



# **FOOD SECURITY, FISHERIES AND AQUACULTURE IN THE BOLIVIAN AMAZON**

IDRC project 106524-003

**Asociación FAUNAGUA, Agua Sustentable, World Fisheries Trust**

**FINAL PROJECT REPORT - May, 2014**

## **FINAL TECHNICAL REPORT**

**Study Location: BOLIVIA**

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**Period: March 1, 2011 to February 28, 2014**

**Date Submitted: May. 30, 2014**





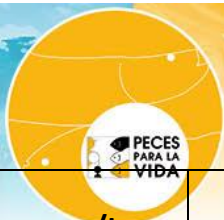
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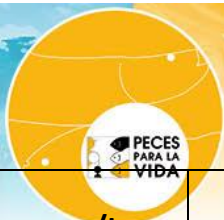


## Glossary and Acronyms

Acronym/term	English	Spanish or Portuguese
<b>Grupo de Mujeres Arapaima</b>	Group of 12 women in Fisheries sector of Riberalta who work on gastronomy and leadership	Grupo de 12 mujeres del sector pesquero de Riberalta quienes trabajan gastronomía y liderazgo
<b>APIAT</b>	Indigenous Amazonian Fishermen's Association of Trinidadito	Asociación de Pescadores Indígenas Amazónicos de Trinidadito
<b>APNI</b>	Aquaculturist Association from Northern	Asociación de Piscicultores del Norte Integrado de Yapacani
<b>AS</b>	"Sustainable Water" – Bolivian NGO	Agua Sustentable
<b>Campeño</b>	Peasant farmer	<b>Campeño</b>
<b>CAPINA</b>	"Cooperation and Support for Projects with Alternative Inspiration" – Brazilian NGO	Cooperação e Apoio a Projetos de Inspiração Alternativa
<b>CARE</b>	Humanitarian organization with focus on food security, rural livelihoods, climate change, health and education	Organización humanitaria con enfoque sobre seguridad alimentaria, medios de vida rural, cambio climático, salud, educación
<b>CCIPCPCT</b>	Indigenous community paiche fish processing centre in Trinidadito	Centro Comunitario Indígena de Procesamiento de Carne de Paiche de la Comunidad de Trinidadito
<b>CEPAC</b>	Center for the promotion of peasant farming	Centro de Promoción Agropecuaria Campesina
<b>CEPTA</b>	Aquaculture Research and Training Center, part of ICMBio (Brazil)	Centro de Pesquisa e Treinamento em Aquicultura
<b>CIDA</b>	Canadian International Development Agency	Agencia Canadiense de Desarrollo Internacional
<b>CIDAB</b>	Bolivian Aquaculture Research and Development Centre, Agency of the MDyRT	Centro de Investigación y Desarrollo Acuicola Boliviano
<b>CIDOB</b>	Confederation of indigenous peoples of Bolivia	Confederación de Pueblos Indígenas de Bolivia
<b>CIFSRF</b>	Canadian International Food Security Research Fund	Fondo Canadiense de Investigación en Seguridad Alimentaria Internacional
<b>CIPOAP</b>	Centre for Indigenous Amazonian Peoples of Origin of Pando	Central Indígena de Pueblos Originarios Amazónicos de Pando
<b>CIRABO</b>	Centre for Indigenous of Amazonian region of Bolivia	Central Indígena de Región Amazónica de Bolivia
<b>CITRAB</b>	Centre for Indigenous Tacana of the Amazon region of Beni	Central Indígena Tacana de la Región Amazónica del Beni
<b>Empresa CURUPAU</b>	Artisanal Family Business	Empresa Familiar Artesanal
<b>DFO</b>	Department of Fisheries and Oceans, Canada	Departamento de Pesca y océanos - Canadá



Acronym/term	English	Spanish or Portuguese
<b>DNA</b>	Deoxyribonucleic acid – genetics basic unit	Ácido desoxirribonucleico (ADN)
<b>EIA</b>	Environmental Impact Assessment	Evaluación de impactos ambientales
<b>ELAP</b>	Emerging Leaders of the Americas Program	Programa de Becas para Líderes Emergentes en las Américas
<b>El Sur</b>	3 communities within the TCO TIM II (Flor de Octubre, Lago El Carmen and 27 de Mayo)	Comunidades indígenas Flor de Octubre, Lago El Carmen y 27 de Mayo (zona sur del TIM II, región Beni)
<b>EMBRAPA</b>	Governmental Company for Agricultural Research (Brazil)	Empresa Brasileira de Pesquisa Agropecuaria
<b>EVE</b>	Economic Viability Study	Estudio de Viabilidad Económica
<b>FAN</b>	Friends of Nature Foundation	Fundación Amigos de la Naturaleza
<b>FAO</b>	Food and Agriculture Organization	Organización de las Naciones Unidas para la Alimentación y la Agricultura
<b>FEUPECOPINAB</b>	Unified Federation of Fishermen, Vendors, and Aquaculturists of the Northern Amazon of Bolivia	Federación Única de Pescadores, Comercializadores y Piscicultores del Norte Amazónico de Bolivia
<b>Fondo Socioambiental CASA</b>	Socioenvironmental fund-CASA. International alliances.	Fondo socioambiental CASA. Alianzas internacionales.
<b>iBol</b>	International Barcode of Life	Código de Barras de Vida International
<b>ICMBio</b>	Instituto Chico Mendes – Brazilian agency for biological conservation	Instituto Chico Mendes de Biología
<b>IDRC</b>	International Development Research Centre	Centro de Investigación y Desarrollo Internacional
<b>IMG Consulting</b>	Consultants, Marketing, Management, Engineering	Ingeniería, Marketing Gestión, Consultores
<b>INIAF</b>	National Institute for Agricultural and Forestry Innovation (Bolivia)	Instituto Nacional de Innovación Agropecuaria y Forestal (Bolivia)
<b>IPD-PACU</b>	Decentralized Public Unit for Fisheries and Aquaculture (Bolivia)	Unidad Pública Desconcentrada de Pesca y Acuicultura (Bolivia)
<b>IPVCA</b>	Participative Value Chain Analysis	Análisis participativo de la Cadena de Valor
<b>IRD</b>	Research and Development Institute (France)	Instituto de Investigación y Desarrollo
<b>IUCN-NL</b>	International Union for Conservation of Nature - Netherlands	Unión internacional para la conservación de la naturaleza- Países Bajos
<b>McGill</b>	McGill University, Canada	Universidad de McGill, Canadá
<b>MDRyT</b>	Ministry of Rural Development and Land (Bolivia)	Ministerio de Desarrollo Rural y Tierras
<b>MMAyA</b>	Ministry of Environment and Water (Bolivia)	Ministerio de Medio Ambiente y Aguas
<b>MRE</b>	Ministry of External Relations (Bolivia)	Ministerio de Relaciones Exteriores
<b>NGO</b>	Non-Profit Organization	Organización no gubernamental



Acronym/term	English	Spanish or Portuguese
<b>OM</b>	Outcome Mapping	Mapeo de alcances
<b>PDM</b>	Municipal Development Plan	Plan de Desarrollo Municipal
<b>PIEB</b>	Program for Strategic Investigations in Bolivia	<i>Programa de Investigación Estratégica en Bolivia</i>
<b>PPV</b>	Fish for Life	Peces Para la Vida
<b>Proteger</b>	“PROTECT” Foundation, Argentinian NGO	Fundación PROTEGER, ONG Argentina
<b>PUFA</b>	Poly-unsaturated Fatty Acids	Ácidos grasos poliinsaturados
<b>RAA</b>	Aquaculture in the Americas Network	Red Acuicultura das Américas
<b>RIMA</b>	Regional Network for Amazonian Women	Red de Mujeres Amazónicas
<b>SENAMHI</b>	National Service of Meteorology and Hydrology- Bolivia	Servicio Nacional de Meteorología e Hidrología - Bolivia
<b>SENASAG</b>	National Agricultural Health and Food Safety	Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria
<b>SWOT - FODA</b>	Strengths-Weaknesses-Opportunities-Threats analysis	Análise Fortalezas - Oportunidades - Debilidades-Amenazas
<b>TCO-TIM II</b>	Indigenous Communal Territory Multiethnic Territory II	Territorio Comunitario Indígena Multiétnico II
<b>UBC</b>	University of British Columbia	Universidad de Colombia Británica
<b>UFRJ</b>	Federal University of Rio de Janeiro	Universidade Federal de Rio de Janeiro
<b>ULRA</b>	Limnology and Aquatic Resources Unit from the Major University of San Simon	Unidad de Limnología de Recursos Acuáticos de la Universidad Mayor de San Simón
<b>UMSS</b>	Major University of San Simon (Cochabamba, Bolivia)	Universidad Mayor de San Simón
<b>UNIBol</b>	Bolivian Indigenous University	Universidad Indígena Boliviana
<b>UVic</b>	University of Victoria	Universidad de Victoria
<b>VDRA</b>	Vice Ministry of Rural Development and Land (Bolivia)	Vice Ministerio de Desarrollo Rural y Tierras
<b>WCS</b>	Wildlife Conservation Society	Sociedad de Conservación Silvestre
<b>WFT</b>	World Fisheries Trust	





# 1. Executive summary

The Peces Para la Vida (PPV) project called on the under-developed potential of fisheries and aquaculture to contribute to improved food security amongst poor populations in the Bolivian Amazon. The core approach was a socio-economic optimization of value chains, based on participative evaluations of social and technical bottlenecks and upgradable pilot interventions. In addition to producing a much-needed baseline on food security and nutrition status for the region and the contributions of subsistence and commercial fisheries, a combination of targeted interventions in the fisheries value chains, local-level social and organizational strengthening, and broader macro-level governance-building initiatives contributed to the development of sustainable fisheries and aquaculture livelihoods and created a supportive, enabling environment for positive social transformation, improved nutrition and food security.

A survey of over 800 households in fishing communities of the Northern Amazon demonstrated significant levels of food insecurity in both rural and urban settings for both wet and dry seasons (moderate to high food insecurity was reported for 58% of rural and 40.6 % of urban households in the low water season, and 50.4 % of rural and 29.6% of urban households in the high water season (HFIAS – Household Food Insecurity Access Scale). Childhood stunting, lack of appropriate knowledge and practices regarding infant and young child feeding, and high rates of infection (diarrheal), coupled with low access to improved water supply and low incidence of adequate water treatment were also evident in results for rural communities. Complementary focus group and interview data revealed relatively high fish consumption levels in most of the rural communities, based on over 57 species, and a high diversity of seasonally available forest products with significant nutritional potential. However, seasonal and geographic variability was demonstrated in livelihood activities, as well as a high frequency of flood events and lack of access to health care, all with significant impacts on nutrition and food (in) security. Project interventions thus focused on improving fishing livelihoods (especially equitable distribution of benefits and new value-added income generation opportunities), as well as improvements in knowledge and practices for hygiene and water treatment, maternal health, infant and young child feeding, and improving dietary diversity and nutrition with locally available ingredients..

Nutritional analysis of ten native species and of paiche identified the armoured catfish known locally as buchere (*Hoplosternum littorale*), as high in several micronutrients, most notably iron and Vitamin A . This fish is seasonally used in subsistence fisheries in the rural indigenous study communities and traditionally eaten as a breakfast soup in the urban areas. Dried fish powders were also identified as a method for conserving nutritional quality of small fish, with good non-refrigerated shelf life, although more work is required to promote cultural acceptance of this new product for Bolivia. Paiche abdominal meat, considered of low market value, is high in fat and was shown to be surprisingly rich in w-3 essential fatty acids. Training on preparation protocols and using local recipes was implemented in rural and urban groups to improve micronutrient provision through novel combinations of fish and other local ingredients, resulting in the publication of a cookbook.



A series of Integrated Participative Fisheries Value Chain Analysis (IPVCA) workshops identified established social and commercial hierarchies and poor hygiene and quality control along the production chain as main impediments to improved fishing livelihoods and equitable distribution of benefits (with the majority of rural indigenous fishing families in the Indigenous Communal Territory known as Multiethnic Territory II (TCO TIM II) study area earning at or below 50% of the national minimum wage of 215 USD/month, and an estimated 30% loss of fish due to improper handling and storage between production and final sale to consumers). Ice provision and an improved cold chain were also identified early in the project as technical bottlenecks. Improved ice boxes were designed and an alternative ice plant considered with the fishing association, but budgetary constraints and concerns about how this would fit into improved social aspects of the value chains slowed progress on this aspect. A hybrid economic-welfare model for optimization and upgrading of fisheries value chains was developed and field-tested during the project. Four pilot strategies were pursued: (1) development of a new production complex with a variety of value-added processing opportunities for the relatively new fishery based on the introduced paiche (*Arapaima gigas*) in one pilot community (Trinidadcito) within the TCO TIM II; (2) social and technical improvements to the value chain for native species fisheries in 3 pilot communities within the TCO TIM II (“El Sur” communities – Flor de Octubre, Lago El Carmen and 27 de Mayo), focussed on fishing technology improvements, fish quality, and negotiations to improve transparency and equitable distribution of benefits from fishing; (3) creation of a women’s productive group (Grupo Arapaima) made up of female members of urban fishing families to develop value-added fish products, promote fish consumption, and develop female leadership; and (4) fish quality and marketing enhancement through training of fish sellers and municipal health inspectors (SENASAG) on hygiene and handling, infrastructure upgrades to a municipal fish market (Mercado Campesino Abasto), and local fish consumption promotional campaigns and fairs.

The experimental paiche production complex established in Trinidadcito (Centro Comunitario Indígena de Procesamiento de Carne de Paiche - CCIPCP) with an associated management and marketing plan, also created new value chains for fish leather and artisanal products from fish scales, supported by a micro-enterprise. By the end of the project, 100% of the paiche fished by the community were being processed locally and active membership in the local professional fishing association had increased by 47% (from 38 to 56, including 7 females in a previously all-male organization.) Income from fishing itself remained stable, though spread over more fishers and including contributions to the main community association. Processing the fish locally created 7 new jobs for community members, as well as providing raw materials for 92 people (70 female) trained for production of value-added leather and scale products. Products from processing included fillets for sale to regional markets at improved prices, as well as highly nutritious belly-meat, trimmings, and “racks” of paiche backbones for local consumption provided free or at lower prices to needy families. This community had reported very low levels of paiche consumption at the start of the project, but this had increased by a factor of four by the end of the project (4.7 to 17.7%). A series of exit interviews and surveys also provided information on upscaling potential of managed paiche fisheries.

Integrated participative value-chain analysis carried out with 3 pilot communities known as ‘El Sur’ (Flor de Octubre, Lago el Carmen and 27 de Mayo) in the TCO TIM II who have recently moved to fishing as a main livelihood activity, created increased transparency in the value-chain, contributed to the affiliation of the local communal association (Central Indígena Tacana de la Región Amazónica del Beni - CITPRAB) with the regional fishing federation (FEUPECOPINAB) and led to a joint proposal by these organizations for changes to the municipally regulated price structure for fish. Technical training and interventions with these communities were based on local identification of needs, addressed key bottlenecks (boat construction,



net repairs, live-fish holding tanks, hygienic fish bins in boats, improved icing and transport protocols, and community gardens to improve dietary diversity). Cooking was identified as a topic of common interest to bring male and female stakeholders together to work on hygiene, fish handling, dietary diversity, economic planning for household enterprise, and improved linkages with public health providers. All 104 community participants (27 adult female, 31 adult male, 46 children, representing 95% of the total population for these communities) demonstrated improved understanding of the topics covered and improved capacity for organization and innovation, as evidenced in exit surveys, though changes in practice on some issues were still developing. An extreme flooding event at the end of the project severely damaged these communities. It is still unknown how these new practices may contribute to their re-building.

A new productive group, Grupo Arapaima, was created with 14 low-income females (from urban-based fisheries sector) to develop new, accessible income-generating opportunities, foster urban fish consumption, and build a core group for leadership training and dialogue on addressing strategic needs of females, including improving women's status in the fishing sector. These females now form part of a regional network for Amazonian women (RIMA). Additionally, four successful family-based micro-enterprises were launched with participants from the group, each generating an estimated new monthly income of Bs 1350-2364, three selling value-added fish products and one building and mending fish nets. Grupo Arapaima also partnered with the municipality and regional fisheries federation FEUECOPINAB to plan two annual municipal fish fairs promoting fish consumption, and lobbied for the establishment of June 29<sup>th</sup> as Fishers Day – recognized in 2012 at the municipal level, and also written into the draft fisheries law for national implementation. A recipe book was developed with the Grupo Arapaima and a professional chef, to promote healthy and diverse cooking using native fish species and paiche and including instructions for improved hygiene and fish handling. This book, and associated messages, were promoted at 13 local and national events, with an estimated participation of 9,450 people, in addition to reaching an estimated audience of 40,000 through 3 regional television programs and 2 local radio shows. Seventeen women improved their income directly with these initiatives (14 Grupo Arapaima members, plus 3 local restaurants led by women) and a further estimated 800 fishermen and women (through fisher associations forming part of FEUECOPINAB) will benefit from increased public profile and associated fish sales.

Fifteen local fish sellers (including 8 females) at the municipal Abasto Campesino market were trained on hygiene and handling to improve fish quality. Subsequently, the fish market infrastructure was improved to improve hygienic conditions and practice at the sales point, in partnership with the two fish sellers associations, the campesino market association, municipal government and public health inspectors (SENASAG). The new facility, completed in February 2014, also guarantees 5 sales points for indigenous fishers who choose direct sales. The market is showing good public support and providing several lessons in market design. 91% of customers surveyed in 2014 considered the quality of fish being sold in the new market space as “good” or “excellent”, compared to 48% in the previous market (2012 baseline survey). Training in hygiene, fish handling, and recipe development was provided to eight local restaurants specializing in fish, including a new restaurant specializing in paiche dishes by one of the female entrepreneurs from the Grupo Arapaima.

With respect to aquaculture, a review of the development and current status of Bolivian tropical aquaculture (26 key informants, including 4 female) highlighted a substantial history of international funding over several decades with relatively little continuing results on the ground. This slow progress is





apparently due to a number of factors, including a focus on communal ownership and subsistence aquaculture for poverty alleviation (without adequate support for necessary social development or seed capital), inadequate technical extension support, institutional isolation and underfunding, and inconsistent government and international support. The project built technical skills and improved collaboration among existing NGOs, extension agencies and private enterprise within the sector through training of key actors, joint publication of better management practices and national development strategies, a new technical forum and spaces for networking, and co-sponsoring the First Bolivian International Aquaculture Symposium. The project collaborated with a regional NGO (CEPAC) to provide training for promising female-led aquaculture initiative, including a farmer-led research experiment to test improved aquaculture protocols for more efficient returns and contributions to nutrition and livelihoods. The introduction of polyculture with sabalo (*Prochilodus nigrans*) improved income and home fish consumption in the pilot project for 6 families supported by the project and an additional 44 adopting the practice spontaneously (30% of fish farming families in the region). New training and research agreements were proposed with the Brazilian National Agricultural Extension and Technology Agency (EMBRAPA) and the FAO-supported Latin American Aquaculture Network (Red de Acuicultura de las Americas -RAA) that will contribute to further development of the sector, as will a follow-up research and training project with two indigenous universities (UNIBol Chimoré and Guarani) - who will co-lead the II Bolivian International Aquaculture Symposium in 2015. Early government resistance to the PPV project evolved into a very supportive partnership with CIDAB, the national-level governmental organization responsible for aquaculture development, and IPD-PACU, its institutional successor, as evidenced by joint publication of a policy document for national strategy for aquaculture and an assessment guide and protocol for development of native-species tropical fish culture. Finally, these documents and development proposals have been officially recognized in the newest government policies and associated recent announcement of USA\$. 10 million to support development of the fisheries and aquaculture sector nationally.

Significant advances in governance at both the national and local levels impacting fisheries and aquaculture were achieved by the project. A languishing proposed national law on fisheries and aquaculture was re-invigorated, carried through national level public revision with community stakeholders (in 3 major basins, as an initiative led by the regional fisheries federation FEUPECOPINAB) and presented to the Minister during the Aquaculture Symposium. The process, supported by the project with FEUPECOPINAB, involved 61 women and 285 men of the fishing sector, 12 politicians, 23 institutional authorities, 6 NGOs, 9 civil associations, and 32 extension specialists. This law will provide greater security, development capacity, and criteria for sustainability of fisheries and aquaculture practices and livelihoods, by better defining access rights, management strategies, and government support. This will affect 15,000 professional fishers directly, and an estimated further 30,000 who are involved in the fisheries sector throughout Bolivia, in addition to an as-yet unknown number of families who are involved in aquaculture. A complimentary bi-ministerial resolution to address introduced species in the Amazon, specifically paiche (*Arapaima gigas*), was developed during a project-led workshop and will help stabilize the contributions of this fishery to food security and livelihoods in the Amazon region, as well as contributing to reducing conflicts between rural indigenous and urban-based fishers. At the local level, resource regulations in indigenous territory were modified as a result of project lobbying, with the legalization of commercial fisheries and improved livelihoods for 13 fishing communities in the TCO TIM II, with 3900 direct beneficiaries.



