested to Fisher community for open water Management and procedure of fishery management, harvesting, conservation, fish seed released in lakes of Pokhara valley by organizing interaction program and monitoring monthly meeting. The suggestions for the improvement of fish productivity are summarized below.

Phewa Lake

Water quality improvement is the prerequisite for the sustainable fish yield. Regular stocking of fish is needed to get regular harvest. Stocking of cages as well as open water fisheries, needs advanced size fingerlings. The outlet area should be always screened to avoid escape of fish from the Lake. For rearing of fish fry, nursery cage operation is essential. It would be better, If PFEC (Phewa fisheries entrepreneur cooperative) could arrange nursery ponds near to lake. The breeding ground of native fish species should be maintained to get regular harvest of native fish species as it fetch higher prices. The protocol of closed season and mesh size should be always followed by Jalari fisher.

Begnas Lake

Regular stocking of fish is needed to get regular harvest. Stocking of cages as well as open water fisheries, needs advanced size fingerlings. For rearing of fish fry, nursery cage operation is essential. Partial feeding with the floating feed of good quality having 35% CP for nursing of fish fry to advanced size fingerlings is recommended. Feed should be floating for the fingerlings. It would be better, If BFEC (Begnas fisheries entrepreneur committee) could arrange nursery ponds near to lake. The outlet area should be always screened to avoid escape of fish from the Lake. The breeding ground of native fish species should be maintained to get regular harvest of native fish species as it fetch higher prices.

Rupa Lake

Regular stocking of fish is needed to get regular harvest. Stocking of cages as well as open water fisheries, needs advanced size fingerlings. For rearing of fish fry, nursery cage operation is essential. Partial feeding with the floating feed of good quality having 35% CP for nursing of fish fry to advanced size fingerlings is recommended. Feed should be floating for the fingerlings. Rupa cooperative could utilize their nursery ponds for the production of fingerlings size fish. The outlet area should be always screened to avoid escape of fish from the Lake. The breeding ground of native fish species should be maintained to get regular harvest of native fish species as it fetch higher prices.

Khaste and Neureni Lakes

For recreational fisheries in the lake, Lake should be stocked with Sahar (*Tor putitora*). This lake could be stocked with common carp (C*yprinus carpio*) and bighead carp (*Aristichthys nobilis*) for regular production. Rohu (*Labeo rohita*) and Naini (*Cirrhinus mrigala*) could be stocked at only 10 % of total stocked fish. For rearing of fish fry, nursery cage operation is essential. Partial feeding with the floating feed of good quality having 35% CP for nursing of fish fry to advanced size fingerlings is recommended. Feed should be floating for the fingerlings. It would be better, if it could be arrange nursery ponds near to lake. The outlet area should be always screened to avoid escape of fish from the Lake. The breeding ground of native fish species should be maintained to get regular harvest of native fish species as it fetch higher prices.

Dipang Lake

Larger size fish of Grass carp (> 400 gm) and common carp (> 500gm) needed to stock in the lakes for biological clearance of aquatic grasses from the lake. For recreational fisheries in the lake, Lake should be stocked with Sahar (*Tor putitora*). This lake could

be stocked with common carp (*Cyprinus carpio*) and bighead carp (*Aristichthys nobilis*) for regular production. Rohu (*Labeo rohita*) and Naini (*Cirrhinus mrigala*) could be stocked at only 10 % of total stocked fish. The outlet area should be always screened to avoid escape of fish from the Lake. The breeding ground of native fish species should be maintained to get regular harvest of native fish species as it fetch higher prices.

Gunde Lake

For recreational fisheries in the lake, Lake should be stocked with Sahar (*Tor putitora*). This lake could be stocked with common carp (*Cyprinus carpio*) and bighead carp (*Aristichthys nobilis*) for regular production. Rohu (*Labeo rohita*) and Naini (*Cirrhinus mrigala*) could be stocked at only 10 % of total stocked fish. The outlet area should be always screened to avoid escape of fish from the Lake. The breeding ground of native fish species should be maintained to get regular harvest of native fish species as it fetch higher prices.

Kamalpokhari

Kamal Pokhari having very small area for culture of fish. It is recommended to use native fish species such as Sahar (*Tor putitora*) as recreation fisheries. This lake could be stocked with common carp (*Cyprinus carpio*) and bighead carp (*Aristichthys nobilis*) for regular production. Rohu (*Labeo rohita*) and Naini (*Cirrhinus mrigala*) could be stocked at only 5 % of total stocked fish. The outlet area should be always screened to avoid escape of fish from the Lake. The breeding ground of native fish species should be maintained to get regular harvest of native fish species as it fetch higher prices.

Maidi Lake

This Lake is occupied by marshy land area. Around 3 ha area is visible as water. Around 10 ha area from the North area should be screened. After screening, larger size fish of grass carp (> 400 gm) and common carp (> 500gm) needed to be stocked in the lake for biological clearance of aquatic grasses from the lake. The nursery ponds should be constructed near to lake in the north part of lake for the growing fry up to 50-100 g. The fish hatchling and fry should be brought from the trusted nursery to avoid diseases.

3.3.2 Environmental/Biological Survey of Lakes and Reservoir in Mid Hill

3.3.2.1 Survey of sediments of lakes of Pokhara valley

The nutrients bind in the sediment plays a crucial role in the productivity of lakes. The objectives of this study was to access the nutrients presents in the sediments of Phewa, Begnas and Rupa lakes of Pokhara valley. Composite sediments samples were taken

from three samplings points: inlet, mid lake and outlet area of each lake from October-November months just after monsoon over.

Nutrients parameters found in the sediments of Phewa Lake, Begnas Lake and Rupa Lake are presented in the table 7.

Table 7: Nutrients parameters (Mean±SD) found in the sediments of Phewa Lake, Begnas Lake and Rupa Lake

Lake	pH	OM %	Nitrogen (%)	Phosphorus Kg/ha	Potash Kg/ha
Phewa	5.2	5.2 ± 0.7	0.26 ±0.04	81±44.3	368.7±25
Begnas	5.9	1.6±0.7	0.09±0.01	18.8± 1.2	287.4±19
Rupa	5.1	7.1 ± 4.6	0.35±0.24	59.8±9.6	293±54.3

3.3.2.2 Survey of water quality of lakes of Pokhara valley

Water samples for physical, chemical and biological parameters of water were collected monthly from Lakes of Pokhara Valley (Phewa, Begnas, Rupa and Khaste). The limnological characteristics of the lakes of Pokhara valley are given in Table 8.

Table 8: Physico-chemical variables of Phewa, Begnas and Rupa Lake water during the year 2076-77

Parameter	Phewa	Begnas	Rupa	Khaste
Water temperature(°C)	15.8-30.5	15.9-29.5	13-29.5	16-30
pH	6.5-9.14	8.35-9.19	9.11-9.16	7.6-9.31
Dissolved oxygen(mg/L)	0.2-10.05	0.3-9.8	5.9-12.21	6.25-9.84
Transparency(m)	1.3-2.0	1.6-3.5	0.2-1.0	0.3-0.7
Ammonium (mg/L)	0.004-0.018	0.004-0.010	0.01-0.015	0.002-0.005
Nitrate plus nitrate (mg/L)	0.002-0.023	0.002-0.011	0.002-0.026	0.004-0.025
Phosphorus(mg/L)	0.000-0.015	0.000-0.005	0.000-0.008	0.001-0.002
Chlorophyll a (mg/m3)	4.0-25.1	2.7-17.3	10.0-65.2	-

On the basis of chlorophyll$_a$ concentration, status of Phewa Lake fluctuated between mesotrophic- eutrophic condition while Begnas Lake fluctuated between oligo-mesotrophic and Rupa is in eutrophic condition. On the basis of transparency Khaste lake is categorized to eutrophic.

3.3.3 Effect of management variables such as stocking size and density, post release performance and harvest regulation on fisheries yield.

On the basis of annual catch data, every year fish population is assessed. The carrying capacity of lakes, fish population and water quality is considered for the stock regulation. The population of native fish is maintained through restocking program each year. The stocking size varied 1-5 g size. Stocking program was coincided during social ceremonies such as fish festival, world fisheries day, wet land day, world environment day etc. to increase awareness of natural resources conservation themes. The stocking program was carried out after the off set of monsoon to avoid flooding effect in close participation with the targeted community. Gill nets were usually used on daily basis mainly in night time to catch fish. Post release performance of fry will be evaluated in year after.

3.3.4 Study on effect of protected breeding ground on fish abundance and social encroachment

Fisher community specifically women groups were encouraged to protect breeding ground of native species and illegal fishing. "Macchapuchhre Women Group (MWG)" in Phewa and "Piple Women Group (PWG)" in Begnas belonging to Jalari community were actively involved in resource conservation as well as cage fish culture and different fishery related works. These groups were supported by providing awareness material (display board, pamphlet, and poster) and to patrol over inlet stream of lakes for native fish protection during their spawning season from June to October. Awareness campaign for protection of fish biodiversity was continued. This program was particularly very effectively implemented in Phewa Lake.

3.3.5 Collection of Fish Catch Data

Daily fish catch data were collected from fish landing sites of Phewa, Begnas and Rupa lakes of Pokhara valley. Total fish harvested from three lakes of Pokhara valley was 125.23 metric ton. Fish harvested from Phewa Begnas and Rupa lakes were 43.01, 26.59 and 55.63, metric ton respectively (**Fig. 6**).

The productivity (yield, kg/ha) of Phewa, Begnas and Rupa lakes were 97.7, 83.1 and 556.3 respectively (Fig.7). The harvest of fish increased in the winter months.

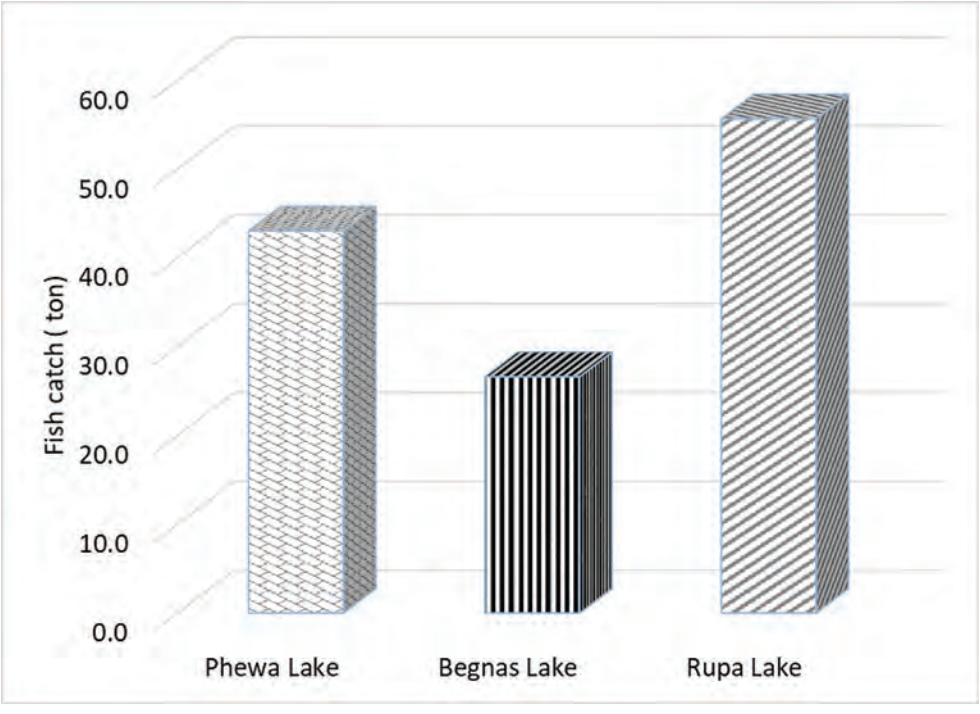


Fig. 6: Annual fish harvest from Phewa, Begnas and Rupa lakes in FY 2076/77.

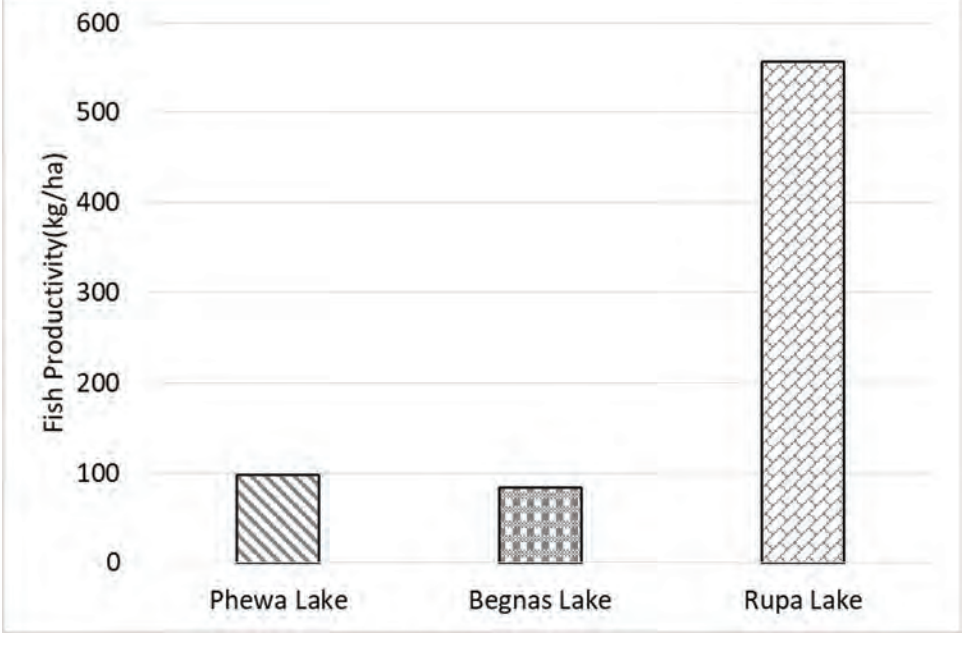


Fig. 7: Productivity of Rupa, Phewa and Begnas Lake in 2076/77.

Fish species contributions to total catch

The list of fish species appeared in the catches and survey are presented in table 9. Total of 20 native and eight exotic fish species have been found in the catch and fish survey. Species contribution to the total catch of each lake was varied greatly.

Table 9: Fish species of Phewa, Begnas and Rupa lakes appeared in the catches and fish survey in FY 2019/20.

S.N.	Scientific name	Local name
A.	**Native fish species**	
1	*Tor putitora*	Sahar
2	*Neolissochilus hexagonolepis*	Katle
3	*Cirrhinus reba*	Rewa
4	*Barilius barna*	Lam Fageta
5	*B. bola*	Fageta
6	*B. vagra*	Fageta
7	*B. bendelisis*	Fageta
8	*Puntius sarana*	Kande
9	*P. sophore*	Bhitte/Bhitta
10	*P. titius*	Bhitte/Bhitta
11	*P. ticto*	Bhitte/Bhitta
12	*Cirrhinus mrigala*	Naini
13	*Catla catla*	Bhakur
14	*Labeo rohita*	Rohu
15	*Mastacembelus armatus*	Chuche Bam
16	*Xenentodon cancila*	Dhunge Bam
17	*Clarias batrachus*	Magur
18	*Mystus bleekeri*	Junge
19	*Channa orientalis/ Channa gachua*	Bhoti
20	*Channa punctatus*	Bhoti
B.	**Exotic fish species**	
21	*Aristichthys nobilis*	Bighead carp
22	*Hypophthalmichthys molitrix*	Silver carp
23	*Ctenopharyngodon idella*	Grass carp
24	*Cyprinus carpio*	Common carp
25	*Clarias gariepinus*	African magur
26	*Oreochromis niloticus*	Nile tilapia
27	*Chanda nama*	*Glass perchlet/ Sisa macha*
28	*Hetropneustes fossilis*	Stinging catfish/ Singhi

Among the native fish species, Bhitta (*Puntius sp.)* contribution was highest (3%) in the total catch of Phewa Lake **(Fig. 8)**. Others native fish species contributions were varied between 0.01% - 1.06 %. Among exotic fish species, Nile tilapia was found contributing highest (74.9%) in total catch of Phewa Lake **(Fig. 9)**.

Among native fish species, Bhitta (*Puntius sp.)* contribution was highest (5.1%) followed by Naini (3.13%) and Bhakur (2.11%) in the total catch of Begnas Lake **(Fig. 10)**. Among exotic fish species, silver carp contributions was highest (61.1%) followed by Nile tilapia (10.15%) in the total catch of Begnas Lake (Fig.11).

Among native fish species, Naini contribution was highest (7.1%) followed by Bhakur (3.84%) in the total catch of Rupa Lake **(Fig. 12)**. Among exotic fish species, carp contributions was highest Nile tilapia (40.18%) followed by silver (38.87%) in the total catch of Rupa Lake. The small size native fish were not catches in the Rupa Lake. Therefore the contributions of native fish species were found less (Fig. 12).

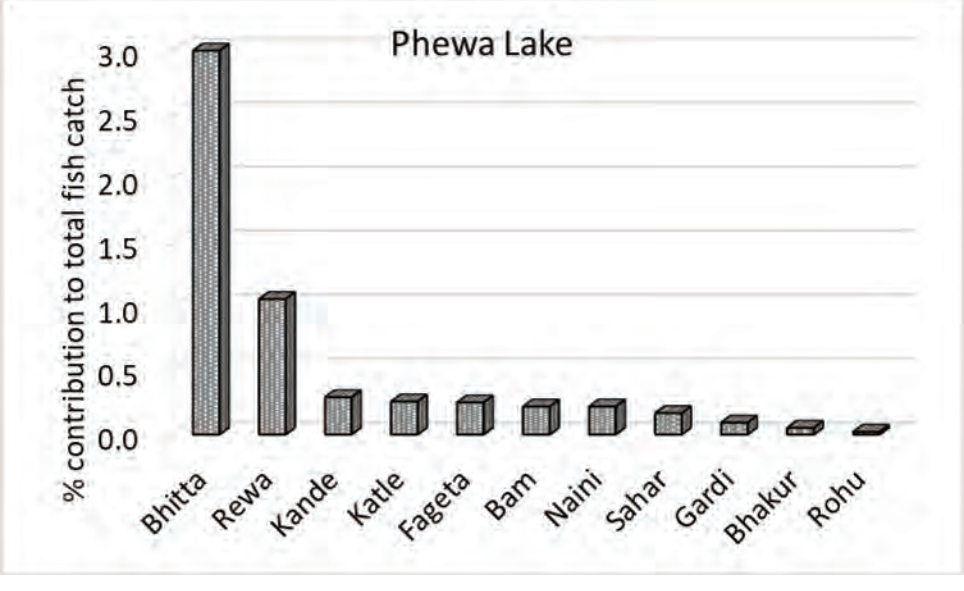


Fig. 8: Native fish species contributions (%) in total fish catch of Phewa Lake in 2076/77

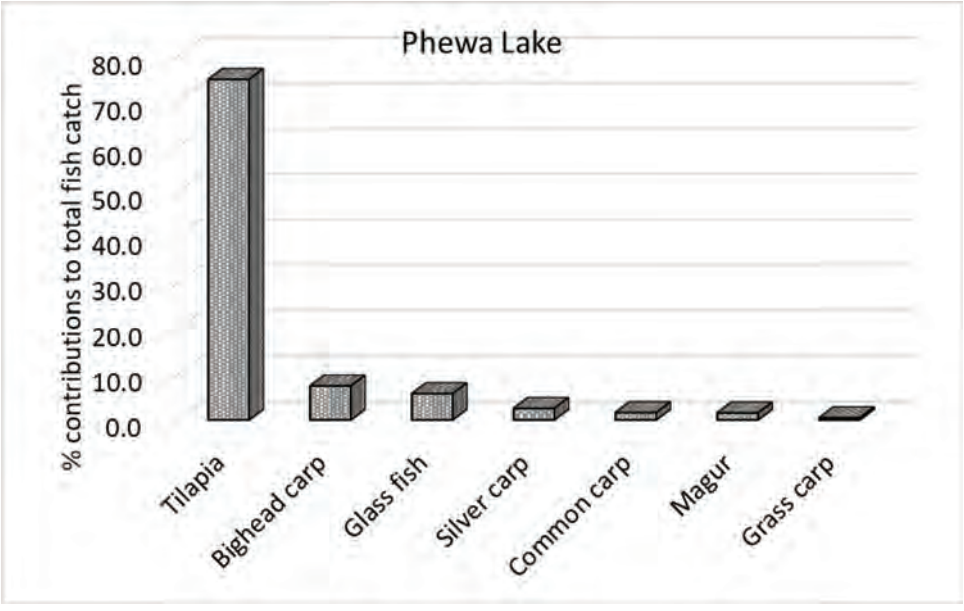


Fig. 9: Exotic fish species contributions (%) in total fish catch of Phewa Lake in 2076/77

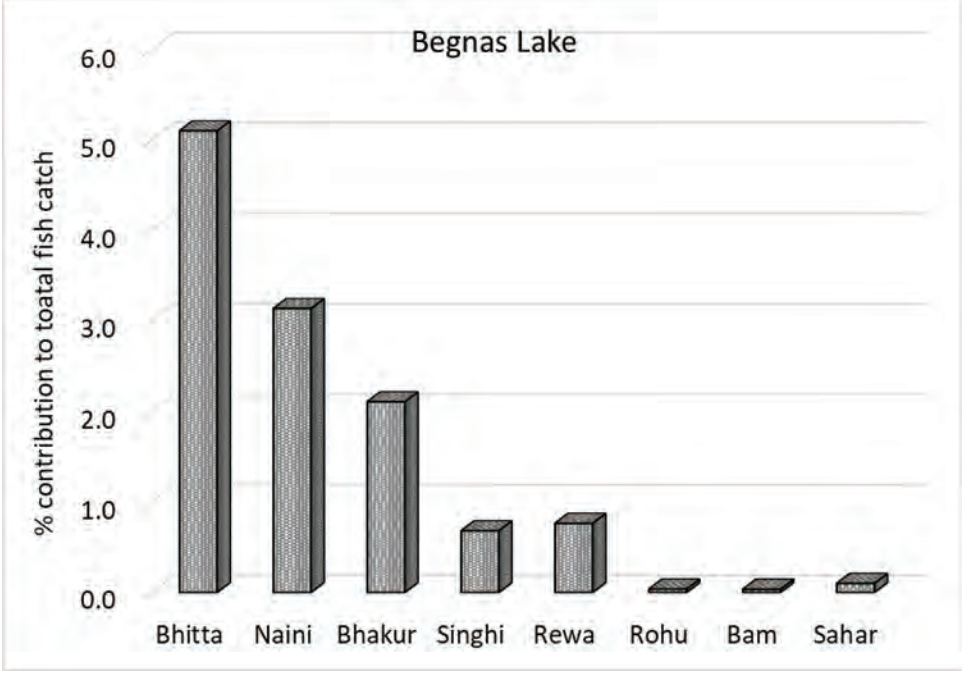


Fig. 10: Native fish species contributions (%) in total fish catch of Begnas Lake in 2076/77.

