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Summary report

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Background information

Carps, barbels and other cyprinids are the top species groups cultured world-wide, accounting for a quarter of global aquaculture production (29 million tonnes) and value (USD 62 billion) in 2018. While China is by far the major producer, this group includes 40 species farmed in 93 countries (Jeney and Bekh, 2020). The top four cultured carp varieties are grass carp, silver carp, common carp, and bighead carp, which are marketed mostly domestically at an affordable price. Common carp are among the key fish species farmed in Europe and Central Asia. Carp production has decreased over the last decades in Europe, especially in western regions. However, considerable potential exists, both in Europe and Central Asia, to increase carp production through innovative production systems that generate high inputs.

This webinar was organized as part of the project titled "Capacity Development for Sustainable Fisheries and Aquaculture Management in Central Asia, Azerbaijan, and Turkey (FISHCap), which was developed under the FAO-Turkey Partnership Program (FTPP II).

The two-day technical event was conducted virtually; the agenda of the webinar is provided in Appendix 1. The webinar was organized by the FAOSEC Office in cooperation with the Freshwater Fisheries Research Centre of the Chinese Academy of Fishery Sciences (FFRC) in Wuxi, China; the Research Institute for Fisheries and Aquaculture (HAKI) based in Szarvas, Hungary; the Network of Aquaculture Centres in Central and Eastern Europe (NACEE); the Ministry of Agriculture and Forestry of the Republic of Turkey; and the Romanian Fish Farmers Association (ROMFISH).

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The aims of the webinar were twofold: (i) to acquaint participants with principles and techniques of carp farming in Eurasia and (ii) to share knowledge on modern and innovative technologies in carp farming. More than 100 participants, including experts, farmers, researchers, representatives of fishers/fish farmers associations and companies, and ministerial staff, attended the webinar. The list of participants is included in Appendix 2.

Opening Addresses

The webinar started with a welcome and opening remarks delivered by Sumiter Broca, Senior Policy Officer for FAOSEC on behalf of Viorel Gutu, Sub-regional Coordinator for Central Asia and FAO Representative in Turkey. Broca underlined that the carp aquaculture sector is key to community economic development, particularly in Asia, where world's largest production of fish, including that of carp, occurs. He thanked to Turkey, the project donor, for its continued support for regional capacity building in the management and development of aquaculture through the project.

In continuation, M. Altug Atalay, Director General for Fisheries and Aquaculture of the Turkish Ministry of Agriculture and Forestry, took the floor and emphasized the importance of carp production in the nutrition of the world population and the role of sustainable aquaculture in the preservation of natural fish stock. Atalay added that carp production in Turkey had generally continued at low levels but national aquaculture subsidies had included carp production since 2019. He reiterated Turkey's commitment to strengthening regional cooperation.

TECHNICAL SESSIONS

The sessions were moderated by Haydar Fersoy, Senior Fishery and Aquaculture Officer and the Lead Technical Officer of FISHCap. Fersoy introduced the objectives and expected outputs of the webinar. The webinar comprised presentations and case studies, the summaries of which are embedded below as per the items on the agenda.

Session I. General aspects


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Laszlo Varadi, President of the Network of Aquaculture Centres in Central and Eastern Europe (NACEE), gave a presentation on the **Status and Development Trends of Carp Aquaculture in Central and Eastern Europe**. The key points of the presentation are highlighted below:

- Production of 6 species of carp provides 48 percent of world freshwater aquaculture production (24.1 million tonnes) and 29 percent of world total aquaculture production. The three most common species are common carp, silver carp, and grass carp. China provides about 71 percent of total carp production after other Asian countries (24 percent), Europe (4 percent), and other regions (1 percent).
- Common carp is the most produced freshwater fish species in Central and Eastern Europe (CEE). 94 percent of European common carp production, 161.5 tonnes, comes from CEE countries. The main production method for common carp in Europe is pond polyculture. Fishponds are not only production facilities but also provide services for the environment. The value of ecological services can be ten times higher than the value of fish production.
- There are efforts to develop innovative fishpond systems in Europe. One of them is the combined intensive/extensive (CIE) system. Common carp could be cultivated either in the intensive unit as a target species or in the extensive unit as a secondary species utilizing organic waste.