Climate monitoring baselines in the Bolivian Amazon were analyzed for the first time through this project, with two new monitoring stations improving capacity for ongoing data collection. While extreme events remain unpredictable from this data, precipitation records (1946-2010) and temperature records (1967-2010) were used to predict limits to the range expansion of the introduced paiche and predicting vulnerabilities of fisheries communities and aquaculture plants to flooding and other climatic events.

Elements of greatest promise for scaling up to contribute to improved food security with fish in vulnerable populations of Bolivia are the paiche fishery and the small-scale aquaculture, together with the associated work on fish hygiene, handling, and marketing. These combine components of policy and technical advances during the project, as well as matching with new government initiatives and existing social networks.

## 2. Research Problem

Despite remarkable biological and cultural diversity and substantial natural resources, Bolivia continues to be South America's poorest country with significant pockets of poverty and food insecurity. This project proposed to enhance contributions of small-scale fisheries and aquaculture to poverty alleviation and food security in the Bolivian Amazon region through improved livelihoods, hygiene and fish quality improvements, and governance. Long-term regional climate patterns and vulnerabilities of fishing communities and fishery resources to the impacts of extreme climatic events were also investigated to contribute to the longer-term vision of sustainability.

The project approach included baseline research and subsequent development of locally-appropriate interventions involving different local, regional and national actors on priority topics (e.g. an improved fisheries value chain) and in ways that build a receptive environment towards positive development and lasting change (e.g. building stakeholder linkages, participative approaches, peer-learning, and improved baseline information for a data-poor region.) Overall, the project aimed to develop and test a model to support resilient livelihoods and food security based on the development of sustainable small-scale fisheries and aquaculture in the Bolivian context. This model, and its lessons learned, should be applicable to other parts of the country for families and communities engaged in fishing livelihoods and experiencing poverty and food insecurity, and provides information on enabling conditions for development processes that are of international interest, particularly in the area of female participation in fisheries livelihoods.

We found that food insecurity, childhood stunting, and associated health issues were significant in the rural regions of study area, despite overall high and diverse fish consumption. We also found that fisheries are key components of both rural and urban food security strategies (through both direct subsistence and indirect livelihoods pathways) with significant potential for improved returns. In the context of rural indigenous communities, fisheries present effective opportunities for overall community engagement and planning, and have high potential to contribute to improved nutrition through the identification of species with high micronutrient value and appropriate preparation methods, considering especially their potential for complementary infant and young child feeding. In the urban setting, fish has potential to contribute to



improved nutrition overall, where consumption levels are currently lower and markets are underdeveloped. Value chain analysis identified social factors as the main impediment to equitable returns from fisheries that could contribute to poverty alleviation, coupled with unclear and/or prohibitive governance policies. The project thus focussed on improving fisheries-based livelihoods, promoting fish consumption in the urban setting as part of market development, and using fisheries as an entry point to address hygiene and community development capacity. This also included several approaches to improving equity in the value chains through (1) development of a new production complex with a variety of value-added processing opportunities for the relatively new paiche fishery; (2) social and technical improvements to the value chain for native species fisheries; (3) creation of a women's productive group to develop value-added fish products, promote fish consumption, and develop female leadership; and (4) fish quality and marketing enhancement and infrastructure upgrades to a municipal fish market.

Thilsted (2012) reports on small bodied fish in Bangladesh that are particularly rich in micronutrients, easily accessible to women and children, and part of the stimulus of this project in Bolivia. A search for such cheap, small-bodied fish identified the armoured catfish buchere (*Hoplosternum littorale*), seasonally used in subsistence fisheries in the rural indigenous communities and traditionally eaten as a breakfast soup in the urban markets. Dried fish powders were also identified as a method for conserving nutritional quality of small fish, with good non-refrigerated shelf life and no spines, so suitable for feeding small children. However, this had not received social acceptance by the end of the project. Omega – 3 essential fatty acids, one of the key perceived benefits for eating fish, is generally low in tropical freshwater fish, but was surprisingly abundant in paiche. Paiche abdominal meat, considered of low market value, is high in fat and is thus also a valuable potential contributor to household food security of vulnerable populations. Increased consumption of this fish meat was demonstrated during the project in the community of Trinidacito. Improved preparation protocols and recipes were also pursued participatively in the communities and urban region to improve micronutrient provision through novel combinations of fish and other local ingredients, resulting in the publication of a cookbook.

In the pilot region where aquaculture initiatives were developed by the project, food security improvements with fish were more clearly associated with livelihood pathways than with improved home consumption, though increased local consumption of the fish produced by polyculture was reported anecdotally by project participants. This aspect of the project focussed on capacity building, empowerment, technology development, network building and governmental strengthening to help move aquaculturists from a subsidized poverty level to a more stable small-scale production. Small-bodied fish in the aquaculture ponds (hatchet-fish – *Trichopterus* spp.) were not found to be particularly high in micronutrients (using analysis of *Astyanax altiparanae* as a proxy Brazilian species) and not culturally accepted yet as food in Bolivia. The larger detritivorous native fish, sábalo (*Prochilodus nigricans*) were thus selected as a species with good cultural acceptance that could be added to a culture pond with minimal extra culture costs, provide potential extra income for the farmer, and improve pond environments.

Hydrological modelling, carried out for the wider Bolivian Amazon region based on historical data, was so far unable to detect any remarkable trends of climate change or predictive capacity for extreme events. Weather and water flow monitoring stations installed by the project, together with this analysis, will increase the predictive capacity. Past community responses to extreme events in the pilot communities in the project's Northern Amazon study region indicate that subsistence and increasingly, commercial



fisheries are critical elements of local resilience strategies, especially in communities with low access to alternate livelihood strategies (El Sur communities, for example.). The project also investigated potential impacts of new and planned hydroelectric developments in the region, demonstrating far greater influence than previously officially recognized. A baseline and proposed response strategies developed by the project will contribute to governmental policies and resilience strategies.

Relative to our overall objectives, the project has advanced considerably on baseline characterisation of the Bolivian Amazon fisheries and aquaculture environments with respect to food insecurity, achieved remarkable success on policy development for its sustainable and equitable management, and contributed significantly to new technologies (social and technical) for enhanced indigenous capacity to access the fisheries resources and associated improved returns to subsistence and livelihoods. Contribution to improving food security in Bolivia with fish can be most clearly identified as being an issue of improving livelihoods, both for fisheries and aquaculture, and substantial advances with respect to different approaches to this were achieved through strategies and technologies designed to promote more equitable value chains. While a variety of initiatives contributed to improved awareness of the nutritional contributions of fish, modes of preparation of fish in combination with a diversity of local ingredients, knowledge of hygiene, and knowledge of complementary infant and young child feeding with specific pilot groups, direct demonstration of the results. Demonstration of improved nutrition contributing to food security through increased fish consumption or micronutrient provision at a wider scale has not yet been possible.

### 3. Progress towards milestones

The milestones are ordered according to the associated Interim Technical Progress Report (ITPR) report number (ITPR 1.x) and corresponding Grant Agreement Milestone number (x.1) and contractually proposed indicators. Interim reporting dates were September 30, 2011 (ITPR report 1), March 2012 (ITPR report 2), September 2012 (ITPR report 3), March 2013 (ITPR report 4), October 2013 (ITPR report 5) and May 2014 (This report - Technical Report 6). Greater detail of results is presented in the Research Results section of this report.

#### ***Milestones from Interim Technical Progress Report 1 (September 2011)***

**1.1. Effective teamwork established (Indicator: Inception workshop report)**

**1.2. Monitoring and evaluation strategy and research proposal established and agreed (I: Document reporting on outcome mapping workshop)**

An inception workshop for the project was carried out in Bolivia in May 2011, in conjunction with an Outcome Mapping Workshop. Preliminary stakeholder maps, priority setting, gender strategy, advisory board development, communications strategy, decision making protocols, adaptive management strategies, conflict management, monitoring and evaluation strategies were discussed at the workshop (Appendix 6, ITPR Report 1). Outcome mapping was kept a main monitoring strategy throughout the project, culminating in a final OM report (Appendix 5, This Report ).

**1.3. Gender mainstreaming strategy (Indicator: Document outlining the gender strategy)**





Following the preliminary discussion on gender strategies in the inception and OM workshops, a draft gender mainstreaming strategy was developed by AS, and reviewed by WFT, and refined in a workshop for the combined project team (Appendix 8, ITPR 1; Appendix 38, ITPR 2). This work evolved primarily into a baseline gender research analysis of issues for females in the fishing communities of Northern Bolivia, which continued throughout the project and a report at its end. Complementary transformative elements were added to the project in the second year including (1) the establishment of a women's group in Riberalta to develop value-added fisheries products, promote fish consumption, and female leadership; (2) a first regional action-research meeting with women from fishing representatives from urban and rural communities to discuss and appreciate the role of women in fisheries; and (3) training of 6 project team members in an 80-hour online course on gender and public policy in Latin America; (4) contributions to a social strategy for value-chain improvements with pilot rural indigenous fishing communities that included a transformative element for improved gender and social equality mainstreaming; and participation by project representatives in a IDRC-supported workshop on gender mainstreaming in South Africa.

#### **1.4. Value chain analysis strategy**

A strategy for quantitative evaluation of the fisheries value chain was initiated by FA in July 2011, with inputs from Oriana Almeida (Federal University of Para, Brazil) later that year. A series of Integrated Participatory Value Chain Analysis (IPVCA) workshops were initiated in November 2011, by John Wojciechowski (WFT) and an extended Bolivian team, resulting in an extensive strategy document for a more qualitative, action-research analysis and associated interventions (Appendix 13, ITPR 1). This process of workshops and related community work continuing through November 2013.

#### **1.5. Household survey proposal**

An extensive household survey for food security, maternal and infant health, and fish consumption was carried out by the project. Agreeing on objectives, developing the survey, gaining ethics approval, and assembling the necessary teams was a long and complicated process. Nevertheless, an initial plan was completed by the end of the first reporting period (Appendix 12, ITPR 1).

#### **1.6. Communications strategy**

A draft communications strategy for internal and external communications tools and approaches was developed in July 2011 (Appendix 9, ITPR 1), including the launch of a project web-page ([www.pecesvida.org](http://www.pecesvida.org)). This plan continued to evolve during the project, including a change in the main communications person in 2012 and a subsequent enhanced focus on external communication. Internal communication was facilitated by pragmatic email and Skype conversations as needed and partner-specific internal organizational tools.

#### **1.7. Environmental Assessment**

Discussions on the need for an environmental impact assessment continued throughout much of the project. At the end of 2013, legal advice to the IDRC indicated that such an assessment was not needed, once details of infrastructure contributions by the project became clearer. Funds reserved for this activity were allocated to other project areas, split between the partners.

### ***Milestones from Interim Technical Progress Report 2 (March 2012)***

**2.1. Improved understanding of the current management structure of Bolivian fisheries in the Amazon (Indicator: Report on stakeholders, fishing rights, access rights, and current practices in lakes in the northern Amazon, including input from technical missions to Canada and Brazil and Brazilian inputs)**



In coordination with the governing indigenous organizations for the region (CIDOB, CIRABO, CIPOAP), three pilot study areas within the indigenous territory (TCO) TIM II were selected. Local fisheries resource access and use patterns were mapped including a detailed revision of the formal and traditional access rights in the pilot zone (Appendix 18; ITPR 2), as well as a comparative study of the fisheries legislation in Peru, Brazil and Bolivia (Appendix 20; ITPR 2). Daily monitoring of fisheries in rural communities was carried out over a period of three months (prepared for publication by Argote *et al.*, 2014 at the end of the project; Appendix ), whereas urban fisheries were monitored daily for a full year (prepared for publication by Coca *et al.*, 2014). The participation of F. Carvajal (FA) in a Coady Institute course on co-management at St. Francis Xavier University in Nova Scotia, Canada, and participation by several project representatives in conferences in Brazil and Peru in 2011 and 2012 were also key elements contributing to design of management strategies.

## **2.2. Improved understanding of the current socio-economic structure of the Bolivian fishing sector in the Amazon region (Indicator: Report on value chain and market analyses in the Bolivian Amazon, including specific gender and ethnic components)**

Participative Integrated Value Chain Analysis (IPVCA), utilized in this project, included the identification and mapping of stakeholders and an analysis of the bottlenecks in the fisheries value chain, summarized in Appendix 8 of ITPR 2. The status of hygiene and fish manipulation was also documented (see Appendix 11; ITPR 2), which formed the basis for subsequent interventions and training in the project, and finally in the participatory implementation of an urban market complying with sanitary regulations. Complimentary funding by PIEB allowed for documentation of the contribution of paiche to urban fisheries (Appendix 10; ITPR 2) and, in the second year, the publication of a book (Coca Méndez *et al.*, 2012), which contributed to the subsequent creation of the community-based paiche processing initiative in Trinidacito. The differential contribution of men and women was considered in all these studies, to build a basis for interventions that mainstream gender equality. A more specific analysis of gender issues in fishing communities was finished at the end of the project (MacNaughton *et al.*, 2014).

## **2.3. Improved understanding of the dynamics of the aquatic environment in the northern Bolivian Amazon and their potential sensitivity to climatic changes (Indicator: Baseline climatology/hydrology report for the northern Amazon, including seasonal discharge patterns in rivers and streams of the northern Amazon and Empirical climate trend projection (ETP) report)**

Historical pluviometric and hydrological time series of the whole Bolivian Amazon basin provided information on daily, seasonal, inter-annual and multi-annual climatic variability, reported on in Appendices 12 and 13 of ITPR 3. An analysis of this data was completed and will be published by Molina *et al.* (2014). This analysis informed the development of a temperature model predicting expansion of paiche in the Bolivian Amazon (Van Damme *et al.*, 2014) and contributed to a baseline of factors potentially impacted by Brazilian hydroelectric development on the border with Bolivia (MRE-MMAyA, 2014).

## **2.4. Improved understanding of current nutritional conditions of Bolivians in the project region and consensus amongst partners on strategies to help improve food security with fisheries and aquaculture (Indicator: Report on baseline nutrition analysis for two locations in the Bolivian Amazon basin- Riberalta and second location to be defined- including analyses of key fish species and recommendations on strategies to improve food security and recommendations for follow-up surveys to monitor progress)**

A household survey on nutrition and health was developed and implemented collaboratively in Oct. 2011 and March 2012. Four strata were sampled in urban and peri-urban Riberalta, in addition to 15 rural communities with different levels of access to fish resources and, ethnicity, poverty levels, and migration. The survey assessed food security indicators and their correlates, as well as participation in fishing



livelihoods and fish consumption. Appendix 14 of ITPR 3) provided a summary of preliminary results and recommendations for interventions, while a full analysis was completed by the end of the project in a thesis (Baker-French, 2013). A discussion on ways to improve food security through fisheries and aquaculture led to a reinforcement of the decision to focus on interventions that improve livelihoods and integrate with associated needs of a broader definition of food security (e.g. health and hygiene). Training in the survey process allowed FA to adapt the survey approach to another study in the Pilcomayo river basin, in the south of Bolivia (published as Pérez et al., 2014). Analysis of nutritional quality of different fish species faced some logistic and budgetary challenges, but resulted in useful training, novel method development and interesting results. Analyses of several Amazonian fish species were carried out through a training period of Tamara Perez (FA) at the Federal University of Rio de Janeiro (UFRJ), analysis of paiche at the UMSS in Bolivia, and analysis of fish powders of Bolivian fish in Canada (Carolsfeld et al., 2014).

### **2.5. Conformity with requirements for Environmental Assessment studies (Indicator: Finalization of the internal and independent environmental evaluations, and integration of the recommendations in the project methodology)**

Discussions on the need for a specific environmental impact assessment (EIA) continued throughout much of the project, with an eventual decision that a specific EIA study was not necessary. Nevertheless, environmental sustainability continued to be a cross-cutting theme throughout the project.

## ***Milestones from Interim Technical Progress Report 3 (September 2012)***

### **3.1. Improved understanding of vulnerability of communities to hydrological impacts of climate change (Indicator: Report on hydrological model simulation under current and futures scenarios, including vulnerability analysis with emphasis on the identification of individuals and communities most vulnerable to impacts of climate variability and extreme events in the northern Amazon)**

In this reporting period, a hydrometric station was set up in Riberalta to measure water levels, and a meteorological station was set up in the town of Chivé, permitting improved on-going climate monitoring for the region, development of improved change models, and contributing to the Early Warning System which SENAMHI (National Service of Meteorology and Hydrology) is implementing at the national level. The analysis of historical precipitation and temperature data was reported in Appendix 4 of ITPR 2. The hydrological simulation did not show clear-cut long-term tendencies, but showed increasing evidence of cyclical occurrence of extreme inundation events that affect riparian indigenous fisheries communities. Vulnerability of fishing communities in the northern Bolivian Amazon to extreme climatic events was studied through a series of workshops, whose results were reported in Appendix 3a (ITPR 4). Inundation data were correlated with vegetation structure, and published in a book chapter (Zambrana *et al.*, 2014), which will facilitate estimation of flood patterns from aerial photo or satellite images. This is being pursued further through an ELAP (Emerging Leaders in the Americas Program)-funded internship of a Bolivian graduate student at the University of Victoria on spectral analysis of satellite images.

### **3.2. Improved understanding of sensitivity of the fisheries sector to outside perturbations, including climatic, political and economic factors (Indicator: Report on resilience and adaptation of the fisheries sector to extreme events and climate variability, including an assessment of sensitivity to political and social factors, other development pressures. Reflects outcome of better understanding and assessing of risks and mitigation strategies).**

Research started in the 2<sup>nd</sup> year and continued to the end of the project. Investigation of the physical, social, organizational, and institutional vulnerabilities of the rural communities was carried out, to help





build adaptive strategies for changes, including climate change. Five participatory workshops were carried out with 54 people in 5 pilot fishing communities of the TCO TIM II to explore past and current adaptation strategies to climate extremes, environmental variability, and socio-political development factors. Reports were included as Appendices 3 in ITPR 4; and 6 in ITPR 5. Results available from this activity so far have informed a regional natural resource management plan currently being developed with the indigenous sector in the Bolivian Northern Amazon (comprising four indigenous territories) in cooperation with the Bolivian NGO (FAN), including also municipalities and indigenous leaders. It is foreseen that key elements of this regional indigenous development plan (including strategic plans for conservation and development of the wood, brazil nut, fisheries, agriculture and cattle sectors) be incorporated in future municipal action plans and budgets. Many of the insights were included as book chapters in MRE-MMAyA (2014) (e.g. Zambrana et al., 2014; Van Damme et al., 2014). A scientific publication is being prepared by Martinez et al. (2014). The lead author on this publication is currently on an ELAP internship at McGill University to enrich this work.

### **3.3. Proposal for improved fisheries lake management developed by partners and stakeholders (Indicator: Fish biology review in lakes & proposal for improving fisheries and lake management for paiche production, informed by technical missions, mini-conference and training workshops and partnerships developed through these activities)**

The development of lake management strategies in the study area was informed by participation and exchange of ideas in a variety of meetings of experts, conferences and working groups, including: a seminar hosted by the “Instituto del Bien Común” in Iquitos, Peru (September, 2011), a project-funded workshop on paiche management in Bolivia and training on stock assessment of paiche with Bolivian and Brazilian practitioners (November 2011) (Appendix 5; ITPR 3), a mini-symposium on paiche management in Manaus, Brazil (August, 2012) hosted by the Instituto Mamirauá, a study on a previous failed processing plant in the indigenous Portachuelo communities of the project study area, funded by CARE (Appendix 3; ITPR 3), and participation by F. Carvajal (FA) in a certificate course on Community-Based Natural Resource Management (Coady Institute, NS) and technical visit and visit to Canadian indigenous groups working on community-based fisheries management (September 2012), a working group meeting on conservation and stewardship in Latin American Small-Scale Fisheries in Curitiba, Brazil (August 2013), a special session on social approaches to fisheries stock assessment at the Canadian Association of Geographers Conference in St. Johns NFLD (August 2013).

Biological research contributing to lake management models is being published by Argote et al. (2014), focused on the paiche – an invasive species, but a cornerstone of impacted lagoon ecosystems and fisheries. This was supplemented by preliminary work of Bolivian researcher F. Carvajal at the University of Victoria (Canada) on population genetics and lagoon system modeling (August – October 2013). A counting survey for paiche produced an estimate of paiche density in 10 lakes, and stock assessment of paiche in Lake Mentiroso of the Trinidacito community (Appendix 4.1.8; this report). These studies indicate that existing informal community level management protocols are probably sufficient to provide sustainability at the current levels and technologies of exploitation. This discussion informed a specific workshop organized in the final stage of the project to develop national policies on paiche fishing, resulting in a bi-ministerial resolution on paiche management (Appendix 4.1.11; ITPR 5; also see section 3.4).