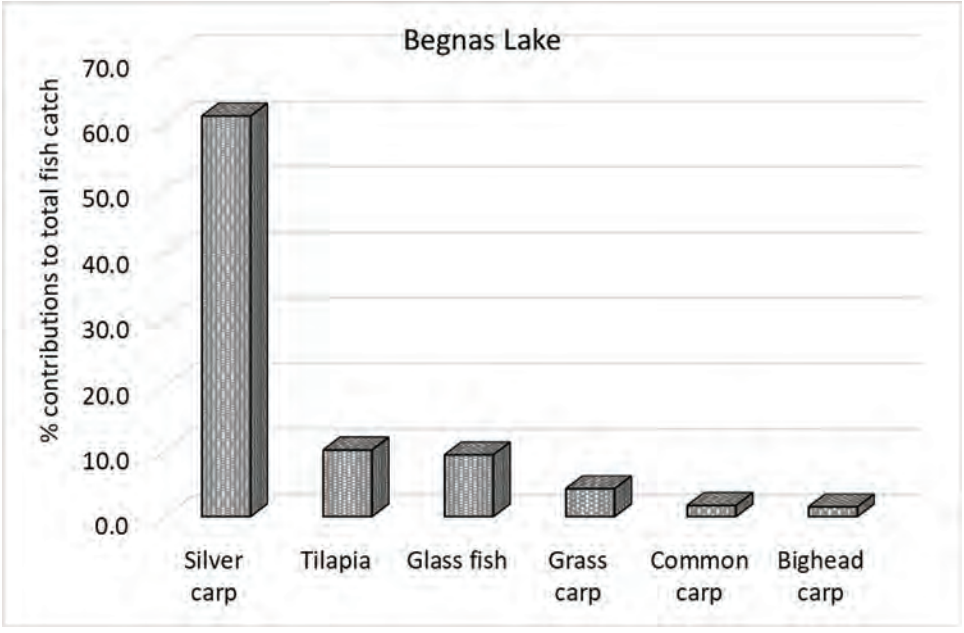


Fig. 11: Exotic fish species contributions (%) in total fish catch of Begnas Lake in 2076/77.

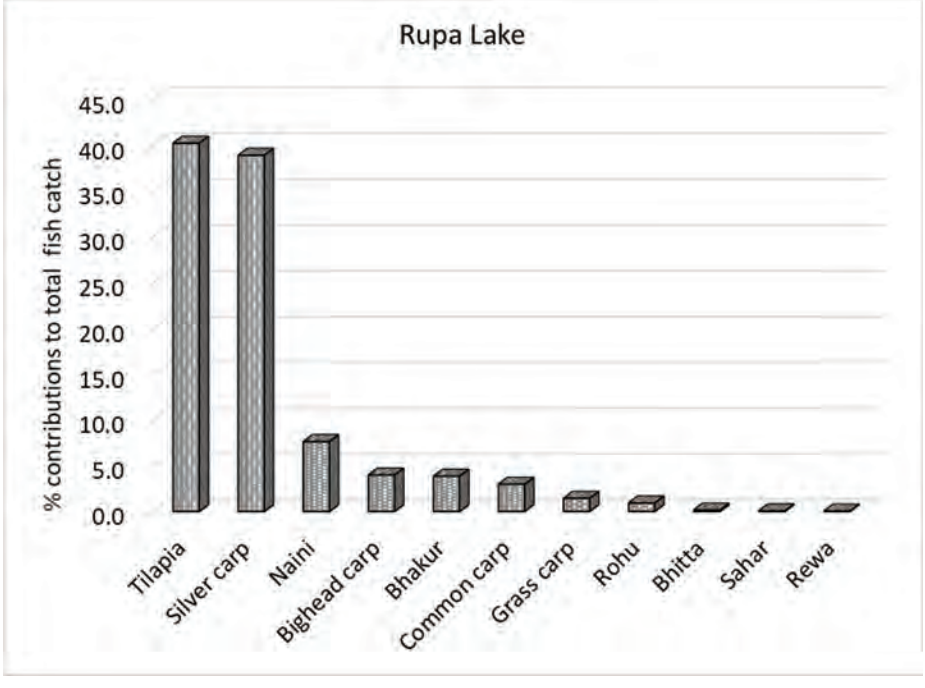


Fig. 12: Native and exotic fish species contributions (%) in total fish catch of Rupa Lake in 2076/77.

Seasonal variations of fish catch

Monthly fish catch trend from three lakes showed that highest catch was obtained during winter months (**Fig. 13, 14, 15**). The fish catch was peaked in the month of December in each lake. In Phewa Lake, the fish catch decreased from April to September. In Begnas Lake, the fish catch was less than 1000 kg from March to June.

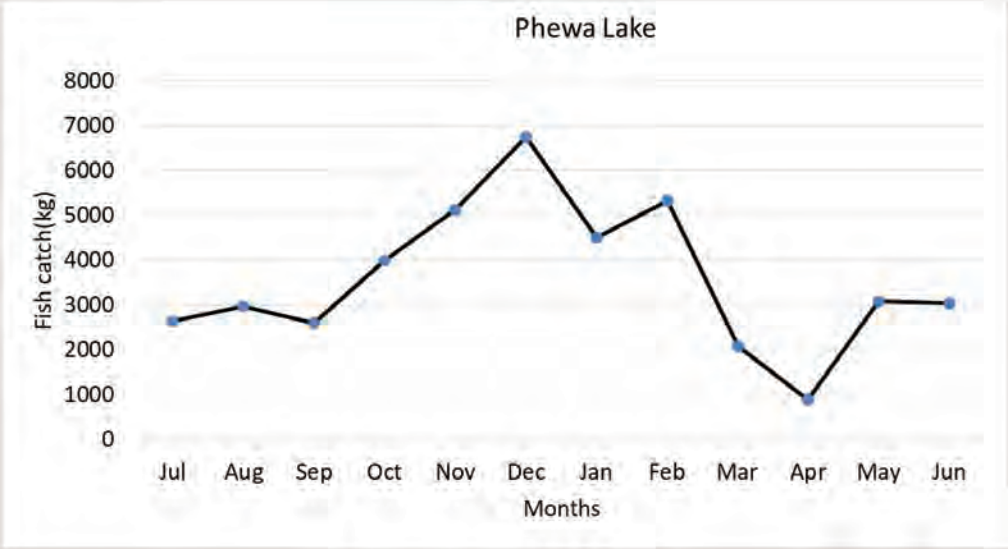


Fig. 13: Seasonal variations of fish harvest in Phewa Lake in FY 2076/77.

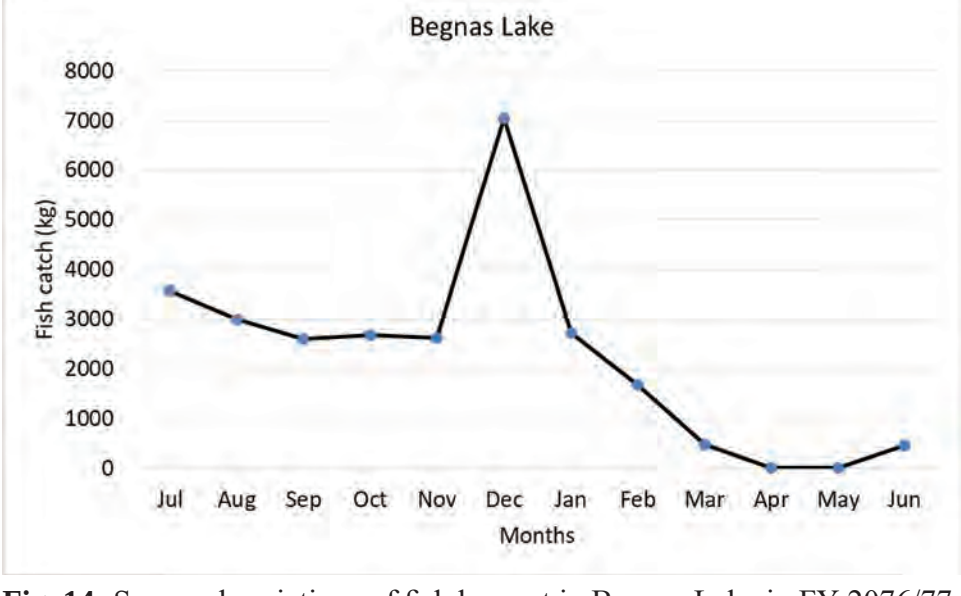


Fig. 14: Seasonal variations of fish harvest in Begnas Lake in FY 2076/77.

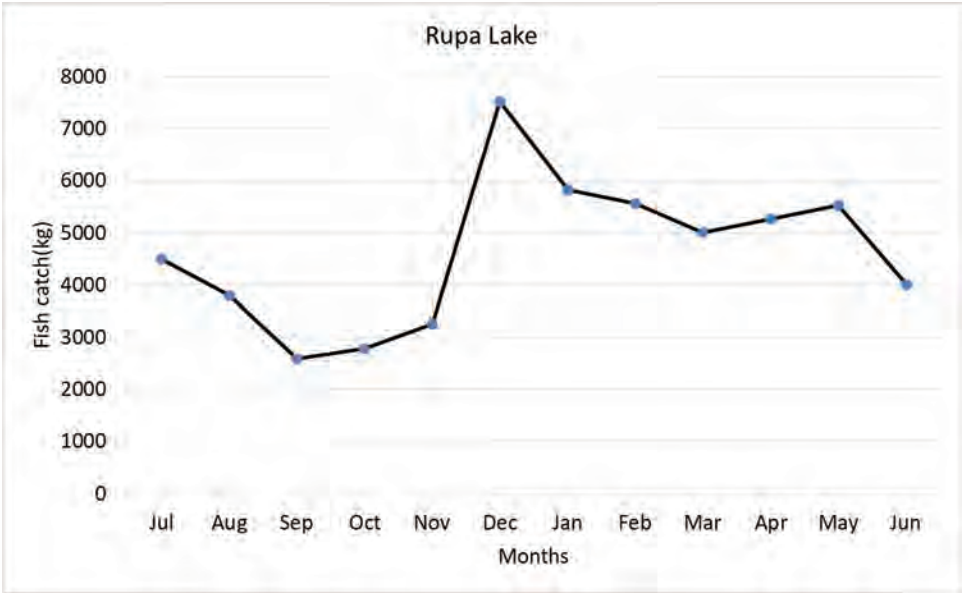


Fig. 15. Seasonal variations of fish harvest in Rupa Lake in FY 2076/77.

3.3.6 Fishing gear used for catch (species, size)

Data on fishing gear survey showed that the major types of fishing gears used by Jalari fishers in the lakes of Pokhara Valley were gill nets, cast nets, and fish hooks. Gill nets of 50m length and 6-10m width used in Phewa and Begnas lake while 50m length and only 4m width in Rupa lake with different mesh sizes(1"-10") to capture small to large fish. Generally, the Jalari used 5-6 gillnet per day to harvest fish from Phewa and Begnas lakes while in Rupa lakes in total 48 gillnets used. They set gillnets in the afternoon and collected fish in the morning time.

3.3.7 Enhancement of fish catches by restocking fry/fingerlings in lakes / wetlands/ ghols/reservoirs

Fish stocking in natural water bodies is prerequisite to enhance fish population for livelihood improvement. Restocked of fish fry and fingerlings in lakes for lake of Pokhara valley Phewa, Begnas and Rupa etc. were increased the catch enhancement of indigenous species. This year more than 11.44 lac fry/fingerlings of different fish species were stocked in the lakes of Pokhara valley by different stakeholder (Table 10). The stocking data showed that stocking density was about 1100 fry/ha, 1275 fry/ha and 2400 fry/ha for Phewa, Begnas and Rupa lakes, respectively. For improvement native stock, 25000 of Sahar, gardi were released in the lakes on the occasion “world fisheries day 2019”.

Table 10: Fry/fingerlings stocked in different lakes of Pokhara Valley in 2076-77

Fish species	No of fry stocked		
	Phewa lake	**Begnas Lake**	**Rupa Lake**
Rohu	160000	25000	30000
Naini	160000	125000	20000
SC/BC	80000	100000	20000
Bhakur	25000	40000	10000
Common carp	18000	100000	75000
Grass carp	30000	15000	82000
Sahar	15000	10000	-
Gardi	2000	2000	-
Total	**490000**	**417000**	**237000**

Note: The number of stocked fry was contribution of different stakeholders/institutions.

3.4 ADVANCEMENT OF BREEDING TECHNOLOGY OF INDIGENOUS AND EXOTIC ORNAMENTAL FISHES

Ornamental fishes are also called 'living jewels' for their beautiful colours and playful behaviour. Ornamental fishes are typically small sized; attractive and bizarre shaped in appearance. Therefore, it is a source of attraction for fish lovers, and aquarists all over the world. With the inspiring popularity of aquarium keeping in households in many part of the world.

The demand of ornamental fishes is increasing in major urban areas of Nepal. Exotic varieties of ornamental fishes are popular marketed in aquarium shop and some few indigenous ornamental fish species are popular in Nepal. Therefore Research on ornamental seed production technology is at beginning stage in Nepal. Considering the economic, and aesthetic values of ornamental fish trade, technology of fish seed production of some imported exotic species as well as possible native species is necessary to substitute import and promote export.

3.4.1 Indigenous/Exotic Brood Fish Collection and Rearing Management.

Different native ornamental fish species such as *Puntius sp*., *Kolisa sp*., *Bhurluk* etc were collected from different water bodies in winter and in summer months and reared for domestication and propagation in plastic tanks of 500 liter capacity. Aeration was maintained each tank. *Puntius sp*. and *Danio* sp. were collected from Begnas Lake and irrigation canal were maintained in the 40 liter aquaria with aeration. Survival rate was

observed for each collected fish. 10 exotic ornamental fish were also procured and kept in tank for rearing.

The domesticated fish species are presented in the table 11. The length and weight of domesticated fish species are presented in the table 12. The survival of local ornamental fish species (*Puntius sophore* and *Danio devario)* were found higher in the months of summer than winter season (Table 13).

Table 11: List of native fish species collected from Begnas for ornamental purpose.

S.N.	Fish species	Order	Family	Local name
1.	*Puntius conchonius*	Cyprniformes	Cyprinidae	Rato pothi
2.	*Puntius sophore*	Cyprniformes	Cyprinidae	Pothi machha
3.	*Danio devario*	Cyprniformes	Cyprinidae	Sera
4	*Danio rerio*	Cyprniformes	Cyprinidae	Chelawa/,zebra fish

Table 12: Length and weight of native ornamental fish species collected from Begnas Lake.

Fish species	Length (cm) Mean± Sd.	Weight (g) Mean± Sd.
Puntius sophore	5.7±0.9	3 ± 1.4
Danio devario	6.3±0.5	3.1±0.7
Danio rerio	3.3 ±0.4	0.4±0.2
Puntius conchonius	4.7±0.3	2.1±0.2

Table.13. Seasonal effects on domestication of local ornamental fish species.

S. N.	Scientific name	Local name	Winter months Survival (%)	Summer months Survival (%)
1.	*Puntius conchonius*	Rato pothi	66.6	-
2.	*Puntius sophore*	Pothi machha	82.82	86.66
3.	*Danio devario*	Sera vitta	62.35	94.59
4.	*Danio rerio*	Chelawa/zebra fish	-	84

Kolisa brood fish was domesticated in metallic tank provided with shelter of water hyacinth and other aquatic plants. Similarly broods of some exotic species such as Goldfish, Fancy (Koi) carp, Guppy, Platy and Swordtail were also reared for breeding purposes. These species are very popular in aquarium purpose in Pokhara valley. Brood fish were fed commercial aquarium fish feed (crumble size) and farm made feed 40 %

CP at three times a day. The water of the brood pond/pools was exchanged as per necessary.

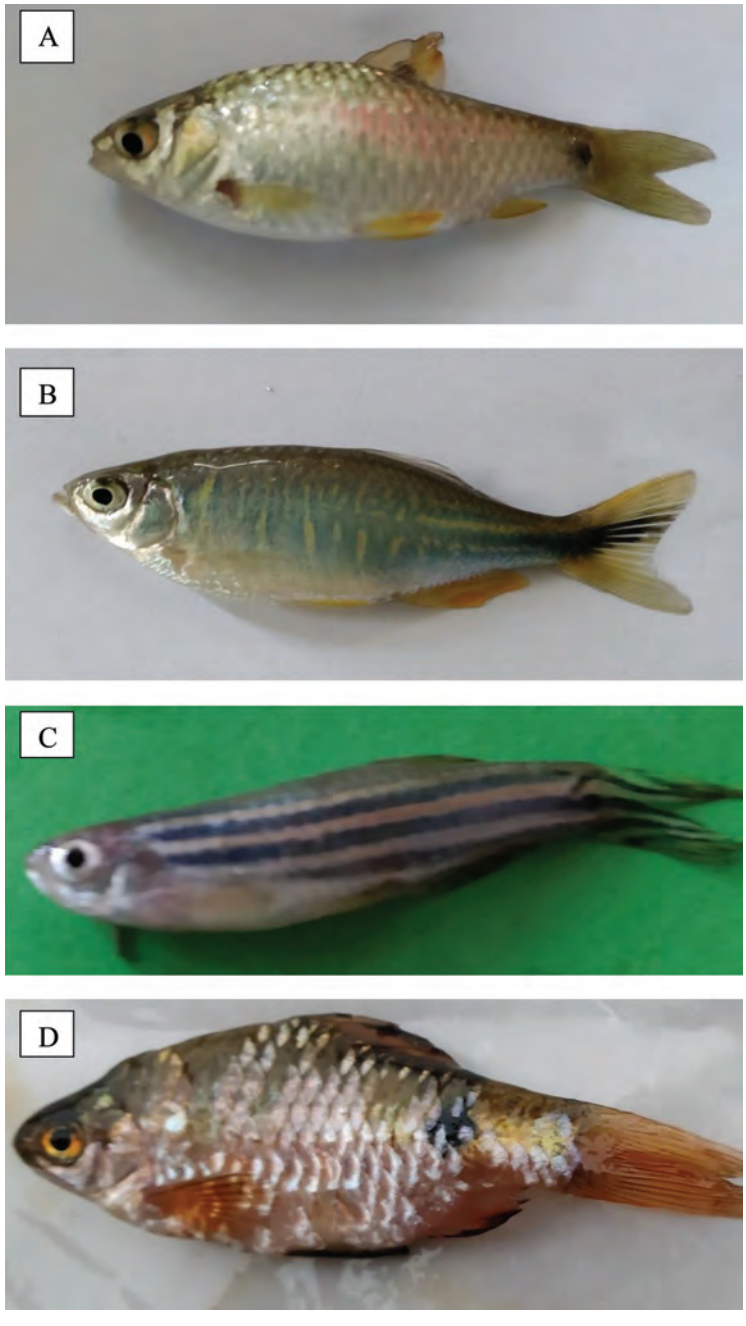


Fig. 16: Native ornamental fish species domesticated at FRS Pokhara; *Puntius sophore* (A), *Danio devario* (B) *Danio rerio*(C), *Puntius conchonius (D).*

3.4.2 Breeding/Hatchery operation

Among exotic species, goldfish was propagated successfully in this year. Fancy carp was bred as per breeding procedure of common carp. Matured female brood fish were given ovolin hormones at the rate of 0.5 ml/kg body weight of female. Male received half dose of ovaprim to that of the female. Hormone induced broods were placed in cement tanks with suitable substrate. Ovulation occurred about 15-18 hours after hormone injection. Platy and swordtail species were bred by natural method provided with suitable environment. Among native species *Kolisa* sp. were also bred by natural spawning method in running water tank. Fresh water was supplied continuously in all spawning tank to maintain oxygen. Different species of ornamental fish were bred at temperature between 21-29°C. Breeding performance of several ornamental fish species in captive condition are provided in Table 14.