Main constraints in the common carp sector in CEE region:

- **The common carp is sometimes considered an "inferior" fish species (e.g. bones, off taste).**
- **Production is based on traditional (sometimes obsolete) technologies.**
- **The innovation level is low due to the lack of long-term strategies.**
- **A lack of appropriate regulations (e.g. on ecosystem services).**
- **Processing and product development lag behind competitors.**
- **Promotion is developing, but market organization remains poor.**

Opportunities in the common carp sector in in CEE region:

- **applying new systems and technologies through innovation, including the use of available knowledge and technologies (e.g. CIE systems);**
- **developing processing and improving product diversity;**
- **continuing and increasing the efficiency of promotion: improving "carp literacy";**
- **strengthening market organization (producers' organization);**
- **assisting carp production development projects in developing countries.**

Carp Farming as a Business: Tradition and Innovation, China Case Study was presented by Yuan Xinhua, FAO Senior Aquaculture Officer. Key messages from the case study are presented below:

- Cyprinidae is the biggest fish family in the world. Carp is an important and cheap protein source for human nutrition. For this reason, it is very important to increase production in a sustainable way in terms of nutrition for the increasing world population and food security.
- China is the world's biggest carp producer. National production has been mainly through polyculture. The production methods vary based on the feeding habits of carp.
- Key success factors of the carp industry include the rich genetic diversity of carp in the country; a very good system for gene banks and seed production; a developed feed and chemical supply chain; many different production techniques, from traditional to high-tech innovative ones (traditional pond culture with external feeding; pond raceway culture; production in reservoirs; rice fish farming and pen culture; aquaponics).
- New technologies and innovations in Chinese carp aquaculture includes digital aquaculture (digitalization for farm monitoring systems, cloud use for management and traceability), remote control and data collection.

A presentation on **Sustainable-Responsible Carp Farming and Management** was given by Bela Halasi-Kovacs, from Hungarian Research Institute for Fisheries and Aquaculture (HAKI). Below are the key points highlighted in the presentation:

- FAO and the European Union developed approaches and defined strategies and goals on sustainability. Trade-offs among the three pillars of sustainability (environmental, social, and economic) impacts the performance of the carp aquaculture industry. Sustainable aquaculture development contributes to economic growth and well-being. Blue Economy in the European Union is one of these approaches which focuses on environmental and economic sustainability in the freshwater aquaculture sector.
- Carp farming in Europe is focused on pond technology. Modern production systems, such as flow through and recirculating aquaculture systems (RAS), are being used for higher-value species.
- The main direction of sustainable carp aquaculture in Europe is the intensification of pond aquaculture. Combining intensive-extensive systems, such as the Pond in Pond System, Cage in Pond System, and RAS-Pond System, are very good techniques for improving productivity. Multifunctional pond fish farming is also important for increasing and diversifying income and additional employment.
- From an environmental point of view, pond aquaculture has a unique role in the maintenance of natural wildlife and preserving biodiversity connected to natural-like wetland habitats that created by pond technology. Pond aquaculture also contributes to better water management, retaining water and its soluble and floating compartments. Pond aquaculture has a wide range of ecosystem service functions.

Halasi-Kovacs also underlined that there are some innovative solutions for the environmental sustainability of freshwater aquaculture. Using integrated and circular farm systems in aquaculture can be a very good solution. The system can contain the Freshwater Integrated Multi Trophic Aquaculture System (FIMA) and integration with other sectors, such as energy plants and vegetable or fruit culture. Digitalization of nutrient management is also important for reducing environmental effects and developing a more cost-effective production system.

Session II. Broodstock management, genetic improvement, and hatchery seed production

The Hungary case study titled **Broodstock Management and Genetic Improvement of Carp** was presented by Jeney of National Agricultural Research and Innovation Centre (NARIC) Research Institute for Fisheries and Aquaculture (HAKI). He started the presentation by introducing an FAO publication, the Technical Manual on Broodstock Management of Common Carp and Chinese Herbivorous Fish (Jeney and Bekh, 2020). Jeney gave a broad range of detailed information about carp broodstock management, including pond preparations and technological phases of broodstock management; the selection of broodstock and their stocking, tagging, and feeding; artificial reproduction and hatchery techniques; and the fry nursery.