### **3.4. Improved understanding by partners and stakeholders of fisheries management options relevant to the Bolivian situation (Indicator: Report on fisheries mini-conference)**

The increased recognition of importance of paiche to Bolivian fishing in the Amazon, indicated that this issue alone would be a better focus of the increasing level of institutional interaction and influence of the project at the national level, than a general fisheries conference. Planning and lobbying for this workshop





continued throughout much of the project, with implementation in September, 2013 (Appendix 3; ITPR 4). The project also participated actively in a related local mini-conference on the impact of hydropower dams on fish diversity and fisheries in November 2013, organized by the L'Institut de Recherche pour le Développement (IRD) and the Unidad de Limnología y Recursos Acuáticos (ULRA) of the Universidad Mayor de San Simón (UMSS).

**3.5. Proposal for aquaculture development discussed and established by partners, based on an improved understanding of the current status, strengths and challenges of Bolivian aquaculture (Indicator: Report on stakeholder mapping and technological review of current aquaculture practices; development proposal and draft “Best Management Practices”)**

Evaluation of the current status of tropical aquaculture in Bolivia, and of impediments to its development, was reported in Appendix 6 of ITPR3, presented at the Canadian Aquaculture Conference, and prepared for submission to the World Aquaculture Journal for publication (Carolsfeld et al., 2014). A technical working group with various aquaculture stakeholders was set up (Appendix 7; ITPR4). These initiatives led to re-definition of the strategy of the PPV project on aquaculture, including an experimental contribution to an existing, promising, aquaculture project of a third partner NGO (CEPAC) (see Appendix 8; ITPR 3), training of key stakeholders, and elaboration of proposals for a development strategy and Bolivia-specific aquaculture practices (protocol for pacú-rearing). These multi-authored documents were presented and validated during the 1<sup>st</sup> Bolivian Aquaculture conference co-organized by the project and published at the end of the project jointly with the IDP-PACU of the national government (MDRyT-VDMA-IPD PACU, 2014a, 2014b). ..

**3.6. Project partners and fisheries stakeholders informed and capable of improving fish processing, handling for increased economic and nutritional returns. (Indicator: Review of Bolivian situation of fish processing and handling and proposal for improvement, including report on technical missions to and from Brazil and Canada and Argentinian training, experiments, draft best management plans, and proposals for supporting infrastructure and programs)**

The strategy for improved handling and processing formed part of the wider Integrated Participatory Value Chain strategy and associated interventions to improve connectivity and returns at different levels of the value chain. This cross-cutting characteristic was reflected during the three years of the project in a variety of activities. Based on a technical review of practices in fish handling and hygiene in the region carried out by specialists from the Argentinian NGO PROTEGER (appendix 9, ITPR 3), and the understanding that municipally regulated price controls prevent rewarding higher quality with higher prices, the project team decided to work, with strategies for improved sales, reduced wastage, customer education, regulation to foster implementation of improved fish handling practices, and the promotion of value-added products. The latter resulted in the establishment of three micro-enterprises lead by women selling fish fillets, fish hamburgers and fish steaks. Technology for fish leather and handicrafts made of fish scales lead to a fourth microenterprise established legally and several individual artisans. A new fish market, as part of the Campesino Abasto market in Riberalta, was built through a cooperation agreement with the municipality, and improved considerably the conditions for improved fish handling. We believe that improved fish availability and handling (and in the future also fish processing) can be encouraged by increased consumer demand, which can be influenced by fish consumption promotion campaigns. The strengths and weaknesses of this approach as well as the role of the regulatory agencies are discussed in a technical review and social strategy document prepared by WFT (Appendix 3, ITPR 5).

**3.7. Improved community capacity and social capital to pursue supportive proposals for fish processing and handling and for autonomous development (Indicator: Participative development of 3 proposals for supplementary funding or benefits, with communities; Report on Social Strategy for implementing**

**improved handling and processing practices, including evaluation of changes in social capital & stakeholder maps)**

At the community level, the capacity to do economic planning and formulate projects was enhanced by an Integrated Participative Value Chain Analysis including a component of economic feasibility analysis (EVE), based on a model adapted from the Brazilian organization CAPINA in an earlier WFT project. Five proposals were developed jointly with fishing communities of El Sur through this process to improve value chain linkages and returns to communities), one proposal on a community paiche processing plant was developed and implemented with the Trinidacito community and a joint proposal by these communities, fish sellers, and the FEUPECOPINAB was presented to the municipality to revise pricing structure for fish, based on existing low returns to producers prices.

In addition, several proposals were developed in a participative way and/or with community input and submitted to a variety of external funders (Interamerica Foundation, Fundo Conexión, Tinker Foundation, MacArthur Foundation, EMBRAPA-Marketplace, IDRC, ELAP) for complementary work or training on fisheries and aquaculture, with an approximate 30% success rate. FAUNAGUA signed an agreement with the Ministry of Foreign Affairs to prepare a base line study in cooperation with fishermen organizations, in part financed by WWF, which, with fishing community participation in monitoring, will help assess future impacts of dams in the Madera river basin. This study, making use of the fisheries biology, value chain and nutrition survey data from the PPV project, was published by the Ministry (Appendix. 2, this report ), acknowledging the different financing sources. FAUNAGUA also signed a contract with the national institute for agro-forestry research INIAF to refine management strategies for paiche (2014-15). Finally, FAUNAGUA was selected to carry out a project on fisheries and food security in the Pilcomayo river basin of southern Bolivia, financed by the IUCN-NL, based on learning from the IDRC project. Two proposals to the Emerging Leaders in the Americas Program (ELAP) were also successful, placing Bolivian graduate student interns from the project at UVic and McGill.

***Milestones from Interim Technical Progress Reports 4 (March 2013) and 5 (October 2013)*****4.1./5.1. Improved social capital amongst Bolivian fisheries and aquaculture participants and stakeholders, including supportive policies and partnerships and improved gender equality (Indicator: Final outcome and stakeholder mapping report)**

Outcome Mapping was used in planning and monitoring in the project. During the third year, an outcome mapping review workshop with project technicians was carried out in August 2013, followed by a final Outcome Mapping workshop, with local beneficiaries and stakeholders, in Riberalta (November, 2013). The overall outcome mapping process was published by AS (Appendix 5, this report ). The conclusions of this workshop included the observation that social capital of participants was significantly enhanced, with new knowledge and capabilities as well as changed perceptions and attitudes, though permanent changes in practices were not yet evident. Also, the facilitator found that the networking and trust building between project participants was very noteworthy, attributed to the participative, joint learning approach taken by project technicians.

**4.2./5.2. Increased food security through improved fisheries and aquaculture practices (Indicator: Report on exit survey of nutritional analysis, including effects of improved fisheries and aquaculture) (40%)**

The project was not long enough to show demonstrable direct changes in improved nutrition and food security, but changes in proxy indicators of livelihoods *have been reported elsewhere* in this project. Indicators for improved livelihoods and knowledge and practices associated with health and nutrition were



documented within groups directly affected by the project, as were changes in social capital and policies that will lead to continued improvement in food security through livelihoods pathways (see, for example, next section). Exit-interviews and targeted surveys of intervention participants were implemented in November 2013 and March 2014 (with some disruption due to the extreme flooding event affecting the entire project region during this period). The project team also participated in the elaboration of a municipal plan for sustainable livelihoods and development in indigenous territories in the Northern Bolivian Amazon. This plan focuses on four productive value chains, one of those is fisheries and aquaculture. (see next section).

\*The exit-survey, planned for November 2013, focused on improved knowledge and behaviours of participants from pilot food security interventions (see Activities section), was delayed and then only partially completed because of floods.

\*The project team cooperated with FAN in the elaboration of a municipal development plan for indigenous territories in the northern Bolivian Amazon. This plan focuses on four productive value chains, one of those is capture and culture fish.

**4.3/5.3. Improved public policies that promote food security and participative processes that support their implementation (Indicator: Report on 2 new public policies – or drafts – for fisheries and aquaculture, including direct contributions by the project team to draft policies and promotion of participative processes) (100%)**

The project made considerable progress improving public policies supportive of the fisheries and aquaculture sector. At the national level, the project managed to re-initiate a stalled Fisheries and Aquaculture Law proposal by facilitating a participative review process, and bringing it to the point of parliamentary review. The Regional Federation of Fishers, Aquaculturists and Fish Sellers of the Northern Amazon (FEUPECOPINAB) was supported by the project in consolidating its membership to include local associations and indigenous groups that were previously excluded from the review process, and co-facilitated the participative processes in the 3 major basins of Bolivia, and finally delivering the participatively revised proposal of the law to the Minister of Land Development (MDRyT) at a national conference on aquaculture that was co-sponsored by the project.

This law clarifies access to fisheries resources and sets criteria for management processes (appendix 7, ITPR 5). For aquaculture, the Law clarifies access to water and areas for use in aquaculture, as well as providing incentives for aquaculture development. The process has been very well received, and through the substantial organizational and networking will contribute not only to the improved livelihoods, but also equitable implementation and enforcement.

Introduced fish species are not covered by the fisheries law, even though up to 80% of the commercial fisheries' catch in Riberalta now consists of the introduced paiche. To deal with this, the project promoted a workshop with government, fishermen, and other stakeholders on the policies for fishing and aquaculture of paiche, reaching consensus on a management strategy for this species in the Bolivian Amazon basin, including access rights to provide returns to indigenous communities. The proposed bi-ministerial resolution was presented to the Minister of Environment and Water and to the Minister of Rural Development and Territory (appendix 4.1.11, this report).

At a regional level, in the TCO TIM II, fishing for commercial purposes was not allowed by local regulations. The project lobbied successfully to have this livelihood option ratified by the TCO indigenous government (appendix 4.1.11, this report 6).

At the municipal level, an important indicator of supportive policies in response to lobbying by the project and its partners, was the designation of 29<sup>th</sup> of June as "Fishermen's day" for the municipalities of Riberalta (18/2012-2013 del 30 de Julio 2012) and Porvenir (5/2012 del 25 de Junio 2012), with preparation for





departmental designation by the Department of Pando (Appendix 7, ITPR 5). The establishment of Fishermen day at national level is also foreseen in the draft Fisheries and Aquaculture Law (Art. 86).

**4.4./5.4. Improved public knowledge and practice in fisheries and aquaculture (Indicator: 10 publications and protocols on best practices in fisheries and aquaculture, including extension materials and educative publications)**

The project team designed and implemented a communication strategy that promotes knowledge and the introduction of good practices in the sector, including a book on fishing, a cooking book, 11 banners, a variety of post cards, posters and leaflets (listed in Appendix 2, this report, with full versions of selected ones in Appendix 4)

Apart from these products, the project webpage [www.pecesvida.org](http://www.pecesvida.org) is revised and updated monthly. The results of the various baseline research, including fisheries data collection, household survey of 2011-2012 and subsequent workshops were summarized and distributed to participating communities.

**4.5./5.5. Improved public and scientific knowledge of Bolivian fisheries and aquaculture and on the enabling environment for development (Indicator: Publications on Bolivian fisheries and aquaculture, including scientific papers – including 3 publications by each partner) (40%)**

Project publications include (a full list is presented in Appendix 2, this report):

\*Books (Coca Méndez et al., 2012; Herrera Sarmiento, 2014)

\*Book chapters (Van Damme et al., 2013; Salas et al., 2013; Carvajal-Vallejos et al., 2013; Zambrana et al., 2014; Argote et al., 2014; Van Damme et al., 2014; Rico Lopez et al., 2014; Pérez et al., 2014; Macnaughton et al. (abstract accepted – chapter in prep gender chapter); Wojciechowski et al. (abstract accepted – chapter in prep TBTI book); Macnaughton et al. (draft abstract accepted – chapter in prep TBTI book); Carolsfeld et al. (draft abstract accepted – chapter in prep)

\*Journal publications submitted (Van Damme et al., submitted; MacNaughton et al., submitted)

\*Journal publications on verge of submission (Carolsfeld et al., 2014; Wojciechowski et al., in prep.; Molina Carpio et al., in prep.; Paola & Molina Carpio et al., in prep)

\*Presentations at conferences (Baker-French et al., Proc. Int. Conf. on Nutrition, Spain, 2013; Baker-French et al., Proc. Health & Wellness 2013, São Paulo Brazil; Carvajal-Vallejos et al., Proc. Meeting Can. Assoc. Geographers, St. John's Newfoundland, 2013)

## 4. Synthesis of research, activities and results

Figure 1 outlines the project's adapted strategy to address the overall objective "to improve food security and livelihood opportunities for the more vulnerable, particularly women and indigenous groups, in the Bolivian Amazon through socioeconomically optimized value-chains of fisheries and small-scale aquaculture". The activities and results presented are grouped and reported on as they relate to the five specific objectives of the project. Appendix 3 provides quantitative and qualitative information on specific indicators of results and (local) impacts. Published project outputs are provided in Appendix 2, this report.



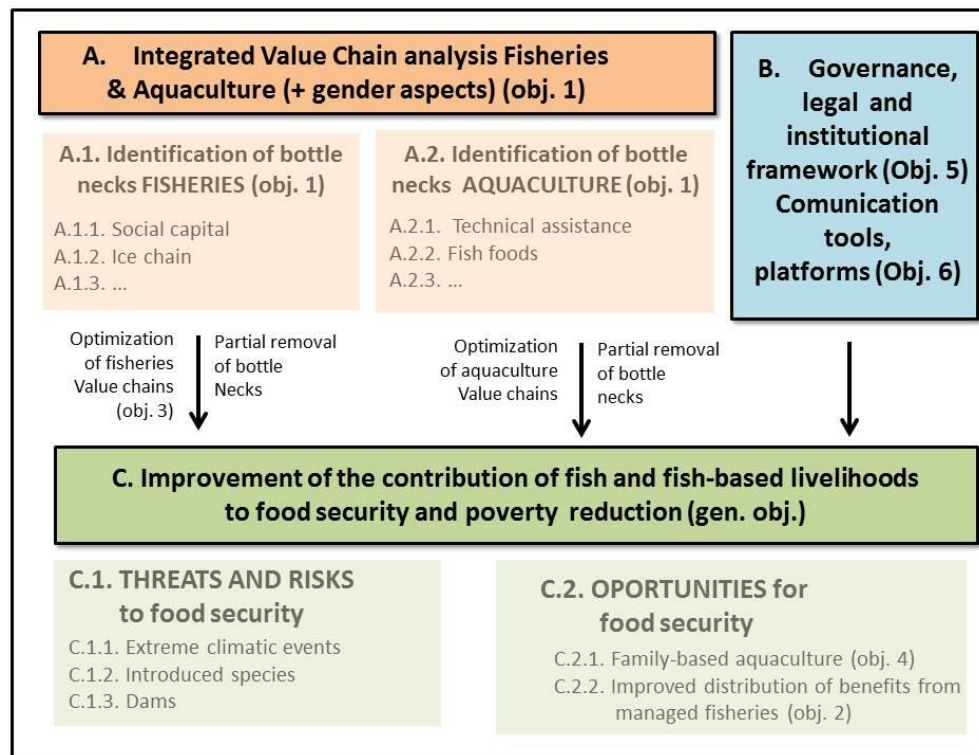


Figure 1: Logic of PPV project interventions

## 1. Integrated Value chain analysis fisheries & aquaculture

### 1.1. Objective 1

To identify stakeholders and analyze bottlenecks for fish value chain development in the Bolivian Amazon with a particular emphasis on nutritional contributions (particularly micronutrients) and fish markets.

### 1.2. Short summary of activities

In the first year of the project, fisheries baseline data were collected through a quantitative analysis of fish landing volumes and sales (by monitoring 1,963 shipments of fish from the indigenous and peasant communities within the Riberalta region). Fisheries value chains were evaluated through Integrated Participative Value Chain Analysis workshops and more traditional economic analyses. Workshops identified bottle necks both in the fisheries and in the aquaculture value chains. Special emphasis was given to evaluation of fisheries outputs and socio-economic challenges of getting the fish to the market. A survey of hygiene and fish handling practices was carried out to characterise fish quality from capture point to final sale in the fish markets. During the second year of the project, analysis of results continued, culminating in the publication of a book about the regional fisheries value chain and various specific publications on the



production link of the value chains. The evaluation of the nutritional value of Bolivian fish aimed at the identification of sources of key micro-nutrients.

### 1.3. Summary of main results

#### *Fisheries and Aquaculture value chains*

Fish landings in the Riberalta region show considerable seasonal fluctuation, associated with lower availability during high water (October –March) when fish are dispersed in flooded areas and markets are harder to reach, as well as with lower participation in fisheries due to more lucrative harvesting of wild Brasil nuts (*Bertholletia excelsa*). The highest volumes were recorded in the months of July and August, with an approximate figure of 12.000 kg/month, whereas the lowest volumes recorded were in February, close to the 4000 kg/month mark. A detailed economic analysis (Rico López *et al.*, 2014; Rico López *et al.*, en prep.) revealed that the annual contribution of the North Amazon fisheries sector to the Gross Internal Product is approx. US\$ 1 200 000, where 498 persons are employed and 4274 day wages are paid. Daily income by fishers is generally lower than is the case in other productive sectors in the area, with indigenous fishers harvesting native species earning an average US\$ 105/month (calculated in project IPVCA workshops), less than half the current national minimum wage for Bolivia.

An overall description of the fisheries value chain is reported in Coca Méndez *et al.* (2012), with a number of more specific publications including information about the production link of the value chains (Rico López *et al.*, 2014a; Argote *et al.*, 2014; Van Damme *et al.*, 2014a; Macnaughton *et al.*, 2014a; Wojchiechowski *et al.*, 2014). A value chain analysis was also formulated for aquaculture, based on key informant interviews (published in MDRyT-VDRA-IDP PACU-PPV, 2014a). The fisheries value chain analysis paid particular attention to the key role played by women, especially at the level of the commercial value links and for family food security. A detailed description of gender aspects is provided in Appendix 4.1.12 (this report) as well as in Macnaughton *et al.* (2014d).

#### *Bottle necks in the fisheries and aquaculture value chains*

Some of the main issues and bottle necks in the fisheries and aquaculture value chains, identified through participatory processes, are presented in Tables 1 and 2, respectively. The participative nature of this process contributed to the strengthening of local partners and increased responsibility in resolving the bottle necks themselves. Three coordination bottlenecks faced by the value-chain were identified. The first challenge concerned the low level of social capital. The second challenge referred to the magnitude of passive demand, ranging from decent housing and electricity to poor health and education services. Finally, there is a low level of inter-institutional dialogue. The same authors provided a detailed description of bottle necks to income generation (“rent-seeking”), including the significant unequal distribution of benefits between different actors in the chain (middlemen vs fishers). (see Wojchiechowski *et al.*, 2014).



**Table 1:** Some of the bottle necks in the fisheries value chain in the northern Bolivian Amazon, defined through a participatory process, from the viewpoint of the different links in the value chain link (Rico Lopez et al., 2011; Wojchiechowski et al., 2011, 2014)

**Bottle necks identified by indigenous and peri-urban fishermen**

- \*Lack of communication, unity and dialogue between the different actors of the fisheries value chain
- \*Limited access to financial support and micro-credits created few possibilities of investment in fishing material and boats and created a high economic dependence on wholesalers.
- \*The sector is not organized and therefore largely invisible and its contribution to food security is not recognized

**Bottle necks identified by salesmen and fish retailers**

- \*There is not usual to pay cash to rural fishermen (by retailers), to urban fishermen (by wholesalers), to wholesalers (by supermarkets)
- \*Fish markets do not offer the right conditions for fish selling, leading to low fish quality and consumer dissatisfaction
- \*Salesmen and fish retailers are not organized and operate in a legal vacuum

**Bottle necks identified by public actors**

- \*There is no legal framework for regulation of fisheries activities (e.g. access to fishing grounds and to fish resources)
- \*There is no communication between public actors and the direct links of the fisheries value chain (indigenous fishermen, peri-urban fishermen, wholesalers, retailers, transporters)
- \*The fisheries do not receive financial support.

**Table 2:** Main weaknesses and bottle necks of the aquaculture fish chain (based on MDRyT-VDMA-IDP PACU-PPV., 2014)

- \*The aquaculture sector is not organized nationally resulting in low level of representation and low level of interchange of information, opportunities and lessons learnt
- \*The limited access to water for aquaculture limits the development of the sector
- \*The geographic isolation of aquaculture production units makes it difficult to provide efficient technical support
- \*There is a lack of integrated planning for the promotion of the aquaculture sector by municipalities, provinces and the national government
- \*Fingerling production and fish food do not match the local demand both in terms in quantity and in terms of quality.
- \*The small fish farmers do not have ready access to the market of goods and services due to their low availability and high cost
- \*There is a lack of procedures and tools that guarantee fish production under unpredictable climatic conditions (cold shocks and variable precipitation levels)
- \*Financial support for fish farming is inadequate or inaccessible for fish farmers.
- \*The ice chain is not developed and does not provide optimized services to the sector
- \*Lack of entrepreneur mentality (on a family, community or company scale)

*Nutritional value of fish of the Bolivian Amazon*

Results of proximal analysis of the fish in the current study indicates that the Amazonian fish are generally “low fat”, with a tendency to lower lipid levels in characids compared with catfish. Paiche was also found to be primarily a very lean fish in the back meat, but had significant, unevenly distributed lipid deposition in the abdominal meat. Fatty acid analyses confirmed the general results that the Amazonian freshwater fish are relatively high in saturated fatty acids and w-9 monounsaturated fatty acids, with a low w-3 to w-6 ratio of the “essential” poly-unsaturated fatty acids (PUFA). High ratios of these two PUFA, 1 or greater, are considered particularly beneficial for the human diet. Surubi catfish (*Pseudoplatystoma* sp.) had one of the best ratio of these PUFAs amongst Amazonian fish, close to 1. The catfish mapara. (*Hypophthalmus*) also



stands out as an Amazonian genus with relatively high w-3 levels and w-3/w-6 ratios of over 1, suggesting that there may be other species in the Bolivian fauna that have beneficial ratios of these PUFA. Paiche, taxonomically unrelated to catfish, also has a good ratio of these two essential fatty acids, with the abdominal meat a particularly rich source that is generally of lower price or discarded.