Table 14: Details of captive breeding performance of ornamental fish species in FRS, Pokhara during F.Y. 2019/20

Breeding parameters	Kolisa sp.	Platy	Sword tail	Guppy	Gold fish	Fancy carp (Koi carp) Mar-May
	Mar-Jun	Mar-Aug	Mar- Aug	Feb-Nov		
Female (No.)	15	20	50	400		3(7.8 kg)
Male (No.)	15	20	25	20		6(8 kg)
Hormone type	-	-	-	-		Ovolin
Hormone dose	-					
Female (ml/kg)	-	-	-	-		0.5
Male (ml/kg)	-	-	-	-		0.25
Time of induction	-	-	-	-		15 hours
Water temperature	21-28°C	21-28 °C	21-28 °C	21-28 °C		22 °C
Ovulation time	-	-	-	-		5 days
Total No. of eggs	-	-	-	-		850000
Fertility %	-	-	-	-		70
Hatching %	-	-	-	-		55
Hatchling No.						300,000
Survival %	-	-	-	-		30
No. of fry produced	350	350	1000	2500		40,000

Successful breeding of two new native fish species (*Danio devario and Danio rerio*)
Two native fish species *Danio devario* and *Danio rerio* was successfully bred in this year.

Danio *devario* is common ornamental fish with silvery greenish body. Pectoral, dorsal, pelvic, anal and caudal fins are yellowish (Fig.16 B). A dark band runs from the middle of the caudal above the middle of anal fin. Head is small and snout is obtusely pointed. Scales small cycloid. Barbels are absent. Mouth is oblique and directed upwards. It is omnivorous, feeding on fish, zooplankton, dipteran larvae and plant matter. Inhabits in streams, riverine pools, canals and lakes. It is also found in rapid streams with rocky bottom.

The zebrafish (*Danio rerio*) is a tropical fresh water teleostei, belonging to the Cyprinidae family. This species is characterized by small size, adult measures about 4-5 cm, have a cylindrical body, and a distinct colour pattern alternating light and dark horizontal stripes. It is omnivorous. It exhibit sexual dimorphism: males are thinner and generally golden in the ventral region, females are more rounded and silvery, mainly in the ventral region, which is most evident in the period close to the spawn. Females may spawn every 2-3 days and a single spawn may contain hundred eggs. The fertilization and the development of the zebrafish are external (Fig. 16C).

Methods adopted for the breeding in captive condition at FRS Begnas
Breeding of *Danio devario*
Tank reared fish were trial in several ways to bred in the captive condition. *Danio devario* were exposed to 4 different environmental condition after measuring their weight(in the aquarium with heater and aerator, in the outer tank exposed to direct sunlight, tank having continuous water flow without sunlight and in open artificial pool) to assess the suitable environment for breeding. The natural bedding (gravels and submerged aquatic plants) was made in aquarium, water temperature was raised, aeration was given with no sunlight. In the outer tank, natural bedding was made with aeration and proper sunlight. In the inner tank natural bedding with continuous water flow, no sunlight. In open artificial water pool with enough sunlight, natural bedding (stones, pebbles and aquatic grass).

To examine the fecundity one of the female *Danio devario* with rounded belly weighing 6.5 gm was selected, dissected and the eggs were manually counted. The count of 0.5 gm of ovary consists of 1500 eggs of matured brood female *Danio devario*.

For the artificial breeding *Danio devario*, hormone was used and female's egg stripped in a bucket and then milt was mixed. However, no hatchlings were produced in that way. *Danio devario* breeding was successful in the artificial water pool (10 m Length, 0.75 m wide and 30cm depth) with enough sunlight with natural bed (stones, pebbles and aquatic grass). The continuous water was added in the pool through pipe. *Danio devario* bred in last week of August in the rainy days at temperature 27-28°C. One fish bred and 25 fry were collected (Fig. 17 A). The collected fry were kept in 40 liter aquaria with aeration and fed with micro feed thrice a day.

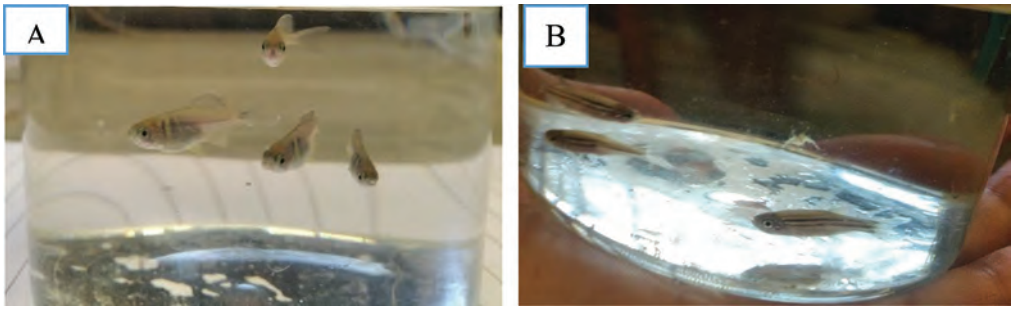


Fig. 17: Fry of *Danio devario* (A) and *Danio rario* (B)

Breeding of *Danio rerio*

Danio rerio kept in 500 liter tank without sunlight and natural bed (Fig.18A). Continuous water sprinkling was provided. 5 parent *Danio rerio* were bred successfully in the tank environment in the month of August, at temperature 26-27 °C and 33 hatchlings were collected (Fig. 17B). Hatchlings were fed with micro feed thrice a day.

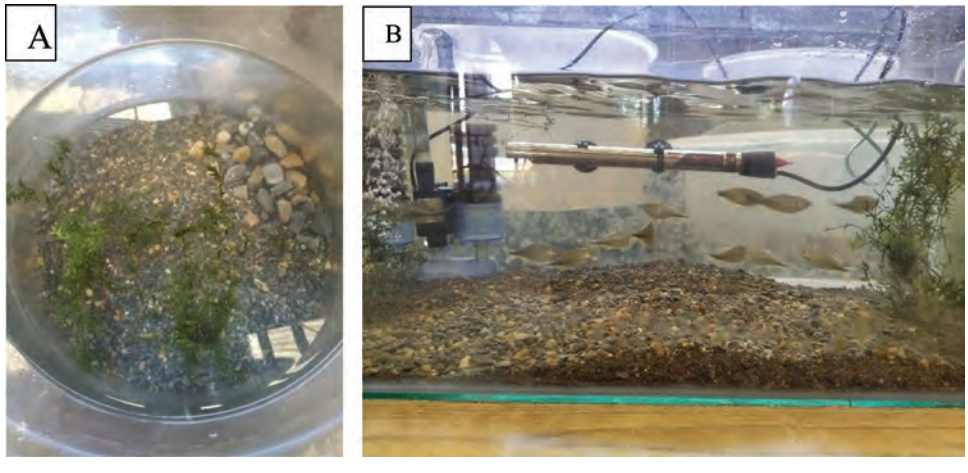


Fig. 18: Rearing environment for ornamental fish in plastic tank (A) and Glass aquarium (B).

3.4.3 Larval Nursing and Rearing Management

Hatchlings of fancy carp produced during breeding season were stocked in previously prepared ponds at 10 million/ha. Fry were nursed in ponds fed with micro feed (40 % CP) for two weeks then with locally prepared feed (25 % CP). In addition about 2500 baby fry of Guppy, 1000 fry of Swordtail, 350 fry of Platy and 350 fry of *Kolisa* sp. (Fig. 19) also produced were nursed and reared in plastic/fiberglass tanks fed with natural feed, micro feed, farm made feed and aquarium feed. About 40,000 no of fancy carp fry were obtained with survival rate of 30%. Total 7466 of ornamental fish of different species were sold in the FY 2076/77.

Fig. 19: Fry of *Kolisa sp*. produced in FY 2076/77.

3.4.4 Monitoring of ornamental fish disease

Regular observation of ornamental fish disease and parasites in species of Guppy, Platy, Sword tail, Fancy carp, Goldfish were done this year. No any disease and parasites was found in Guppy, Platy, Sword tail, Fancy carp. But *Argulus* were found highly affected to the goldfish broods. Weekly monitoring of *Argulus* sp. infestation in goldfish broods was observed. There was 65 % prevalence of infestation. Treatment with 3% salt to the goldfish broods resulted effective control of *Argulus* however parasite emerge later on suggested need to be treated frequently.

3.5 FORMULATION OF COST EFFECTIVE FEEDS FROM LOCALLY AVAILABLE INGREDIENTS FOR CARPS

At present, technology of subsistence carp farming in various systems has been practiced in Nepal. It is necessary to improve productivity by increasing various inputs including feed during culture period. Feed played an important role for acceleration of fish growth especially in an intensive fish culture system. Feed requirement differed with fish species and size. The cost of feed is major factor in the economic production of fish.

In Nepal, shrimp imported from India is generally used as a source of fish meal. Limited market accessibility with relatively high cost, the shrimp remains one of the major elements to raise production cost of trout and fish farming . Further, there is widespread concern over the increasing use of fish meal in aquaculture sectors despite of cost and availability. A move towards the use of upgraded vegetable protein as a partial replacement of fish meal would help to reduce cost of production and also reducing the potential for excretion of enriching nutrients by the cultured organisms. Most of the study have been done in past mentioning substituting animal protein sources with soybean meal in diet. Therefore, it is necessary to find out possibility of partial replacement of fish meals by vegetable proteins (Such as oilseed cake, pulses, cereals and cereal by-products) that help to reduce the cost of feeds without reducing their efficacy.

3.5.1 Collection and curing of feed ingredients

Some feed samples commercially prepared for fish were collected from Rupandehi. The feed sample collected was feed floating feed (Factory made) as well as different feed ingredients were formulated to the fishes and prepared at station were subjected to nutrient analysis.

3.5.2 Feed formulation and proximate analysis

The collected feed samples were kept at refrigeration temperature till the end of the study. The samples were taken from the refrigerator and kept to the room temperature for few hours. Then the required amounts of samples were finely ground by a small mortar and kept it airtight container for subsequent chemical analysis. The proximate composition of different farm made fish feeds were analyzed in triplicate according to standard procedure given in Association of Official Analytical Chemists (AOAC, 2000).

Different feed were evaluated for its crude protein content. Laboratory evaluation of following feed was done for crude protein, ash, moisture and crude fat and minerals analysis are provided in table 18, table 19 and table 20.

3.5.2.1 Feed formulations

Table 15: Pokhara pellet feed new composition

	% Composition	
Ingredients	**Grow out feed**	**Brood Feed**
Wheat	35	20
Maize	20	20
Soya Choker	15	20
Oil cake	15	20
Rice bran	10	15
Shrimp	3	3
Bone mill	1	1
Vitamin mix	0.2	0.5
Mineral mix	0.8	0.5
Total	**100**	**100**

Table 16: Feed formulations for ornamental fish

Ingredients	% composition
Shrimp	40
Mustard oil cake	15
Soya whole	36
wheat	4
vegetable oil	3
Mineral	1
Vitamins	1

Table 17: Composition of three types of low cost formulated feed

S.N.	Ingredients	Feed 1(0% shrimp)	Feed 2(5% shrimp)	Feed 3(10% Shrimp)
		Ratio	**Ratio**	**Ratio**
1	Shrimp	0	5	10
2	Soya choker	42	40	30
3	Oil cake	40	30	34
4	Rice bran	8	15	16
5	Wheat	5	5	5
6	Maize	4	4	4
7	Vitamin mix	0.5	0.5	0.5
8	Mineral mix	0.5	0.5	0.5
	Total	**100**	100	100

3.5.2.2 Proximate and mineral analysis

Table 18: Proximate analysis of three low cost feeds (Mean ± S.E.)

Constituents	Feed 1	Feed 2	Feed 3
Crude Protein (%)	31.33±1.15	32.09±0.75	32.51±0.85
Ash (%)	10.6±0.2	12.4 ±0.1	9.3±0.4
Moisture (%)	10.3±0.3	10.7±0.5	10.7±0.6
Crude fat (%)	24.6 ±0.3	24.8±0.2	24.9±0.1
Crude fiber (%)	4.7±0.6	4.6±0.6	4.5±0.5

Table 19: Proximate analysis of three formulated feeds

Feed types	Moisture %	Crude fat (%)	Crude protein (%)	Total ash (%)	Crude fiber (%)
Ornamental Feed	7.02	16.49	34.85	20.14	12.43
Brood feed	12.34	6.62	24.13	10.38	9.52
Grow out Feed	11.87	4.97	22.22	7.37	11.77

Table 20: Mineral analysis of three formulated feeds

Feed types	Calcium (mg/100g)	Phosphorus (mg/100g)	Iron (mg/100g)	Carbohydrate (%)
Ornamental Feed	2045.07	875.17	33.13	21.5
Brood feed	1248.56	737.96	30.03	46.52
Grow out Feed	892.59	508.36	13.81	53.58

3.5.3 Evaluation of developed feeds against growth and survivability of warm water fish species.

Growth of Pure line common carp in the formulated feed.

Three feed with three different formulations was tested against growth of pure line common carp**.** The experiment was conducted in 100 sq. meter pond at Phewa. The stocking was done at the rate of 1fish/m^2. Three formulated feed was used to feed the fish (Table17). The fish was fed at the rate for 3% of body weight one times a day. The growth recorded in every 30 days interval and water quality parameters were checked in each day for temperature, pH, DO, and fortnightly for chlorophyll a. Water quality recorded during the study period: water temperature 24.06±3.8, pH 7.3, and D.O. 6.7±2.8, Chlorophyll a 46.3 ±4.13 mg/m^3. The growth of pure line common carp was higher in feed composition without shrimp but it was not found significant difference between feed composition ($p>0.05$). The results showed that the feed composition based on plant protein can be used for fish farming with lower price (Table 21).

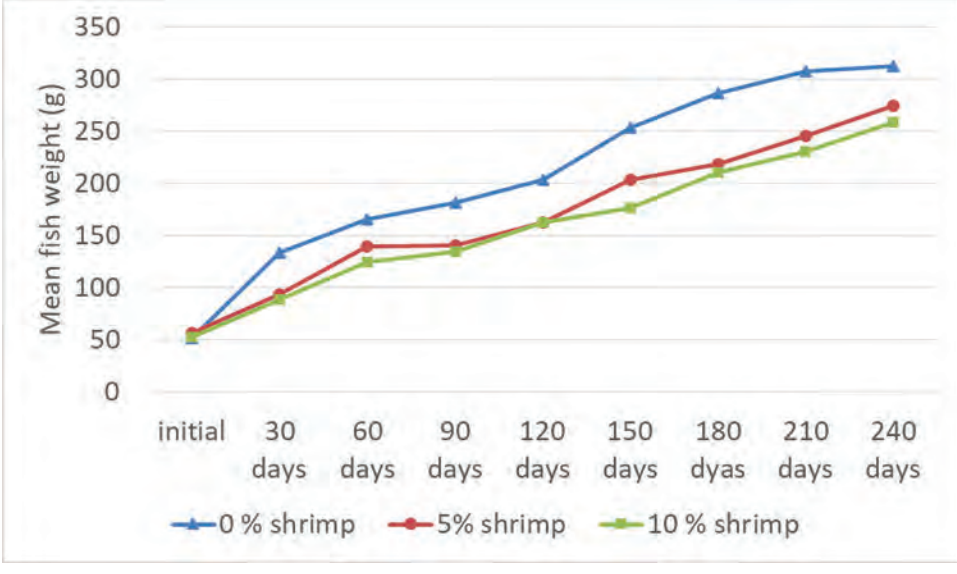


Fig. 20: Growth of Pure line common carp in the formulated feed.

3.5.4 Cost-benefit analysis of test diet

The price of Feed 1 composition (Soybean mix without shrimp) was calculated low. The price was found higher as the percentage of shrimp addition to the feed formulations was increased. Comparatively, the crude protein also increased with increased shrimp percentage in the feed formulations.

Table 21: Price of different formulated feed

Feed types	Major Ingredients mixed	CP%	price /kg
Feed 1	Soybean mix without shrimp	31.33±1.15	67.9
Feed 2	Shrimp ratio 5% and Soybean 40%	32.09±0.75	71.7
Feed 3	Shrimp(10%) mix soybean 30%	32.01±0.85	73.40
Ornamental Feed	Shrimp (40%)	34.85±0.73	111.05
Brood feed	Soya choker, Oil cake	24.13±0.72	64
Grow out feed	Soya choker, Oil cake	22.22±0.75	62

3.6 PARTICIPATORY TECHNOLOGY DEVELOPMENT AT OUTREACH SITES

Outreach activities as per approved project were delivered the aquaculture and fisheries technologies developed on station and support services priority clients. The activities such as survey of feasible sites for fish farming, verification trial, scaling up of rainbow trout culture technology, disease diagnostic services etc. and publication and dissemination of technical information was main activities accomplished this year.

