E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2020; 8(5): 16-21

www.fisheriesjournal.com
Received: 09-07-2020
Accepted: 14-08-2020

Bidika Subedi
Agriculture and Forestry University, Chitwan, Nepal

Manita Paudel
Agriculture and Forestry University, Chitwan, Nepal

Corresponding Author:
Bidika Subedi
Agriculture and Forestry University, Chitwan, Nepal

Rice cum fish farming: Trends, opportunities and challenges in Nepal

Bidika Subedi and Manita Paudel

Abstract
Rice cum fish farming is a new intervention and has a huge scope in the context of Nepal with the high feasibility in Terai region. Since, rice is the dominant cereal crop of Nepal, its production along with fish in the rice fields has been found profitable. The total area coverage is only 0.013% of irrigated rice fields with the production of 15 metric ton. The overall productivity of both rice and fish are increasing due to mutualistic relationship between two crops. Rice cum fish farming is the integrated sustainable farming system resulting in the optimum utilization of resources, enhancement of rice production, food security and increment in the income of the farmers. However, the trend of adoption of this technology is decreasing due to lack of technical knowledge, triggering socio-economic conditions and policy constraints. Implementation of government policies related to research and extension in this technology can result in the wider adoption that plays an important role for the upliftment of living standard of rural farmer of Nepal by reducing the poverty and malnutrition.

Keywords: Farming, fish, rice, trends, opportunity

1. Introduction
Nepal is a landlocked country neighboring China at its north and India at its south, east and west. It is topographically divided into 3 regions mainly Himalaya, Hilly and Terai with a total coverage of 147,181 km^2. Nepal is the land of water with 6,000 rivers including rivulets and tributaries and is very rich in natural water resources in the form of rivers, reservoirs, ditches, lakes, ponds, flood plains and large areas of rice field. Out of total water resources, river, lakes and reservoirs comprise 48.55%, irrigated paddy fields 48.14%, marginal swamps 1.4%, ponds 1.38%, irrigation canal 0.38% and highway side ditches 0.03% [1]. The availability of abundance of water resources gives Nepal an opportunity to exploit its resources for various usages such as the electricity production, irrigation, and fish farming [2]. Fish farming has been traditionally practiced by some tribes in Nepal since time immemorial. Generally, Tharu, Kewat, Das, Kahar, Mallaha, Lodh, Gaud, Gaha, Gurung, Kumal, Gupta and Magar tribes were traditionally involved in capture fishery [3]. They were mainly dependent on capture fishery for their livelihood and food sources, which is still a common practice across the country, but is unorganized and done mostly at subsistence level [4]. Culture fishery is relatively new in Nepal and was initiated in a small scale in the mid-1940s with the introduction of Indian major carp's seed [5]. With the further development of aquaculture in Nepal, various approaches of integrated farming got into the practice. Among them rice cum fish farming has been the one with additional opportunities due to the widespread availability of paddy fields in the southern plains and mid-hills of the country.
Rice is one of the most important traditional staple food crops in Nepal [6]. Rice is by far most important crop of Nepal, primary source of livelihood and income for more than two-thirds of farm households which contributes 20% to the Agricultural Gross Domestic product (AGDP) and more than 7% to the total GDP [7]. In Nepal, rice is grown in all the three agro-ecological regions: terai, hills and mountains under two water regimes as irrigated and non- irrigated. The terai contributes 70% of the country's rice output, hills contribute 27% and mountain about 3% [8]. Out of total rice farming area, 398,000 ha. is irrigated which provide the opportunity for the rice cum fish farming in Nepal [1]. To enhance the further production of rice an alternative method, rice cum fish farming can play a crucial role as rice production increases by 10-12% in this farming compared to rice monoculture [9,10].
The growing of rice and fish simultaneously in the same field is named as rice fish farming [11].