Mineral analysis was carried out primarily on fish powders, with the exception of the paiche analysis. Calcium was high in most of these powders, as could be expected in powders with bone residue. The boneless fillets and viscera of some species, such as the buchere, nevertheless also seem to be good sources of calcium. Of the fish analyzed, the armoured catfish known as buchere (*Hoplosternum littorale*) stands out as a good source of iron, important in combatting anemia. Vitamin analysis was also carried out on fish powders. Retinol (Vitamin A) was found in appreciable amounts in the fish powders of buchere and of piraña (*Serrasalmus sp.*), but primarily in the A2 form, specific to freshwater fish and about 40% as effective as retinol in humans.

As a conclusion, buchere is a particularly interesting, low cost fish with potential to provide micronutrients to vulnerable communities. Abdominal meat from the paiche is an accessible source of w-3 essential fatty acids. Fish powders provide a practical vehicle high in protein and micronutrients that can extend the utility of fish for consumption with unrefrigerated storage, as well as providing a new mechanism for informative nutritional data of hard-to-reach fish fauna.

## 2. Improvement of the contribution of culture-based fisheries of paiche to food security

### 2.1. Objective 2

\*To improve the contribution of culture-based adaptive fisheries management to food security, household income and value chain participation of women and indigenous groups in a pilot zone (Northern Bolivian Amazon)

### 2.2. Short summary of activities

“Culture-based” within the context of this project refers to management of lagoons to primarily optimize paiche (*Arapaima*) fisheries. Paiche is a non-native species of high commercial value that potentially has deleterious impacts on the native ecosystem. Effort was thus focussed on understanding the impact of paiche on lake ecosystems (including impacts on native fish), local income, indigenous livelihoods, and sustainable fishing estimates with a focus on one pilot community practising almost exclusively paiche commercial fisheries (Trinidadcito) while the fisheries for native species was considered in another set of indigenous communities (el Sur communities). Specifically, the following studies were carried out:

- A study on how aquatic ecosystem structure & functioning affects paiche colonization success and modelling further expansion of the species based on temperature sensitivity;
- Surveys to estimate the relative abundance of paiche in a variety of lakes, using a Brazilian direct counting technique adapted to Bolivia for use with local fishermen.
- Development of elements of a pilot community-based lake management strategy
- National-level workshops for a multi-stakeholder consensus on paiche management strategies in the Bolivian Amazon, including lobby and development of regulations for: a) a social and legal framework for





paiche management at a regional scale, informed by local experiences; b) strengthened indigenous policies and regulations to allow for sustainable exploitation of introduced fish resources (see also objective 6).

- Development of an experimental community-based fish processing unit that allows for improved community benefits, higher quality products, and a diversified value chain that makes use of paiche by-products such as leather and scales.
- Exploration of adaptation strategies of fisheries communities to climate variability and flooding (see also objective 6)

## 2.3. Summary of results

### *Ecosystem and fisheries studies*

Studies carried out on the diet of paiche (Villafán, 2014; Aguilar et al. 2014 ) showed that the fish in Bolivia is eating primarily small detritivorous fish, as well as shrimp and plants (either intentionally or accidentally), but not larger fish. In this sense, with respect to impacts on fish of interest to fisheries for humans, paiche is competing with humans for small fish used in subsistence fisheries, it may be eating the young of fish such as pacu and displacing adults through territorialism, and it is competing for food with some of the larger carnivorous catfish that are in the lagoons at times, as well as also displacing these territorially. Nevertheless, net impacts on lagoon ecosystems remains unclear. Complementary to the lake ecosystem studies, consideration was given to predicting the spread of the paiche to other parts of Bolivia, either naturally or intentionally. Fisheries records indicate that the fish has invaded river systems of Bolivia at a rate of about 20 km/yr. A survey of 10 lakes indicated that paiche prefer newer, deep, and large oxbow lakes, similar to trends observed in Brazil. This habitat is abundant in parts of the Bolivian Amazon still without paiche, where the expansion may be more rapid. However, evidence from aquaculture trials suggests that the fish is sensitive to low temperatures. The historical climate data analysed by Agua Sustentable in the project was thus applied to creating minimum temperature contours that predict the potential extent of the paiche invasion (Van Damme et al., 2014).

A base line of indigenous fisheries was developed during the project, with data published by Coca Méndez *et al.* (2012), Argote et al. (2014), MacNaughton *et al.* (2014a) and Herrera Sarmiento (2014). These studies demonstrate the increasing importance of paiche for family income in some communities and the very important contribution of native fish species to food security.

### *Stock assessment*

An originally Brazilian technique for paiche counting (practiced by trained fishermen) was transferred to Bolivia through the PPV project with a technical mission by Brazilian fishermen. Counting in 10 lakes indicated a great diversity in fish densities, but an abundance of adults that is positively correlated with the size of the lakes, possibly different from the relationship Castello et al (2013) reports for Brazil. The highest density of paiche was found in Mentiroso Lake, the site of paiche fishing by the community of Trinidacito, where the pilot processing plant and management plan was carried out. Van Damme et al. (2014) comments that the present catch rate (0.8 kg/ha/year) is still below the suggested sustainable catch rate reported by Castello *et al.* (2013) (1.5 kg/ha/year) for a similar lake. The stock assessments allowed for the estimation of paiche fisheries potential in the Northern Bolivian Amazon, which is more than three times higher than the current yield (see preliminary calculations in appendix 4.1.8, this report). These data will be used to inform the



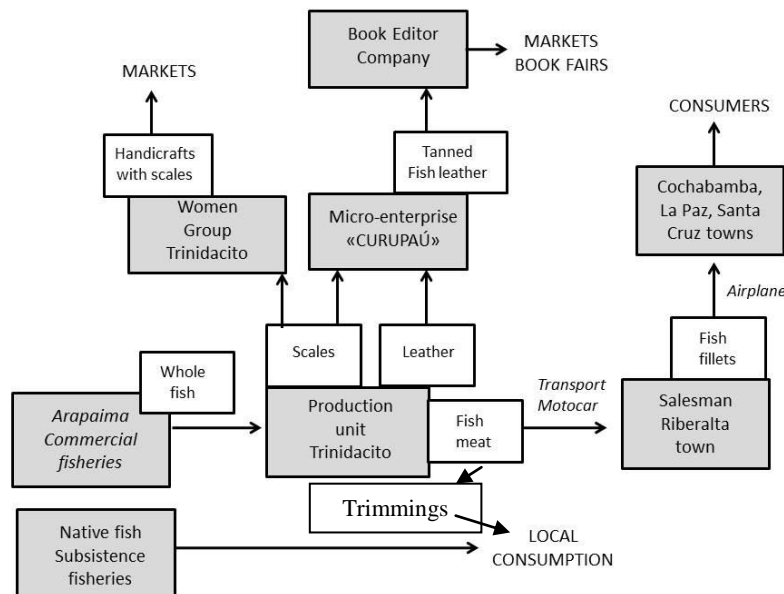
national government on a paiche management program (see objective 5), but it is possible that these densities are higher than eventual equilibrium managed ones, so further monitoring will be needed to ensure the sustainability of this strategy.

### *Lake management*

Effective fisheries management in the Bolivian context requires a robust social licence, regulatory basis, and recognition of need. A conclusion at the end of the project was that fisheries returns are still quite good, and that there is no urgent fisheries crisis with the current levels of exploitation and community management. There is community support for “socially optimized” fisheries management of this kind, but apparently little appetite for a more aggressive biologically optimized utilization plan. In this project we worked on the legislative component (see objective 6), and the social licence through value chain improvements and community-based projects to improve local food security (see objective 5). A more robust management strategy will become more feasible as draft fisheries regulations are approved and implemented, communities decide on their management goals, and biological limits of paiche fishing in Bolivia are better understood. Currently, using Brazilian models and based on the initial stock assessment, the biologically sustainable catch in Lake Mentirosa is approximately 3 tonnes annually, close to what is currently being fished. However, while local communities will be able to apply such management plans to “their” lake(s), and paiche biology lends itself to this level of management, there is also a need for management strategies on a larger regional scale. Therefore, the project has been able to estimate a sustainable yield of about 190 t/year for the TCO TIM II, extrapolating survey data to all 300 lakes in the area (see appendix 4.1.8). This informs the national government on a strategy for specific management of the paiche as an introduced fish species (see objective 6).

### *Paiche processing and value-chain upgrading*

At the start of the project, paiche were generally sold as whole gutted carcasses, without heads, into urban centres – such as Riberalta - for processing and subsequent shipping to more distant markets. This limits the returns to local communities, particularly indigenous communities that are disadvantaged in the somewhat specialized fisheries and transport needs of the paiche and subject to unfavorable “habilito” credit arrangements with middlemen and women. To optimize the returns from paiche, the project thus set up a pilot processing plant in Trinidadito that works with community members to produce high quality filleted fish for select buyers, while also creating accessory returns from the skins and scales through leather and scale artisanal products that involves tanners, handicraftsmen or women and salesmen and women. This initiative increased fisheries participation in the community, and created new processing jobs (Table 3 and appendix 3 of this report). Income from by-products is still growing, as the markets for the new products are developing. These artisans are still mostly urban-based, but include one legally established small enterprise (CURUPAÜ) that is training further artisans, including in the fishing communities. The Trinidadito processing plant also made paiche meat more accessible to local vulnerable populations, increasing their food security (Table 3). The highly nutritious “racks”, heads, and abdominal meat that would normally be discarded in the urban processing, became available to vulnerable populations, along with recipes for their utilization. Consumption of paiche in Trinidadito, initially very low, increased significantly during the project (Table 3).



**Figure 2:** Trinidadito fish value chain set up and strengthened through diversification by the PPV project – note use of both fish meat and fish byproducts

In parallel, the consumption of paiche was being promoted in Riberalta to help build and stabilize the market for this fish, as well as set the stage for vulnerable populations to make better use of this resource. Development of recipes and value-added products with paiche meat, including fish burgers, sausages, chips, and more novel plates from cheaper processing by-products such as the head, skin, and racks, culminated in the publication of recipes in a fish cookbook with the “Arapaima” group of women in Riberalta. Promotion in the annual fish fairs, creation of a paiche-specific restaurant – led by one of the Arapaima women, and creation of two other women-lead micro-enterprises specializing in ready-made paiche meals all contributed to the improved livelihood of women living in poverty and helped diversify local diets to include healthy fish products (see also objective 4).

The project intervention had an impact on employment (e.g. inclusion of women fileting, tanners and handicraftsmen), local income (e.g. 20% increase in income per kg of fish), fisheries-based livelihoods and food security (p.e. consumption of paiche meat by 20% more families) in Trinidadito. Also, thanks to the local agreement to permit commercial fisheries in the indigenous territory TIM II (see objective 6), the possibility was opened to LEGALLY produce – in a sustainable way - and commercialize paiche from the indigenous territory TCO TIM II, with the potential to provide further employment, stable income and more secure livelihoods.

The local processing plant in Trinidadito, together with the enriched new value chains it has created, so far appears to be quite successful by a variety of measures. However, some time will be needed to see how these changes survive after the project. We judged the history, social capital and paiche resource in Trinidadito to be adequate to receive sustainable benefits from this initiatives, but other lake communities (for example, with lower paiche densities or different community development history) would need to judge how well their situation is suited for such a processing plant or different portions of the intervention.



**Table 3:** Key data and indicators on results of the intervention to improve paiche management in Trinidadito

Locality	Indicador	Base line value	Monitored value at project finalization
Trinidadito (TCO TIM II)	Number of men defined as commercial fishers	38	47
Trinidadito (TCO TIM II)	Number of women defined as commercial fishers	1	7
Trinidadito (TCO TIM II)	Number of male members in the Asociación de Pescadores de Trinidadito (APIAT)	39	41
Trinidadito (TCO TIM II)	Number of female members of fishing association of Trinidadito (APIAT)	0	5
Trinidadito (TCO TIM II)	Total fish volume (kg/month) captured in the community of Trinidadito (Base line: mean of 3 months – Oct 2001/Mar 2013/Nov 2013) (Monitoring after project intervention: mean of 5 months July-Dec 2013)	1567	4095
Trinidadito (TCO TIM II)	Number of filets sold during five months	0	10237
Trinidadito (TCO TIM II)	Mean income from a paiche of 100 kg (\$US)	80	103
Trinidadito (TCO TIM II)	Leather sales (\$US/kg)	0	3.2
Trinidadito (TCO TIM II)	Households that eat fish (Base line: 24h recall in November 2011; Monitoring: 24h recall in October 2013) (%)	100	92
Trinidadito (TCO TIM II)	Households that ate paiche (Base line: 24h recall in November 2011; Monitoring: 24h recall in October 2013) (%)	5	18
TCO TIM II	Volume of paiche with providenc of TIM II that legally can be commercialized (based on preliminary extrapolations on the basis of paiche counting in 10 lakes) (kg/year)	0	45 000
Riberalta	Income obtained through the selling of handicrafts produced with by-products of paiche during 2 years by one enterprise (CURUPAÚ) (US\$)	0	2928
Trinidadito (TCO TIM II)	Number of persons dedicated part-time to handicrafts based on fish by-products, diversifying their livelihoods	0	7 (4 men, 3 women)

### 3. Contribution of aquaculture to food security

#### 3.1. Objective 5

To improve the contribution of small-scale aquaculture to food security, indigenous household income and gender-sensitive participation in a pilot zone (Mamoré Basin)

#### 3.2. Summary of activities

Activities in the project related to aquaculture included: (1) review of the current status and challenges faced by Bolivian tropical aquaculture; (2) development of a strategy for improved development of this aquaculture in Bolivia, (3) recommendation of, and training in, adapted technologies for small scale tropical aquaculture in Bolivia; (4) strengthen the capacity of the fish growers and technicians to manage their fish ponds, innovating and problem-solving as needed; and (5) improve the quality of life and food security of a pilot group of fish growers through improved income, access to high quality fish, and new technologies.

Tropical aquaculture in Bolivia continues to be in its early stages, even though it has been promoted as a means of mitigating poverty and improving community development for more than two decades.





Unfortunately, the results from these projects have not been very promising, which is why the PPV project opted to firstly review likely reasons for past poor performance of the sector and secondly collaborate with an existing initiative by CEPAC, an NGO partner, that appeared to be addressing the problems of sustainability with new innovation. CEPAC (Centro de Promoción Agropecuaria Campesina), working out of Santa Cruz, has promoted aquaculture for women of Yapacani, working with a model of aquaculture on private lands and with private ownership with supportive associations, rather than focusing on communal land and development

### 3.3. Summary of results

#### *Aquaculture reviews, training, and strategy development*

Two review missions were carried out to assess the current status of Bolivian tropical aquaculture, with Bolivian, Canadian and Brazilian participants, including training seminars in the process that reached 207 people (including 85 women). These reviews resulted in a multi-authored document on an appropriate development strategy for aquaculture in Bolivia, published at the end of the project with the Bolivian government and adopted by the new national agency responsible for aquaculture development (IDP PACU). A guide to tropical aquaculture in Bolivia was also developed and published with IDP PACU, primarily outlining better practices of pacu culture adapted to Bolivian conditions.

Training opportunities that arose out of these reviews included a month-long training mission for five sectorial leaders (including 3 women) to CEPTA, a Brazilian centre of expertise on fish conservation and culture. Subsequently, this group helped organize a specific training course in Bolivia on fish nutrition, with 124 participants (including 60 women) and helped organize the 1<sup>st</sup> International Bolivian Conference on Aquaculture, with 250 participants (including 50 women) and substantial educational and exchange opportunities. Finally, EMBRAPA, the national Brazilian agricultural research entity, committed to collaborating on future aquaculture education and research programs in Bolivia.

#### *Aquaculture farmer research*

The PPV Project identified the lack of adequate ongoing technical support as one of the key bottlenecks to aquaculture development in Bolivia, complicated by a possible over-dependence of farmers on this support and potential reluctance to adopt new practices. Participative farmer research was tested in this project as a means of addressing some of these issues within the Bolivian context, as recommended by Hartwich *et al.* (2007). A technological innovation that appeared suited to this challenge was polyculture of pacu with sabalo - a detritivorous native fish species. The hypothesis, based on Brazilian experience, was that this innovation would improve conditions of pacu culture in rain-fed ponds, provide extra fish production for minor extra costs, provide cheap fish for home consumption of the fish grower, and provide a platform to build improved pond management skills. This innovation was tested with selected female farmers of the APNI (Asociación de Piscicultores del Norte Integrado de Yapacani), in collaboration with CEPAC. The experiment resulted in the expected production of extra “free” fish that are both consumed directly or sold, though the growth of the sabalo was not as great as the farmers expected. Impacts on pond environments by the sabalo were subtle, with better maintenance of a slightly turbid environment throughout the year the most evident effect. A longer experimental period is needed to see evidence of the expected lower incidence of disease. Improved practices in pond management, as evidenced by better record keeping, was not easily achieved in the experiment, and would need some re-evaluation of strategies. However, the



polyculture innovation was broadly adopted by 15 other farmers, indicating the value of the participative approach to rapid adoption of new technologies (see Table 4).

*Policy and food security contributions:*

In July of 2013, the project participated in a technical visit organized by CIDAB, the organization responsible for aquaculture development at the time, with a group of leaders interested in aquaculture of pacu (3 women (1 municipal councilor), and 20 men), with CEPAC, WFT, and the growers of the APNI association showing the aquaculture of the region and the polyculture experiment. This has contributed to the design and implementation of the new national organization of IDP PACU, and will influence how it is implemented. Social surveys were carried out in conjunction with the aquaculture project, indicating that aquaculture, run primarily by women, has effectively replaced the rice culture that was previously the families' primary livelihood. Over 50% of the households surveyed count fish culture as their prime source of income. While numeric data is not available, these report greater income and economic stability, and women have greater participation in decision making – over 40% of the city councilors are now women. Interestingly, the concentration of women-led small-scale aquaculture in Yapakani has supported the opening of 14 restaurants, as well as a variety of other occupations associated with the fish value chain.

The project has been supporting an ongoing process of expansion of aquaculture in the study area, while aquaculture remains incipient or is decreasing in other areas of the country. Local impact indicators show a steady increase of fish production, income and secured livelihoods (Table 4). The right geographic and climatic conditions, appropriate land property rights and facilitating social and political environments seem to be key factors for success and replicability.

Aquaculture is clearly an appropriate solution to improve livelihoods for low income people, particularly women, but remains elusive for people living in more extreme poverty. Models with communal ownership have been tried for this in Bolivia, but appear to be unsustainable in that they rely on on-going external funding and organizational support. More dedicated management of lake fisheries, including that of the non-native paiche, based on natural reproduction, better stock assessment, and managed fishing rates (see discussion in objective 2. above), should also be considered part of aquaculture strategies, as part of a solution for fishing villages living in poverty.

**Table 4.** (Local) Impact indicators of the intervention on fish farming

Locality	Indicador	Base line value	Monitored value at Project finalization
Chore	Number of fish species used in fish culture	1	2
Chore	Number of families working with polyculture combining pacú and sábalo (o a total of 60 families)	0	6 (supported by the project) 15 (copying the other families at the start of the project) 50 (at own initiative at the end of the project)
Chore	% of production used for own consumption (this is almost exclusively sábalo) (% of total fish produced)	Low to very low (<2) (due to high price of pacú in the markets)	Aprox. 10 (mostly consisting of sábalo)
Chore	Number of families that consume cultivated sabalo at least once a month (on a total of 60 families)	0	13



Locality	Indicador	Base line value	Monitored value at Project finalization
Chore	Number of families that consume cultivated sabalo at least 2 times in 2013 (on a total of 60 families)	0	40
Chore	Average number of ponds per family	2	5
Chore	Number of fish (pacú de 0.8 kg, sábalo de 1 kg) production by 15 families through polyculture in one year	45 000 0	225 000 4 500
Chore	Fish (pacú, sábalo) sold by 15 families in one year (kg)	36 000 0	180 000 4 500
Chore	(Bruto) Income generated by 15 families in one year through polyculture (US\$)	164 571	738 000 (720 000 + 18 000)
Yapacani surroundings	Number of adjacent communities where aquaculture was initiated copying the successful example of Chore between the end of 2012 and the start of 2014 (without external support except microfinancing)	4	20

## 4. Value chain optimization & upgrading and improvements in fish manipulation, processing and marketing

### 4.1. Objectives (combining objectives 3 & 4 of the proposal)

\*To improve the contribution of culture-based adaptive fisheries management to food security, household income and value chain participation of women and indigenous groups in a pilot zone (Northern Bolivian Amazon)

\*To improve fish handling, processing and marketing in pilot zones.