3.6.1 Feasibility Study of New Sites for Carp and Trout Farming

A huge water source is available which is suitable for trout farming in the country but commercial trout producers are limited to few districts. The trout farming technology is needed to be scaled up to increase production and employment in the high and mid hills of the country. Similarly, carp farming technology is also need to be expanded in feasible areas in mid-hill region. This year farmers were supported for site selection in Kaski, Tanahu and Baglung districts to establish new trout and carp farm as well as smoothly run existing farms. During visit other technical support including water quality monitoring and health care services were also provided to existing farm (**Table 22**)

Table 22: Monitoring and support services were provided to the following carps and trout farms
कृषकसँग सहभागितात्मक बाह्य अनुसनधान कार्यक्रम अन्तर्गत सम्पादन गरिएका र प्राविधिक सेवाटेवा:

किसानको नाम	ठेगाना	माछापालनको किसिम	क्षेत्रफल	पानीको श्रोत	पानीको गुणस्तर	सल्लाह रसुझाव
१. हारुन खान	पोखरा महानगरपालिका व.डा न. २१, गैह्री खेत, फुस्रे खोला	कार्प माछापालन	१३ रोपनी	फुश्रे खोला	खोला तापक्रम: २२ डिग्री सेल्सियस पानीमा घुलित अक्सिजन: ७.५ मि. ग्राम/लि. पी.एच. ६.५	कार्प माछापालन हुन् सक्ने देखिएको छ । पोखरिहरूको निर्माण गरि माछापालन गर्न सकिन्छ ।
२. ल्यांगादी मल्टी एग्रो फार्म	पोखरा महानगरपालिका व.डा न. ३३	कार्प माछापालन	१५ रोपनीमा माछापालन	खोल्साको पानि	पोखरीको तापक्रम: २३ डिग्री सेल्सियस पानीमा घुलित अक्सिजन: ६.५ मि. ग्राम/लि. पी.एच. ६.५	पोखरीहरुमा पानीको प्रवेस र निकासको व्यास्थापन गर्नु पर्ने ।
३. पोखरा महानगरपालिका वडा न. ३२	पोखरा महानगरपालिका को वडा न. ३२	कार्प माछापालन	१०० हेक्टर	खुदी खोला	तापक्रम: २० डि.से. पानीमा घुलित अक्सिजन: ८.५ मि.ग्राम/लि.	स्थलगत निरीक्षण अनुसार मत्स्य पोखरी निर्माणको लागि बढी लागत लाग्ने देखिएको छ । पोखरी निर्माण गर्नु अगाडी इन्जीनियर को परामर्श गर्नको लागि सिफारिस गरियो ।
४. फेदी खोला गाउपलिका, स्यांग्जा	फेदी खोला गाउपलिका, स्यांग्जा	कार्प माछापालन		फेदी खोला		स्थलगत निरिक्षण गरि सर-सल्लाह दिईयो ।

क्र.सं.	कृषक को नाम	स्थल, ठेगाना र फार्म	दिएको सेवाहरू
१	लोकेन्द्र घले	मनाङ्ग रेन्बो ट्राउट फार्म	२०० वटा माऊ छनौट गरि ८० वटा माउ निचोरी ६०,००० अन्डा भुरा कोरलन राखेको र भुरा नर्सिङ्ग मा सहयोग गरेको
२	अपिल लामा	ट्राउट फार्म	ट्राउट प्रजननका लागि अन्डा निचोर्ने काममा सहयोग गरियो
३	लछिन गुरुङ अमृत गुरुङ	गण्डकी रेन्बो ट्राउट फार्म	अमेरिकाबाट ल्याएको ३ लाख ५० हजार अन्डा र ह्याचलिंगको नर्सिङ्ग मा सहयोग पुर्याएको
४	रुद्र पौडेल	मर्दी खोला ट्राउट फार्म, कास्की	माऊमाछा व्यवस्थापनमा सहयोग, प्रजनन् को लागि पोथी छुट्टाउन सहयोग पुर्याएको
५	इन्द्र गौचन	क्षेत्रदीप अन्नपूर्ण रेन्बो ट्राउट फार्म	धजष्चष्लिन रोगको उपचारको औषधि सिफारिश गरी रोग नियन्त्रण भएको
६	श्यामराजा महत	ढोरखानी एकीकृत कृषि फार्म, ढोरफिर्दी, तनहुँ	कार्प माछापालनका लागि तिन थरिको दाना - तैरिने र डुब्ने पेलेट र धुलो दाना प्रयोग गरि माछाको वृद्धि दर प्रिक्षन को शुरुवात गरियो
७	पदम खत्री, दीपा राना, सुबास राजभण्डारी	ताराखोला रेन्बो ट्राउट फार्म	माऊमाछा व्यवस्थापनमा सहयोग, प्रजनन् का लागि ५०० पोथी छुट्टाउन लगाएको
८	कमल बस्नेतर, यदु अधिकारी	घट्टेखोला, माछापुछे, कास्की	माऊमाछा व्यवस्थापनमा सहयोग, प्रजनन् का लागि पोथी छुट्टाउन लगाएको

3.6.2 Participatory Trout Breeding and Seed Production

Trout farmers were supported for breeding and seed production program of trout in Kaski district to fulfil the demand of fry from private sector. Besides breeding, technical support to the rainbow trout breeders and growers were also provided for brood fish management, feed preparation, monitoring and support in health management as per demand of the farmers.

This year about 1559 female and 574 male trout were used for breeding purposes producing about 425, 00, 00 no of eggs (**Table 23**). The hatchability was very low (approx. 50 %) due to high turbidity in upstream water in Chhetradeep and Machhapuchhre trout farms.

Table 23: Breeding Performance Record of Trout in Private Sector, Kaski

Particulars	Name of trout farm		
	Machhapuchhre Agri Farm, Annapurrna RM Bhurjung Khola, Kaski	**Saiti Ghatta Trout Farm, Kuibang Machhapuchhre Kaski**	**Gandaki Trout, Bhurjung khola Annapurrna RM Kaski**
No of female used	45 (avg. 250-300 g)	14 (avg. 500-800 g)	1500(avg. size 500-700g)
No of male used	18	6	550
Responded female	40	10	145
No of eggs incubated	30,000	6,000	500,000
No of eyed eggs	20,000	5,000	400,000
No of fry produced	8,000	4,000	2500,00
Water temperature (°C)	9-11	9-11	9-12

3.6.3 Verification study in the farmer's field

3.7.3.1 Verification of fish species combination on fish productivity in small-scale fish farming (Cage/pond)

The verification trial was conducted at Baglung munciplity-3.Silver, grass and common carp were stocked 750 per ropani. Three types of feed was used: floating pellet (25% CP), powdered feed (25% CP) and oil cake+rice bran. Ponds were stocked with fry of 3 carp species in different ratios: common carp (40%), silver/bighead carp (40%), and grass carp (20%). Ponds were dried and limed at 500kg/ha of lime before stocking. Bighead carp growth was fast in supplementary feed with floating feed (Fig. 21), common carp in supplementary feed with oil cake + rice bran (Fig.22).

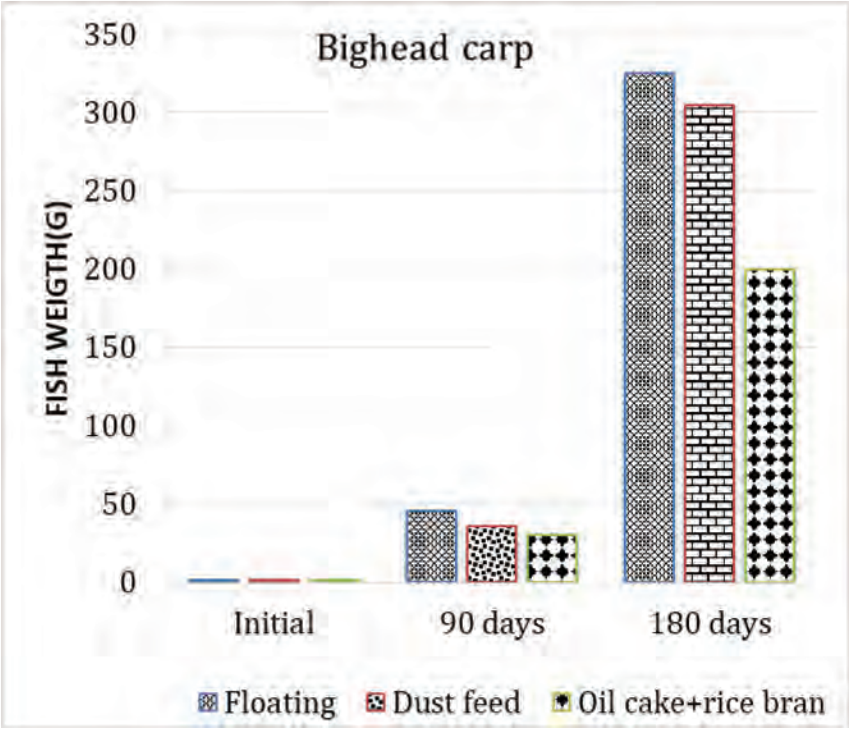


Fig. 21: Growth of bighead carp in ponds with supplementary feeding

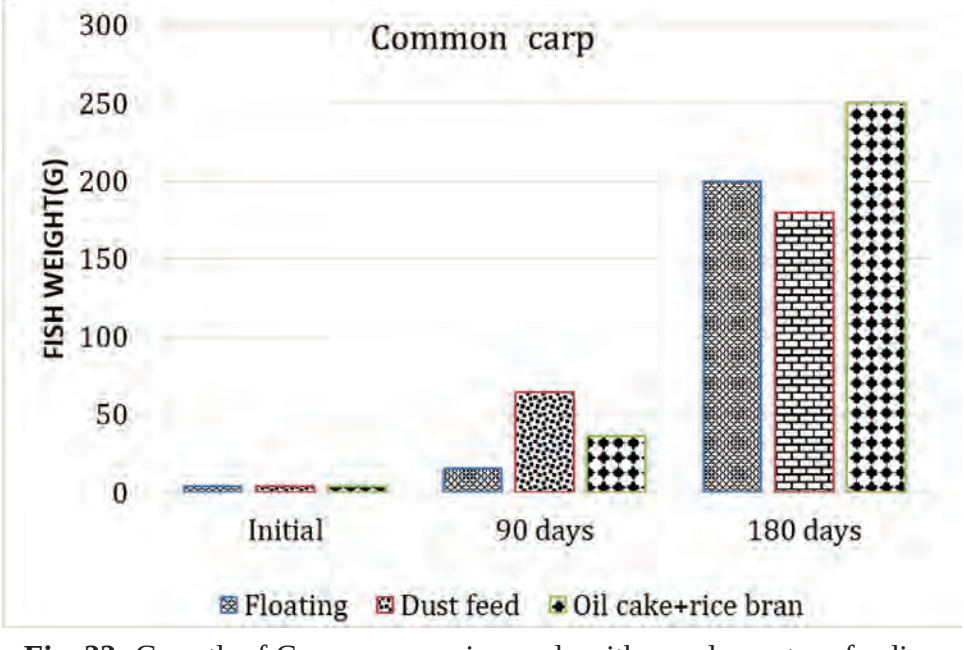


Fig. 22: Growth of Common carp in ponds with supplementary feeding

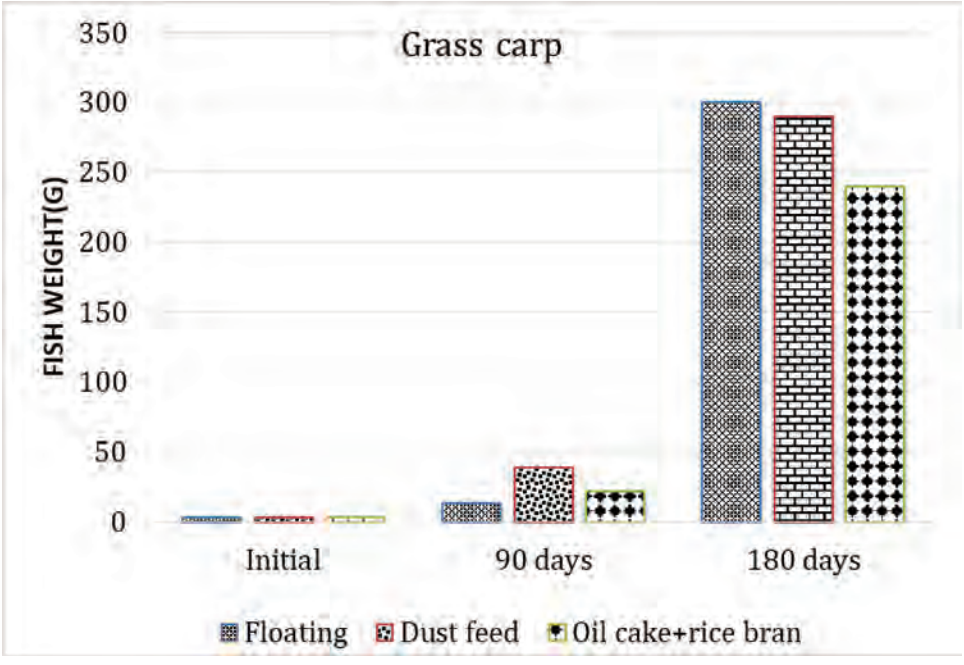


Fig. 23: Growth of Grass carp in ponds with supplementary feeding

3.6.4 Water Quality Monitoring Support Services to Fishers

Farmers having problems of water quality were provided services to monitor different water quality parameters on station and on farm to sort out their problems. Farmers got support mainly included farmers/ farms for fish farming in ponds and raceways in command districts. This included both study of new farms as well as existing fish farms. Water quality parameter such as temperature, dissolved oxygen, ammonia nitrogen and pH were usually monitored. Major water quality problem encountered in ponds was low dissolved oxygen in carp culture and water turbidity as well as contamination in the source water in trout culture. All these farmers/farms had been given suggestive measure for improving water quality.

3.6.5 Training on SMS/JT/JTAs

Three day training to Army officer of Lamjung Barrack was completed. Twenty four number of participants were participated in training.

3.6.6 Feasibility study to establish new OR site for aquaculture

One trout farm and three carp feasibility study was completed. Among them, Pokhara municipality ward no -31 was visited for pond construction. The feasibility study was

completed and suggestions were given to make fish farm. The land of Harun Khan at Pokhara municipality ward no -21 feasibility study was completed and suggestions were given to make fish farm. For trout farm, near Pumdi Bhumdi, Kaski was visited.

3.7 FISH SEED NURSING MANAGEMENT IMPROVEMENT FOR ENHANCING FISH SEED SURVIVAL AND GROWTH

The demand for carp fingerlings in the country has increased in recent years for stock in various water bodies for culturing table size fishes. In spite of rapid growth in the fish seed production sector, the major problems encountered on station and farm is great variation in growth and survival in field conditions during nursing period. With the increase in survival and growth of fish fry, production capability and capacity of the private sector would become self-reliance in sustaining the fisheries industry primarily for enhancing livelihood of the farmers and other stakeholders in value-chain, and ensuring food security and economic welfare in the region.

3.7.1 Trials on the Effect of Larval Density on Survival of Fry

A trial was conducted at FRS, Begnas nursery ponds to assess the survival and growth of grass carp hatchling to fry. Ponds were prepared as per standard practices following drying, liming (300kg/ha) and frequent fertilization with 20 kg Urea/ha and DAP 20kg/ha. In this experiment, hatchling of grass carp hatchlings were stocked at 40, 60 lacs and 80 lacs per hectare. Growth and survival data of 40 days rearing are presented in **Table 24**. The results showed that 40 lacs stocking density of grass carp was found to better survival than 60 and 80 lacs stocking density, however growth was better in 80 lacs/ha density. It is due initial mortality of fry in high stocking density.

Table 24: Growth and survival of grass carp hatchling to fry nursing

	40 lacs/ha	**60 lacs/ha**	**80 lacs/ha**
Initial weight(g)	0.004±0.001	0.004±0.001	0.004±0.001
20 days	0.0113±0.026	0.035±0.012	0.035±0.004
40 days	0.48±0.09	0.56±0.28	0.95±0.36
Survival (%)	30±3.4	15±2.6	10.5±2.3

3.8 IMPROVEMENT OF FISH SEED TRANSPORTATION METHODS USING ORGANIC SEDATIVES

3.8.1 Determination of appropriate density during fish fry/fingerlings transportation

An experiment was conducted to determine the packing density for transportation of bighead fry (5.95±1.4 g) for six hour under the hatchery of FRS, Begnas. The fish was

conditioned for 12 hr. before packing. This experiment was conducted in the simulated condition. The fry were stocked at 50g/L, 100g/L and 200g/L in plastic bag filled with oxygen. This experiment was conducted at 24.1±0.3°C.The results showed that lowest mortality (1-2%) was found at packing density 50g/L. The mortality of bighead fry increased with the packing density. The mortality was found 2.5-4 % in the packing density of 100g/L and higher (7-10%) in the packing density of 200g/L.

3.8.2 Determination of sedatives doses for fish fry/fingerlings transportation

An experiment was conducted to know the handling and transportation doses on bighead fry size 8.9±1.6g. For this, induction and recovery trials were done in 40 liter aquarium. Clove oil of different concentrations were tested on bighead fry. Final concentration 0.015/L, 0.025/L and 0.035/L were evaluated. The result showed that induction and recovery times significantly decreased with increased concentration of clove oil. 0.025ml/L of clove oil concentration was found optimum dose to reach surgical anaesthesia (A3b) of bighead fry within three minutes (Fig. 24).The water temperature and dissolved oxygen recorded during experiment were 29.2 ±0.01°C and 5.5 ±0.05 mg/L.

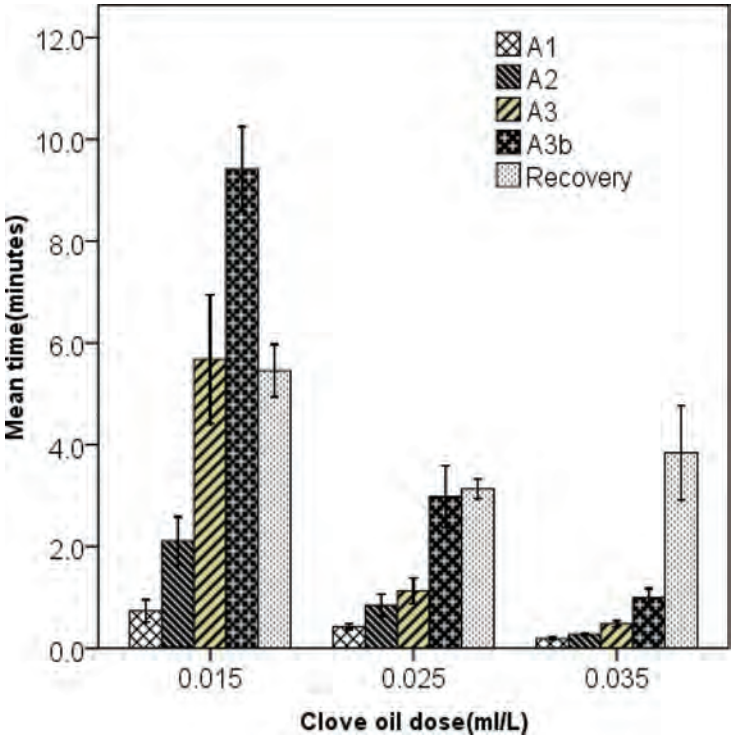


Fig. 24: Induction and recovery test of bighead fry with three concentration of clove oil.

3.8.3 Evaluation of sedative effect during and post transportation on fry and fingerling survival

A simulation experiment was conducted to evaluate the sedative effects of clove oil on survival of fry in transportation**.** Factorial experimental design was applied in this experiment with two times (6hr, 12 hr.) and two concentration of clove oil doses (5µl/L, 10µl/L). Control was without clove oil. Grass carp (2.9±1.1g) and common carp (1.5±1.2) was used in this experiment. Packing density (100g/L) was same in each treatments. Water temperature was 28.6 °C at packing time and increased to 31.0 °C after 12hr. No mortality of fish was found after six hour transportation in clove oil. The results showed that at higher temperature causes higher mortality. In the control, 31.1% of mortality was observed (Table 25). Clove oil 5µl/L was found effective for fish seed transportation.

Table 25: Behavioural observations and mortality of fry after 12 hr. transportation.

Dose of clove oil	Observations of live fish (after 5 minutes in freshwater) 12 hr.	Mortality(%) after12hr		
		CC	GC	Total
5µl/L	Active, free swimming	0.7±0.1	1.9±0.7	2.5±0.7
10µl/L	Active, free swimming	3.3±1.4	5.8±0.8	9.1±2.0
No clove oil	sluggish, stressed	6.5±0.3	24.8±1.7	31.1±1.7

3.9 DEVELOPING PEARL CULTIVATION PRACTICES USING LOCALLY AVAILABLE BIVALVES IN NEPAL

3.9.1 Collection, identification ad rearing of bivalves in captivity

The mussels collected from drainage canal was ***Lamellidens marginalis*.** This mussel was identified for pearl farming. These mussels are reared in canals and ponds of FRS, Pokhara.

Fig. 25: *Lamellidens marginalis* maintained in the outlet canals of Fishery research Station

The mussels collected from the fish growing farmer Mr. Din Bhadur GC resident of the pyuthan munciplity ward -9 were range to 80-206 gm (Fig.26). These mussels are kept in the ponds for rearing and inoculations.