It is an integrated farming practice where rice is the primary crop and fish is the secondary crop. This integration can significantly reduce the production costs in both rice cultivation and fish culture through symbiosis which minimizes the feed requirement for fish and fertilizers, herbicide and pesticide for paddy [9]. Rice fish farming can be broadly classified as capture or culture systems depending on the origin of the fish stock. In the capture system, wild fish enter the rice fields from adjacent water bodies and reproduce in the flooded fields. In contrast, rice fields are deliberately stocked with fish in the culture system either simultaneously or alternatively with rice crop. The wet terrace rice fields where surface and ground water is sufficiently available can be utilized for the rice fish farming. The addition of fish in the rice field helps to gain ecological, economic and social benefits. Rice cum fish farming is an example of mutualism where both of the entities are benefited with the increment in their production. The rice fields provide shelter for the fish while fish controls the weeds and rodents in the rice field along with the maintenance of nitrogen cycle. It is one of the simple and environment friendly farming systems for increasing the rice field productivity for nutritious food, employment and higher income [12].

Rice cum fish farming was introduced in 1964 by Department of Fisheries in Nepal and has been practiced in the Bhaktapur, Kaski, Tanahu, Syangja, Dhading, Gorkha, Chitwan and Makwanpur districts of mid-hill and terai regions [13]. It is one of the well-suited integrated farming practices in mid-hills and inner-terai districts of Nepal with the higher feasibility in terai associated with the factors such as climate suitability, larger areas for construction of trench and refuse system in rice field comparing to hilly terraces[14,15]. Recently, rice fish culture is practiced only in 0.013% of irrigated rice field producing only 15 metric tons of fish [1].

2. Trends of rice cum fish culture in Nepal

The area covered and production of fish from rice cum fish farming from 2006/07 to 2018/19 is shown in the figure-1 and figure-2 respectively below [1,16]. The area coverage by rice cum fish culture was constant from 2006/07 to 2008/09 i.e. 300 ha and then decreases abruptly to 100 ha in 2009/10 and recently it cover only 50 hectare. Similarly, the production was 135 metric tons in 2006/07 which remains constant up to 2008/09 and then decreases abruptly to 45 metric tons in 2009/10 and recently the production is only 15 metric tons. The decrease in the production is due to the less area coverage by rich cum fish culture which is the result of less adoption by the farmers. The most important constraint for the poor adoption of this farming system in Nepal is lack of public awareness and other factors include socio-economic, cultural and policy constraints [17].

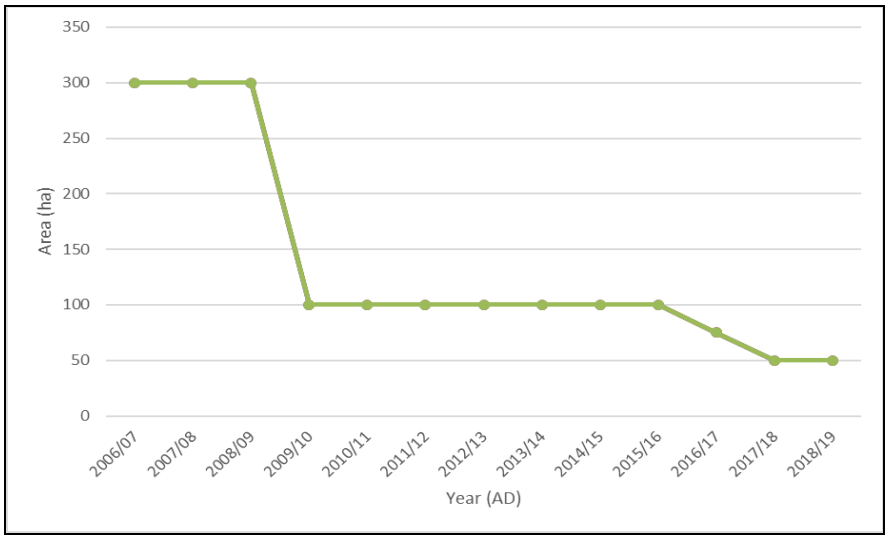

Fig 1: trends of area coverage by rice cum fish culture in Nepal [1,16]