In the second part of the presentation, Jeney presented a case study from Hungary on broodstock management and the genetic improvement of common carp. Participants were informed about gene banks, genetic experiments, and improvements; Hungarian and foreign carp strains and their high-quality commercial hybrids; and the role and historical development of the gene bank, referring to the FAO publication, Genetic Resources of Common Carp at the Fish Culture Research Institute, Szarvas, Hungary (Bakos and Gorda, 2001). The genetic improvement of common carp in Hungary was started in 1962 by HAKI, using traditional selection (family and mass selection) and other types of genetic manipulations, such as inbreeding, gynogenesis, and hormonal sex reversion, and intra-specific hybridization. The case study shows how strategic planning, technological developments, and fisheries research contributed to the genetic improvement of common carp in Hungary. Key accomplishments include:

- A living gene bank collection at HAKI, comprising 18 Hungarian strains (landraces) and 13 strains from outside Hungary (primarily former Soviet Republics, Eastern Europe, and Asia).
- Production and testing of more than 150 combinations of common carp strains have been achieved. These research efforts produced 3 outstanding hybrids of common carp: the Szarvas 215 mirror and the Szarvas P31 and Szarvas P34 scaly hybrids, which represented 80 percent of the total carp production in Hungary during the 1980s, when the Hungarian aquaculture produced the highest production of more than 40 000 tonnes/year. Five main features were evaluated to determine the economic value of the resulting strains: survival, weight gain, feed conversion ratio, slaughter value, and fat content of the meat.
- HAKI was a key part of a national breeding programme in Hungary that provides fish farms and fish seed production units with parental lines of hybrid common carp.

The presentation noted the following reported challenges for broodstock management in Central Asia and the Caucasus (CAC):

- a lack of governmental incentives for long-term

national breeding programs;

- a lack of specific institutions and research centres for fish breeding;
- a lack of quality fish stocks for broodstock use;
- a lack of high-quality and disease-free seed;
- a lack of investments;
- a need for updated information on hatcheries and existing broodstock;
- insufficient implementation of national policies for aquaculture development;
- a slow return on long-term breeding programs (investment);
- no interest among farmers in long-term breeding programs;
- a lack of infrastructure for broodstock management and breeding programmes;
- a need for the renovation of broodstock;
- a need for pure strains of all farmed fish species, including the common carp and Chinese carps;
- a lack of regular, practical training for the staff involved in the maintenance of broodstock;
- a lack of specialized feed for all cultured species;
- a lack of state aid supporting the fish feed supply;
- no well-developed production basis for broodstock management, which is costly, and
- the high production cost of broodstock management.

Zaijie Dong from Freshwater Fisheries Research Centre, Chinese Academy of Fishery Sciences (FFRC) delivered a presentation on **Induced Breeding and Nursery Management of Carps in China**. The processes of induced spawning, breeding, and nursery management of carps were explained.

The highlights of the presentation are below:

- Induced breeding processes have four components, starting from the selection and care of the broodstock which can be selected from natural water bodies or ponds at a sex ratio of 1:1 or 1:1.5. The stocking ratio of parental carp is changeable according to body size and weight. The feeding of broodstock and fertilization rates of earthen ponds also vary according to carp species, but broodstock of different carp species can be stocked together like a polyculture to take advantage of their different feeding habits.
- Carp spawning is a natural phenomenon which develops spontaneously depending on biological, physiological, and environmental conditions. However, this natural period depends on seasonal and climatic conditions. Scientists have discovered that they can perform this natural cycle artificially with pituitary and hormone injections. Subsequently, they began to promote spawning with exogenous hormones to overcome physical conditions such as water temperature and seasonality. Hormones such as pituitary, LHRH, and HCG are applied to induce spawning in carp. Hormone injections can be applied in one or two doses depending on the broodstock and environmental conditions. If the gonads are well matured and the water temperature is high, a single dose is sufficient. Intraperitoneal or intramuscular injections can be done in carp species. Hormones are used in combination with dopamine antagonists to prevent the destructive effect of dopamine.
- After the hormone injection is given, depending on the water temperature and the type of hormone used, ovulation occurs within 12-24 hours.
- Eggs are pooled into a hatching jar or kept in a hatching circulator after fertilization. The circulator should be equipped with continuous flow-through fresh water at 22-24 °C. The duration of incubation varies depending on the water temperature. The water circulating in hatch ponds must have at least 4 percent dissolved oxygen.
- Hatching containers must be disinfected for protection from disease. Since the carp larvae and eggs are very small, a filter must be used against harmful animals, and treatment must be applied. 5-10 ppm potassium permanganate can be used against fungal diseases that may occur due to the pollution of the water used for hatchery or excessive egg stocking.
- Carp eggs to be hatched can be obtained artificially after hormone administration, or they can be collected in natural spawning pools using materials such as hapa and cacaban. Artificial insemination can be done using the dry method or by adding solution. In the dry method, the goose feathers are used to mix eggs and sperm.
- Carp larvae are very vulnerable during the first 15-20 days after hatching. Any kind of mismanagement in this critical period can cause a poor survival rate and insufficient growth of fish. Nursery ponds must be carefully prepared and disinfected. Ponds should be cleared of larval predators and pests, and juveniles should be carefully protected and fed throughout the period. Fry have a higher metabolic intensity, faster growth, and greater food intake, but all of these decline relatively to the increase in their body weight. The amount of their food intake varies with the kinds of food and water temperature, etc. at different developmental stages. By the end of the rearing period, juveniles, called summer fingerlings, can reach 25-30 mm in body length.