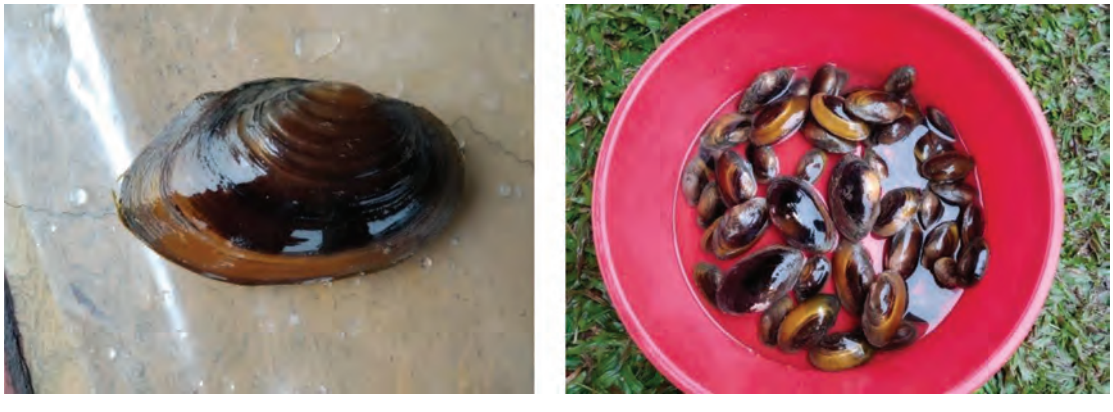


Fig. 26: *Lamellidens marginalis collected from Pyuthan*

3.9.2 Maintenance of bivalve stock

Mussels are maintained in the drainage canals, ponds, tank of FRS, Pokhara. Bivalves are feed by natural phytoplankton development in ponds. In tank artificial feed as powdered feed were fed.

3.9.3 Evaluation of feeding, handling and water quality for mussels farming

The ponds selected for pearl culture was manured by compost, urea and DAP frequently to maintain phytoplankton level.

Table 26: Water quality parameters recorded in pearl culture pond

Parameters	Range
Temperature(°C)	15.0-30.0
Dissolved oxygen(mg/L)	5.1-10.2
pH	7.0-8.5
Total alkalinity(mg/L)	35.0-55.0
Total hardness(mg/L)	62.0-76.0
Secchidisc reading (cm)	30-40

3.9.4 Establishment of mussels grafting facility

Procurement of mussels grafting materials such as spatula, knife, and instrument box were completed. Image bead and circular bead were prepared for the implantation in the mussels.

Methods of image and circular bead preparation

Materials required: Shells of mussels, motor and pestle, bleaching powder or lime, sieve, araldite (epoxy adhesive), molds, forceps, needles.

Procedure

The shells of dead mussels were soaked in to lime and water solution for 20-25 days and stirred periodically. To decrease the time period bleaching powder could be used. After the desired soaking period when the shells become whitish, the shells are taken out, wash with water and sun dried. The sun dried shells are grind into mortar and pastel to make powder. The powder is sieved. To make the dough of fine shell powder, the araldite adhesive is taken equal part, mixed equally and add powder and mixed again. The small quantity of dough is taken and put on molds to from the images. The circular bead is made by use of finger and palm.

Fig.27: Image beads

3.9.5 Study on grafting methods for pearl culture

Mantle cavity implantation were done in 500 mussels (Fig. 28)**.** The implanted mussels are placed in ponds for culture. Bead are attached to mussels successfully. The beads are partly covered by white shining materials (Fig. 29).

Fig. 28: Beads placement in the mantle cavity of mussel *Lamillidens marganalis*

Fig. 29: Attached beads in the mantle cavity of mussel *Lamillidens marganalis*

3.10 ASSESSMENT OF NUTRITIVE VALUE OF NATIVE FISH SPECIES OF NEPAL

Fish is a major source of food for mankind, providing with a significant amount of the animal protein diet, excellent dietary sources of highly unsaturated fatty acid (HUFA) and polyunsaturated fatty acid (PUFA), especially the omega-3 and omega-6 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Today, there is increasing interest in fish consumption because of their high PUFA content. Extensive research has been done on fish protein, lipids, fatty acids and amino acids. However, a big variation has been noticed in these compositions of different individuals of the same fish species. Therefore, when fish is suggested for consumption, both fat content and the PUFA composition must be considered. Malnutrition in women and child is still exist a serious concern in Nepal. Knowledge of nutritional composition of native fish species for recommendation of dietary plan of respective area to combat with nutritional deficiencies in women and children is necessary in Nepal. This study has documented the nutrient profile of native fish species.

3.10.1 Evaluation on present status of fish consumption in Nepal

The survey results of Kaski district showed that the consumption rate is differed by family to family. The consumption rate of fish is varied by economic status of people, family size, community and feeding habits. The people generally consume fish 80-150 gm weekly.

3.10.2 Collection of fish samples

The sample of native fish were collected from Begnas Lake are presented in the table 27. Nine native fish were collected from the Begnas lake and irrigation canal.

Table 27: Fish species collected for the analysis of nutrients from Begnas lake of Pokhara valley

S.N.	Fish species	Order	Family	Local names
1	*Puntius sophore*	Cypriniformes	Cyprinidae	Bhitte
2	*Puntius conchonius*	Cypriniformes	Cyprinidae	Bhitte
3	*Danio devario*	Cypriniformes	Cyprinidae	Sera Bhitte
4	*Barilius barna*	Cypriniformes	Cyprinidae	Fageta
5	*Mastacembelus armatus*	Synbranchiformes	Mastacembelidae	Chuchhe Bam
6	*Xenontodon cancilla*	Beloniformes	Belonidae	Dunge Bam
7	*Mystus vittatus*	Siluriformes	Bagaridae	Junge Machha
8	*Channa striatus*	Perciformes	Channidae	Bhote
9	*Heteropneustes fossilis*	Siluriformes	Heteropnuestidae	Singhi/ Chille

3.10.3 Analysis of nutrient composition of native fish species

3.10.3.1 Sample preparations for analysis

The collected fish species were identified by the book "Ichthyology of Nepal", Shrestha 2008. After collection, the individual length (cm) and weight (gm) of fishes were recorded. Samples were manually cleaned with tap water, then gutted, viscera and scale removed and again washed with water. The weight of gutted fish were taken and kept in the oven for 24 hours at 50℃ for drying. The weight of dried fish was taken and homogenization was carried out by the use of homogenizer and a grinder mixture respectively and finally, homogenized weight of fish were recorded respectively (Fig. 30). The homogenized samples were placed in the jipper bags, sealed and refrigerated for certain period of time before analysis. Those minced samples are now finally send to Food Research Division, Khumaltar, Lalitpur for their further nutrients analysis. The proximate and minerals analysis were done by methods: determination of moisture content (hot air oven method), crude protein (Micro-Kjeldahl), crude fat (ether extraction method), total ash and minerals (iron, phosphorous, and calcium) were done based on AOAC (2000) standard methods.

A. Gutting of fish sp.

B. Gutted fish sp.

C. Drying in oven

D. Homogenized samples

E. Seiving of the samples

F. Fianl sample

Fig. 30: Process of sample preperation of native fish species for nutrients analysis (A-F)

Table 28: A-F. Number of individuals, total body weight (g), gutted weight (g), dried weight (g) and homonized weight (g) of native fish species samples (six time) collected from Begans Lake.

A. Fish species collected from Begnas (1st sample collection)

S. N.	Fish species	No. of Individuals	Body weight (gm)	Gutted weight (gm)	Dried weight (gm)	Homogenized weight (gm)
1	*Puntius sophore*	24	96	79.54	26.61	24.79
2	*Puntius conchonius*	28	112	92.4	28.49	27.41
3	*Danio devario*	6	19.12	16.78	7	6.22
4	*Barilius barna*	14	66.73	32.56	13.4	13.77
6	*Mastacembelus armatus*	4	74.6	64.86	14.42	12.54
7	*Xenontodon cancilla*	3	54.06	50.28	13.32	11.44

B. Fish species collected from Begnas (2nd sample collection)

S. N.	Fish species	No. of Individuals	Body weight (gm)	Gutted weight (gm)	Dried weight (gm)	Homogenized weight (gm)
1	*Puntius sophore*	18	72.51	59.65	18.95	17.04
2	*Puntius conchonius*	34	136.96	112.67	39.43	38.76
3	*Danio devario*	8	152.88	119.93	42.5	35.2
4	*Barilius barna*	7	26.11	19.35	5.48	4.34
5	*Mystus vittatus*	11	65.065	58.465	12.22	10.395

C. Fish species collected from Begnas (3rd sample collection)

S. N.	Fish species	No. of Individuals	Body weight (gm)	Gutted weight (gm)	Dried weight (gm)	Homogenized weight (gm)
1	*Puntius sophore*	7	28.2	23.2	7.35	6.76
2	*Puntius conchonius*	16	64.45	53.02	13.39	12
3	*Danio devario*	18	60.53	49.77	12.8	11.88
4	*Barilius barna*	4	23.66	21.26	5.55	3.78

D. Fish species collected from Begnas (4th sample collection)

S. N.	Fish species	No. of Individuals	Body weight (gm)	Gutted weight (gm)	Dried weight (gm)	Homogenized weight (gm)
1	*Danio devario*	34	116.32	94.01	20.41	18.42
2	*Channa striatus*	6	79.44	73.2	26.9	24.5
3	*Xenontodon cancilla*	3	55.95	48.645	12.32	9.64
4	*Mastacembelus armatus*	15	270.3	251.4	88.8	62.48

E. Fish species collected from Begnas (5th sample collection)

S. N.	Fish species	No. of Individuals	Body weight (gm)	Gutted weight (gm)	Dried weight (gm)	Homogenized weight (gm)
1	*Danio devario*	23	78.86	63.595	13.8	12.69
2	*Barilius barna*	3	17.745	15.945	4.12	2.83
3	*Channa striatus*	9	82.23	75.69	35.94	34.72
4	*Xenontodon cancilla*	6	111.9	97.29	22.21	21.63
5	*Heteropneustes fossilis*	6	41.16	38.58	14.28	13.14

F. Fish species collected from Begnas (6th Sample collection)						
S. N.	**Fish species**	**No. of Individuals**	**Body weight (gm)**	**Gutted weight (gm)**	**Dried weight (gm)**	**Homogenized weight (gm)**
1	*Danio devario*	16	54.73	44.24	9.6	8.99
3	*Puntius sophore*	45	189.78	166.3	40.22	39.89
4	*Channa striatus*	9	82.23	75.69	35.94	34.72
4	*Mystus vittatus*	6	118.008	102.414	24.75	24.22

Nutrients level in the native fish species

The results of nutrients level are presented in the table 29 and 30. It showed that nutrients contents were varied in each species. Comparatively, high amount of crude protein was found in the *Mastacembelus armatus*, calcium was found in the *Puntius conchonius*, phosphorus was found in the *Channa striatus* and iron was found in the *Xenotodon cancilla* (Table 29 and 30).

Table 29: Nutrients level in native fishes of Begnas Lake (Dry basis)

S. N.	Fish species	Moisture (%)	Crude fat (%)	Crude protein (%)	Total ash (%)
1	*Puntius sophore*	8.39	12.85	43.46	17.39
2	*Puntius conchonius*	6.88	12.45	60.44	19.65
3	*Danio devario*	8.34	13.88	63.28	13.66
4	*Barilius barna*	8.35	12.66	61.87	16.18
5	*Mastacembelus armatus*	8	6.62	68.19	12.64
6	*Xenontodon cancilla*	7.17	11.6	67.16	12.79
7	*Mystus vittatus*	7.6	11.61	65.14	15.53
8	*Channa striatus*	7.45	10.51	64.68	16.4
9	*Heteropneustes fossilis*	7.56	11.27	59.52	16.08

Table 30: Mineral levels in native fishes of Begnas Lake (Dry basis)

S. N.	Fish species	Calcium (mg/100g)	Phosphorus (mg/100g)	Iron (mg/100g)
1	*Puntius sophore*	4950.86	917.02	6.94
2	*Puntius conchonius*	6282.45	924.37	3.1
3	*Danio devario*	4596.8	967.59	1.65
4	*Barilius barna*	5827.32	2552.49	4.04
5	*Mastacembelus armatus*	3259.63	4053.35	9.27
6	*Xenontodon cancilla*	2375.6	3946.28	14.53
7	*Mystus vittatus*	4797.77	4312.5	4.88
8	*Channa striatus*	5233.06	4510.8	7.82
9	*Heteropneustes fossilis*	4818.13	2943.07	10.61

3.11 Domestication of native fish species for aquaculture and conservation

3.11.1 Collection of fish catch data

Nepal is rich in freshwater resources and among this river is major source of freshwater. Rivers are supporting to the livelihood of fishermen leaving along the riverside. Damming across the river causes the negative impact in river ecosystem and aquatic environment. Dam at Mirmi under Kaligandaki 'A' hydropower has blocked the path of migratory fish, which causes the negative impact to aquatic biodiversity. Kaligandaki Fish Hatchery has been conducting some mitigating approach to meet the objective of the maintaining fish biodiversity in the river. Hatchery has been collecting and conducting study on the biology of valued fish.

Existing fish Status in Kali Gandaki river System

- Total 157 fish species has been reported from Gandaki River System.
- Altogether 57 fish species has been reported from Kali Gandaki River.
- 30 species were collected, identified and displayed in KG hatchery fish museum.
- 15 live species are rearing in ponds/ raceways at KG fish hatchery
- Breeding of 12 fish species succeeded.

The fish catch data were collected from Belatari and Mirmi fish catch landing sites of Kaligandaki River. The total around 17 fish species reported from Belatari catch landing sites while only 8 species were catch at Mirmi in the FY 2018/19 (Fig. 31 and 32). The catch record of Gardi and Rajbam was highest in the Belatari station while in Mirmi, Gardi and katle catch was highest. Seasonal variation in the catch were observed in both landing sites.

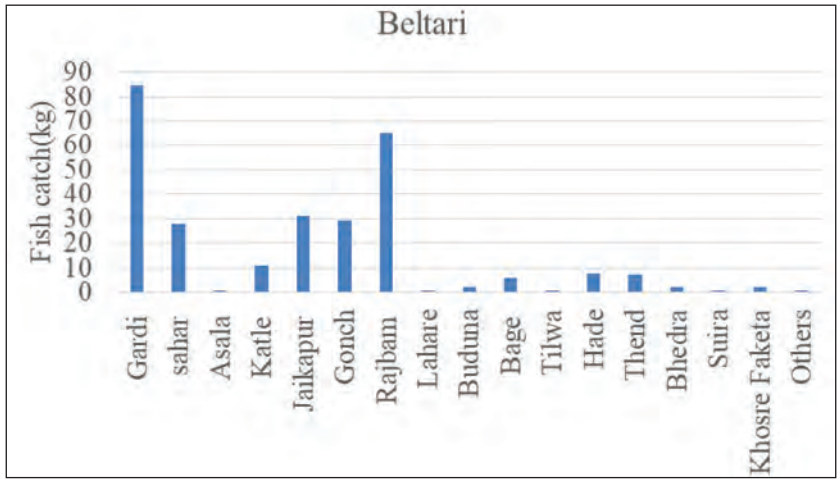


Fig. 31: Species wise catch records at Beltari catch landing sites of Kaligandaki River

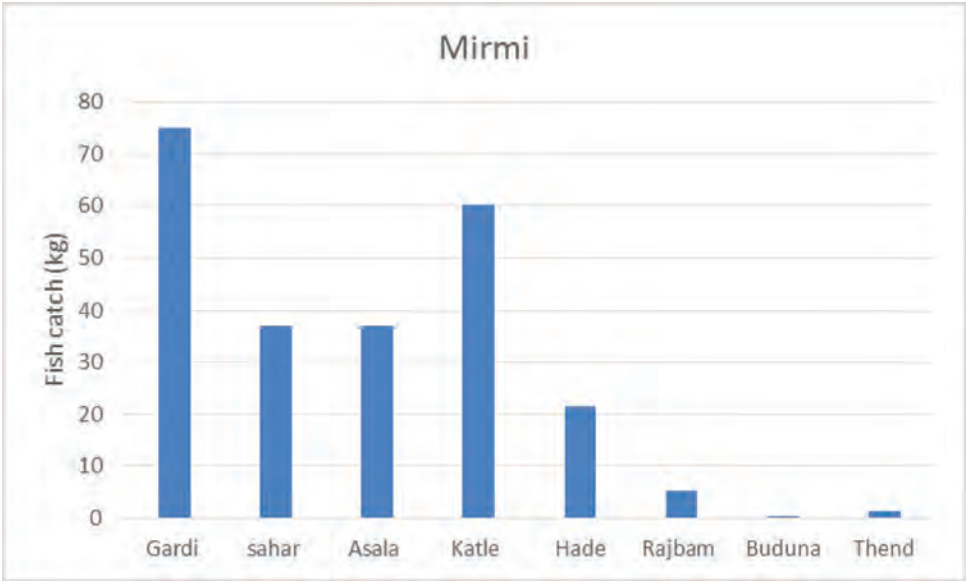


Fig. 32: Species wise catch records at Mirmi catch landing sites of Kaligandaki River.

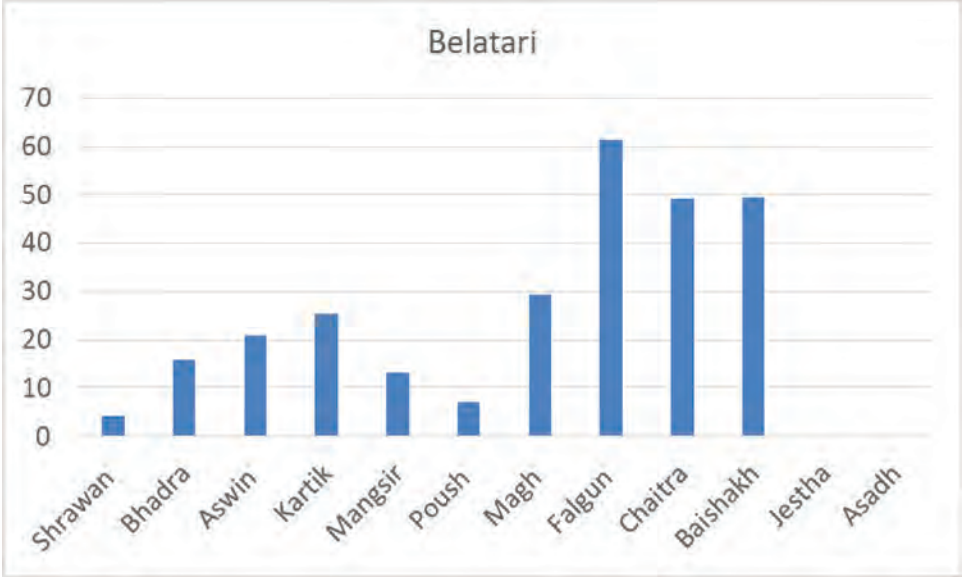


Fig.33: Seasonal variations in catch records at Belatari catch landing sites of Kaligandaki River.

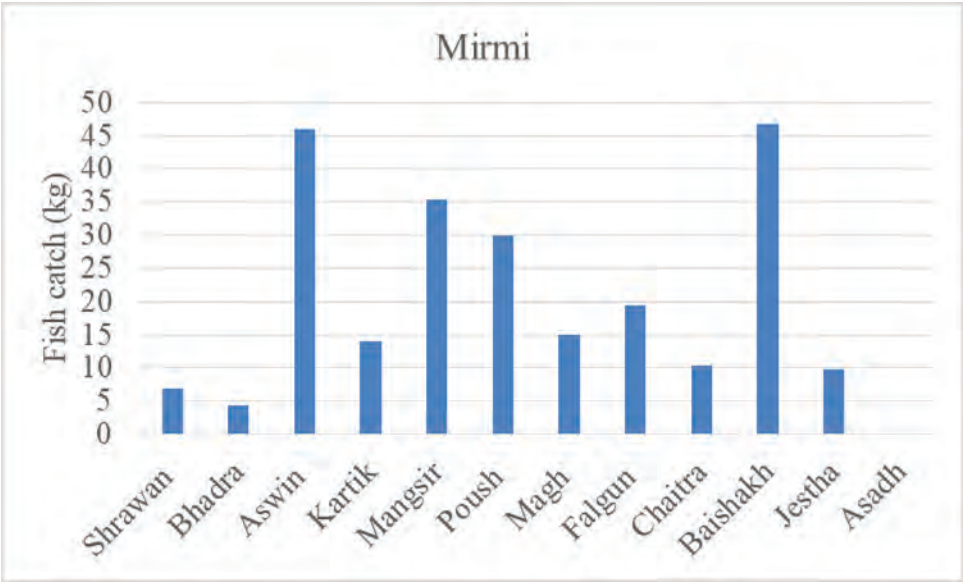


Fig.34: Seasonal variations in catch records at Mirmi catch landing sites of Kaligandaki River.