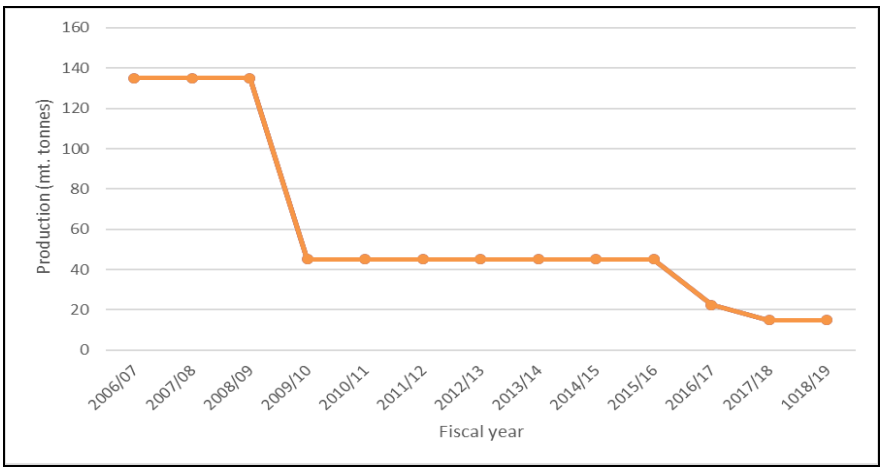

Fig 2: production trends of fish from rice cum fish culture in Nepal [1,16]

The productivity graph of rice cum fish culture according to the above data is shown in the figure: 3. The productivity was 0.45 mt. tons/ha in 2006/07 which remains constant upto 2015/16 and decreased to 0.3 mt. tons/ha in 2016/17 and recently it is 0.3 mt. tons/ha [1, 16].