Session III. Innovative production systems

The second day started with a presentation by Zhu Jian from the Freshwater Fisheries Research Centre (FFRC) about **Innovative Production Systems on Carp Farming in China**. He focused on the innovative production systems of Chinese carps. The following key points were highlighted:

- Grass carp, silver carp, bighead carp, common carp and crucian carp are the major carp species being farmed in China. Traditional carp farming in China depends on the extensive and polyculture techniques. Pond aquaculture is the most important culture system in the country. Key success factors of intensive pond fish farming are material (water, seed, and feed) and technical measures (stocking density, culture model, carrying capacity, disease prevention, and management). On the other hand, production in reservoirs and lakes mostly depend on restocking and stock enhancement.
- A new approach to pond culture is ecological pond aquaculture, a system which includes ecological pond engineering, pond biological rehabilitation, and recirculation aquaculture systems.
- Zhu introduced a new study that allows water purification by carp farming in cases where eutrophication is not severe. This system is based on a method of increasing fish stocks in the open water system to preserve biodiversity and improve water quality. The main idea of this approach is to combine hydroponics and aquaculture for biological control of nitrate and phosphors decomposition in the water through aquatic organisms and fishery activities. The most important issue is stock development on the basis of lakes and reservoirs and balancing their carrying capacity in terms of aquaculture.
- One another approach is the use of filter-feeding fish for water purification and ecological pond culture. Target species are the silver carp and bighead carp filtering fishes, to control eutrophic water. It is estimated that 1 kg silver carp and bighead can move out 29.40g N, 1.46g P and 118.60g C. In addition, silver carp and bighead carp can help reduce biomass of blue-green algea.
- Integrated fish farming is a traditional production technique in China. It is a combination of water use for fish and rice farming in puddles. This production model provides enormous fish production for small holders and rice producers in the whole country. It improves soil quality and fertility and reduces the usage of pesticide.

In the second part of his presentation, Zhu listed the main measures of water management as follows: hydroponics purification, the usage of effective microorganisms (EM), the usage of probiotics, environmentally friendly chemicals, and aeration. It was also stated that additional measures for water management are construction of wetlands representing 5 percent of the total culture area in a fishpond. Creation of an in-pond raceway for fish culture provides water treatment in ponds.

Cage culture and pen culture were used for fish culture in large water resources. Both methods are now mostly recommended for model stock enhancement and clean water fisheries with filter-feeding fishes controlling the water environment. Zhu introduced a new approach to environmentally friendly cage culture based on cage culture methods in reservoirs. The layout of cage culture with non-feeding cages for filter-fed carps and feeding cages for grain-fed fishes prevents sediments from cages from entering the environment. At the end of the lecture, he underlined the following issues:

- Aquaculture engineers are needed for water monitoring, feeding systems, mechanic harvesting, and transportation.
- Intelligent aquaculture provides for the monitoring of water quality, precise feeding, and other activities automatically. Pond management even can be controlled by internet and mobile phone applications.
- China has the capacity for over 20 million tonnes of carp farming production. The carp industry needs to have a good fish processing infrastructure encouraging consumer fish consumption.

The presentation on **"Farmer's Organization: Capacity and Support for Small-Scale Farmers"** was delivered by Catalin Platon, President of the Romanian Fish Farmers Association (ROMFISH). Key messages from the presentations were as follows:

- Farmers can solve their problems with NGOs, consumers, and the media, but they should be organized for governmental services and demands. The key needs of fish farmers are:
    - methods, tools and techniques for data collection and dissemination;
    - capacity building for uniform application of legal requirements;
    - negotiating power for the acquisition of inputs in sales or auctions and stimulating legislative changes;
    - training for workforce qualification and farmer managing;
    - partnerships for discussions with decision makers, NGOs, and other associations;
    - it is important that sustainable partnerships among farmers are established to increase competitiveness, sustainability, and social acceptance and to promote self-regulation and participation in the decision process at all levels.
- Carp literacy is a very important step for sustainable carp farming because carps are a part of the culture. There are about 500 carp farmers in Romania, but only 60 farmers are members of an association. The history of farmers' associations in Europe goes back 150 years, as common carp dominated the European freshwater fish farming for more than 500 years. The European Union has effective fish farmers' associations, like the Polish Fisheries Society, The Austrian Association for the Fishery Industry and Aquaculture, Hungarian aquaculture and Fisheries Inter-Branch Organisation, The Association of German Freshwater Fishing and Aquaculture, the Czech Fish Farmers Association, and the Romanian Fish Farmers Association.
- Partnerships, research and development, and regional-international cooperation are key to sectoral success.
- The involvement of women and youth in fisheries and aquaculture is decreasing (the fisheries and aquaculture sector in Romania has only 20-30 percent representation by women).
- Farmers' organizations should focus communication with the society on the values they bring about, as carp farming creates human-made wetlands, which are the most complex ecosystems generating a full range of ecosystem services.

"What we have is a life story, and we must share it with others"

The case study on **"Ornamental Fish Farming in Turkey"** was presented by Soner Sezen of the Mediterranean Fisheries Research, Production, and Education Institute (MEDFRI) in Turkey. He underlined

that, after photography, keeping an aquarium is the second-most preferred hobby/activity to prevent stress. The basic reason why people enjoy it is that an aquarium provides a relaxing environment that reduces stress and heart attack risk.

The global aquarium market is estimated to be valued at USD 30 billion and include 200 different species. The biggest producer is Singapore, with 20 percent of total production. Turkey has almost 50 years of background in the aquarium sector. With increasing interest, it is a rapidly growing sector in aquaculture, reaching approximately USD 15 million: 30 million fish are bought and sold annually. However, 70-80 percent of this fish demand is met through imports. The remaining annual production is around 7.5 million fish with 30 species. Goldfish take first place among fishes produced in freshwater aquariums. Anemonefish (*Amphiprion ocellaris*) are produced in marine aquariums.

The aquarium (ornamental) fish industry and market size is increasing globally. Singapore ranks first in exports. Some Asian countries are re-exporters of ornamental fish. In addition, The Czech Republic and Israel are leading ornamental fish producers. The Czech Republic has made the development of the sector a state policy, and Israel has achieved success in closed circuit systems in the desert environment, especially with genetic projects. It is seen that the consumer segment is formed by the USA and European countries.

Sezen provided information about the activities of the MEDFRI, which was established in 1983 with a focus on fry production for restocking. It was noted that MEDFRI is currently the single Turkish public production centre for aquarium fish. Participants were informed about culture techniques used by the centre for aquarium fish (i.e., goldfish, koi, pangasius, zebra fish, cichlids, and live bearer species). Fish are cultured naturally (without any induced production) in greenhouses and ponds using natural methods.

It was underlined that to obtain an appropriate colour for koi fishes, selected colour males and females can be fertilized, thanks to techniques developed by a Japanese expert.

Session IV. Fish feeding and fish health management

The session IV focused on **"Fish Feeding and Fish Health Management"**. The first presentation was delivered by Thomas Ashley Shipton, Chief Technical Advisor for FAO Kyrgyzstan, on carp nutrition and feeding, which is important to farmers as feed costs in semi-intensive and intensive production systems usually account for 50–60 percent of production costs.

To understand how to feed fish effectively, it is vital to have an understanding of the nutritional physiology of fish. Under extensive culture conditions, fish generally consume natural feeds, and additional feed inputs are generally not required; however, under more intensive culture conditions, fish rapidly consume natural feed supplies, and supplemental and pellet feeds are required. There is, therefore, a close correlation between production intensity and feeding. In extensive and semi-intensive systems, natural productivity varies during the production cycle, often peaking at the start of the production cycle and reducing as the fish grow and consume more of the natural feed in the pond. Natural productivity is not important in intensive systems and less so in cage systems. In order to increase natural productivity in fishponds, they are usually fertilized with organic or inorganic fertilizers.