3.11.2 Improvement Of Fisheries Management Of Kali Gandaki River Through Stock Enhancement And Aquaculture

Mainly three species of the *Labeo* found in Kali Gandaki River namely Gardi, *Labeo dero,* Hade, *L. pangusia* and Thend, *L. angra* and other indigenous species are rearing in the hatchery as the brood fishes. The fry of these three species are producing in mass scale by hormone treatment in the season from June to July; and other indigenous fishes Sahar, Asala and Katle are matured in the pond and eggs are collected by hand stripping. The fingerling produced in the hatchery, are released in the upstream (Mirmi Reservoir) of Kali Gandaki hydro-dam (**Table 31**)

Table 31: Fingerling released in upstream (Mirmi Resrvoir) of Kali Gandaki Hydro-dam.

Fish species	**Total**
Gardi	2206500
Hade	121000
Thend	190000
Golden Sahar	1000
Malunge Sahar	500
Total	**350000**

Limnological Parameters of reservoir at Mirmi and Belatari

Table 32: Limnological Parameters of reservoir at Mirmi measured on 2019/20.

S.N.	Parameters	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Water Temperature (^{0}C)	20.0	21.0	21.0	17.0	15.0	12.5	12.5	14.0	17.0	21.3	23.0	22.0
2	Water Transparency (Cm)	3	2	15	14	20.0	50.0	54.0	50.0	40.0	15.0	12.0	3.2
3	pH	7.5	7.4	7.6	7.8	7.6	7.5	7.2	7.9	7.5	7.8	7.6	7.9
4	Dissolved Oxygen (mg/L)	7.0	7.6	9.1	8.2	9.6	9.2	9.0	9.0	9.7	8.2	8.5	7.5
5	Conductivity (µ mhos/Cm)	134.33	179.11	179.11	223.89	194.1	209.0	209.0	223.89	209.0	209.0	209.0	119.42
20.26	TDS(mg\l)	90.0	120.0	120.0	150.0	130.0	140.0	140.0	150.0	140.0	140.0	140.0	80.0
7	Total Alkalinity (mg/L)	LOW	88.0	Low	38.0	43.0	59.0	50.0	55.0	50.0	109.0	101.0	90.0
8	Total Hardness (mg/L)	<2.0	33.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
9	Ammonia((mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
10	Nitrate(mg/L)	0.00	0.15	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	
11	Nitrite(mg/L)	0.00	8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
12	Phosphate(mg\l)	LOW	2.36	Low	0.19	Low	Low	Low	Low	Low	1.30	0.70	

Table 33: Limnological Parameters of Kaligandaki River at Beltari measured on 2019/20.

S.N.	Parameters	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Water Temperature (^{0}C)	20.0	21.0	22.0	18.0	17.0	17.2	16.0	15.5	18.5	23.5	24.5	24.5
2	Water Transparency (Cm)	3.0	3.0	8.0	13.0	32.0	53.0	55.0	45.0	45.0	13.0	11.0	6.0
3	pH	7.4	7.5	7.2	7.9	7.7	7.3	7.6	7.8	7.2	7.6	7.7	7.8
4	Dissolved Oxygen (mg/L)	7.2	7.4	7.0	9.9	9.1	9.5	9.5	10.2	9.9	8.2	8.7	8.9
5	Conductivity (µ mhos/Cm)	149.26	149.26	209.0	194.1	209.0	209.0	223.89	209.0	223.89	223.89	194.1	149.26
6	TDS (mg\l)	100.0	100.0	140.0	130.0	140.0	140.0	1450.0	140.0	150.0	150.0	130.0	100.0
7	Total Alkalinity (mg/L)	Low	87.0	Low	104.0	81.0	81.0	78.0	89.0	80.0	108.0	108.0	95.3
8	Total Hardness (mg/L)	<2.0	63.0	<2.0	16.0	<2.0	10.0	8.0	4.0	4.0	4.0	<2.0	
9	Ammonia (mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
10	Nitrate (mg/L)	0.00	0.00	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
11	Nitrite (mg/L)	0.00	0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
12	Phosphate (mg\l)	Low	0.25	Low	Low	Low	Low	Low	Low	Low	0.27	0.75	

4. FISH SOURCE SEED PRODUCTION AND FISH BREEDING MANAGEMENT (FISH SEED AND TABLE FISH PRODUCTION).

4.1 Brood Fish Rearing, Breeding and Hatchery Management

Different fish species of exotic and indigenous broods are being reared in ponds, cages for breeding purposes. A pond was regularly fertilized with organic and inorganic fertilizer and frequent water exchange was done. All these brood fish were fed with different types of feed suitable for the species prepared at station. Breeding performance of different species is provided in **Table 34.**

Eight fish species were breed seasonally to produce fish seed. The fish species includes Common carp, Sahar, Grass carp, Gardi, Rohu, Naini, and Bhakur. The breeding season starts from Falgun and ended in the shrawan months.

Table 34: Details of breeding performance of different fish species in FRS, Pokhara during FY2019/20.

Fish species A. Common carp

Breeding parameters	Date 2076-11-07	Date 2076-11-07	Date 2076-11-07
Fish Species	Common carp	Common carp	Common carp
Female(No.wt.kg)	3(14.8)	3(10.3)	3(9.965)
Male(No.wt.kg)	4(10)	5(10.3)	5(9.5)
Hormone Type	Ovatide	Ovatide	Ovatide
Hormone Female (ml/kg,µg/kg)	0.5	0.5m	0.5
Hormone Male (ml/kg,µg/kg)	0.25	0.25	0.25
Time of injection	2:00PM	2:00PM	2:00PM
Water Temperature(°C)	18°c	18°c	18°c
Total No.of eggs	140000	100000	100000
Fertility%	60%	60%	60%
Hatching%	49%	48%	48%
Hatchling No	400000	288000	288000

Breeding parameters	Date 2076-11-12	Date 2076-11-18	Date 2076-11-19	Date 2076-11-20
Fish Species	Common carp	Common carp	Common carp	Common carp
Female(No.wt.kg)	4(10.686)	4(11.474)	4(11.800)	3(11.496)
Male(No.wt.kg)	7(18.0)	5(15.0)	5(17.00)	5(12.0)
Hormone Type	Ovatide	Ovatide	Ovatide	Ovatide
Hormone Female (ml/kg,µg/kg)	0.5ml/kg	0.5ml/kg	0.5ml/kg	0.5ml/kg
Hormone Male (ml/kg,µg/kg)	0.25ml/kg	0.25ml/kg	0.25ml/kg	0.25ml/kg
Time of injection	2:30pm	2:35pm	2:40pm	3:40pm
Water Temperature(°C)	20°C	20°C	20°C	20°C
Total No.of eggs	1141000	929600	1575000	1743000
Fertility%	70%	75%	65%	65%
Hatching%	63%	72%	49%	53%
Hatchling No	500000	500000	500000	600000

Breeding parameters	Date 2076-11-28	Date 2076-11-29	Date 2076-12-04	Date 2076-12-20
Fish Species	Common carp	Common carp	Common carp	Common carp
Female(No.wt.kg)	3(10.824)	4(12.310)	3(12.346)	3(10.926)
Male(No.wt.kg)	5(13.0)	7(20.0)	5(15.00)	5(14.0)
Hormone Type	Ovatide	Ovatide	Ovatide	Ovatide
Hormone Female (ml/kg,µg/kg)	0.5ml/kg	0.5ml/kg	0.5ml/kg	0.5ml/kg
Hormone Male (ml/kg,µg/kg)	0.25ml/kg	0.25ml/kg	0.25ml/kg	0.25ml/kg
Time of injection	3:45pm	2:40pm	2:45pm	2:50pm
Water Temperature(°C)	20°C	20°C	20°C	20°C
Total No.of eggs	1703100	1796200	2034200	1957600
Fertility%	65%	55%	60%	54%
Hatching%	55%	51%	46%	48%
Hatchling No	600000	500000	550000	500000

Breeding parameters	Date 2076-12-23	Date 2076-12-28	Date 2076-12-28	Date 2076-12-28
Fish Species	Common Carp	Common carp	Common carp	Common carp
Female(No.wt.kg)	3(14.724)	3(10.824)	3(10.008)	4(12.020)
Male(No.wt.kg)	5(13.0)	5(14.0)	6(15.00)	7(18.0)
Hormone Type	Ovatide	Ovatide	Ovatide	Ovatide
Hormone Female (ml/kg,µg/kg)	0.5ml/kg	0.5ml/kg	0.5ml/kg	0.5ml/kg
Hormone Male (ml/kg,µg/kg)	0.25ml/kg	0.25ml/kg	0.25ml/kg	0.25ml/kg
Time of injection	2:20pm	2:25pm	2:30pm	3:35pm
Water Temperature(℃)	23℃	23℃	23℃	23℃
Total No.of eggs	154000	1789200	1477000	1426600
Fertility%	60%	58%	60%	61%
Hatching%	55%	49%	51%	46%
Hatchling No	500000	500000	450000	400000

Breeding parameters	Date 2076-11-05
Fish Species	Chinese Common carp
Female(No.wt.kg)	6(13.1)
Male(No.wt.kg)	11(27.5)
Hormone Type	Ovatide
Hormone Female (ml/kg,µg/kg)	0.5ml/kg
Hormone Male (ml/kg,µg/kg)	0.25ml/kg
Time of injection	2:55pm
Water Temperature(℃)	18℃
Total No.of eggs	1330000
Fertility%	60%
Hatching%	51%
Hatchling No	400000

Fish species B. Fencey carp

Breeding parameters	Date 2076-12-5
Fish Species	Fancy carp
Female(No.wt.kg)	9(8.4)
Male(No.wt.kg)	13(15.0)
Hormone Type	Ovutide
Hormone Female (ml/kg,µg/kg)	0.5ml/kg
Hormone Male (ml/kg,µg/kg)	0.25ml/kg
Time of injection	2:50pm
Water Temperature(°C)	18°C
Total No.of eggs	1345400
Fertility%	76%
Hatching%	59%
Hatchling No	600000

Fish species C. Grass carp

Breeding parameters	Date 2077-1-07	Date 2077-1-21	Date 2077-1-30	Date 2076-2-06
Fish Species	Grass carp	Grass carp	Grass carp	Grass carp
Female (No.wt.kg)	4(22.800)	4(22.592)	4(27.690)	6(27.430)
Male (No.wt.kg)	6(26.0)	6(19.0)	6(27.00)	6(26.0)
Hormone Type	LRHA-2	LRHA-2	LRHA-2	LRHA-2
Hormone Female (ml/kg,µg/kg)	20µ/kg	20µ/kg	20µ/kg	20µ/kg
Hormone Male (ml/kg,µg/kg)	10µ/kg	10µ/kg	10µ/kg	10µ/kg
Time of injection	12:20pm 9:30pm	1:45pm 10:35pm	12:11pm 9:14pm	12:46pm 9:40pm
Water Temperature(°C)	23°C	25°C	27°C	27°C
Total No.of eggs	3117600	2938800	2973600	2194800
Fertility%	70%	65%	65%	52%
Hatching%	69%	53%	52%	53%
Hatchling No	1500000	1000000	1000000	100000

Breeding parameters	Date 2077-2-10	Date 2076-2-13
Fish Species	Grass carp	Grass carp
Female(No.wt.kg)	4(28.584)	5(24.484)
Male(No.wt.kg)	6(29.0)	7(28.5)
Hormone Type	LRHA-2	LRHA-2
Hormone Female (ml/kg,µg/kg)	20µ/kg	20µ/kg
Hormone Male (ml/kg,µg/kg)	10µ/kg	10µ/kg
Time of injection	12:20pm 9:21pm	12:15pm 9:10pm
Water Temperature(℃)	25℃	26℃
Total No.of eggs	2130000	2681400
Fertility%	70%	68%
Hatching%	68%	66%
Hatchling No	1000000	1200000

Fish species D. Naini

Breeding parameters	Date 2077-2-21	Date 2077-2-21	Date 2077-2-29	Date 2076-3-09
Fish Species	Naini	Naini	Rohu	Rohu
Female(No.wt.kg)	7(16.871)	7(31.769)	5(13.974)	5(14.382)
Male(No.wt.kg)	9(15.0)	7(31.769)	7(10.5)	7(12.0)
Hormone Type	Ovulin	Ovulin	Ovatide	Ovatide
Hormone Female (ml/kg,µg/kg)	0.5ml/kg	0.5ml/kg	0.5ml/kg	0.5ml/kg
Hormone Male (ml/kg,µg/kg)	0.25ml/kg	0.25ml/kg	0.25ml/kg	0.25ml/kg
Time of injection	9:35pm	9:37pm	8:30pm	9:34pm
Water Temperature(℃)	29℃	28℃	30℃	28℃
Total No.of eggs	2480000	2240000	2320000	2688000
Fertility%	88%	93%	90%	90%
Hatching%	83%	87%	87%	75%
Hatchling No	1800000	1800000	1800000	1800000

Breeding parameters	Date 2077-3-15
Fish Species	Rohu
Female(No.wt.kg)	5(16.0)kg
Male(No.wt.kg)	7(11.5)
Hormone Type	Ovatide
Hormone Female (ml/kg,µg/kg)	0.5ml/kg
Hormone Male (ml/kg,µg/kg)	0.25ml/kg
Time of injection	8:00pm
Water Temperature(℃)	30℃
Total No.of eggs	2360000
Fertility%	85%
Hatching%	80%
Hatchling No	1600000

Fish Species E. Bhakur

Breeding parameters	Date 2076-3-11
Fish Species	Bhakur
Female(No.wt.kg)	5(18.796)
Male(No.wt.kg)	7(20.0)
Hormone Type	Ovatide
Hormone Female (ml/kg,µg/kg)	0.5ml/kg
Hormone Male (ml/kg,µg/kg)	0.25ml/kg
Time of injection	9:26pm
Water Temperature(℃)	29℃
Total No.of eggs	2560000
Fertility%	92%
Hatching%	85%
Hatchling No	2000000

Fish Species F. Gardi

Breeding Parameters	Date 2076.04.05
Fish species	Gardi
Female (No.wt.kg)	10(1.7)
Male (No.wt.kg)	10(1.662)
Hormone type	Ovatide
Hormone female	0.4ml/kg
Hormone Male	0.2ml/kg
Time of injection	8:00 PM
Water Temperature	29°c
Total no.of egg	170000
Fertility%	70
Hatching %	80
Hatching N.	95200

Fish species: G: Sahar

Breeding parameters	Date 2076/12/07	Date 2076/12/27
Fish species	Sahar	Sahar
Female (No. wt kg)	2(4.5kg)	2(3.6kg)
Male (No. wt kg)	4(3.6 kg)	4(4.2 kg)
Water temperature(^{0}C)	21.1°C	21.3°C
Total weight of egg	328 gm	250 gm
Fertility %	95%	94%
Hatching %	91%	90%
	%%	%%
Hatchling No.	10000	9000

4.2 Fish Seed Nursing/Rearing and Production Management

Fry nursing and rearing of different species of fry were done to distribute fry and fingerling to farmers of command district. Nursing of fry was done following standard practice. This year about 3 million hatchlings were produced and 2.3million fry and fingerlings as well as 10 lac hatchlings were sold till end of fiscal year and distribution was continued. Annex 4.2.

4.3 Management for fish distribution to fish grower

This year 2318143 number of fry and fingerlings and 10 lac of hatchlings of different

fish species were distributed to farmers for nursing and fish production in pond culture, cage fish culture, rice-fish culture etc. The details are provided in **Annex 4.3.**

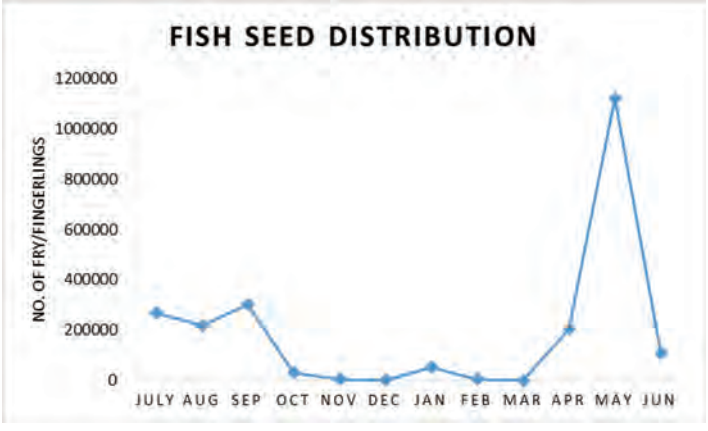


Fig. 35: Monthly fish seed distribution

Fish seed distribution was found higher in the month of May (Fig. 35). Grass carp was highest sale record followed by common carp, rohu and Naini in the FY 2076/77 (Fig. 36).

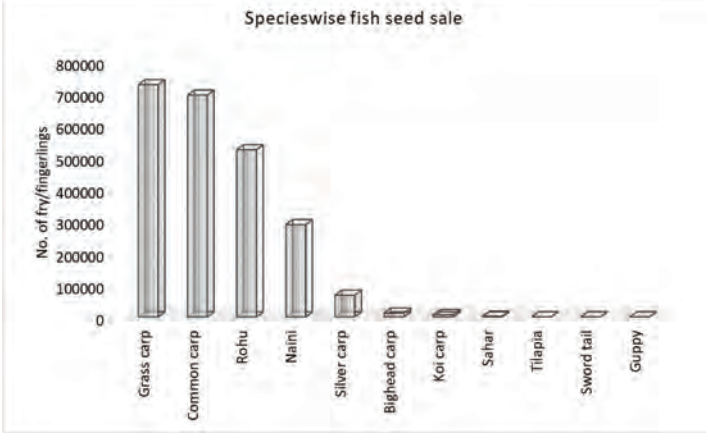


Fig. 36: Species-wise fish seed distribution

4.4 Table Fish Production Management

Table fish production program was mainly conducted in cages landed in Phewa, Begnas and Rupa cages for resource utilization. Standard table fish production method was adopted. Currently due to changing pattern of lakes, plankton production was limited. Despite this, some table fish was also sold as outcome of research by product. About 1416.2 kg of table fish was sold to local consumers in this fiscal year.

5. TECNOLOGY TRANSFER and SERVICES

5.1 Services and support to farmers

The farmers are supported for new site selection, water quality and fish diseases monitoring, fish breeding Annex-5.1.

5.2 Visits

Farmers, students, extensionist, researchers, entrepreneur and NGO personals were visited to observe different activities of this station are provided in **Annex 5.2**.

5.3 Training/Workshop

Three day training to the retired army personal of Lamjung barrack was provided from this station. 25 army personals were actively participated and learn about the fish breeding, nursing and fish farming.

5.4 Publications

This year annual report and pamphlet, leaflet and booklets were published and provided in **Annex 5.4**.

5.5 Participation of staffs in trainings and seminar

The list of trainings and workshops attended by staffs of this stations are summarized in table in Annex-5.5.

5.6 Information through media

Some information regarding conservation and utilization of native fish and management of Lake Environment were disseminated through newspaper.

6. BUDGET and EXPENDITURE

Budget and expenditure details of fiscal year 2076/77 of this station provided in **Annex 6.**

7. KEY PROBLEMS

Researchable and management problem at FRS, Pokhara

- Lack of researchable ponds.
- Some equipment are old (generator) and some are old model (lab analytical equipments).
- Insufficient scientists and middle level staffs.

8. Way Forward

- Upgrade the Fishery Research Station, Pokhara to National Aquaculture and Fisheries Research Institute for strengthen the fishery research in the country through coordination with all fisheries research stations and units to develop novel technology for farmers.
- Improvement of research facilities (researchable ponds and laboratory facilities).
- Improvement in the lake resource management and fish production through community participation.
- Good working environment will create better output in future.
- Scientist and technical level staffs should be fulfilled.