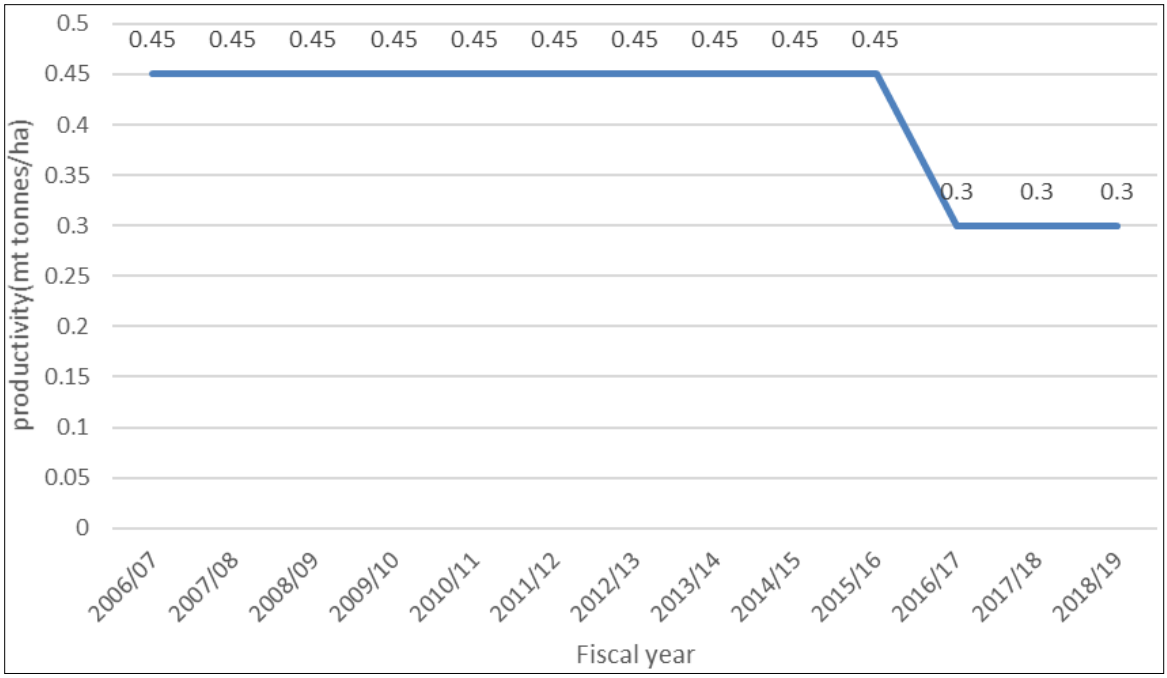

Fig 3: Productivity of Rice cum fish culture in Nepal

3. Techniques of fish culture in rice fields

3.1 Site selection: The field having 70-80 cm of water is considered optimum for this integration. There should be the availability of adequate supply of water. The soil of the paddy field should be rich in organic matter with a high water retention capacity (silty clay or silty clay loam are most suitable).The pH should range from 7.0-9.0. The rice field subjected to flood and landslides should be strictly avoided.

3.2 Dike/ Bund construction: The dike should be strong enough and sufficiently increased so that it can hold at least 15 cm of water and prevent the escape of fingerlings. The height and breadth of the dike should be from 1m to 1.5 (50-60cm) and the top width should be of 30-40 cm for the walking purpose

3.3 Trench construction: The trench serves as a refuge for fish when the water level drops to low, when the temperature of rice field is too high and when there is a threat of predators. It also serves as catch basin during harvest. The trenches are of peripheral, linear and T-shapes and should be constructed during the ploughing. In Nepal, peripheral trench is commonly practiced for rice-fish farming and are of 50cm width and 30 cm depth [18]. For the maximum yield of rice, trench should not account more than 10% of the paddy area.

3.4 Pond refuse construction: It may be circular, square or rectangular shape with about 1 m of depth. It should cover 10-15% of total rice field. The excavated soil is used to make dikes. It is also used to hold the fishes.

3.5 Inlet and outlet construction: The water in a rice field must be drainable. The inlet and outlet are placed diagonally opposite to maintain more water circulation. Inlets and outlets are provided with screens to prevent the entry of unwanted fish, tadpoles and escape of stocked fishes.

3.6 Rice plot preparation: For fishing raising, 3 nursery ponds of 5*10 m and 2 grow out ponds of 10*20m should be prepared in the rice plot.

3.7 Rice field preparation: Prior to rice plantation, 100 kg cow dung, 1 kg Urea and 1kg DAP per katha (0.0338 hectare) should be added and the field should be ploughed. Two to three rice seedlings are planted at a distance of 20-25cm [18]

3.7.1 Fertilization: Experiment at Nuwakot district in Nepal concluded that application of fertilizers both organic and inorganic in the field show higher yield of fish [19].

Table 1: Dosage of fertilizers and application methods [18]

Fertilizers	Dose	Method of application
Compost/cow dung	5-7 t/ha	With the 1st ploughing of rice field
Chemical Fertilizers	100:60:50	½ Nitrogen, Phosphorous and whole dose of potash during field puddling and ½ nitrogen after 1st and 2nd transplantation in equal proportion. As a source of Nitrogen, Urea should be used instead of ammonium sulphate

3.7.2 Suitable rice varieties: Late maturing, non-lodging and water logged tolerance rice varieties are suitable. The suitable rice varieties for rice cum fish farming in Nepal according to Government of Nepal, 2019[18] are listed below:

- For hilly region: Chandina, IR-36, IR-42, Ir-52, IR-54
- For terai region: Bindeshwari, Chandina, Barkhe-2, Barkhe-4, IR-9727
- Other varieties: Pani dhan, Tulasi, CR-23077, Radha-4, Janaki, Mansuli, Sabitri. Farmers generally prefer to cultivate Mansuli as it can provide high quality straw for the livestock [20].