### 4.2. Summary of main activities

Fisheries for native species are quite distinct from those of paiche, requiring lower investments, serving a more local market, involving a broader spectrum of indigenous communities, and working with more entrenched value chains. As with the paiche, effective fisheries management in the Bolivian context requires a robust social licence, regulatory basis, and recognition of need. In this project we worked on the legislative component (see objective 6), and the social licence through value chain improvements, community-based projects to improve local food security and hygiene with fish handling. The following activities were developed:

\*A new conceptual model for value chain optimization was developed

\*In addition to the quantitative benchmarking of the fisheries value chain (see objective 1), a workshop was organized to obtain qualitative information from the main stakeholders regarding the fish produce flows from pre-harvest to post-harvest.

\*The new model for value chain optimization was field-tested in the indigenous small-scale fisheries value chain in the northern Bolivian Amazon. With regards to the specific upgrading initiatives the value-chain stakeholders identified key fronts of action. The key objective was to move towards value-chain upgrading, based on a negotiated approach amongst the intervening agents and the value-chain stakeholders, reflecting priorities defined by participants and the socio-political context:

a) improve fish quality and handling processes throughout the value chain stages



- b) improve market place conditions;
- c) improve hygiene and food security in vulnerable (indigenous) groups
- d) insertion of gender equity strategies and general food security precautions.
- e) fair pricing structure amongst fishers and retailers;

A sixth prioritized upgrading action (promote new legal frameworks) is presented under objective 6.

### 4.3. Summary of main results

#### *New concept of value chain optimization*

One of the main results of the project is the development of a new concept of value chain optimization, which is a hybrid between a wealth generation model and a welfare model (see Wojchiechowski et al., 2014) (Table 5). The approach is action-research based, including both equitable income-seeking approaches (which are at the center of the economic wealth model), and a wide array of livelihood options pertaining to the welfare model. The analytic framework consists of four value chain upgrading components: a) value chain coordination through vertical integration; b) value chain coordination through vertical and horizontal negotiated agreements; c) specific upgrading components (including increased income margins for fishers, gender equity mainstreaming, quality and sanitation improvement, insertion of food security improvement strategies – all within the local socio-cultural context and political priorities); d) action-research methodology, integrating technical information and local know-how and creating trust-building spaces of encounter amongst the various local stakeholders. The framework contemplates 21 indicators that cross-reference the scale and scope of the value-chain upgrading, and can also serve as an evaluation framework tool, as described for this project in Wojchiechowski et al. (2014).





**Table 5:** Framework for Hybrid Value-Chain Analysis and Upgrading developed for the project (Wojciechowski et al., 2014).

VALUE CHAIN UPGRADING COMPONENTS	DESCRIPTION	NATURE OF INTERVENTION WITHIN THE THREE STAGES OF A VALUE CHAIN								
		1 <sup>st</sup> Degree			2 <sup>nd</sup> Degree			3 <sup>rd</sup> Degree		
		(actions)			(Rules & Regulations)			(Principles)		
		Pre	Harvest	Post	Pre	Harvest	Post	Pre	Harvest	Post
A. VC Coordination through vertical Integration	I. Insertion of one node in other VC nodes (processing, transportation, retail)	Training opportunities and capacity building workshops are implemented with various VC stakeholders to improve their core capacity or to carry out actions outside of their traditional/core competency			Agreement amongst various VC nodal actors on joint work (ex. joint point of sale, shared transportation costs, participation in fishstock monitoring, etc)			Fair representation of voice and vote of value-chain stakeholders in governance structures guaranteed		
	II. Vertical (inter) contractualization	Formal and collective negotiation and/or dialogue amongst <b>DIFFERENT</b> node actors on fair and/or conservation, and/or inclusive practices for capture and sale of fish products			Development and approval of charter, protocol and any other document, recognized by <b>ALL</b> stakeholder categories of the value chain regarding a specific facet of value-chain improvement			<b>ALL</b> categories of the value-chain stakeholders sign on to shared or collaborative framework regarding a facet of value-chain improvement		
B. VC Coordination through Contractualization	I. Vertical (inter) contractualization	Formal and collective negotiation and/or dialogue amongst <b>SAME</b> node actors on fair and/or conservation, and/or inclusive practices for capture and sale of fish products			Development and approval of charter, protocol and any other document, recognized by <b>MEMBERS</b> of a VC stakeholder category regarding a specific action or rule for value-chain improvement			<b>MEMBERS</b> of a specific VC stakeholder category sign on to shared or collaborative framework regarding a facet of value-chain improvement		
	II. Horizontal (intra) Contractualization	Formal and collective negotiation and/or dialogue amongst <b>SAME</b> node actors on fair and/or conservation, and/or inclusive practices for capture and sale of fish products			Development and approval of charter, protocol and any other document, recognized by <b>MEMBERS</b> of a VC stakeholder category regarding a specific action or rule for value-chain improvement			<b>MEMBERS</b> of a specific VC stakeholder category sign on to shared or collaborative framework regarding a facet of value-chain improvement		
C. Specific Upgrading components (embedded in local socio-cultural context and political priorities)	I. Increased income margins for fisherfolks	Identification of fair pricing schemes and profit margins			Contractuation of fair pricing practices through value-chain stages			Fair pricing recognized formally as a value-chain trademark (by all value-chain stakeholders)		
	II. Quality and sanitation improvement	Safety practices in place and quality protocols developed			Quality protocols approved by all producers, transporters and retailers			Sanitation and food quality recognized by local institutions, consumers and producers as a		
	III. Gender equity mainstreaming	Actions undertaken to guarantee men and women have equal gain for equal tasks (economic and social)			Gender equity guaranteed in protocols and community agreements			Gender equity (representation and voice) recognized in key value-chain governance structures		
	IV. Insertion of food Security strategies into value chain upgrading	Demand and supply driven actions in place to increase food security of fisherfolks and/or consumer in the region			Local council approval of local food security strategy, normative or law based on fish produce consumption			Food security recognized by value-chain stakeholders as a political priority for value-chain upgrading strategies		
D. Intervention Method (Action-Research, appreciative inquiry, etc)	I. Integration of technical information and local know-how in generating upgrading strategies	Technical personnel (intervening agents) and local stakeholders (direct agents) participate in value-chain decisions			Decision-making rules are inclusive of both technical and local know-how and are recognized by all actors involved			Social Learning recognized in governance structures as a pathway to value-chain upgrading		
	II. Generation of spaces of encounter amongst various local stakeholders	Meetings, workshops, training sessions implemented with language and content adapted to local social profile			Decision-making rules are identified and recognized by all actors involved			Collaborative structures in place recognizing cooperation as a key value-chain upgrading principle		

*Field testing value chain optimization 1: improve fish quality and handling processes throughout the value chain stages*

The improvement of fish quality and handling procedures considered contamination risks at the pre-harvest, harvest and post-harvest stages. In addition the improvement strategy focused on three different types of interventions: 1) training and manuals; 2) physical interventions and improvement in equipment; 3) social management of the improvement interventions. The interventions were preceded by a review of current practices (see objective 1).



The action-research strategy was developed to address key bottlenecks through improved communication and cooperation between actors, with a focus on locally-developed interventions at the levels of fish markets and with producers in rural communities. The intervention strategy aimed at improvements of the quality and a reduction of losses during “fish capture” and “commercialization”, through a) The adoption of new practices of manipulation and conservation of fish; b) increase in the communication between stakeholders occupying the same value chain link (fish-fish, salesman-salesman), from different links, and between direct and indirect actors..

Regional fisheries organizations’ capacity and engagement in fisheries governance together with strengthening indigenous sector planning in this area has also been implemented (see objective 6 below). In addition, work was carried out specifically on the ice chain, assessing an ice plant offered to the fishing association and designing a proposal for insulated boxes for the fishing vessels.

### *Field testing value chain optimization 2: Improved fish market conditions*

Review of market conditions with sellers indicated a support for improved facilities, and indigenous fishers expressed the need for access to sales facilities. A participative design of a new facility in an adjacent building, through renovation, led to its construction in late 2013/early 2014. As these sales include the cheaper fish species, this improved market will make higher quality fish available to an estimated 3,000 urban low-income or poor families. Early results in 2014 indicate a positive response by consumers (Table 6), though some adaptations are still underway to achieve full occupation.. This market will fulfill several roles: a) demonstrative role (market conditions may be copied to other fish markets); b) protocol for participative design of fish markets, replicable (with modifications) to other municipalities); c) location for direct and indirect sales of cheap (native) fish from indigenous and campesino communities.

Training of sellers consisted of initial technical demonstrations of hygienic practices and discussions on site, followed by a workshop in December, 2013, on hygiene and use of ice that included 24 sellers, fishers, and regulatory agencies. An early indicator of the impact of this training is 100% adoption of improved, regular cleaning of sales tables with bleach.

A practical tool to monitor fish quality was developed and might be of future use by SENESAG (governmental agency controlling food quality). Fish quality at the market is an important component of improved health and hygiene in the fish value chain, with low quality influencing both sales and reflecting significant losses to fishing incomes. However, adequate indicators of fish quality for consistent monitoring appear to be difficult to establish and implement under the local field conditions. We initially adopted a European scale (which in turn evolved from a more extensive international scale developed by the FAO) and carried out a week-long survey of fish quality in the Campesino (Abasto) market in November 2012. Subsequently, we carried out some decomposition trials with selected species to see how characteristics used in this quality analysis actually changed over time, and developed simplified, species-specific assessment protocols.

**Table 6:** Consumer Impact indicators of the fish market intervention (Abasto market intervention)

Locality	Indicator	Base line value (before market intervention)	Monitored value at Project finalization (after market intervention)
Riberalta (Abasto market)	Perception by buyers of fish on quality of fish bought in the Abasto market (base line in oct 2012: N=69; monitoring in march 2014: N=107) (% with positive perception)	48	91.5
Riberalta (Abasto market)	Number of families benefitting from the improved access to fish of better quality sold in hygienic conditions	-	Aprox. 3000



### *Field testing value chain optimization 3: Improving hygiene and food security of vulnerable (indigenous) groups*

The household survey indicated that children in rural communities were malnourished, as indicated by moderate stunting rates. While causative relationships could not be statistically defined by the broad-brush survey instrument, likely observed contributing factors include abbreviated period of breast-feeding, high incidence of diarrhea, and low diversity of foods. To build an integrated, culturally appropriate approach, the project incorporated these elements into cooking workshops, with Vicente Cuevas, an Argentinean chef. These workshops included elements of hygiene, health (infant development, breastfeeding challenges, and danger signs of cough, fever, and diarrhea), the use of highly nutritive local ingredients, diversified use of local fish, and discussions on food security improvements. This integrated approach provided relevance and interest for community members and created better opportunities for full family participation.

Four indigenous communities of the TCO TIM II, and one vulnerable urban group in Riberalta (“Hogar de Angelitos”) participated in these workshops. 95-97% of the community members participated in the activities, totalling 167 individuals: 45 women, 28 men, 3 young women, 10 young men, 35 boys, 46 girls. The workshops were presented by multidisciplinary intervention teams (up to 3 women and 4 men from WFT, FAUNAGUA, PROTEGER, and the Municipal Health Network 07). Collateral health benefits to community members are outlined in Appendix 4. By the end of the project, a manual on better practices in fish handling was published, based on these experiences and those from a similar project by Faunagua in the Pilcomayo (Ledezma *et al.*, 2014).

### *Field testing value chain optimization 4: Gender equality strategy*

In April 2013, the project working group on gender organized and facilitated the first-ever regional forum for women in fisheries in the Riberalta region, with 47 representatives from indigenous and campesinos communities in TCO TIM II and area, as well as representatives of regional organizations, local fishing and fish selling associations in Riberalta, defensoria del pueblo, and public health. The workshop increased the visibility and appreciation of women’s multiple roles, contributions and challenges related to food security and fisheries-based livelihoods, as well as creating a space for peer-to-peer learning. This also helped identify local needs and priorities, and contributed to a subsequent CFSRF-wide workshop in South Africa in June, attended by three representatives of the PPV project working group.

The Arapaima Group of women build capacity in value-added fish processing, distributed their recipe book of traditional fish dishes, served sample dishes in promotional fish fairs (now an annual event). These activities both increase visibility and further displayed the relationship between women and fish. Table 7 showed some impacts of the project on income generated by the Arapaima group. These data are important as they indicate economic return in the fisheries sector that could be generated through microfinance.

**Table 7: (Local) Impact indicators of fisheries micro-enterprises by women of the “Arapaima women group”**

Locality	Indicator	Base line value	Monitored value at Project finalization
Riberalta	Number of women working in fish processing and/or selling new fish products	0	12
Riberalta	Number of women that started own micro-enterprises (restaurants, handicrafts, processed fish)	0	5
Riberalta	Net Income generated by women through selling of fish products in july-september 2013 a) restaurant “El busn sabor”; b) Selling of fresh fish aggregating value (packaging,, etc.); c) Net repair; d) Fish filets and provision on order (US\$/month)	0	a) 364 b) 306 c) 140 d) 156



### *Field testing value chain optimization 5: Feasibility studies as a means of increasing fishers' income and integrating the fishers and retailers with a joint point-of-sale*

In general fishers are not aware of the market side of the value chain, focusing predominantly on their core competency. Based on the identification of rent-seeking bottlenecks the intervention strategy included the following components: a) participatory creation of a market-based fish price table; b) carrying out a feasibility study with fishers from the main fish supplying communities; c) negotiating better prices associated with the joint point-of-sale strategy in the new fish market. Both intra-nodal (fishers, retailers) and inter-nodal negotiations were organized.

**Table 8:** Key economic feasibility indicators of indigenous fishing in the Riberalta region (summary) (Wojchiecowski et al., 2014)

PEFS results	Current scenario	Proposal 1	Proposal 2
Monthly fish volumes	160 kg	160 kg	160 kg
Average price paid to fisher	12.6 Bs	15.0 Bs	17.0 Bs
RESULTS	Current values	Proposal 1	Scenario 2 (100% minimum wage)
Monthly result (Gross monthly income – Monthly cost)	503.4 Bs	887.4 Bs	1207.4 Bs
Ratio to minimum wage	42%	74%	100%

Wojchiecowski et al. (2014) summarized the results of the feasibility study (Table 8), which suggests the increase of the average price paid to the fisher should be 56%. Table 8 demonstrates the key feasibility indicators as well as the increase in fisher income that could be achieved with a negotiated price change. The authors evaluated the project's reach (in terms of income generation, livelihood contributions, and the multiple scales of interventions), and summarized the evaluation of the actions, rules and principles.

## **5. Enabling environment for governmental strategic planning of the fisheries and aquaculture sector**

### **5.1. Objective 6**

To help construct the enabling environment for governmental strategic planning of the fisheries and aquaculture sector

### **5.2. Summary of main activities**

The construction of an enabling environment for governmental strategic planning of the fisheries and aquaculture was done through these initiatives:

- \*Improvement of the legal framework for fisheries and fish culture through a highly participatory process. This has been pursued through stakeholder strengthening (the Northern Amazon Regional Fisheries Federation FEUPECOPINAB playing a key role), workshops and creation of a steering committee.
- \*Elaboration of other legal instruments supporting the fisheries sector at the municipal, provincial and national level
- \*Participatory elaboration of planning tools for the aquaculture sector:





- \*Strengthen the capacity of the Ministry of Foreign Affairs and the Ministry of Environment and Water Issues to design a strategy to protect local biodiversity and fisheries-based livelihoods in the Bolivian Amazon against dam impacts (Jirau and Santo Antonio dams).
- \*Characterisation of climatic cycles and tendencies, with a focus on flooding and cold shocks - two climatic events that affect fisheries and aquaculture particularly
- \* Characterisation of spontaneous adaptation strategies by fisheries communities to climatic variations, informing economic development plans for four indigenous territories in the northern Bolivian Amazon in four municipalities.

### 5.3. Summary of results

#### *Improvement of the legal framework for fisheries and fish culture*

One of the principal goals of the PPV project has been to help clarify the legal situation of fisheries and aquaculture (see fig. 3). The approval of a new law would be an essential step towards governmental strategic planning of the fisheries and aquaculture sector and for participants to have security in their livelihoods. The fisheries & aquaculture law proposal, approved by local stakeholders in September 2013 (App. 4), is now being reviewed by the Ministry of Rural Development and Territory. This proposal of the law foresees ongoing participation, planning and management between the public authorities and the fisheries & aquaculture sector within an integrated river basin framework. In comparison with a previous (FAO-supported) proposal, the present project is characterized by a strong emphasis towards “fish for food security with sovereignty” and “environmental sustainability”. The law project also introduces the concept of “production complexes”, putting emphasis on ensuring the profitability of the fisheries and aquaculture sector. Resource access is recognized and regulatory systems (including how access rights are assigned) are proposed. A scheme for further specific law development (at the river basin level, department level, municipal level and at the level of autonomous indigenous territories) is foreseen. This law will help to make the fisheries & aquaculture sector more visible, strengthen its contribution to nutrition and food security, and create opportunities for new mechanisms to guarantee conservation and environmental sustainability.

#### *Specific legal instruments*

A specific legal tool regulating the management of the paiche, as an introduced fish resource, has been developed in close cooperation with the Ministry of Environment and Water and the Ministry of Rural Development and Territory. Paiche is an introduced species of fish in Bolivia, so is not covered by the national fisheries law. Access rights and management are thus without clear legal foundation, creating conflicts amongst different users. The PPV project thus lobbied for a governmental clarification, and by the end of the project had managed to convene a multi-stakeholder workshop that resulted in a bi-ministerial consensus on paiche management and exploitation. This plan allows for individually tailored sustainable harvest management plans within the naturalized range of the paiche, and discouragement of further introductions in other river basins. At the end of the project, the Ministry of Environment and Water promulgated a ministerial resolution regulating the environmental aspects and exploitation of the paiche introduction (App. 4). Besides this legal instrument, two local legislative instruments were approved, establishing “Fisher day” (23th of June 2014) (municipality of Riberalta, department (province) of Pando) (App. 4).

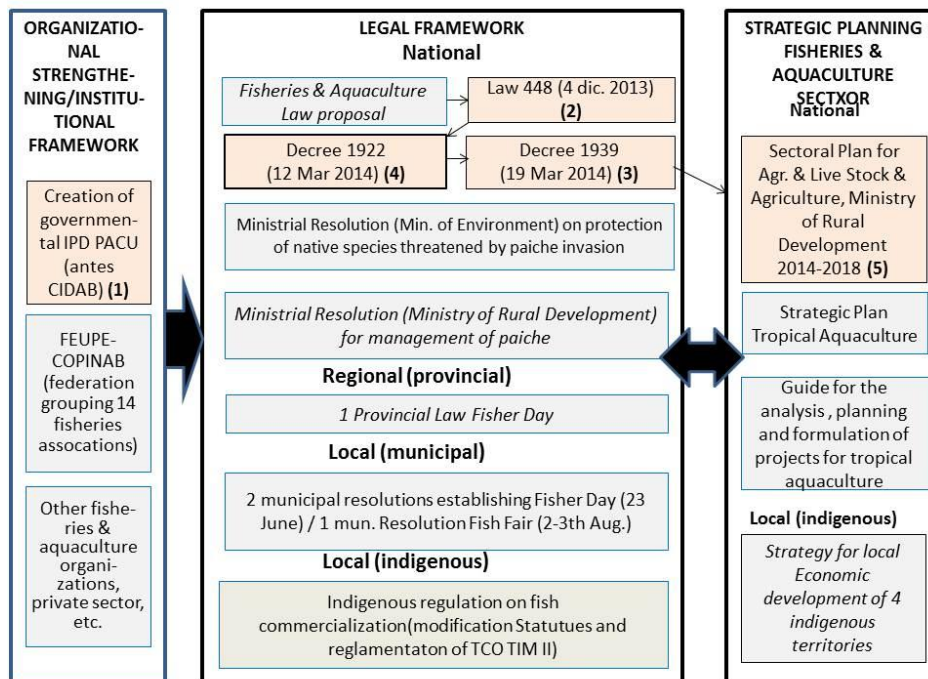


Fig. 3: Diagram showing public advocacy and creation of a facilitating environment for the fisheries & aquaculture sector, as facilitated by the PPV-project. The grey shaded boxes are direct interventions by the project. Orange shaded boxes are external advances which have made use of project inputs. Text in italic reflect tools in process of approval.<sup>1</sup>

### Local regulations

In addition to the national legal instruments for paiche, the project helped to strengthen local fishing norms. Before the project, the Indigenous Territorial regulations allowed for subsistence use of fish resources, but not their commercialization. Though this regulation has not being enforced, it created levels of uncertainty and conflict amongst the different stakeholders.. The PPV project managed to get a resolution passed in the indigenous government that now permits fishing for commercial purposes in the TCO TIM II (App. 4), which opens the door to legitimate development of fisheries livelihoods and their improved contribution to food security.