Annex 1: Description of infrastructure and facilities

Phewa Office: Total area 1.3 ha		
Infrastructure/facilities	**No.**	**Area**
Nursery pond	6	0.15 ha
Research pond	12	0.15 ha
Office cum laboratory	1	
Residence/Quarter	4	
Watch man house	1	
Feed house	1	
Net shed	1	
Aquarium house	1	
Fish Hatchery (Old)	1	
Begnas Office: Total area 6.8 ha		
Brood fish pond	4 x 0.20 ha / 6 x 0.10 ha	0.8 ha / 0.6 ha
Nursery pond	40 x 0.05 ha	2.0 ha
Raceway	9	
Office cum laboratory	1	
Warm water hatchery	1	
Indigenous hatchery	1	
Feed house	1	
Training house	1	
Net shed	1	
Fish collection shed	1	
Residence	7	
Generator house	1	
Canteen	1	
Store house	1	
Lake Rupa: Total area 0.1 ha		
Office building	1	
Residence	2	1 damaged

Annex 2.1: Name of working employees with their post

नेपाल कृषि अनुसन्धान परिषद
मत्स्य अनुसन्धान केन्द्र, वेगनास, पोखरा, कास्की
कर्मचारीहरुको विवरण (२०७६ श्रावण देखि २०७७ असार मसान्तसम्म)

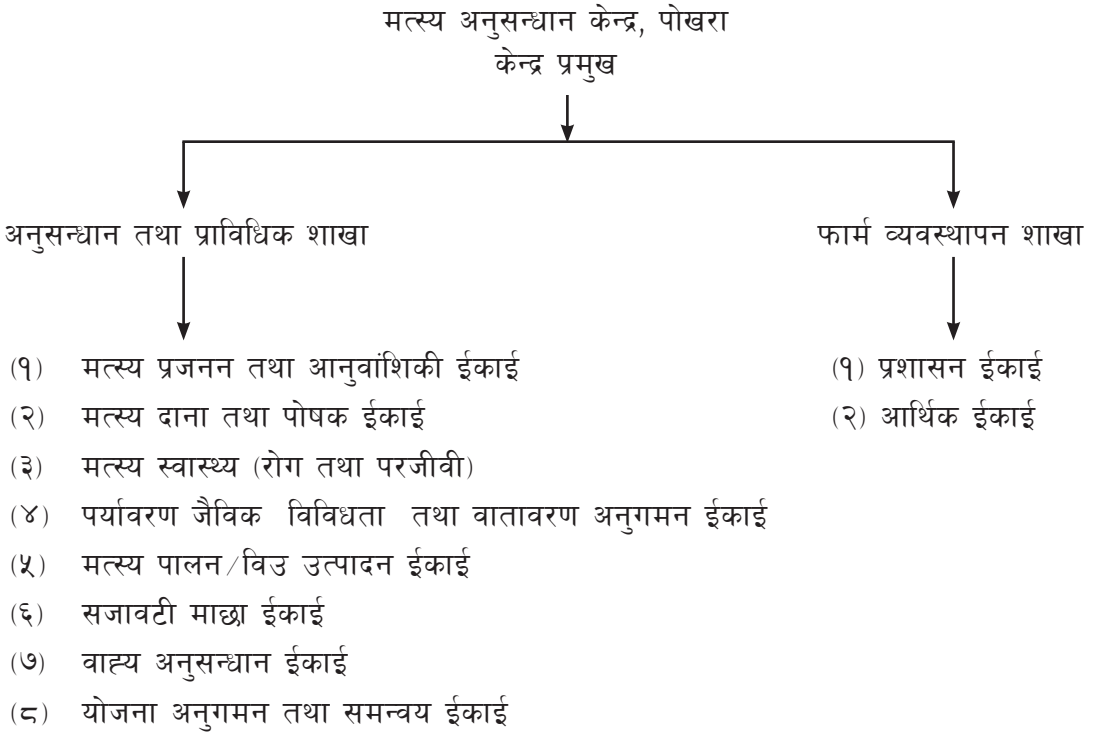
क्र.सं.	कर्मचारीको नाम	पदरतह	उप समूह	शैक्षिक योग्यता	कैफियत
१	श्री अग्निप्रसाद नेपाल	केन्द्र प्रमुख र ब. वैज्ञानिक	फिसरिज	एम.एसी. अक्वाकल्चर	२०७६ भाद्रदेखि सेवा निवृत्त
२	डा. मो. ईकबाल हुसेन	केन्द्र प्रमुख र ब. वैज्ञानिक	फिसरिज	पी.एच.डी.	२०७६ भाद्रदेखि केन्द्र प्रमुख
३	श्री देव प्रसाद शर्मा	ब. प्राविधिक अधिकृत	फिसरिज	बि.एस.सी. एग्री.	२०७६ भाद्र देखि सेवा निवृत्त
४	श्री भरत कुमार श्रेष्ठ	प्रा. अधिकृत	फिसरिज	आई.ए.	२०७६ पौषदेखि सेवा निवृत्त
५	श्री हरेराम देवकोटा	प्रा. अधिकृत	फिसरिज	एम.एसी. अक्वाकल्चर	म.अ. महाशाखा सरुवा (२०७७/३/१४)
६	श्री ओम नारायण शर्मा	ले. अधिकृत	लेखा	बि.ए.	
७	श्री राजेन्द्र प्रसाद पो खेल	प्र. अधिकृत	प्रशासन	एम.ए.	
८	श्री सुनिता चन्द	प्रा. अधिकृत	फिसरिज	बि.एस.सी. एग्री.	क्षे.कृ.अ. केन्द तरहरा सरुवा (२०७६/४/१९)
९	श्री भगवती थापा	प्र.प्र. सहायक	प्रशासन	एम.ए.	
१०	श्री माया पुन मगर	टाईपिष्ट	प्रशासन	एस.एल.सी	२०७६ माघदेखि सेवा निवृत्त (राजिनामा)
११	श्री कमल राना	प्रा. सहायक	प्राबिधिक	जे.टि.ए.	कफी अनुसन्धान केन्द्र गुलमि सरुवा (२०७७/४/४)
१२	श्री मनिराम बराल	ह.स.चालक	प्रशासन	साक्षर	२०७६ पौषदेखि सेवा निवृत्त
१३	श्री दान बहादुर मगर	प्रा.स. पाँचौ स्तर	प्राबिधिक	साक्षर	२०७६ फाल्गुणदेखि सेवा निवृत्त (राजिनामा)
१४	श्री कृष्ण बहादुर कार्की	प्रा.स. पाँचौ स्तर	प्राबिधिक	एस.एल.सी.	

क्र.सं.	कर्मचारीको नाम	पदरतह	उप समूह	शैक्षिक योग्यता	कैफियत
१५	श्री इस्वर गुरुङ	प्रा.स. पाँचौ स्तर	प्राबिधिक	एस.एल.सी.	२०७६ माघदेखि सेवा निवृत्त (राजिनामा)
१६	श्री सुशिला थापा	प्रा.स. पाँचौ स्तर	प्राबिधिक	साक्षर	२०७६ असोजदेखि सेवा निवृत्त
१७	श्री तोला कुमारी शर्मा	प्रा.स. पाँचौ स्तर	प्रशासन	७ पास	बागवानी अनुसन्धान केन्द्र मालेपाटन सरुवा (२०७६/७/२९)
१८	श्री बुद्धि बहादुर सार्की	प्रा.स. चतुर्थ स्तर	प्राबिधिक	एस.एल.सी.	
१९	श्री भोजराज तिमिल्सिना	प्रा.स. पाँचौ स्तर	प्राबिधिक	एस.एल.सी.	
२०	श्री ठाकुर प्रसाद लामिछाने	प्रा.स. तृतीय स्तर	प्राबिधिक	साक्षर	
२१	श्री हरिनारायण रेग्मी	प्रा.स. प्रथम स्तर	प्राबिधिक	एस.एल.सी.	
२२	श्री रमेश राज पन्त	प्रा.स. प्रथम स्तर	प्राबिधिक	एस.एल.सी.	
२३	श्री राजु लम्दारी	प्रा.स. प्रथम स्तर	प्राबिधिक	साक्षर	
२४	श्री बिष्णु बि.क.	प्रा.स. प्रथम स्तर	प्राबिधिक	आठ पास	क्षे.कृ.अ. केन्द्र लुम्ले, सरुवा (२०७६/७/२९)
२५	श्री उमा स्याङ्तान	प्रा.स. प्रथम स्तर	प्राबिधिक	साक्षर	
२६	श्री रक्षा पराजुली	प्रा.स. प्रथम स्तर	प्राबिधिक	आई.ए.	
२७	श्री उपेन्द्र सिंह दनुवार	प्रा.स. प्रथम स्तर	प्राबिधिक	एस.एल.सी.	

Annex 2.2: Organogram of the Station

संगठनात्मक ढांचा

केन्द्रको संगठानात्मक ढांचा यस प्रकार रहेको छ:



Annex 3: Summary of activity wise achievements

Annual Progress Report F.Y. 2076/77
Fishery Research Station, Pokhara
From 2076/04/01 to 2077/03/31

S. N.	Project/Activities	Annual Budget in Rs. '000'	Activity completion trimester	Annual progress	Remarks
129	**Genetic improvement of carp stocks for quality fish seed production**	**610.00**			
1	Maintenance of pure-line of re-introduced carps (3)		3	Pureline brood maintenance continued	completed
2	Production of foundation seed (3)		3	10 thousands of common carp fry harvested.	completed
3	Comparison of multi-trait (reproduction, growth, shape and FCR) of pure line and existing stocks of carp (3)		3	Experiment preparation and setup completed	completed
4	Selective breeding of Common carp (3)		3	Brood were selected on the basis of phenotype character and breeding of those selected brood was completed.	completed
5	Monitoring the performance of foundation seed in private hatchery (3)		3	Common carp pure line yearling distributed to three hatchery.	completed
6	Crossing of Chinese male and existing female (3)		3	Chinese male and Pokhara female was crossed. Fry nursing continued.	completed
130	**Exploration of culture potential of Indigenous fish species (Sahar and Gardi (A. Husen)**	**414**			
1	Brood management of sahar and Gardi (3)		3	Brood management continued	completed
2	Comparative evaluation of seasonal performance of sahar		3	The breeding of Sahar was completed and seasonal evaluation completed. The response of brood was better in the spring than the autumn season.	completed

3	Hatchling nursing and fry rearing of Sahar and gardi		3	Sahar fry rearing management continued.	completed
4	Effect of probiotics on growth and yield of sahar (3)		3	Probiotics effects on growth trial growth check and data compilation completed. Sahar growth was found better by addition of probiotics in the feed.	completed
5	Growth study of sahar and gardi with carp polyculture in different agro-ecological zone (3)		3	Growth study management continued.	completed
131	**Fish yield enhancement of open water (lake and reservoir) fisheries through fish stock management with community participation (Core) (A. Husen)**	**390**			
1	Strengthen capacity of fisher community for open water fisheries management and sustainable use (1)		1	Interaction meeting in each lake of Pokhara valley completed. The recommendation for each lake for the improvement of fish yield and conservation of native fish species was the major issues discussed. Management of lake was also discussed.	completed
2	Environmental/biological survey of Lakes and Reservoirs in mid-hills (3)		3	Water quality monitoring data compilation completed. The data showed that Phewa and Rupa is eutrophic condition while Begnas under mesotrophic condition.	completed
3	Effect of management variables such as stocking size and density, post release performance and harvest regulation on fisheries yield (3)		3	Regular stocking of native fish species have in to lakes increased their population.	completed
4	Study on effect of protected breeding ground on fish abundance and social encroachment (3)		3	Sahar breeding ground and social encroachment in each lake studied. It was found that the breeding ground have been affected due to social encroachment of lakes.	completed

5	Collection of fish catch data (3)		3	Data compilation completed.	completed
6	Trend analysis of alteration of fishing gear on catch (species, size and CPUE (3)		3	fishing gear survey data compilation completed	completed
7	Enhancement of fish catch by restocking fry/ fingerlings in lakes/wetlands/ghols/reservoirs (3)		2	25000 of native fish were released from Fisheries research station, Begnas, Pokhara on the occasion world fisheries day.	completed
8	Survey of socio-economic of wetlands community		2	Survey of jalari fisher completed	completed
136	**Advancement of breeding technology of indigenous and exotic ornamental fishes for commercialization**	**400**			
1	Collection and maintenance of native and exotic germplasm		3	Thirteen exotic procured and three native fish collected and domesticated. Two native fish species breed in the captive environment.	completed
2	Brood fish management of ornamental fish species.		3	Brood management continued in the tank and aquaria.	completed
	Larval nursing and rearing of ornamental fish				completed
3	Selective breeding of Koi carp for colour improvement		3	Selective breeding of Koi carp and rearing completed. The fry of koi carp sold to the consumers.	completed
137	**Formulation of cost effective feeds from locally available ingredients for carp**	**496**			
1	Collection and curing of feed ingredients.		3	Laboratory evaluation completed.	completed
2	Feed formulation and proximate analysis.		3	Low cost feed formulation and proximate analysis completed. One feed formulation for ornamental fish developed.	completed
3	Evaluation of developed feeds against growth and survivability of warm water fish species.		3	Growth study completed. Use of soya choker in the feed formulation have reduced the cost of feed and have found better performance on the common carp.	completed

4	Cost-benefit analysis of test diet		3	Analysis started.	completed
5	Trials on the effect of different commercial feeds on fish yield and production economic		3	Trial at farmer's field at Dhorphirdi, Tanhu continued. The preliminary growth showed that floating pellet feed have better performance than sinking pellet and powdered feed on the growth of fish.	completed
3	**Participatory technology development at outreach sites - Station Chief**	**486**			completed
1	Technical services to farmers at sites		2	Six new sites for carp and trout feasibility study was completed.	completed
2	Carp nursing verification study		2	Rohu carp fry nursing continued at farmers.	completed
3	Verification of on station aquaculture technology in farmer's field		3	Common carp, bighead carp, Rohu and Naini growth study continued at farmer's level.	completed
4	Farmers training and interaction/village level workshop		3		completed
5	Dissemination of technology through mass media and publications		3	Fish seed transportation technology booklet and leaflet published.	completed
135	**Fish seed nursing management improvement for enhancing fish seed survival and growth**	**309**			
1	Factorial experiment on effect of density on feeding conditions on the survival rate of fry and fingerlings		3	Trials completed	completed
2	Effect of stinging nettle (Sishnu) feed on reproductive performance of carp and survival of fry and fingerlings		3	Trials completed	completed
3	Study on the effect of commercially available micronutrients and vitamins on growth & survival of larvae to fry		3	Trials completed	completed
4	Development of guideline for good management of fish seed nursing		3		completed

132	**Improvement of fish seed transportation methods using organic sedatives (A. Husen)**	**906**			completed
1	Determination of appropriate density during fish fry/fingerlings transportation		3	50- 100 gm/ liter of fry was found optimum density.	completed
2	Determination of sedatives doses for fish fry/ fingerlings transportation		3	5 microliter /liter of water sedative dose of found effective	completed
3	Evaluation of sedative effect during and post transportation on fry and fingerling survival		3	Sedative dose have reduced the mortality rate.	completed
4	Study on live fish (table) transportation		2	Not done due to Covid-19.	Not completed
5	Scaling up of use of sedatives in fish seed and table fish transportation		3	Booklet and leaflet published and distributed to the farmers.	completed
133	**Developing pearl cultivation practices using locally available bivalves in Nepal. (A. Husen)**	**600**			
1	Collection, identification and rearing of bivalves in captivity		2	One species mussels from Pyuthan was collected and domesticated.	completed
2	Evaluation of feeding, handling and water quality for mussels farming		3	Application of fertilizer on weekly/ fortnightly basis could maintain the algal density for grazing of mussels and improves the water quality.	completed
3	Establishment of mussels grafting facility		2	Procurement of tools and adhesive, chemicals completed.	completed
4	Study on grafting methods for pearl culture		3	500 hundreds spherical and image beads prepared.	completed
5	Study on development of pearl in different farming system			Image pearls have been harvested. The bead was properly attached to the mantle cavity but the coating was not good.	completed
6	Final report preparation and submission		3	data compilation completed	completed
2	**Fish source seed production and fish breeding management (fish seed and table fish production)**	**1678**			

1	Brood fish rearing and hatchery management		3	Brood fish Management continued	completed
2	Fish seed nursing/rearing and production management		3	Fish seed nursing management continued	completed
3	Management for fish seed distribution to fish growers		3	Total 2318143 fry and 10 lakh hatchlings were sold in this fiscal year.	completed
4	Table fish production management		3	1332.5kg table fish sold to the consumers.	completed
134	**Assessment of nutritive value of native fish species of Nepal (A. Husen)**	375			
1	Evaluation on present status of fish consumption in Nepal		2	Survey in Kaski districts completed.	completed
2	Collection of fish samples		2	Collection of fish sample completed. Six native fish from lakes of Pokhara valley was collected and prepared for the analysis.	completed
3	Analysis of nutrient composition of native fish species		2	Fish samples prepared for analysis.	completed
4	Preparation of nutrition profile of native fish species		3	Management continued.	completed
1	**Farm Management Project (FMP)** Station Chief	3238			
1	Farm operation and maintenance (Labour wages for security and maintaining office and surrounding		3	Research support management completed	completed
2	Farm machinery and electricity operation and maintenance		3	Farm management completed	completed
3	Research Support (Admin, research services etc.):		3	Research support management completed	completed
3.1	Lab equipment maintenance		3	Management completed	completed
3.2	Admin travel and vehicle fuel expenses		3	Research support Management completed	completed
4	Annual report/publication and newspaper expenses and workshop participation		3	Annual Report Published	completed

5	On station farmers training and study observations tour		3	Withheld due to COVID-!9	completed
6	Celebration of important days (NARC day, world wetland day, world fisheries day etc.)		3	World fisheries day, wetland day and NARC day celebration program completed	completed
7	Establishment of live Gene Bank		3	Collection and domestication of local fish completed	
138	**Domestication of native fish species for aquaculture and conservation**	1101			
1	Collection and biological studies of native fishes		3	Collection and domestication of local fish completed	completed
2	Brood fish management and Hatchery operation of native fishes		3	brood management and breeding continued	completed
३	Fish release in open water up stream and down stream		3	About 3 lakh fish released in the Kaligandaki river completed	completed
4	Comparative growth study on economically important native fishes		3	Management continued	completed
139	**Farm Management Project (FMP) Kaligandaki**	1689			
1	Labour wages for farm sanitation, office, Pond ,Reservoir and flower garden		3	Research support management completed	completed
2	Farm operational maintenance		3	Farm management completed	completed
2.1	Farm machinery and other maintenance		3	Research support management continued	completed
2.2	Operational electricity maintenance		3	Management continued	completed
3	Research support (Admin, lab service etc.)		3	Research support Management completed	completed
3.1	Lab equipment maintenance		3	Management completed	completed
3.2	Admin travel and vehicle fuel expenses		3	Management completed	completed
4	Annual report publication, newspaper expenses workshop participation and awareness Training conduct		3	Management completed	completed

Annex 4.1: Total number of fish produced/sold in the FY 2076/77.