3.7.3 Suitable fish species: According to Coche [21] fish species cultivated in rice field must have the following characteristics:

- They must thrive in shallow water.
- They must tolerate high water temperature.
- They must tolerate low dissolved oxygen.
- They must withstand fairly high turbidity.
- They must have to grow rapidly to marketable size.

Carps and tilapia are the main species reared by the farmers in the rice field of Nepal [13]. Common carp (*Cyprinus carpio*) and tilapia (*Oreochromis niloticus*) are the two species under culture in rice field of Nepal.

3.8 Fish Stocking: Fishes of 25-50gram can be stocked after 15-20 days of rice transplantation [18].The larger fingerlings should not be stocked until rice has turned fully green, otherwise the fish may damage the seedlings but the stocking of relatively larger size of fingerlings can substantially reduce predation mortality [19]. As soon as, the fingerlings are brought for the stocking, they should not be placed into the field. The packet should be kept in the water of rice field for the proper acclimatization. After that, the mouth of the pack should be opened to let the fingerlings pass into the field one by one. This condition forbids the temperature fluctuation and prevents the mortality of fishes.

3.8.1 Stocking density: According to annual publication of Nepal 2011/12, it is suitable to release 200-350 fingerlings/ropani (1 ropani= 508.74 m^2) in hilly region and 4000-7000 fingerlings/ ha in terai region of Nepal [22]. But the stocking density depends on fish species. According to the annual publication of Government of Nepal, 2019 the stocking density of common carp is 4000-5000 fingerlings/ha and for tilapia is 7000-10000 fingerlings/ha [18].

Table 2: Stocking density of fish in relation to holding place [18]

Structure of holding place	Feed management	Fish species	Weight of fingerlings(gram)	Stocking density(/ha)
Trench	No	Common carp	5-10	3000-4000
	Yes	Common carp	5-10	5000
	No	Tilapia	4-7	5000-6000
	Yes	Tilapia	5-10	7500-8500
Ditch	Yes	Common carp	5-10	4000
	Yes	Tilapia	4-7	5000-6000
Pond refuse	Yes	Common carp	5-10	6000
	Yes	Tilapia	4-7	8000-10000

3.8.2 Fish feed: Rice field serves as the rich source of natural organisms, however for the enhanced production supplementary feeding is provided. Ball feed of rice bran and mustard oil cake in 1:1 is given @2-4% of body weight of fish per day [18]. Production was higher when the feed was given with the highest yield in the treatment where 4% of feed was supplied [19].

3.8.3 Care and Management

a. Snake should be controlled using snake trap.
b. Birds should be controlled using flash guns, sirens and bells.
c. The water leakage should be prevented for the good holding of fishes.
d. The use of pesticides should be avoided to prevent the fish.

4. Harvesting of fish: The fish should be harvested 10-15 days prior to the rice harvest. The fishes can be harvested either from the trench or from gradual draining of water from rice field. Fish growth and production in rice field depends on food availability, space, size of fish, predation and mortality [23].

5. Methods of Rice-fish farming

5.1 Simultaneous/Synchronous: In this farming system, rice and fish are grown together and are harvested at the end of rice growing season.

5.2 Alternate/Rotational: In this farming system, the flooded rice field after the harvesting of rice is further used for the raising of one crop of fish. After harvesting paddy, the stubbles are not removed which serves as the substrate for the development of fish food organisms and upon further decomposition serves as the organic fertilizer for rice crop: overall increasing the production of both entities.

6. Opportunity and Prospects of rice cum fish farming in Nepal

Nepal is an agriculture country where 70% of population depends directly on agriculture and farmers allocate most of their lands for rice cultivation, there is high opportunity for the rice cum fish farming. Especially, the irrigated rice field of mid-hills and terai region of Nepal are suitable and has high opportunity for rice cum fish farming. Furthermore, Terai region has high opportunity of this farming system due to well- developed infrastructures like irrigation, availability of fingerlings and highest contribution of rice in Nepal with plain area. Rice is the most important crop of Nepal which is the primary source of food and income for many farm households. But there is huge rice yield gap- the difference between attainable and potential yield which is between 45-55% in Nepal [7]. Also, there is increasing demand of food supply in the country, so to meet the demand there is a need to increase the rice and fish production. To minimize this gap and meet the demand of food supply, rich cum fish farming may be one of the alternative in Nepal to enhance the production of rice field as well as to increase the income from the fish production from same field.