### Tools for aquaculture planning

The Project has triggered and supported the development of two key planning documents: a Guide/Protocol for tropical aquaculture in Bolivia (MDRyT-VDM-IDP PACU-PPV, 2014b) and an Aquaculture Development Strategy

<sup>1</sup> Notes: (1) Creation of the Decentralized Public Institute “Pesca y Acuicultura” (PACU), successor of CIDAB, is motivated partly by project results; the institutional framework is derived from PPV-project results; (2) Law 448 creates the “National Program for Fisheries”, one of its objectives being “to strengthen fisheries and aquaculture sectors and their contribution to food security with sovereignty”; the formulation of this objective originated in the PPV-project; (3) Decree which creates IDP PACU which has to implement the “National Program for Fisheries”; (4) Specific decree which leans directly on PPV-inputs, f.e. it foresees augmenting fish consumption to 5.2 kg fish/year/person and augmenting surface area for semi-intensive aquaculture to 7 923 ha for the production of 71 310 t of fish (65% Amazon basin; 20% Altiplano; La Plata 15%) (5) Sectorial plan foresees 10 000 000 US\$ investment for fisheries & aquaculture.



(MDRyT-VDM-IDP PACU-PPV, 2014a). Both documents, co-published with the IDP “PACU” (De-centralized Public Institute for Fisheries and Aquaculture) - the Bolivian agency that is currently responsible for aquaculture development - have the following target audiences: (i) municipal governments and other organization that are considering aquaculture as a development tool, (ii) individuals and associations that want to start aquaculture and (iii) technicians that are involved in assisting aquaculture development. The principal focus of the Aquaculture Protocol is to provide support for informed decision making on (1) whether aquaculture is the right tool for development within a specific local situation, (2) what development strategy could be the best for this situation, and (3) planning of this strategy. In addition, the Protocol provides basic technical information about current best practices for tropical aquaculture in Bolivia, but referring to other existing manuals for more detailed technical information. The Development Strategy document also contains a detailed description of the current state of tropical aquaculture in Bolivia, as a SWOT analysis of internal and external factors affecting the sector, informing the strategic planning proposal.

*Support to the governmental program focusing on the mitigation of dam impacts on aquatic resources and fisheries-based livelihoods in the Bolivian Amazon*

Project results were used to inform an ongoing governmental strategy aiming at mitigation of the impacts of the Jirau and Santo Antonio Madera dams, co-financed by WWF. In particular, the project team designed a diagnostic document which will be used by the Ministry of Foreign Affairs and by the Ministry of Environment and Water Issues as a base-line in the framework of the monitoring of dam impacts in Bolivian territory. This base-line, though elaborated by the project team, is authored by the respective ministries’ (MRE-MMAyA, 2014). It contains four specific contributions based 100% on PPV project results, written by team members, on commercial fisheries (Van Damme et al., 2014), on artisanal fisheries in the Indigenous Territory TIM II (Argote et al., 2014), on fish consumption (Pérez et al., 2014) and on fisheries economics (Rico Lopez et al., 2014).

*Towards the development of a municipal adaptive strategy for climatic impacts*

As a first step, climatic cycles and tendencies were investigated, with an emphasis on precipitation, temperature and river water levels. Regional differences in discharge regimes were found both at the seasonal and interannual level (see Molina Carpio et al., 2014). At the interannual level, differences were found between Andean, lowland, and eastern tributaries. Discharge at the Porto Velho station (drainage point of the whole Upper Madera basin), resembles primarily the hydrological regimes of the Beni and Madre de Dios Rivers, both originated in the Andes, than that of the lowland Mamore and Itenez Rivers. After taking into account the varying record lengths, only a diminishing trend for monthly minimum annual runoff was detected as significant for the 1967-2013 period. Discharge variability is consistent with rainfall variability. A second analysis of regional variability of rainfall and temperature in the northern, central and southern regions of the Bolivian Amazon plain and the sub-Andean region of Chapare, distinguished four regional groups. The results do not evidence a long-term trend of change in rainfall, but the wet and dry periods on multi-decadal or interannual time-scales can be identified. In contrast, the average temperature shows a widespread trend to increase at a rate of 0.15 °C per decade, more evident in the northern region of the Bolivian Amazon plain. Both rainfall and temperature evidence a “break point” from the mid-1970s, that introduced the current wet period, a significant increase in average temperature.

A second step was the study of the impact of extreme events, such as cold shocks and flooding, on fisheries and aquaculture resources. A model, described in detail by Van Damme et al. (2014) permitted the prediction of the impact of these extreme events on fish resources, fisheries, aquaculture and value chains. This model is



integrated implicitly in the ministerial resolution that regulates paiche fisheries (see above). A third step consisted in the development of an adaptive strategy based on vulnerability analysis in a pilot zone subject to flooding (four indigenous communities in the TCO TIM II) (Appendix 4.1.10, this report). As a last step, information and lessons learnt informed a municipal/indigenous economic development plan focused on indigenous strategies for adaption, being prepared by the NGO FAN.

## 6. Communication tools

### 6.1. Objective (6)

To develop communication tools and a public profile for the fisheries and aquaculture sector in the Bolivian Amazon

### 6.2. Summary of main activities

The main activities developed in the framework of the communication strategy were:

- \* Design and implementation of a virtual platform on fisheries and aquaculture (webpage)
- \* Communicational support to productive units in fisheries and aquaculture
- \* Support to a promotion campaign on fish consumption and food security
- \* Elaboration and distribution of specific communication tools on hygiene, fish manipulation, fisheries and aquaculture
- \* Fishing fairs as a promotion tool
- \* I International Symposium on Aquaculture in Bolivia

### 6.3. Summary of results (see details in Appendix 6)

*Webpage [www.pecesvida.org](http://www.pecesvida.org)*

The webpage of the “Peces para la Vida”-project ([www.pecesvida.org](http://www.pecesvida.org)) - available in Spanish and English - was uploaded on the 13th of August 2013. At the end of the project it is the main platform and center of resources on fisheries and aquaculture in Bolivia. Publications, articles, videos and other communication products are uploaded on a periodic basis. The virtual platform has various innovations such as the inclusion of videos, aquaculture forums, etc. Use of the webpage as monitored between the 15th of May 2013 and the 15th of April 2014, indicated:

- In 11 months, the webpage was visited 4486 times, with 10669 individual pages having been visited.
- The visits are mainly from Bolivia (57%), from Santa Cruz, Cochabamba and La Paz, and other South American countries, but also from Canada, United States and Europe (%).

*Fish consumption promotion campaign*

At the local level, the communication strategy has focused on a « fish consumption promotion campaign » which has been launched in August for the local public, also promoted by the Riberalta municipality. The campaign included spots on radio and 3 television channels, as well as television interviews. More than 500





folders on “100 good reasons to eat fish” have been distributed, as well as a cooking book “Cocinando Pescado Sano” [Healthy Cooking of Fish], distributed to more than 46 institutions in Riberalta and 4 indigenous communities (Cuevas et al., 2013; see further details in Appendix 6).

#### *Communication tools on hygiene, fish manipulation, fisheries and aquaculture*

Three products have been specifically designed within the framework of the external communication strategy: a) radio programs (reaching stakeholders in the most remote areas); b) Book with fish recipes, elaborated by the local stakeholders; c) a manual on hygiene and fish manipulation (in cooperation with the governmental agency for food safety SENESAG) (Ledezma et al., 2013).

#### *Fisheries & Aquaculture fairs and symposia*

Symposium and fairs have been promoted as potentially strong tools facilitating communication and interchange between stakeholders of the fisheries & aquaculture sector. Fish fairs were promoted in Riberalta and are now being organized yearly (see respective reports). The Symposium on Aquaculture (version I supported by the project) will be organized on a bi-annual basis and will bring together all relevant stakeholders. As such, these tools will form essential part of a permanent platform.

## 7. Conclusions and recommendations

Some of the main conclusions:

- \*Fisheries and aquaculture in Bolivia contribute to food security both through direct fish consumption and commercial livelihoods
- \* Fish, from a high diversity of species, are the prime source of protein for rural indigenous communities that are living in conditions of poverty and food insecurity, as well as providing an income “safety net” in a primarily agrarian livelihood
- \*The paiche fishery, while dependent on an introduced species, is a potentially great latent contributor to improved indigenous well-being in the Bolivian Northern Amazon. Its biology and the relatively new value chains provide opportunities for novel management strategies and for new, equitable value chains (as with local processing plants);
- \*Productive microenterprises based on fisheries show great promise, particularly for women, but require governmental and/or microcredit support to get started;
- \*A hybrid participative value-chain analysis that evaluates both income-generating and “welfare” functions of native species fisheries show substantial potential to assist the complex life of communities in the high-risk Amazonian floodplain environments, but highly engrained local social economic norms, together with substantial health and environmental risks (such as availability of clean water) may slow down the process;
- \*Pond aquaculture with women is a very viable means of improving the lives and food security of low income families through facilitated private enterprise models, given adequate technical, economic, and government support. Technology adoption is facilitated greatly by participative research;
- \*Buchere, paiche abdominal meat, and fish powders show particular promise as micronutrient and protein contributors to local diets of vulnerable populations



Some recommendations:

- \*Considering that fisheries is likely to remain the main source of fish protein in the next 10 years, their management remain a challenge; regional development goals will need to marry regional fish management with local management tools at the community level
- \*Aquaculture has great potential to become the main fish protein source in Bolivia, but a facilitating environment for its development will be crucial;
- \*Threats affecting the fish resource and fisheries- or aquaculture-based livelihoods (e.g. dams, flooding, cold shocks) should be studied more and adaptation strategies continued to be developed within sound planning strategies.

## 5. Synthesis of results towards AFS outcomes

AFS OUTCOMES	
<b>#1 New technologies and/or farming systems and practices.</b> <i>How has the project developed new and improved agricultural technologies and/or farming systems and practices that increase food production? (e.g. technologies and innovations; staple crops; crop-livestock interactions; agricultural water management; new seeds and plants)</i>	<b>#9 Income generation.</b> <i>How has the project contributed to improving vulnerable/poor people's ability to purchase more and better quality food, in particular for the benefit of women and children?</i>
Project Objectives	
<b>1.2 To improve the contribution of culture-based adaptive fisheries management to food security, household income and value-chain participation of women and indigenous groups in a pilot zone (northern Bolivian Amazon)</b>	<b>1.3 To improve the contribution of small-scale aquaculture to food security, indigenous household income, and gender sensitive participation in a pilot zone (Mamoré River basin).</b>
<p>The project worked with new technologies for small-scale fisheries and family-based aquaculture in two distinct regions of Bolivia. The technologies were very successful at the local levels at improving income and female and indigenous participation in value-chains for both fisheries and aquaculture, and in several cases have already contributed to national level policy impacts.</p> <p>In the Northern Amazon, the technologies included:</p> <ul style="list-style-type: none"> <li>- Participatory value chain assessment (based on paiche and native species fisheries);</li> <li>- Participatory stock assessment for paiche (based on the successful Brazilian example) and modelling of sustainable yields;</li> <li>- Processing and new value-added products (based on the introduced paiche fish and including food products, fish-leather and crafts made from fish-scales).</li> </ul>	



The results of implementing these technologies include:

- a) Improved understanding of the value chain and associated bottlenecks at different levels (186 people participated in value-chain mapping at local and regional levels. It was discovered that indigenous fishing families at the producer level are currently earning below the nationally established minimum wage (equivalent to \$ 214 USD/month)<sup>2</sup> and in many cases estimated to be operating at an average annual loss, in large part associated with low sale price and exploitative credit relationships with middlemen. A joint application by indigenous fishers, sellers, and the fishing association was developed and presented to the municipality to review the set market value, but not yet successfully by the end of the project.
- b) Improved knowledge of the existing and potential exploitation levels for paiche in 10 local lakes;
- c) Increased and diversified income to families at the producer level, primarily to women and indigenous communities. This includes two small enterprises based on paiche leather and scales (CURUPAÚ) employing 7 people directly, two new community groups (an indigenous paiche processing plant in Trinidacito (CCIPCP) associated with the existing community fishing association (APIAT) (benefitting 47 association members with an estimated 25% increase in monthly income, and adding 5 additional new jobs), a new female producers association (Grupo Arapaima, with 15 active members) in the urban fishing community), and four female-led microenterprises (three of the female entrepreneurs previously had no income-earning activities, each now earns an average of \$ 250 USD/month, or 17% more than the national minimum wage); and
- d) Increased female leadership, indicated in that representatives from the all-female producers group ARAPAIMA participated in 5 regional and 2 national level fairs, promoting the diversified, increased consumption of fish and associated fish-based value-added products (fresh and cooked).

At the end of the project, the most significant impact of these results is directly improved livelihoods (for an estimated 250 families) through new household income associated with value-added processing and improved distribution of the benefits of fisheries. Additionally, we have confirmed that the current levels of fishery exploitation (a main livelihood activity practised by more than 300 families in 8 communities in the TCO TIM II study region) are within ecologically and socially sustainable levels. We expect that within 3 years, as returns at the local level continue to improve through increasing fisheries production and value-added processing, resource sustainability will be ensured through the implementation of a model (initiated during the project) that estimates and monitors environmentally sustainable yields that also support ecological diversity and socially sustainable returns (based on the stock assessment technology).

In the Amazon region (Yapacani aquaculture pilot focus), technology included:

- A polyculture experiment (using native species *Colossoma macropomum*, *Piaractus brachypomus* or their hybrids, and *Prochilodus nigricans*) that provided new fish for home consumption and sale, in addition to improving water quality and pond productivity for existing fish culture;
- Technical training for producers, extension agencies and private sector (5 in technical exchange, over 200 in workshops, and over 300 in national aquaculture symposium) on: nutrition, disease prevention and treatment, cold chain, and breeding; and
- A technical review and participatory gap analysis of past interventions in the region with a wide range of partners at national, regional and local scales.

Key results included:

<sup>2</sup> According to Bolivian National Institute for Statistics, <http://www.ine.gob.bo/indice/general.aspx?codigo=41201> consulted online May 23, 2014



- a) High local acceptance for polyculture and associated training (all 37 families provided with fish continue to implement polyculture and perceive the returns as very positive both in terms of new income potential and subsistence);
- b) Regional uptake of polyculture (an estimated 50 families not engaged in the experiment are now also implementing polyculture based on positive perceptions of the experiment.)
- c) A new protocol (PACU Protocol) for assessing the feasibility, designing and implementing family-based aquaculture initiatives based on native-species. This was developed in partnership with a regional NGO (CEPAC) and the national aquaculture institute IDP PACU (formerly CIDAB).

At the end of this project, the most significant impacts include improved livelihoods for 87 families associated with new income and food and improved pond productivity produced through polyculture, and the official adoption by the national government (through the new national agency responsible for fisheries and aquaculture, MDRyT – IPD PACU<sup>3</sup>) of the PACU protocol. Additionally, in April 2014, IPD-PACU hosted the first National Fisheries and Aquaculture Expo in La Paz, to improve recognition of the important contributions and potential of the fisheries and aquaculture sectors nationally. Associated with this, a planned investment of 40 million Bolivianos (approx. CAD \$6 million) was announced to promote development of the fisheries and aquaculture sector, through support for families at the producer level, with an emphasis on value-added processing. We expect that over the next 3 years, the PACU Protocol (in addition to the training delivered to a variety of actors through project workshops and symposia) will contribute to the design and implementation of new projects for family-based aquaculture, using these new funds.

## AFS OUTCOME

**# 2 Dietary diversity & nutrition.** *How has the project contributed to dietary diversity/balanced diets, particularly for women and children? (e.g. food safety practices and regulatory frameworks; food fortification; local nutritional needs)*

### Project Objective

**1.2 – To improve the contribution of culture-based adaptive fisheries management to food security, household income and value-chain participation of women and indigenous groups in a pilot zone (northern Bolivian Amazon)**

The project developed and tested a food security assessment tool (household survey) (n=811) adapted to the local context. Based on application of the survey tool, a baseline understanding of the current nutritional status, food security and dietary diversity of rural and urban households in this under-studied region was developed, including a focus on the contributions of fish and the nutritional value of key native fish species<sup>4</sup>. Pilot interventions were

<sup>3</sup> MDRyT IPD – PACU is the Decentralized Public Institute for Fisheries and Aquaculture, associated with the national Ministry of Rural Development and Lands, created by national decree on March 12, 2014, and replacing CIDAB.

<sup>4</sup> The survey detected moderate to high food insecurity (58% of rural and 40.6 % of urban households in the low water season), stunting and high rates of chronic infection. Poor knowledge and practices regarding Infant and Young Child Feeding were identified as a contributing factor, as well as moderately low dietary diversity. In focus groups and fisheries data collection (including a detailed dietary diversity study) in 6 rural indigenous fishing communities, we found relatively high levels of fish consumption in both wet and dry seasons, based on a very high diversity of native species (n=57), and a wide variety of locally harvested forest products with significant potential to contribute to improved diets.





developed and implemented on a case-by-case basis with rural and urban groups, according to the needs and priorities identified for each.

New partnerships with the municipal health network 'Red de Salud' and the national food security program Desnutrición Cero ("Zero Malnutrition") were developed, resulting in co-delivery with the Red de Salud of intervention workshops (training on infant and young child feeding, maternal health), renewed commitments to meet existing mandate to provide services to vulnerable rural groups (monthly visits), and co-production and distribution (n=500) of an updated poster developed in community workshops and promoting dietary diversity for Amazon families based on locally available foods.

Nutritional analysis revealed a variety of micronutrient values significant for some of the lower cost native fish, with buchere (*Hoplosternum littorale*), and lisa (*Leporinus trifasciatus*) being particular standouts overall, especially if eaten whole. In the case of the paiche (*Arapaima gigas*), appreciable levels of essential fatty acids were detected, with higher concentrations in the lower-value (sometimes discarded) abdominal meat. Consequently, food distribution to needy families (paiche abdominal meat) was promoted at the new paiche processing centre established in Trinidadito, training on recipes using paiche (abdominal meat and other underutilised parts) and a diversity of local ingredients was carried out in cooking workshops for urban and rural groups, and a new demand for these products is growing.

At the end of the project, our understanding of the complexity of the specific food security and dietary diversity issues faced by the urban and rural communities has greatly improved. However the impact of project interventions on directly resolving these issues was limited. The project proposal had hypothesized that promoting increased fish consumption could be a means to address food insecurity in general. We found this to be applicable in the urban and peri-urban groups in cases, where lower-cost fish are available in markets and their consumption was promoted. Accordingly, the interventions emphasized making better use of previously undervalued or discarded fish with significant nutritional value, including the lower-value belly meat of paiche, thus increasing both the nutritional and income contributions.

Complementary to this, the workshop interventions in the rural indigenous fishing communities included training to improve income generation for improved access to purchasing food (value-added fish processing, improved handling to improve returns to producers); training on knowledge of locally available foods with high micronutrient value (to improve nutrition through use of wild-harvested foods<sup>5</sup>); and health knowledge and behaviours related to hygiene and to infant and young child feeding (to improve nutrition). However, these communities also face significant issues beyond fisheries which limit their ability to achieve improved nutrition and dietary diversity, including: high seasonal vulnerability to floods and associated crop failure; lack of adequate drinking water and lack of access to public healthcare. The project worked on social capital to address these issues as well, building awareness of needs among policy-makers and key public authorities, supported development of complementary proposals that might address some of these issues more directly, and counselled communities on lobbying for access to health services. In fact, during the course of the project, one of the communities received a project for a new well to improve their drinking water source.

At the national level, the new fishery & aquaculture law proposed by the project makes specific reference to the important contributions of fish to food security. This is also referred to within the 13 pillars of the Strategic National

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<sup>5</sup> Several of the rural communities have access to wild palm fruits with significant nutritional properties, including for example peach palm or 'chonta' (*Bactris gasipaes*) and buriti, or 'palma real' (*Mauritia flexuosa*) which are both excellent sources of Vitamin A.



12-year Plan “Agenda Patriótica 2025,” which was launched in 2013. It is expected that this law will represent an umbrella for further development of regulatory frameworks at regional (department) and local (municipal) level. We expect that the fisheries management planning initiated by the project will continue to develop over the next three years, supported in part by complementary proposals developed during the project, as well as by development of regulations under the new ministerial resolution on paiche and the new fisheries law, both developed by the project. This will ensure a sustainable harvest and continued positive returns (for subsistence and income generation) to the communities that depend on these resources. The market demand for value-added fish products will continue to develop and expand, contributing to nutrition through improved income and livelihoods pathways. The final results of the baseline study and nutritional analysis of fish have recently been distributed to national policy makers, including Red de Salud and Desnutrición Cero, and it is expected that on-going partnership development with these agencies could result in improved recognition of the value of fish contributions regionally, as well as new plans to improve service delivery to the marginalized rural communities. Specifically, improved water, access to healthcare and planning to address significant flood vulnerabilities of the rural indigenous study communities continue to be critical factors which will need more direct attention in order to improve nutrition and overall food security. Fisheries livelihoods are a good theme to help also carry these other issues of integrated community needs.