Fish species	**Total Number**
Fry/fingerlings	**Number of fry/fingerlings**
Grass carp	725215
Common carp	692256
Rohu	521850
Naini	288170
Silver carp	68120
Bighead carp	12320
Koi carp	6900
Sahar	2356
Tilapia	390
Sword tail	246
Guppy	320
Total	**2318143**
Hatchlings	**Number of hatchlings**
Rohu	450000
Naini	450000
Bighead	100000
Total	**1000000**

Annex 4.2: Monthly species wise fish seed sold in the FY 2076/77

Month	Common carp	Sahar	Grass carp	Silver carp	Bighead	Rohu	Naini	Fancy	Sword tail	Guppy	Tilapia
Sharwan	35655	0	0	17070	720	152248	62100	524	30	35	170
Bhadra	704	1081	10000	51050	3500	67840	81900	1065	49	50	220
Aswin	3760	1010	7200	0	2500	183508	103100	506	96	171	0
Kartik	1483	120	15	0	4000	23318	1200	340	16	10	0
Mansir	855	0	0	0	0	525	2250	173	30	46	0
Poush	50	0	0	0	0	650	1100	130	0	0	0
Magh	1095	0	0	0	400	50850	0	299	0	0	0
Falgun	2550	5	200	0	1200	304	20	175	0	0	0
Chaitra	0	0	0	0	0	0	0	0	0	0	0
Baishakh	205714	0	0	0	0	107	0	45	5	0	0
jestha	430310	0	688950	0	0	0	0	946	0	0	0
Asar	10080	140	18850	0	0	42500	36500	2697	20	8	0
Total	**692256**	**2356**	**725215**	**68120**	**12320**	**521850**	**288170**	**6900**	**246**	**320**	**390**

Annex 4.3: Table Fish Production/Distribution

From sharawan 2076 to Asar 2077

Month	**Table fish (Kg)**
Sharwan	51
Bhadra	90.5
Aswin	157
Kartik	144.5
Mansir	78.5
Poush	147
Magh	141
Falgun	245.8
Chaitra	47
Baishak	21.5
Jestha	78.4
Asar	214
Total	**1416.2**

Annex 5.1: सेवा प्रवाह गरिएको सेवाहरू

प्रयोगशालार फिल्ड प्रिक्षणरपरामर्श सेवा आदि	संख्या	मुख्य सेवा ग्राही
मत्स्यपालन विभिन्न पक्ष बारे परामर्श	१०५	मत्स्य तथा अन्य कृषक
पानीको गुणस्तर जांच तथा सुक्षाव	१५	मत्स्य कृषक
कार्प माछा पालन, पोखरी निर्माण सम्बन्धि परामर्श	४७	मत्स्य कृषक
रोग, किरा, माटो, झारपात व्यवस्थापन र परजीवी नियन्त्रण	२२	मत्स्य कृषक
प्रयोगशाला सेवा	२३	मत्स्य कृषक
मत्स्य रोग जांच तथा सुक्षाव	७	मत्स्य कृषक
मत्स्य रोग तथा अन्य प्राविधिक परामर्स	२५	मत्स्य कृषक

Annex 5.2: भ्रमण अवलोकनको विवरण

समुह	संख्या	जिल्ला	भ्रमण अभिरुची
१. कृषक	८००	२०	माछापालन रमत्स्य अनुसन्धानका गतिविधि
२. उधमी	६५	९	माछापालन रमत्स्य अनुसन्धानका गतिविधि
३. प्रसारकर्ता	५८	१४	माछापालन रमत्स्य अनुसन्धानका गतिविधि
४. विद्यार्थी रशोधकर्ता	२०००	काठमाण्डौ, कास्की, चितवन र अन्य जिल्ला	
	अवलोकन र शैक्षिक भ्रमण		
५. गैर सरकारी संस्था	२५	काठमाण्डौ, कास्की र अन्य जिल्ला	मत्स्य अनुसन्धानका गतिविधि
६. विदेशी संस्था	५	जापान, अमेरिका, चीन, भारत	मत्स्य अनुसन्धानका गतिविधि
जम्मा	२९५३		

Annex 5.3: तालिम सञ्चालन विवरण

विषय	प्रशिक्षार्थी स्तर (विषय विशेषज्ञर प्राविधिज्ञरकृषकरअन्य)	प्रशिक्षार्थीको संख्या	तालिम अवधि
१. माछापालन	नेपाल सेनाको सैनिक (लमजुंग बेरेक)	२५	३ दिन

Annex 5.4.1: प्रकाशनको विवरण

क्र.सं.	प्रकाशित कृति को नाम	किसिम	भाषा	प्रकाशित संख्या
१.	Annual Report 2075/76 (NPSN 00699-713/2019/20)	किताब	अंग्रेजी	१००
२	सुरक्षित माछा भुरा प्रविधि (NPSN 00700-714/2019/20)	किताब	नेपालि	२००
३	सुरक्षित माछा भुरा प्रविधि (NPSN 00701-715/2019/20)	फोल्डर	नेपाली	२००

Annex 5.4.2: Paper published in the FY 2019-20

S. N.	Title of paper	Authors	Name of Journal/ Proceedings
1.	Status of nutrients in the sediments of Phewa, Begnas and Rupa lakes	Md. Akbal Husen, Tek Bahadur Gurung and Agni Prasad Nepal	Proceedings of 11th National Workshop on Livestock and Fisheries Research in Nepal
2.	Drivers of fisheries and their management in the lakes of Pokhara Valley, Nepal	Md. Akbal Husen, Tek Bahadur Gurung, Agni Prasad Nepal	Journal of Fisheries 7 (2): 706–713
3.	Fish Marketing System in Nepal: Present Status and Future Prospects	Md. Akbal Husen	International Journal of Applied Sciences and Biotechnology 7(1): 1-5.
4.	Temporal changes of water quality parameters in Rupa Lake and their impact on productivity	Md. Akbal Husen, Ram Prasad Dhakal, Agni Prasad Nepal	ZOO-Journal 5: 41-47.
5.	Cage fish farming in lakes and reservoirs of Nepal: a mini review and update.	Md. Akbal Husen, Agni Prasad Nepal, Tek Bahadur Gurung and Suresh Kumar Wagle	Nepalese Journal of Aquaculture and Fisheries Vol. 5 (2018) : 34-41
6.	First report of two fish species: *Chanda nama,* and *Hetropneustes fossilis* from Begnas Lake	Md. Akbal Husen, Tek Bahadur Gurung, Agni Prasad Nepal, Asha Rayamajhi and Sunita Chand	International Journal of Fauna and Biological Studies; 6(4): 44-49.
7.	Status of ornamental fish import, research and scope in Nepal.	Md. Akbal Husen	Research Journal of Animal, Veterinary and Fishery Sciences, 1: 6-9.
8.	Chapter 10: Cage and Pen fish farming in lakes to obtain income and employment for landless fisher community	Md. Akbal Husen	In: S.S.Giri. S.M. Bokhtiar, B.N. Paul snd S.K. Sahoo (Eds.). (2019). Diversification in Aquaculture: Towards Achieving Sustainability. SAARC Agriculture Centre, SAARC, Dhaka, Bangladesh, 192.pp.

Annex 5.5 तालिम/गोष्ठी/सेमिनारमा कर्मचारीहरूको सहभागिताहरूको विवरण

कर्मचारीको नाम	पद	तलिम रगोष्ठी र सेमिनारको नाम	अवधि	स्थान र देश	आयोजकको नाम
डा. मो. ईकबाल हुसेन	वरिष्ठ बैज्ञानिक (एस.३)	SAADC 2019	३ दिन	पोखरा	नेपाल एनिमल सांइन्स असोसियन
हरेराम देबकोटा	प्राविधिक अधिकृत (टि-६)	Advance level statistical analysis	३ दिन	NASRI, Khumaltar	NASRI, Khumaltar
कमल राना	प्राविधिक सहायक (टि-४)	Field data collection and entry	७ दिन	क्षेत्रिय कृषि अनुसन्धान केन्द्र, तरहरा	NASRI, Khumaltar

Annex 6.1: वार्षिक बजेट तथा खर्चको विवरण २०७६/७७

क्र.सं.	बजेट शिर्षक	वार्षिक बजेट (०००)	वार्षिक खर्च (०००)	प्रतिशत
१	चालु खर्च कार्यक्रम	३३६४४	२९०११	८६.२
१.१	उपभोग खर्च	९९१०	८५३१	८६.१
१.२	संचालन खर्च	१२७९२	१०८४७	८४.८
१.३	प्रशासनिक खर्च	१०९४२	९६३३	८८.०
२	पुँजीगत खर्च	९०९०	५६४२	६२.१
	कूल जम्मा	४२७३४	३४६८१	८१.२

Annex 6.2: वार्षिक राजश्व विवरण आ.व. २०७६/७७

क्र.सं.	राजश्वको श्रोत	तेस्रो चौमासिक रकम (रु.)	बार्षिक रकम (रु.)
१	बाली		
२	बागवानी		
३	पशुपन्छी		
४	मत्स्य	८,६१,७१०	१८,४९,७९५.५
५	प्रशासनिक विविधबाट	६१,९६०	४,४९,५४०
६	अनुसन्धान, सेवा आदिबाट		
७	अन्य श्रोतबाट आम्दानी		
	जम्मा	९,२३,६७०	२३,९९,३३५

Annex 6.3: बेरुजी स्थिति एवम् फछ्र्यौट विवरण आ.व. २०७६/७७

विवरण	जम्मा बेरुजु	म.ले.प. बाट फछ्र्यौट	तहसिल कार्यालयबाट फछ्र्यौट	कूल फछ्र्यौट	प्रतिशत	बाँकी
साविक आ.व. २०५९/६० सम्मको (म.ले.प.को वार्षिक प्रतिवेदन, २०६१)	-	-	-	-	-	-
आ.व. २०६०/६१ देखि २०७३/७४ सम्मको (म.ले.प.को वार्षिक प्रतिवेदन, २०७४)	१०७१०					१०७१० * स.प्.को लागि लेखि आएको
आ.व. २०७४/७५ (म.ले.प. प्रतिवेदन २०७५) २०७५/७६	२९१६१.८४	६८०४.८४		६८०४.८४	२३.३३%	२२३५७
जम्मा	**३९८८१.८४**	**६८०४.८४**		**६८०४.८४**	**२३.३३%**	**३३०६७**

Annex 7: Feed Production and Consumption Record

मत्स्य अनुसन्धान केन्द्र, वेगनास, पोखरा, कास्की

आ.व. २०७६/०७७ मा दानाको कच्चा पदार्थ खरिद तथा खर्च विवरण

क्र. सं.	कच्चा पदार्थ	गत सालको अ. ल्या. (के.जी.)	यो आ. व. मा खरिद (के.जी.)	जम्मा कच्चा पदार्थ (के.जी.)	यो आ. व. मा खर्च	बाँकी (जिम्मेवारी सार्नुपर्ने) (के.जी.)
१.	गहुँ	१,४०४.९८	५,४५८.००	६८६२.९८	५,२३७.८०	१६२५.१८
२.	मकै	१,२८०.९४	४,९९६.००	६२७६.९४	५,१३७.२०	११३९.७४
३.	भटमास चोकर	१,३१०.७०	५,५७५.००	६८८५.७०	५७४५.६०	११४०.१०
४.	तोरीको पिना	१,३२२.३६	५,७८७.००	७१०९.३६	५,६०१.००	१५०८.३६
५.	धानको ढुटो	१,२६३.१०	४,०७३.००	५३३६.१०	४,२०६.८०	११२९.३०
६.	झिंगे माछा	२३१.१०	८५०.००	१,०८१.१०	९८१.१०	१००.००
७.	हड्डीको धूलो	१०४.००	१६०.००	२६४.००	२४५.००	१९.००
८.	भिटामिन	००.००	२३७.५०	२३७.५०	२३७.५०	००.००
९.	मिनरल	००.००	२३६.५०	२३६.५०	२३६.५०	००.००
१०.	अण्डा	००.००	५.००	५.००	५.००	००.००
११.	मस्यौरा	००.००	२०.००	२०.००	२०.००	००.००
१२.	पाउडर दूध	००.००	५.००	५.००	५.००	००.००
जम्मा:		६,९१७.१८	२७,४०३.००	३४३२०.१८	२७,६५८.५०	६६६१.६८

मत्स्य अनुसन्धान केन्द्र, वेगनास, पोखरा, कास्की

आ.व. २०७६/०७७ मा दानाको खर्च विवरण

क्र. सं.	दानाको किसिम	बेगनास	फेवा	मस्य ह्याचरी बेल्टारी	जम्मा	कैफियत
१.	धूलो दाना	१२,५८५.००	३,२५०.००	७२५.००	१६,५६०.००	
२.	माउको दाना	७,५३८.००	१,३३०.००	१६०.००	९,०२८.००	
३.	ट्रायलको दाना	१,५१९.००	५०२.००	००.००	२,०२१.००	
४.	माईक्रो फिड	४९.५०	००.००	००.००	४९.५०	
		२१,६९१.५०	५,०८२.००	८८५.००	२७,६५८.५	

Annex 8: Annual budget expenditure

नेपाल सरकार

नेपाल कृषि अनुसन्धान परिषद

मत्स्य अनुसन्धान केन्द्र

वेगनास, कास्की

आ.व. २०७६/७७ को वार्षिक कार्यक्रम तथा बजेट खर्च

क्र. सं.	लेखा कोड नं	लेखा शिर्षकको नाम	बार्षिक बजेट	जम्मा खर्च	बजेट बाँकी
क		**उपभोग खर्च**			
१	२१११११	तलब	८८७००००	७७७७९२५.४	१०९२०७४.६
२	२११३२	महंगी भत्ता	६०००००	४४१८४२	१५८१५८
३	२११३४	कर्मचारी बैठक भत्ता	७००००	६३४००	६६००
४	२११२१	पोशाक	२५००००	१६००००	९००००
५	२१२१३	योगदानमा आधारित बिमा कोष खर्च	१२००००	८८०८५	३१९१५
		जम्मा उपभोग खर्च	९९१००००	८५३१२५२.४	१३७८७४७.६
ख		**प्रशासनिक खर्च**			
१	२२१११	पानी तथा बीजुली	१६४००००	१३५०३१८.०७	२८९६८१.९३
२	२२११२	संचार महसुल	३०००००	१८६८५६.८	११३१४३.२
३	२२२१३	सवारी साधन मर्मत खर्च	६२००००	६१८९३६.५	१०६३.५
४	२२२१४	बिमा तथा नबिकरणा खर्च	१८००००	१०६३५०	७३६५०
५	२२२२१	मेशिनरी औजार मर्मत संभार खर्च	५८००००	५६७०७६	१२९२४
६	२२२३१	निर्मित सार्वजनिक सम्पत्ती मर्मत संभार	५२५५०००	५०२७८३१.०९	२२७१६८.९१
७	२२२९१	अन्य सम्पत्तीहरुको मर्मत संभार खर्च	९००००	८२५३३.४३	७४६६.५७
८	२२३११	मसलन्द तथा कार्यालय सामाग्री	५१२०००	५०७६०२.८२	४३९७.१८
९	२२३१४	ईन्धन अन्य प्रयोजन	१६५०००	१४३१३०	२१८७०
१०	२२४११	सेवा र परामर्स खर्च			०
	२२४१२	सुचना प्रणालि सफ्टवेयर संचालन खर्च			०
११	२२४१३	करार सेवा शुल्क	१५०००००	९४२९०२	५५७०९८
१२	२२७११	बिबिध खर्च	१०००००	९९४७६	५२४
	२८१४३	सवारी साधन तथा मेशिनरी औजार भाडा			०
		जम्मा प्रशासनिक खर्च	१०९४२०००	९६३३०१२.७१	१३०८९८७.२९
ग		**संचालन खर्च**			
१	२२२१२	ईन्धन (कार्यालय प्रयोजन)	६३१०००	४६८९८५.९९	१६२०१४.०१
२	२२३१२	पशुपंछीको आहारा	२३५००००	१६७६३१६	६७३६८४
३	२२३१५	पत्र पत्रिका सूचना प्रकाशन खर्च	१०००००	९२९९८	७००२
४	२२३१३	पुस्तक तथा सामाग्री खर्च	५००००	४४३१०	५६९०
५	२२५१२	सीप बिकास तालिम गोष्टी	३०००००		३०००००

६	२२५२१	उत्पादन सामाग्री सेवा	७४०६०००	७२६९३२१.०५	१३६६७८.९५
७	२२६११	अनुगमन मूल्याङ्कन खर्च	१५००००		१५००००
८	२२६१२	भ्रमण खर्च	१८०५०००	१३२२४२५	४८२५७५
९		**जम्मा संचालन खर्च**	१२७९२०००	१०८७४३५६	१९१७६४३.९६
३		**पूजिगत खर्च**			०
१	३१११२	गैर आबासिय भवन निर्माण	६५०५०००	५१०९३५९.६९	१३९५६४०.३१
२	३११२२	मेसिनरी तथा औजार	२२१००००	१५७९९१.८५	२०५२००८.१५
३	३११२३	फर्निचर फिक्सचर	३७५०००	३७४९९५	५
४	३११७१	पुजिगत सुधार खर्च सार्बजनिक निर्माण			०
		पूजिगत खर्च जम्मा	९०९००००	५६४२३४६.५४	३४४७६५३.४६
		कूल जम्मा	४२७३४०००	३४६८०९६७.७	८०५३०३२.३१

Major past contribution of organization in fisheries research/ milestones

- Preparation of aquatic environment database of the Lakes of Pokhara valley.
- Development and scaling up of cage fish culture technology in lakes and reservoirs.
- Improvement and scaling up of low cost, small-scale rural aquaculture technology.
- Domestication and development of production technology of indigenous fish species (*Tor putitora, Labeo dero,* etc.*)*.
- Feed formulation of carp for different development stages.
- Standardization of carp seed production technology in mid hill region of Nepal.
- Strengthening co-management model for Lake Fishery conservation and utilization.
- Breeding and nursing technology of some ornamental fish species.
- Scaling up of trout fish farming in mid hill region.
- Safe fish seed transportation technology

मुख्य उपलब्धीहरू:

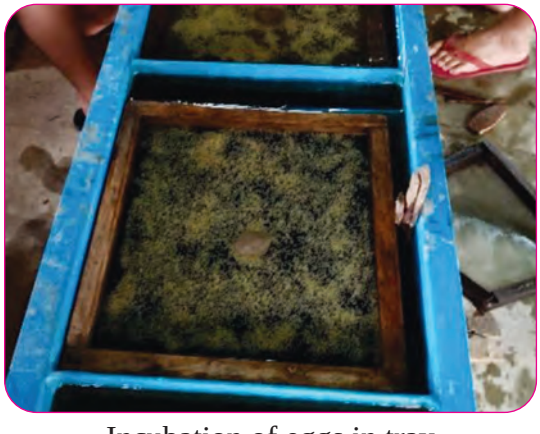
- पोखरा उपत्यकाका तालहरुको जलीय वातावरण अध्ययन (Limnological data base) ।
- ताल तथा रिजरभ्वायरहरुमा पिंजडामा माछापालन प्रविधि विकास तथा विस्तारण ।
- लघु मत्स्य पालन प्रविधि विकास, परिमार्जन र विस्तारण (पिंजडामा ग्रासकार्प माछा पालन तथा मागुर माछा पालन) ।
- स्वदेशी माछाहरू जस्तै सहर, गर्दी आदिको घरेलुकरण तथा पालन प्रविधि विकास ।
- माछाहरुको लागि आबश्यक पोषणयुक्त दाना बनाउने प्रविधि विकास ।
- केन्द्रको कार्य क्षेत्रमा आवश्यक पर्ने माछाभुरा उत्पादन तथा आपूर्ति ।
- स्थानीय समुदायसंगको सह-व्यवस्थापनमा ताल संरक्षण तथा उपयोग कार्यक्रम सुदृढीकरण ।
- सजावटी माछाहरुको प्रजनन तथा भुरा हुर्काउने प्रविधि विकास ।
- पश्चिम नेपालमा परिमार्जित ट्राउट माछा पालन प्रविधि विस्तार ।
- सुरक्षित माछा भुरा ढुवानी प्रविधि ।

Breeding of Sahar (*Tor Putitora*)

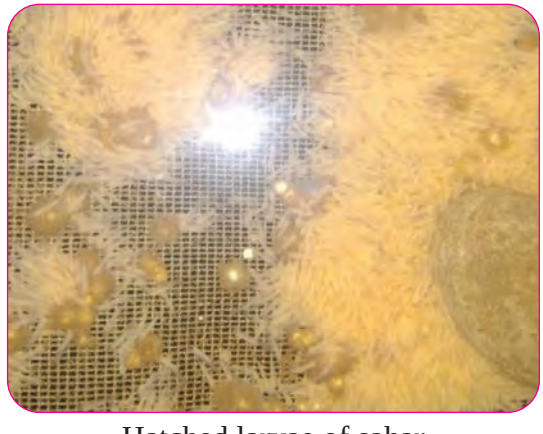
Sahar brood selection

Egg striping

Egg and milt



Incubation of eggs in tray



Hatched larvae of sahar

Feasibility study of fish farming in the Kaski (Pokhara metropolitan-21)

Feasibility study of fish farming in the Kaski district (Pokhara metropolitan-21)

Feasibility study of fish farming in the Kaski district (Pokhara metropolitan-33)

Feasibility study of fish farming in the Kaski (Pokhara metropolitan-32)

Pure line future brood fish handover to new Mukhiya farm, Nanupatti, Dhanusha

Pure line future brood fish handover to new Mukhiya farm, Nanupatti, Dhanusha

Field visit and interaction meeting with the chairman and members of lake management committee of Gunde, Khaste and Neurani, Deepang, Maidi and Kamalpokahri lakes of Pokhara valley.

Gunde

Gunde

Khaste and Neurani

Kamalpokahri

Deepang

Maidi

Native fish release program in the Kaligandaki River from Kaligandaki hatchery, Belatari Syanja run under Nepal Agricultural research Council (NARC) and Nepal Electricity Authority.

International Scientists participated in the International Conference SAADC 2019 at Pokhara were visited and station Chief Dr. Md. Akbal Husen has give short overview of the research activites of Fishery Research Station, Begnas, Kaski.

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Cirrhinus reba

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