Shipton provided detailed information about fertilization measures for inorganic and organic fertilizers:

- As a general rule, it is important to apply manure and other fertilizers about 10-15 days before stocking the fish. Fresh manure is usually applied at the equivalent rate of 10-20 kg dry matter per 100 m^2; the amount of manure applied will depend on the source. A few days after stocking, fresh manure can be applied at an equivalent dry matter rate of about one-tenth of the weight of fish stocked per 100 m^2. Every day thereafter, or at least twice a week, manure is usually added to the pond according to the water quality and the levels of productivity in the system. In general, fertilizer use should be gradually increased as the total weight of fish in the pond increases, until a maximum amount of dry matter which can be safely applied on any one day is reached; this usually equates to about 1.2 kg/100 m^2 (in a tropical climate) or 0.6 kg/100m^2 (in a temperate climate).
- As production intensity increases to semi-intensive levels (e.g., stocking density ≤10 000/ha), supplementary feeds may be required. Supplementary feeds are typically inexpensive agricultural biproducts that are high in carbohydrates (energy) and low in protein, on the understanding that fish are able to consume the necessary protein for growth from the phyto- and zooplankton in the natural foods, while the energy in the carbohydrate portion of the supplemental feed is used to meet the energy requirements of the fish.
- As production intensity increases further, natural productivity and supplemental feeding will no longer be sufficient to support good growth and production, and thus nutritionally complete pellet feeds need to be used. Understanding the nutritional

requirements of common carp is very important as it provides information about the levels of dietary protein, lipids, carbohydrates, fibre, minerals, calcium, phosphorus, gross energy, and protein energy required in the feeds. These dietary nutritional requirements vary according to the fish species and the growth stage of the fish (e.g. larval, fingerling, grower, broodstock).

- Two types of pellet feeds are usually available: compressed pellet feeds and more expensive and generally higher-quality extruded feeds.
- The feed conversion ratio (FCR) provides an indication of the amount of feed (kg) that needs to be fed to a fish to produce 1 kg of body weight. Major factors impacting feed consumption are fish size and water temperature.
- Calculating the feed ratio and ensuring that feed is used effectively, minimizing over- or under-feeding, is important for good farm management. Feed rations are calculated using feed tables that are usually supplied by the feed manufacturer. The feed ratio is calculated according to the prevailing water temperature, the average weight of the fish, and the total fish biomass in the pond.
- Optimal feeding frequency is species-specific and specific to the life stage of the fish. As a rule of thumb, carps should be provided with feed every three to six hours during daylight. Smaller fish require feeding more often.


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Storage of the fish feed is important, as the nutritional value of the feed can easily deteriorate under poor storage conditions. Feed quality is primarily affected by temperature, sunlight, moisture, exposure to air (oxidation/rancidity) and pests (which consume the feed). Ideally, feed stores should be in secure areas, maintained at room temperature, and dry. The feed should be stored off the ground in well ventilated areas (e.g., on pallets). Access by rodents, birds, and insects should be restricted. Feed should be used on a first in/first out basis.

Ren Mingchun from the Freshwater Fisheries Research Centre (FFRC) in China provided a lecture on **"Carp Farming Technology Extension in China: the Role of the Aquafeed Company"**. Mingchun organized his presentation around three components: aquafeed companies in China, the role of aquafeed companies, and international cooperation.

- Aquafeed comprises 4 percent of animal feed. The largest aquatic feed production is carp feed, followed by shrimp and tilapia feed. The feed industry plays an important role in national food security, the quality of aquatic products, and the developing circular economy. Feed companies are the mainstay of the Chinese feed industry with more than 22 million tonnes of fish feed production. It was underlined that China is the biggest fish feed producer in the world which has two sub-branches. The first is that fish feed companies have a central unit and branches in many countries. The companies have management, production, purchasing, and human resources departments for operational purposes. The second sub-branch is an aquaculture research institution which provides technical consultation for the aquaculture and feed sector.
- Feed companies provide additional services to fish farms and consumers.
- Since the first feed company in Viet Nam was built in 1999, the New Hope group has established more than 40 companies operating in production, construction, preparation, and investment in nearly 20 overseas countries and regions, which are mainly engaged in the production and sales of livestock, poultry, and aquatic feed products. The main challenges were underlined: international political risks, inherent political and economic risks in the host country, lack of project funds, insufficient

government support, a language barrier, a lack of talent, and fluctuating policies.

Ren invited the participants to increased collaboration and partnership.

The last presentation of the webinar **"Health Management on the Carp Farm"** was conducted by Dr. Xi Bingwen from the Freshwater Fisheries Research Centre (FFRC) in China. The session provided detailed information about fish disease and sanitation for the main cultured species of carp: black carp, grass carp, silver carp, bighead carp, common carp, crucian carp and Wuchang bream.