<b>AFS OUTCOME</b>	
<b># 3 - Engagement of Canadian researchers with Southern researcher organizations (for CIFSRF-funded projects only). Is there increased use of Canadian knowledge and resources to address environmentally sustainable agricultural productivity and nutrition problems in developing countries?</b>	
Project Objectives	
<b>1.2 – To improve the contribution of culture-based adaptive fisheries management to food security, household income and value-chain participation of women and indigenous groups in a pilot zone (northern Bolivian Amazon)</b>	<b>1.3 – to improve the contribution of small-scale aquaculture to food security, indigenous household income, and gender sensitive participation in a pilot zone (Mamoré River basin).</b>
<p>Most of the research in the project was done jointly, building on synergies between Canadian and Bolivian experience and know-how, as evidenced by the multi-authored nature of all of the publications. Canadian know-how on genetic analysis, nutritional analysis, food security surveys, participative value chain assessments and aquaculture are some specific contributions to the project, in addition to Brazilian know-how on aquaculture and economic evaluation that came out of earlier CIDA-funded projects in Brazil.</p> <p>Canadian researchers have contributed substantially to the project through direct engagement, coordination and collaboration on project activities in the field, remote support for methodology development, inputs during technical visits, and training. Canadian knowledge has thus been integrated into the objectives of the project, but Canadian researchers have also gained substantial knowledge about food production, nutritional problems, and research in Bolivia. This bilateral learning is reflected in the publications that are coming out of the project, collaboration with on-going research elements, and collaboration on new proposals (including a CIFSRF proposal for scaling up).</p> <p>In terms of training, the methodology for the household survey was developed in partnership with UBC and with contributions from FA and WFT, training 22 Bolivians in survey methodologies, while the aquaculture initiative trained a total of 448 Bolivians (including 243 women) with direct Canadian input, and the value-chain initiative involved over 186 Bolivians (over half females). Brazilian collaborators of the Canadian team</p>	



(trained during previous CIDA-funded projects in Brazil), provided training opportunities in Brazil for 5 key aquaculture practitioners (including 3 women) on nutrition, disease prevention and breeding (CEPTA), one Bolivian female researcher on nutritional analysis (UFRJ), and 2 Bolivian women on Participatory Economic Development for agricultural producer groups (CAPINA). Brazilians (also from past CIDA-supported initiatives) also provided training in Bolivia for fishermen and women on paiche stock assessment. Additionally, project research contributed to 2 Canadian graduate theses (one female) and three Bolivian theses (two female, one male).

Two Bolivian researchers (including 1 woman) spent a combined total of 12 weeks visiting Canadian research institutions to participate in training and technical exchange on topics including: indigenous aquatic resource management and governance (Namgis Resource Management, Alert Bay, BC; First Peoples House, University of Victoria, BC), community-based resource management (COADY Institute certificate course in community-based resource management (St. Francis Xavier University, NB)), nutrition research (Land and Food Systems, UBC; DFO Marine Ecosystems & Aquaculture Division of the West Vancouver Lab), genetic research on fish (iBOL and University of Guelph, Waterloo, ON; Department of Biology, University of Victoria BC, SeaStar Biotech, Victoria, B.C.), development of environmental DNA tools (Seastar Biotech and Department of Biology, University of Victoria BC), and modelling of lagoon ecosystems and fisheries to inform development of sustainable fisheries management plans (Department of Biology, University of Victoria BC). Two other Bolivian students (both women) associated with the Bolivian partner organizations, are currently on ELAP internships at Canadian universities (UVic and McGill), organized by the CIFSRRF project.

We foresee that on-going collaboration between Faunagua and other Bolivian organizations with WFT and their Canadian and Brazilian collaborators will continue to provide appropriate inputs to Bolivian issues associated with the current project, at least for the next 5 years. In addition, new research collaboration on spectral analysis of waterways (UVic) and social impacts of climate change (McGill) are new complimentary initiatives that will mature over the next several years.

## AFS OUTCOMES

**# 4 Research groups.** *How has the project contributed to stronger research groups for improved food security policies and decision-making?*

### Project Objective

**1.5 To help construct the enabling environment for governmental strategic planning of the fisheries and aquaculture sector**

The Bolivian partners in the project, in particular FAUNAGUA, have been considerably strengthened through the project, with multiple training opportunities for staff, greater recognition of its input in multi-stakeholder venues and government policy development. FAUNAGUA has been able to expand its institutional capacity to new areas, conducting innovative research in domains with high potential for improving food security. For example, FAUNAGUA has been sought out to provide inputs to the fisheries and aquaculture regulations, policy of the IDP-PACU, and the foreign ministry on the impacts of hydroelectric dams, and the Moore Foundation on participative monitoring. These strengths contribute to food security through both improving livelihoods of fisheries and aquaculture practitioners and the availability of fish to the public.

The project engaged 168 policymakers and 65 NGOs in activities, including 3 Ministries (Ministry of Environment, Ministry of Lands and Rural Development, Ministry of the Exterior) and the National Centre for Aquaculture Development Research (CIDAB, now IPD-PACU). This has meant a good reach in terms of



influencing policy both through technical contributions and facilitating consensus-building amongst stakeholders, reflecting on the improved capacity of Faunagua, which they have successfully leveraged to secure funding from the Brazilian NGO Fondo Socioambiental CASA, the Bolivian NGO Fundación Amigos de la Naturaleza (FAN) and the Programa de Investigación Estratégica en Bolivia (PIEB), the Dutch branch of the International Union for Conservation of Nature (IUCN-NL) for work in southern Bolivia, the Ministry of the Exterior, and The National Institute for Agricultural and Forestry Innovation (INIAF). Internally, Faunagua considers the project a 'programmatic approach' for initiatives with fisheries, and, uses it as a model and framework to support integrated approaches in its other projects, an approach that is likely to grow over the next years.

#### AFS OUTCOMES

**#5 - Food distribution.** *How has the project contributed to more equitable food distribution for food security? (e.g. more equitable access to quality food)*

**#8 - Access to resources.** *How has the project contributed to improved access to resources for food production and security? (e.g. land tenure, extension and credit, market access)*

#### Project Objective

**1.3 To improve fish handling, processing and marketing in pilot zones.**

**1.5 To help construct the enabling environment for governmental strategic planning of the fisheries and aquaculture sector**

The project has contributed significantly to the consolidation of a fish market in Riberalta where low-priced (native) fish are available and to the development of models and (regulatory) frameworks that guarantee fish quality in these markets. The project collaborated with the Riberalta municipal government in developing Fish Fairs to promote consumption of high quality and diverse local fish. These were implemented in each of the three years of the Project, with official designation of the event for the 5-6th of August by the Municipal law N° 18/2012-2013.

New paiche processing in Trinidadito provides previously unavailable fish meat from the belly portion of paiche and "racks" of paiche ribs that are sold locally at affordable prices or donated to local needy families. Nutritional analysis suggests that these are in fact the parts of the fish that are most nutritious in terms of micronutrients and essential fatty acids. Local consumption of paiche during the project increased from 5 to 18% of the households in Trinidadito, as measured in 24 hr recall interviews.

The PPV Project also contributed significantly to the legalization of the commercial exploitation of fish resources by indigenous communities, opening the door to improved indigenous livelihoods. Prior to this, commercial fishing was prohibited in the TCO TIM II, even though about 13 communities depended on this livelihood directly or indirectly. Now they can do this legally, through establishing local Community Plans that include a resource harvesting and management strategy.

The project has influenced government policy directly through participative writing and review of the new fisheries and aquaculture law (now approaching final approval), discussions and negotiation with indigenous governments on commercial use and access of fisheries resources (leading to a new regulation for the approval of commercial opportunities for fishing in one indigenous territory so far), consolidation of a national working group to address introduced aquatic species (leading to two specific ministerial resolutions on commercial fisheries for the introduced paiche fish, one to be approved in June 2014 and the other one





expected this year) and the development of a protocol for culture of the native pacu fish, as well as a strategic plan for development of family-based aquaculture in the Amazon region (both to be published this year). While the contribution of fish to food security was included in the law proposal, it is expected that effects of all of these policies on food security will be secondary and long-term, through improved resources access, strengthened policy support for value chains (“productive complexes”) and improved livelihoods.

The family-based aquaculture units supported by the project sustain a value chain supplying high quality fish to local markets in Yapacani (over 60% of the production), which traditionally had only seasonal access to a depleted resource in the local rivers. Polyculture with sabalo provides the fish farming families a low-cost option to supplement their household diets with high quality protein when needed.

Collaborative work with the Municipal Health network produced an educational poster on the use of nutritional local food ingredients (see above).

All of these initiatives are starting points to continuing contributions for the foreseeable future.

#### **AFS OUTCOME**

**#6 - Food processing and storage.** *How has the project contributed to improved post-harvest food processing and storage techniques for food security?*

##### **Project Objective**

##### **Objective 1.4 To improve fish handling, processing and marketing in pilot zones**

An area of the project specifically deals with improving handling and processing of fish to improve the quality reaching the consumer, carried out in collaboration with the Argentinean Foundation PROTEGER. A survey was conducted to identify problems in fish handling, as well as a survey on current market conditions, and a component of a household survey that indicated a high incidence of diarrhea (potentially an indicator of poor water quality and/or hygiene). As a result, training workshops were held focussed on cooking of fish, including using appropriate hygiene and promoting the use of healthy cooking techniques and recipes that make use of a diversity of locally available, highly nutritious foods. Additionally, an integrated program to improve hygiene and processing at all stages of the fish production chain (from river to plate) was piloted, involving a variety of different actor groups, and associated with a process to improve local technologies for fish conservation and processing (testing live-storage boxes, improved hygiene in transportation boxes, monitoring quality along the production line), an upgrade to the local fish market, and the documentation of protocols for hygiene and processing in an accessible manual (together with SENASAG - the government institution with responsibility for food safety). Research on improved assessment tools for fish quality and improved, socially equitable provisioning of ice were initiated, but not completed within the project period. Improved ice boxes were designed, and as an alternative to ice, live-holding facilities were designed and constructed for remote fishing communities..



## AFS OUTCOME

**#7 - Risk-mitigation.** *How has the project contributed to better risk-mitigation for food security? (e.g. mechanisms that cope with the impacts of climate change, and other shocks such as food price volatility)*

### Project Objective

**Objective 1.5 To help construct the enabling environment for governmental strategic planning of the fisheries and aquaculture sector.**

Historical data on rainfall since 1946 were tabulated and analysed in the project, with new monitoring stations for rainfall and water level established for improved on-going monitoring. This provided a baseline and an opportunity to look at climate trends, to help predict the likelihood of climate-change related impacts.

The sensitivity of fishing communities to climatic changes and existing spontaneous adaptation strategies in 4 pilot communities were also mapped and presented to local and regional institutional partners for discussion. Significant contributions have been made to the inclusion of adaptation strategies in planning of fisheries in indigenous territories, in this case the territories affiliated to the indigenous organizations CIRABO and CIPOAP through a cooperative agreement with FAN). The indigenous strategic plan will gradually be incorporated in municipal development plans (PDM), thus guaranteeing governmental support in risk-mitigation and strategic intervention. The effectiveness of this will become evident in the response to the flood of February/March 2014.

The project, together with other partners, investigated two further stressors to the region: introduced species and dams. The effect of the introduction of the paiche fish was studied, including its impact on native fish and its contribution to changing fishing livelihoods. These results are being published in a number of venues, and contributed to designing a draft governmental policy on management of the paiche.

Dams are a second predictable threat. Two large dams were recently built on the Madeira River in Brazil, influencing the migration of fish, and potentially changing the flood regime in Bolivia. FAUNAGUA prepared a baseline document on indicators of impacts of these dams for the Ministry of Foreign Affairs, informed by the PPV project. Approx. 65% of the base line data originated from the project. These monitoring tools (base line + monitoring system) will be valuable for predicting impacts and risk-mitigation to protect livelihoods that depend on fish.

The vulnerabilities maps from 3 indigenous fishing communities has been presented as part of the results brochure (Appendix-Publications) to the TCO TIM II government, as well as 3 municipal governments (San Lorenzo, Riberalta, Gonzalo Moreno) for help in planning. The rainfall and temperature data has also been shared in a results meeting in Riberalta.

The information generated in the project on introduced paiche fish, including impacts on native fish and changing fish livelihoods was shared through multiple means, including conferences, results meetings, local media and publications. They have been used directly in designing a draft governmental policy on the management of paiche.

The project provided 65% of a baseline document on indicators of impacts of Brazilian dams for the Bolivian Ministry of Foreign Affairs, providing valuable tools for predicting impacts, such as elimination of migratory fish and changed flood regimes, and designing risk mitigation to protect livelihoods that depend on fish.

PPV contributed significantly to the inclusion of adaptation strategies of fisheries in indigenous territories through CIRABO and CIPOAP through a cooperative agreement with FAN; an indigenous strategic plan developed with them is being gradually incorporated in municipal development plans (PDM), thus



guaranteeing governmental support in risk-mitigation and strategic intervention. The effectiveness of this will become evident in the response to the flood of February/March 2014.

The climate baseline information, change analysis, and ongoing data collection from the monitoring stations will allow municipal governments in the region to better predict and prepare for climate-change related impacts, including improved responses to extreme events.

The Bolivian Ministry of Foreign Affairs will be able to make use of the dam impact studies and related monitoring in their negotiations with Brazil for appropriate mitigation measures and compensation. This will also inform any Bolivian plans for hydroelectric development.

Likewise, the Ministry of Rural Development and Land will be able to use the studies on impacts of paiche, and the ministerial resolutions on its exploitation, in planning the appropriate use of this resource for livelihood and food security improvements, while mitigating risks of impacts on native ecosystems.

#### **AFS OUTCOMES**

**# 10 - Policy options.** *How has the project influenced the development and implementation food security policies?*

##### **Project Objective**

##### **1.5 To help construct the enabling environment for governmental strategic planning of the fisheries and aquaculture sector**

The project engaged 168 policymakers and 65 NGOs in activities, including 3 Ministries (Ministry of Environment, Ministry of Lands and Rural Development, Ministry of the Exterior) and the National Centre for Aquaculture Development Research (CIDAB, now IPD-PACU). This has meant a good reach in terms of influencing policy both through technical contributions and facilitating consensus-building amongst stakeholders. This is evidenced by the approval of the new aquaculture and fisheries law, creation of a draft policy on the use of introduced fish species (paiche), joint publication of aquaculture development strategies and protocols, and a baseline of fisheries data to assess the impacts of hydroelectric development. The new national Public Decentralized Institute for Fisheries and Aquaculture (IPD PACU) has incorporated and endorsed project outputs including the strategic policy directions for Tropical Aquaculture document, and the protocol for tropical family-based aquaculture. The Bolivian partner (Faunagua) has leveraged the project and successfully secured funding from the Brazilian NGO Fondo Socioambiental CASA, the Bolivian NGOs Fundacion Amigos de la Naturaleza (FAN) and the Programa de Investigación Estratégica en Bolivia (PIEB), the International Union for Conservation of Nature (IUCN) for work in southern Bolivia, the Ministry of the Exterior, and The National Institute for Agricultural and Forestry Innovation (INIAF).

Access to the fishing resource is a key component for urban fishing livelihoods, but also a source of conflicts between urban commercial fishers and rural indigenous fishers. It was decided not to intervene directly in this conflict, but rather to strengthen local stakeholders to prepare them for engaging in multi-stakeholder discussion, as well as help build a clearer legal environment.

As a first step, the project helped create a legally constituted regional fishing Federation that represents 14 existing fishing and commercial associations who previously did not have legal status – including both urban and rural fishers. This is the first time that indigenous fishermen and women from this region are specifically represented at the national level. The Federation played a crucial role in the participative review and modification of the Fisheries & Aquaculture Law, where resource access by the two groups in conflict is partly



clarified and regulated. The project contributed to this law in other venues as well, through participative writing and review. This draft law was presented to the Minister in October, 2013, and is in the final approval stages.

Introduced aquatic species, such as paiche, are not considered in the Fisheries and Aquaculture Law, despite representing a large proportion of some of the Amazonian fisheries. The project thus facilitated a specific bi-ministerial resolution on fisheries for introduced Amazonian fish such as the paiche, expected to be approved in 2014. This will clarify access and management options for this fish.

For aquaculture, the project produced a development strategy for tropical aquaculture and improved culture protocols for family-based culture of the native pacu fish, both to be published this year with IDP-PACU of the national government.

In the fisheries & aquaculture law a specific “principle” was included due to project input on the contribution of fish to food security:

“Art. 4. Seguridad y soberanía alimentaria: La pesca y acuicultura contribuirán de forma prioritaria a la seguridad alimentaria de la población boliviana. Se considera a la carne de pescado como un producto estratégico para contribuir a la seguridad alimentaria del pueblo boliviano.”

Though this article is not in itself a guarantee for more equitable (fish) food distribution, the impact of its content might cascade along the regulatory systems at regional (autonomous governments) scale which have to be designed and/or adjusted in the next few years. It is expected that effects on food security of all of these policies will be long-term, through improved resources access, strengthened policy support for value chains (“productive complexes”) and improved livelihoods. The Minister of Rural Development and Lands has re-evaluated the 2010-2015 strategic plan for the agricultural sector to formally include fisheries and propose to increase the per capita fish consumption from the current 1.8 kg/person/year to 5.2 kg/p/yr.

The Household survey results and the vulnerability and adaptation research, in addition to new partnerships with local and regional health authorities will allow for the development of more relevant food security programs and policies integrating fisheries into the larger local food security question. This will address specific needs in the region, including contribution to the “Plan Operativo Annual” of the municipalities for 2014 and 2015. There is keen national interest in the results of the household survey, especially though the Desnutrición Cero program. Examples of inclusion of project results in municipal POAs have been the contribution to local resource utilization plans through a collaborative project with the FAN, another Bolivian NGO, and the creation and legal designation by municipalities of the fish fairs and the 5-6th of August as “Fisherman/woman’s Day”.

#### **AFS OUTCOME**

**# 12 - Gender.** *How has the project considered women’s specific needs in the design of the research, participation of women in the research, and potential impact of research on women? How has the project: a) improved women’s access to and control over income?; b) reduced women’s drudgery or workload (time spent) in agriculture?; and/or c) improved women and children’s access to adequate and diversified diets?*

#### **Project Objective**

**1.2 – To improve the contribution of culture-based adaptive fisheries management to food security, household income and value-chain participation of women and indigenous**

**1.3 – to improve the contribution of small-scale aquaculture to food security, indigenous household income, and gender sensitive participation in a pilot zone (Mamoré River basin).**





**groups in a pilot zone (northern Bolivian Amazon)**

The project's gender strategy included a variety of activities at different levels: gender specialist engagement in research design; training of project staff on concepts and tools for gender analysis, gender-responsive activity planning and data collection; participatory approaches to research and development interventions that included either a gender-responsive aspect or a gender transformative approach; and the collection of gender-sensitive sex-disaggregated data for baseline and monitoring. The gender analysis carried out by the project identified overall social and economic marginalization of rural fishing families, lack of recognition of female participation in fisheries value chains (especially with respect to subsistence fishing and family food security) (rural women), lack of access to and control over income (urban and rural women), and high incidence of domestic and sexual violence (urban and rural women) as significant issues in the study area.

The First Regional Fisherwomen's Forum, implemented in Riberalta in 2013, in addition to providing valuable information on gender aspects of fisheries livelihoods, value chains and dietary diversity that informed the selection and design of community-level interventions for the project, also contributed to the formation of a collective identity for women in the fisheries sector. Since the forum, 1 of the regional fishing associations (representing approx. 60 members) has elected a new female president, and 5 females have joined the professional fishing association in Trinidadcito (with a total 47 members).

The Arapaima Association created by the project to develop new income generation opportunities for urban-based women engaged in the fisheries sector (value-added paiche fish products), provided opportunities for leadership development and increased visibility of women in fisheries, and created a safe space for reflection and dialogue on gender inequalities and women's empowerment. Four female-led family-based microenterprises were initiated with members of this group (three of the female entrepreneurs previously had no income-earning activities, each now earns an average of \$ 250 USD/month, or 17% more than the national minimum wage).

15 female fish sellers benefitted from improved hygiene and product quality in the newly constructed fish market space at the Campesino market (Abasto) in Riberalta.

37 female fish culturists in Yapacani who participated as part of a farmer-led research experiment involving polyculture (including sabalo as food fish and to improve returns in existing pacu ponds) earned additional income and fish for subsistence use, as well as participating in technical training in Brazil (n=3) and Bolivia (n=37).

17 indigenous women in Trinidadcito were trained on artisanal craft making with paiche by-products (leather and scales), one of these women won a national award for artisanal craft in 2013. 5 women also gained new employment in paiche processing in the new paiche processing centre (CCIPCP).