In the rice cum fish farming, fish production can reach 163-514 kg/ha and rice production increased by 10-15% even when about 3-5% rice field was used to dig trench [24]. The current fish production needs to be increased to three - or four-fold to be comparable with neighboring countries [25]. This can be achieved through the integration of rice and fish since it is better than rice monoculture in terms of resource utilization, diversity, productivity and both the quality and quantity of the food produced [26]. Rice cum fish farming is the ecologically sound method of the most economic utilization of land which enables the farmers to diversify their

harvest. From this integration, both the source of carbohydrate and animal protein are obtained which accounts for the increased food security and the farm income of the family. Similarly, the recycling of nutrients by the fish through the deposition of feces in soil increases uptake of essential nutrients: nitrogen and phosphorous which significantly increases the yield of both rice and fish through the reduced use of pesticides. Fish serves as an excellent agent for integrated pest management as its activities in standing water destroys the eggs and larval stages of the pests, insects harmful for the paddy. Hence, it could substantially reduce abuse of insecticides and pesticides on the rice field and their bio-magnification affect in human health [19]. This integration accounts for more income per unit area reducing the input expenses of fertilizers and pesticides, lowering the financial burden of the farmers. Hence, rice cum fish farming is viable, environment friendly, low-cost, additional income activity with multiple benefits including increased income and greater availability of fishes to rural fishing communities [27]. This practice creates livelihood opportunities to promote poverty alleviation with the efficient utilization of limited fresh water resource and land, which forecasts an excellent opportunity for the further development of rice cum fish farming system in the vast tracts of rice fields in Nepal.

6.1 Challenges

Though the rice-fish integration systems tends to have enormous benefits to the farmer; however, this technology has not been widely adopted because of several reasons [23]. Firstly, the farmers don't have enough knowledge and awareness regarding the integrated farming system. As a result of which, only a small portion of land is under cultivation that ultimately limits the potential production of rice and fish enterprise. Similarly, the lack of sustainable fingerlings supply system is the another major challenge [28]. The inadequate supply of large sized fingerlings somehow repress the willingness of farmers towards rice fish farming since the rearing of stocked small sized fingerlings take longer time and more management practices till they attain the marketable size. Large amount of fishes are lost due to birds predation. Likewise, for the better and higher yield of rice crop farmers use the pesticides intensively, which affects the habitat of the fish leading to the harmful and lethal effects to the fish. This leads to the decreased production of animal protein and hinders the growth of rice cum fish farming. This integration system has also been found risky during the events like flooding and landslide and poisoning. Based on which the farmers don't intend to practice this system with the fear of losing their investment. For wider adoption of rice-fish farming some problems like poaching have been encountered besides occasional problems of poisoning and use of pesticides [12]. The successful farmers are also demoralized for the continuation of farming practice because of the social problems like theft, vandalism. The lack of proper governmental policy and planning, dissemination of proper knowledge and lack of extension services like training, FFS (Farmer Field School) are also the hindrances in achieving the milestone in rice cum fish farming systems. Hence, the rice cum fish farming has been facing serious challenges in the context of Nepal; which continuously has limited its potential.

7. Recommendation

- For the wider adoption of rice cum fish farming in Nepal, the various training should be conducted focusing the knowledge regarding techniques and benefits of rice cum fish farming among the rural farmers.
- The decentralization of fish seed production and distribution mechanism at village level is required for the adequate and timely supply of fingerlings to promote the expansion of rice cum fish farming.
- Increasing the awareness and expansion area under rice cum fish farming at the community level helps to reduce the various social constraints such as insecticide, pesticide use, poaching and poisoning in rice field.
- Government policy and planning, research and extension works related to rice cum fish farming should be given priority and focus.