Bingwen stressed that the aquaculture sector had seen incredible development in the previous decades but had also experienced some difficulties, mainly more than 10 different fish diseases which broke out. During his presentation, he summarized some of the common diseases:

1. Grass carp reovirus disease, which affects fingerling fish in the summer season.
2. Cyprinid herpesvirus 2 (CyHV-2) poses serious economic losses in gibel carp farming with a mortality rate . It is characterized by kidney necrosis in carp, bleeding, swelling, and necrosis of the intestinal organs.
3. KHV/Cyprinid herpes viral disease (CyHV-3), which affects common carp in high-density stocked ponds in the summer season.
4. Carp edema virus, also called Koi Sleepy Disease when it was diagnosed in 2015, shows the following external clinic signs: swollen gills, excess mucus, discolouring, rot, etc. Due to the fact that it was diagnosed very recently, it is difficult to distinguish from other diseases, since some viruses show different effects depending on the water temperature.
5. Columnaris disease, caused by *Flavobacterium columnare*, afffects both wild and cultured carp species leading to skin lesions, fin erosion and gill necrosis which would be severe.
6. Enteritis, caused by aeromonas spp and pseudomonas spp, which is seen very frequently in unsuitable environmental conditions and insufficient feeding periods.
7. Aeromonas septicaemia, which is seen very frequently not only in carps also in other freshwater fishes, mostly causes hyperaemia & haemorrhage.
8. Gibel carp myxospore disease, which affects the liver and skin and causes mass mortality in young fish.
9. Dactylogyrus disease, which affects young fish and eggs.

The next part of the presentation was on disease control cases. The presenter informed the participants about the treatment of some important diseases and sanitation methods.

- Dactylogyrus diseases: treatment with Trichlorfon: 0.3-0.5ppm Praziquantel: 3- 5ppm two times a month.
- Aeromonas septicaemia: aeromonas spp., vibrio spp. are opportunistic pathogens. Poor water quality, injury caused by parasites, and operations render the reared fish at risk of disease. Although motile aeromonads appropriately receive much notoriety as fish pathogens, it is important to note that these bacteria also compose part of the normal intestinal microflora of healthy fish. Therefore, the presence of these bacteria, by itself, is not indicative of disease, and, consequently, stress is often considered to be a contributing factor in outbreaks of disease caused by these bacteria.

It was underlined that isolation of pathogens and drug tests are very important for aquaculturists to prevent disease.

- Grass carp reovirus disease requires treatment as for all other diseases as well as strict quarantine of seed and broodstock, SPF; pond clearing and tool disinfection; before stocking, medicinal bath with 30ppm iodine for 15-20 minutes. and vaccination.

Currently, there are almost six different certificated vaccines, and the four most commonly used are listed as follows:

- Grass carp hemorrhagic virus (GCHV) inactive vaccine
- GCHV attenuated vaccine
- *Aeromonas hydrophilia* inactive vaccine
- *Edwardsiella tarda* attenuated vaccine

Common criteria for treatment of many kind of diseases in freshwater fish were suggested:

- Stop feeding
- Disinfection: bromine chlorine hydantoin 0.2-0.3ppm;
- 0.5 kg herbs (rhubarb, scutellaria baicalensis, cortex phellodendri and radix isatidis), add 0.5 salt to pellets for 100 kg fish for 7 days. If there is a bacterial infection, it is better to add antibiotics.

The most common diseases encountered in carp in carp farming include: Grass carp reovirus disease, Gibel carp herpes viral disease (CyHV-2)/golden fish spleen and kidney necrosis; KHV /Cyprinid herpes viral disease (CyHV-3); Carp Edema Virus/Koi Sleepy Disease; rotten gill: bacteria Flavobacterium cloumnare; Aeromonas septicaemia; Gibel carp myxospore disease; Dactylogyrus diseases, and their treatment methods were summarised by guiding the FAO Publication "Field Guide to the Control of Warm-Water Fish Diseases in Central and Eastern Europe, the Caucasus, and Central Asia" (Molnar, Szekely and Lang, 2019).

Fish feed production and the structure of feed facilities in China were introduced in the last session of the webinar.

Conclusion and recommendations

The webinar was organized in line with the beneficiary countries' requests. Key conclusions from the webinar are as follows:

- Carp farming has a long history, starting in China.
- Central Asian and Caucasus countries have great potential for carp farming.
- Carp are important for diet and have an important role in some countries' cultures.
- Carp farming could be a good business.
- Carp farming is one of the most valuable protein sources for the healthy diets of generations.
- Aquaponics and other polyculture systems for carp farming can be useful for the sustainable management of natural resources.
- Aquaponics systems can be developed in Central Asia and the Caucasus in natural and man-made reservoirs.
- It is important to increasing public awareness about carp production.
- Consumption of fish and fishery products should be considered.
- New systems and technologies should be applied through innovation, including the use of available knowledge and technologies (e.g., CIE systems).
- Processing and improved product diversity should be developed.
- Promotion should continue and increase in efficiency to improve "carp literacy".
- Market organization (producers' organization) should be improved.
- The main causes of fish diseases is stress, including high water temperatures, high fish density in the pond, and insufficient environmental conditions.
- Fish disease is a key issue in fish farming.