8. Conclusion

There is the huge potential and opportunity of rice cum fish farming in Nepal due to the availability of the large area of rice field in the mid hills and terai region and dependence of many farmer on rice and fish farming for their livelihood and income. The techniques of the rice cum fish farming is simple which can be easily understood and performed by the farmers if the training and sufficient infrastructures are provided to them. Fish farming requires less time and labor compared to other animals due to which housewives and children can easily take care of the fish after the field preparation and stocking which can be adopted as supplement employment for the family. Fish can be grown with or without feeding as the natural food in the rice field will be sufficient but the various research has concluded that the production of fish was higher when supplementary feed was given. Hence, Rice cum fish farming can be an alternative technology to enhance the production of both the rice and fish which in turn uplift the lifestyle of rural farmers in Nepal.

Besides the various potentialities and opportunities of rice cum fish farming the trend of adoption of this technology in Nepal is decreasing annually which results in decrease in production from this sector. However, the productivity was constant from 2006/07 to 2015/16 i.e. 0.45 mt. tons/ha and decreases thereafter to 0.3 mt. tons/ha. The reasons for the decreasing in adoption of this technology in Nepal are lack of proper knowledge about the technology among the farmers, lack of awareness among community people that results in social constraints like poisoning, poaching etc., unavailability of fingerlings at village at appropriate time, lack of government policy and research gap in this field. Hence, to promote the wider adoption of this technology the training, awareness, research and extension works, government planning and policy related to rice cum fish farming should be conducted.

9. References

1. CFPCC. Fisheries national data base. Balaju, Kathmandu: Government of Nepal; Ministry of Agriculture and livestock Department, Department of livestocks. Central Fisheries Promotion and Conservation Centre, 2019.
2. Parajulee Karki, Neeta Fish farming in Nepal: trends, opportunities, and constraints. Nepalese Journal of Agricultural Sciences, 2016, 201-210.
3. Dahal KR, Sharma CM, Gupta RK. Threats on fishery resources and fisheries livelihood due to riverbed extraction in Tinau river, Nepal. Journal of Sustainable Environmental Research. 2013; 2(1):1-11.
4. Rajbanshi KG. Zoo-geographical distribution and the status of coldwater fish of Nepal. FAO Fisheries