About the FAO-Turkey partnership programmes

The objectives of the FAO-Turkey Partnership Programmes are to provide support to ensure food security, rural poverty reduction and sustainable forest management, combat desertification and preserve ecosystems in Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan and Uzbekistan and other countries of mutual interest.

Established in 2007, the first phase of the FAO-Turkey Partnership Programme on Food and Agriculture (FTPP) has benefited from trust fund contributions totalling USD 10 million, financed by the Government of Turkey and represented by the Ministry of Agriculture and Forestry.

During the first phase of the programme, 28 projects were implemented in 16 countries between 2009–2015. In 2014, Turkey and FAO commenced the second phase of the FTPP along with the first phase of the FAO-Turkey Forestry Partnership Programme (FTFP) with an additional fund of USD 20 million, bringing Turkey's total contribution to USD 30 million.

Under this new phase, a range of projects will be implemented in the areas of:

- food security and nutrition;
- agricultural and rural development;
- protection and management of natural resources;
- agricultural policies;
- food safety;
- sustainable forests, land and natural resource management and land degradation neutrality;
- institutional reform, training and national capacity enhancement.

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Appendix 1

Agenda

Tuesday, 8 December 2020	
Moderator: *Haydar Fersoy, Senior Fishery and Aquaculture Officer, FAO*	
Opening Session	
10:00 - 10:10	**Opening Remarks** • *Viorel Gutu, Sub-regional Coordinator for Central Asia and Representative in Turkey, FAO* • *Ministry of Agriculture and Forestry of the Republic of Turkey*
10:10 - 10:15	**Objectives and Expected Outputs of the Virtual Workshop** • *Haydar Fersoy, Senior Fishery and Aquaculture Officer, FAO*
Session I. General Aspects	
10:15 - 10.45	**Status and Development Trends of Carp Aquaculture in Central and Eastern Europe** • *Laszlo Varadi. President, Network of Aquaculture Centres in Central and Eastern Europe (NACEE)*
10:45 - 11:15	**Carp Farming as a Business: Tradition and Innovation, China Case Study** • *Yuan Xinhua, Senior Aquaculture Officer, FAO*
11:15 - 11:35	**Sustainable/Responsible Carp Farming and Management** • *Bela Halasi Kovacs, Research Institute for Fisheries and Aquaculture (HAKI), Hungary*
Session II. Broodstock Management, Genetic Improvement, and Hatchery Seed Production	
11:35 - 12:05	**Broodstock Management and Genetic Improvement of Carp, Hungary Case Study** • *Zsigmond Jeney, Research Institute for Fisheries and Aquaculture (HAKI), Hungary*
12:05 - 12:45	**Induced Breeding and Nursery Management of Carps in China** • *Dong Zaijie, Freshwater Fisheries Research Centre (FFRC), China*
12:45 - 13:00	**Q&A Session**

Wednesday, 9 December 2020 **Please note that the timetable displays Ankara time (GMT+3)*	
Moderator: *Haydar Fersoy, Senior Fishery and Aquaculture Officer, FAO*	
Session III. Innovative Production Systems	
10:00 - 10:30	**Carp Farming in China: Technology and Dissemination** • *Zhu Jian, Freshwater Fisheries Research Centre (FFRC), China*
10:30 - 11:00	**Farmers' Organizations: Capacity and Support for Small-Scale Farmers** • *Catalin Platon, President of the Romanian Fish Farmers Association (ROMFISH)*
11:00 - 11:30	**Ornamental Fish Farming, Turkey Case Study** • *Soner Sezen, Mediterranean Fisheries Research, Production, and Education Institute, Turkey*
Session IV. Fish Feeding and Fish Health Management	
11:30 - 12:00	**Carp Nutrition and Feeding** • *Thomas Shipton, Chief Technical Advisor, FAO*
12:00 - 12:20	**Carp Farming Technology Extension in China: The role of the Aquafeed Company** • *Ren Mingchun, Freshwater Fisheries Research Centre (FFRC), China*
12:20 - 12:50	**Health Management in Carp Farm** • *Xi Bingwen, Freshwater Fisheries Research Centre (FFRC), China*
12:50 - 13:00	**Q&A Session and Closing Remarks**

Appendix 2

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