Technical paper. 2002, 221-246.
5. Food and Agriculture Organization (FAO). National aquaculture sector overview of Nepal, 2005. http://www.fao.org/fishery/countrysector/naso_nepal/en
6. Pokharel TP. Rice development programme in Nepal. International Rice Commission Newsletter. Food and Agriculture Organization of United Nations, Ed. by Dat Van Tran. FAO Publishing Management Group, 1997, 46.
7. Joshi KD, Upadhaya S. The rise of rice in Nepal published in Nepal times, 2020. https://www.nepalitimes.com/banner/the-rise-of-rice-in-nepal/
8. Tripathi BP, Bhandari HN, Ladha JK. "Rice Strategy for Nepal". Acta Scientific Agriculture 2018; 2(9):171-180.
9. Weimin M, Clausen J, Funge-smith S. Development of Small-scale aquaculture in highland area and remote areas: An opportunity for aquaculture development in Nepal published in Small-scale Aquaculture for Rural Livelihoods: Proceedings of the National Symposium on Small-scale Aquaculture for Increasing Resilience of Rural Livelihoods in Nepal, 2012.
10. Sah U, Mehta SN. Rice-fish farming model in water-logged condition in eastern terai region of Nepal. International Journal of Fisheries and Aquatic Research. July 2018; 3(3):35-37.
11. Das DN, Mandal RN, Mukhopadhyay PK. Deep water rice-fish integrated culture system: A viable option for increasing fish production as well as natural water harvest, World Aquaculture, 2009; 40(3):58-63.
12. Gurung TB. Study on the performance of rice-fish farming under the integrated rice-fish culture in the hills. Project Completion Report submitted to HARP, Kathmandu, Nepal, 2001; 71:99
13. Paudel Samita. Rice-cum-fish farming: opportunities in Nepal. International Youth Journal, 2017.
14. Pradhan GB, Dahal SP, Singh DM. Status and potentiality of rice-fish farming and implication approach of developed technology, A paper presented in the workshop on "Workshop on rice-fish farming for productivity enhancement: A scientific basis for wider adoption" held in Kathmandu on, 2002.
15. Gurung TB, Subedi A. (Eds). Rice-fish farming: an adoption for rice field productivity enhancement. Proceedings of the workshop on rice-fish farming for productivity enhancement, 2002. A scientific basis for wider adoption in Nepal Available from: https://www.researchgate.net/publication/305114408_Rice-fish_farming_an_adoption_for_rice_field_productivity_enhancement
16. CFPCC. Annual book of fish. Machhapokhari, Balaju, Kathmandu: Government of Nepal; Ministry of Agriculture and Livestock Department, Department of Livestocks. Central Fisheries Promotion and Conservation Centre, 2018, 135-136.
17. Gautam R, Chaudhary P, Subedi A. Factors influencing Farmer's Decision and key issues for implication to enhance Rice-Fish integrated farming for people and nation. A paper presented in the workshop on "Workshop on rice-fish farming for productivity enhancement: A scientific basis for wider adoption" held in Kathmandu on, 2002.
18. Fish farming episode- 25. Balaju, Kathmandu: Government of Nepal, Ministry of Agriculture and Livestock Development, Department of Livestocks. Central Fisheries Promotion and Conservation Centre, 2019.
19. Gurung TB, Bista J, Dhakal HP. Ecological principle of rice-fish farming and research experiences: An implication for wider adoption, A paper presented in the workshop on "Workshop on rice-fish farming for productivity enhancement: A scientific basis for wider adoption" held in Kathmandu on, 2002.
20. Mallick RN. Rice in Nepal. Published by Kala Prakashan 8/38, Bhagwan Astha, Chawel, Kathmandu, Nepal, 1971, 72.
21. Coche AG. Fish culture in rice fields: a world synthesis. Hydrobiologica. 1967; 30(1):1-44.
22. Fish farming episode- 18. Government of Nepal, Ministry of Agriculture Development, Department of Agriculture. National Natural and Artificial Reservoir Fishery Development Programme, fiscal year 2011; 12:39-41.
23. Wagle SK. Refuse system, fish species and density, rice cultivar, fertilization and feeding regime in rice-fish farming. Review report, Agriculture Research Centre (Fisheries), Pokhara, 2000.
24. Aryal BP. Benefits and constraints in Rice Fish Farming and their policy implication: An extension view point, A paper presented in the workshop on "Workshop on rice-fish farming for productivity enhancement: A scientific basis for wider adoption" held in Kathmandu on, 2002.
25. Gurung TB. Harnessing Fisheries Innovation for Transformational Impact in Nepal. Hydronepal: Journal of water, energy and Environment. 2014; 15:53-59.
26. Rahman MA. Integration of Aquaculture with Rice Farming: A Way to Increase Farm Productivity, Food security, Livelihood Improvement and Better Environment, presented at the 6th International Conference on Agriculture, Environment and Biological Sciences (ICAEBS'16) Kuala Lampur (Malaysia), 2016
27. Goswami M, Biradar RS, Sathiodas R. Techno-economic viability of rice-fish culture in Assam. Aquaculture Economics and Management. 2004; 8(5, 6):309-317.
28. Gurung TB, Mulmi RM, Kalyan KC, Wagle S, Pradhan GB, Upadhayaya K *et al*. Cage culture: an alternative livelihood option for communities displaced by reservoir impoundment in Kulekhani, Nepal. In: Success Stories in Asian aquaculture, 2010, 85-102.