114 members of rural indigenous fishing families (more than half female) were trained on economic feasibility analysis, increasing transparency and understanding of the fixed and variable costs of fishing at various levels of the value chain and providing a basis for improving control over income through collective price negotiations with middlemen and municipal authorities.

In sum, at the end of the project, livelihoods of over 137 women were directly improved through enhanced access to and control over income generation. An estimated additional 250 women benefitted indirectly from improvements in knowledge and practices regarding hygiene, maternal and infant health, infant and young child feeding, and dietary diversity.

Over the next three years, it is expected that the female-led family-based enterprises initiated during the project will continue to be successful and that other local women may also start similar initiatives, as existing demand for their products is currently high and local interest and market acceptance for paiche products



overall continues to grow. In the case of the polyculture initiative in Yapacani region, CEPAC will continue to provide assistance, and has applied for complementary funds for additional training through the Brazilian national agency EMBRAPA, as well as the Latin American Aquaculture Network (RAA) and the InterAmerica Bank. National support for family-based aquaculture is also expected to increase significantly, with the endorsement by the new national agency IPD-PACU of the project-developed protocol for planning family-based aquaculture initiatives, a new national target for fish consumption of 16kg/person/year (increase from current estimated consumption of 1.8kg/person/year) and the announcement of \$ 40,000,000.00 Bolivianos (equivalent to CAD \$6 million) to support family-based fisheries and aquaculture producers, as part of an overall \$ 88,000,000.00 investment to the fisheries and aquaculture sector between 2014-15.

### **AFS OUTCOME**

**# 13 - Environment.** *How has the project tested for and contributed to environmental sustainability? (e.g. Has the project affected the environment? If so, are contributions environmentally sustainable?)*

#### **Project objective**

#### **1.5 To help construct the enabling environment for governmental strategic planning of the fisheries and aquaculture sector**

The environmental assessment for the project was waived by IDRC, as it was determined that there were no likely significant negative environmental impacts of construction activities of the project. Nevertheless, the project fostered environmental sustainability throughout, in its focus on promoting training and planning for aquatic resource management that is environmentally and socially sustainable, both for fishing and aquaculture. Environmentally responsible aquaculture practices were published in a national protocol for small-scale culture of tropical native species, developed participatively with small and large scale aquaculturists, and published with the national agency responsible for aquaculture development. Finally, the project was involved in assessing environmental impacts of Brazilian hydroelectric development on Bolivia, within the scope of risk assessment for the fisheries sector.

## **6. Problems and challenges**

The main challenges that the project faced included:

*Changing recognition of needs as the project advanced.* The multi-faceted nature of the project called on a diverse set of partners to provide expertise on its various aspects, and engaged a great variety of stakeholders. However, matching the expectations, schedules, and relevance of these different proposed partners with the needs and schedules of the project as it developed meant changes in the use of some of these partners, some new partners, revised project strategies, and other adaptive mechanisms. Logistically, this meant delays in some areas (for example, nutritional analysis and training missions), re-organized budgets (for example, increasing in-country management and research presence of WFT), and re-evaluated plans (e.g. for food security and gender interventions);



*Government support.* As a non-governmental project proposing changes at the community and policy levels, the PPV project was highly sensitive to vagrancies of government engagement. The approach taken was to ensure the production of reputable, useful technical products, a solid community base of support, and a focus on equitable, non-partisan engagement, and reconciliation between stakeholders. In this fashion, an initial governmental reluctance to collaborate with the project turned into examples of superb collaboration – for example, with CIDAB and its successor, IDP-PACU and an increasing call for technical inputs for governmental initiatives. Nevertheless, challenges of engagement continued throughout the project to its end.

*Financial challenges.* Expectations of WFT for some aspects of the project, especially in-country activities, developed as greater than initially budgeted, and for AS, whose initial budget did not include much work in the final years of the project. Nevertheless, overall budgets for carrying out the needs of the project were adequate.

## 7. Recommendations

### *Administrative Recommendations to IDRC on scope, duration, or budget.*

The research partnership between Faunagua, Agua Sustentable and World Fisheries Trust involved a significant amount of cross-disciplinary and inter-institutional dialogue, with substantial knowledge sharing, joint strategy development and integrated approaches to research and interventions in the field. With such a large and diverse team, maintaining effective coordination and communication has been an ongoing challenge, and as the partnership continued to mature, a memorandum of understanding for coordinated project management was signed, including regular coordination meetings, new interactive tools for communication and cooperation. They also discussed the following topics: a) Appropriation of the project and results by different beneficiaries (communities, fisheries organizations, local government) - levels of co-responsibility and management; b) Economic and productive aspects of proposed sub-projects - improved access to information, capacity building, economic and technologic resources; c) Institutional autonomy of counterparts, including perspectives on strengthening and organizational learning, based on creative, flexible, independent decision making processes and collaboration opportunities; d) Collaborative inter-institutional and inter-stakeholders networks based on common agendas about food security and fisheries production.

Development of partnerships and linkages led to a collaborative agreement with the non-governmental organization CEPAC for work with family-based aquaculture, with IMG CONSULTING for work on aquaculture planning, with ULRA (San Simón University, Cochabamba) and WCS (Wildlife Conservation Society) for work on paiche biology and management. A partnership agreement with the government agency responsible for fisheries development, CIDAB was signed in early 2013, and at the end of the project there was a smooth cooperation with the newly created governmental agency IDP PACU, which replaced CIDAB.

With respect to IDRC, flexibility in the expectations and contributions to the project strategy to help address the changing needs and opportunities of the project, particularly towards its end, were greatly appreciated.



## 8. References cited in report

- Arantes, C.C., Castello, L., Cetra, M., Schilling, A. 2013. Environmental factors affecting the distribution of arapaima in floodplains of the Amazon. *Environmental Biology of Fishes* 96: 1257–1267.
- Argote A., Van Damme P.A., Macnaughton A.E., Carvajal-Vallejos F.M. (2014). Línea de base: la pesca artesanal en la Amazonia boliviana: un caso de estudio en la Tierra Comunitaria de Origen Multiétnico II (Pando, Beni). p. 167-175. En: MRE-MMAyA (Eds.). Línea de base sobre ecosistemas y recursos acuáticos de la Amazonia boliviana en el marco de la evaluación de los impactos de las represas Jirau y Santo Antonio en territorio boliviano. Edit. INIA, Cochabamba, Bolivia. 400 pp. (appendix 4.3.1, this report)
- Baker-French, S. (2013). Food security and nutritional status in fishing communities in Bolivia's northern Amazon: results of a household survey. B.Sc in Food, Nutrition and Health (Dietetics), University of British Columbia. 172 p. (appendix 4.4.1, this report).
- Carolsfeld J., Rainville T., Céspedes A., Van Damme P.A., Davy.F.B. (2014). Bolivian tropical aquaculture – viable contributions to food security and poverty alleviation? Submitted to World Aquaculture Society Journal. (Appendix 4.5.3, this report)
- Castello, L., Stewart, D.J., Arantes, C.C. 2011. Modeling population dynamics and conservation of arapaima in the Amazon. *Reviews in Fish Biology and Fisheries* 21: 623-640.
- Castello, L., McGrath, D.G., Arantes, C.C., Almeida, O.T. 2013. Accounting for heterogeneity in small-scale fisheries management: the Amazon case. *Marine Policy* 38: 557–565
- Carvajal-Vallejos, F.M., Macnaughton, A., Coca, C., Trujillo, S., Carolsfeld, J., & Van Damme, P.A. (2013). The introduction of *Arapaima gigas* in the Bolivian Amazon: impacts on fisheries, emerging value chains and perspectives for community-based management. In: Ellen Sílvia Amaral Figueiredo (Ed.) *Biologia, Conservação e Manejo de Pirarucus na Pan-Amazonia*. Tefé, Brazil: IDSM. 278 p. ISBN:978-85-88758-29-2 (appendix 4.3.2, this report)
- Carvajal-Vallejos, FM, Zambrana, V., Barrozo, D., Argote, A., Villafán, S., Zapata, M., Magnaughton, A., Carolsfeld, J. Van Damme, P. 2014. Perspectivas de aprovechamiento sostenible de *Arapaima* aff. *gigas* en Bolivia en base a la pesca indígena. (In prep; Appendix 4.5.4, this report)
- Coca Méndez C., Rico G., Carvajal-Vallejos F., Salas R., Wojciechowski M.J., Van Damme, P.A. (2012). La cadena de valor del pescado en el norte de la Amazonía boliviana: la contribución del paiche (*Arapaima gigas*). PIEB, 220 p. (Appendix 4.2.1, this report).
- Cuevas, V., Carranza V y el Grupo de Mujeres ARAPAIMA. (2013). Cocinando Pescado Sano: cuaderno de recetas, trucos y consejos para cocinar pescado en el Norte Amazonico de Bolivia. Cochabamba, Bolivia: Editorial INIA. (Appendix 4.2.2, this report).
- Hartwich, F., Monge Pérez, M., Ampuero Ramos, L. and Soto, JL. 2007. Knowledge management for agricultural innovation: Lessons from networking efforts in the Bolivian Agricultural Technology System. *Knowledge Management for Development Journal* 3(2): 21-37.
- Herrera Sarmiento E. (2014). Los Ese Ejja y la pesca: adaptación y continuidad de una actividad productiva en un pueblo indígena de la Amazonía peruano-boliviana. Edit. INIA, Cochabamba, Bolivia. 198 pp (Appendix 4.2.3, this report).
- Ledezma, J. Cuevas, V. Coca, C. Carolsfeld, J. Rainville, T. Perez, T. and Zambrana, V. (2013). Manual de buenas prácticas de higiene y manipulación del pescado. Cochabamba, Bolivia: Editorial INIA. (Appendix 4.2.4, this report).
- Macnaughton A., Carvajal-Vallejos F.M., Argote A., Rainville T.K., Carolsfeld J., Van Damme P.A. (2014a). “Paiche reigns!” Local perspectives on livelihoods and management in indigenous fisheries after the





- introduction of *Arapaima aff. gigas* in Bolivia's Northern Amazon. Submitted to *Maritime Studies*. (Abstract accepted to special issue of this journal in November 2013). ((Appendix 4.5.7, this report).
- Macnaughton, A., Perez, T., Baker French, S. et al. (2014b). The contributions of small-scale fisheries to food security and socio-ecologic resilience: rural indigenous communities in transition, Northern Bolivian Amazon. In preparation. Abstract accepted to special issue of *Food Security Journal*, October 2015: "Resiliency-focused approaches to food security in smallholder and subsistence farming systems." (Appendix 4.5.8, this report).
- Martinez, N., Ford, J., Soto, A., Pacheco, P., Rainville, T., McDowell, G. (2014). Vulnerability Assessment in indigenous communities of the TCO TIM II. In prep. (Appendix 4.5.9, this report).
- Molina Carpio, J., Gutierrez Caloir, B., Vauchel, P., Espinoza, V., Jhan, C., Guyot, J.L., Castel, A.P., Noriega, L. (2014). Spatio-temporal variability and trends in the hydrology of the upper Madera River (1967-2013). In prep. (Appendix 4.5.10, this report).
- MDRyT-VDMA-IPD PACÚ (2014a). *Acuicultura Boliviana: Lineamientos estrategicos para el desarrollo de la piscicultura tropical en Bolivia*. Contributing authors: Mendoza J., Cruz C., Flores M., Céspedes A., Carolsfeld J., Rainville T., Macnaughton A. & Van Damme P.A. La Paz, Bolivia: Editorial Inia. (Appendix 4.2.5, this report).
- MDRyT-VDMA-IPD PACÚ (2014b). *Acuicultura Boliviana: Protocolo para el análisis, evaluación y formulación de proyectos de acuicultura tropical*. Contributing authors: Céspedes A., Carolsfeld J., Rainville T., Van Damme P.A., Macnaughton A., Mendoza J., Cruz C., and Flores M. La Paz, Bolivia: Editorial Inia. (Appendix 4.2.6, this report).
- Perez Rivera T. & Argote A. (2014). Nutrición y consumo de pescado en la cuenca del Río Pilcomayo: aspectos metodológicos y primeros resultados de una encuesta. En: Carvajal-Vallejos FM, Van Damme PA, Ledezma J (eds) *Arribando el río Pilcomayo*, pp XX-XX. Editorial INIA, Cochabamba, Bolivia. (Appendix 4.3.3, this report).
- Pérez T., Zambrana V., Van Damme P.A., Carolsfeld J. (2014). Línea de base: consumo de pescado per cápita en la Amazonia boliviana. p. 189-218. En: MRE-MMAyA (Eds.). *Línea de base sobre ecosistemas y recursos acuáticos de la Amazonia boliviana en el marco de la evaluación de los impactos de las represas Jirau y Santo Antonio en territorio boliviano*. Edit. INIA, Cochabamba, Bolivia. 400 pp. (Appendix 4.3.4, this report).
- Rico López, G., Coca Méndez C., Trujillo S., Wojchiechowski M.J. (2014a). Línea de base: situación económica de la pesca en la cuenca baja de los ríos Madre de Dios y Beni (flota pesquera de Riberalta). P. 219-230. En: MRE-MMAyA (Eds.). *Línea de base sobre ecosistemas y recursos acuáticos de la Amazonia boliviana en el marco de la evaluación de los impactos de las represas Jirau y Santo Antonio en territorio boliviano*. Edit. INIA, Cochabamba, Bolivia. 400 pp. (Appendix 4.3.5, this report).
- Thilsted, S.H. 2012. The potential of nutrient-rich small fish species in aquaculture to improve human nutrition and health. In R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan & P. Sorgeloos, eds. *Farming the Waters for People and Food*. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand. 22–25 September 2010. pp. 57–73. FAO, Rome and NACA, Bangkok.
- Van Damme P.A., Carvajal-Vallejos (2013). Los recursos pesqueros de la Amazonía boliviana: explotación actual, potencialidades y amenazas. p. 18.30. In: Collado L., Castro E., Hidalgo M. (Eds.). *El manejo comunitario y gobernanza colaborativa de las pesquerías en la cuenca amazónica*. IBC, Lima, Perú. 164 p. (Appendix 4.3.8, this report).
- Van Damme P.A., Coca Méndez C., Carvajal-Vallejos F.M. (2014a). Línea de base: composición de los desembarques comerciales de pescado en la Amazonía boliviana. p. 176-188. En: *Línea de base sobre*



ecosistemas y recursos acuáticos de la Amazonia boliviana en el marco de la evaluación de los impactos de las represas Jirau y Santo Antonio en territorio boliviano. Edit. INIA, Cochabamba, Bolivia. 400 pp. (Appendix 4.3.9, this report).

Villafán, S. (2014). Dieta del paiche – Arapaima aff. gigas (Osteoglossiformes: Arapaimidae) en el lago El Mentiros, río Madre de Dios (Bolivia). Tesis de grado, presentada para optar al diploma académico de Licenciatura en Biología. Universidad Mayor de San Simón. 61 p. (Appendix 4.4.2, this report).

Wojciechowski, M.J., Coca C., Macnaughton, A.E. (2014). Value chain optimization within a SSF “economic-welfare” hybrid model: an analysis of interventions in the indigenous small scale fisheries value chain in Bolivia's northern Amazon region of Riberalta. In preparation (Appendix 4.5.15, this report).

Zambrana V., Salinas A., Vanderlinden A., Zapata M. & Van Damme P.A. (2014). Línea de base sobre el estado poblacional del bufeo (Inia boliviensis) en la Amazonía boliviana. En: MRE-MMAyA (Eds.). Línea de base sobre ecosistemas y recursos acuáticos de la Amazonia boliviana en el marco de la evaluación de los impactos de las represas Jirau y Santo Antonio en territorio boliviano. Edit. INIA, Cochabamba, Bolivia. 400 pp.

## 9. List of Appendices

**Appendix 1 – Completed AFS Outcomes Narrative Questionnaire**

**Appendix 2 – List of Project Research Outputs** (Publications, research and technical reports, all years)

**Appendix 3 – Quantitative Indicators of Project Results and Impacts**

**Appendix 4 – Detailed Research Outputs (full text versions)** – Research and Technical reports and publications for reporting period September 2013 – March 2014.

### 4.1 FINAL TECHNICAL REPORT

4.1.1. CCIPCPT – Trinidacito Community Paiche Processing Centre

4.1.2. Report on value-added processing: Empresa de Artesanías Curupaú

4.1.3. Report on Grupo Arapaima Lessons Learned

4.1.4. Report on Food Security Focus Groups and Intervention Workshops: contributions to baseline and preliminary monitoring results.

4.1.5. i. Alimentos para la familia Amazonica – Dietary diversity poster.

4.1.5. ii. El Sur Community Research Results Booklet.

4.1.6. Activities and Results for Integrated Participatory Value Chain Analysis and Hygiene interventions in La Zona Sur.

4.1.7. Nutritional Qualities of Bolivian Amazon fish

4.1.8. Report on Lake Fisheries Management

4.1.9. Report on aquaculture interventions

4.1.10. Vulnerability Analysis and Spontaneous Adaptation Strategies in 5 Communities in TCO TIM II

4.1.11. Report on Organizational Strengthening and Public Policy Interventions for Fisheries and Aquaculture in Bolivia

4.1.12. Gender Analysis: Women in the Fisheries Value Chain in Bolivia's Northern Amazon

4.1.13. Economic Analysis of Fisheries in the Lower Madre de Dios and Beni River Basins

4.1.14. Summary of Final Project Meetings: Results Dissemination (Riberalta, La Paz)



## 4.2 BOOKS

- 4.2.1. Coca Méndez et al (2012). La cadena de valor del pescado en el norte de la Amazonía boliviana: la contribución del paiche (*Arapaima gigas*).
- 4.2.2. Cuevas et al (2013). Cocinando Pescado Sano: cuaderno de recetas, trucos y consejos para cocinar pescado en el Norte Amazónico de Bolivia.
- 4.2.3. Herrera Sarmiento E. (2014). Los Ese Ejja y la pesca: adaptación y continuidad de una actividad productiva en un pueblo indígena de la Amazonía peruano-boliviana.
- 4.2.4. Ledezma et al. (2013). Manual de buenas prácticas de higiene y manipulación del pescado.
- 4.2.5. MDRyT-VDRA-IPD PACÚ (2014a). Acuicultura Boliviana: Lineamientos estratégicos para el desarrollo de la piscicultura tropical en Bolivia.
- 4.2.6. MDRyT-VDRA-IPD PACÚ (2014b). Acuicultura Boliviana: Protocolo para el análisis, evaluación y formulación de proyectos de acuicultura tropical.
- 4.2.7. MRE-MMAyA (2014). Línea de base sobre ecosistemas y recursos acuáticos de la Amazonia boliviana en el marco de la evaluación de los impactos de las represas Jirau y Santo Antonio en territorio boliviano.

## 4.3 BOOK CHAPTERS

- 4.3.1. Argote et al. (2014). Línea de base: la pesca artesanal en la Amazonia boliviana: un caso de estudio en la Tierra Comunitaria de Origen Multiétnico II (Pando, Beni).
- 4.3.2. Carvajal-Vallejos et al. (2013). The introduction of *Arapaima gigas* in the Bolivian Amazon: impacts on fisheries, emerging value chains and perspectives for community-based management.
- 4.3.3. Perez Rivera T. & Argote A. (2014). Nutrición y consumo de pescado en la cuenca del Río Pilcomayo: aspectos metodológicos y primeros resultados de una encuesta.
- 4.3.4. Pérez et al. (2014). Línea de base: consumo de pescado per cápita en la Amazonia boliviana. p. 189-218.
- 4.3.5. Rico López et al. (2014a). Línea de base: situación económica de la pesca en la cuenca baja de los ríos Madre de Dios y Beni (flota pesquera de Riberalta).
- 4.3.6. Salas et al. (2013). La Amazonía boliviana en tiempo de cambio: oportunidades y desafíos para la pesca artesanal.
- 4.3.7. Trujillo Bravo, S. (2013). Fishing in Bolivia's Northern Amazon, History, Problems and Perspectives.
- 4.3.8. Van Damme and Carvajal-Vallejos (2013). Los recursos pesqueros de la Amazonía boliviana: explotación actual, potencialidades y amenazas.
- 4.3.9. Van Damme et al. (2014a). Línea de base: composición de los desembarques comerciales de pescado en la Amazonía boliviana.
- 4.3.10. Zambrana et.al. (2014). Zonas de Inundación en el norte amazónico

## 4.4 Graduate Theses

- 4.4.1. Baker-French, S. (2013). Food security and nutritional status in fishing communities in Bolivia's northern Amazon: results of a household survey
- 4.4.2. Villafan, S. (2014). Dieta del paiche – *Arapaima aff. gigas* (Osteoglossiformes: Arapaimidae) en el lago El Mentiroso, río Madre de Dios (Bolivia).



#### 4.5 WORKS IN PREPARATION

##### Peer Reviewed Articles

- 4.5.1 Aguilar et al. (2014). Determinación de la dieta de Arapaima aff. gigas (Osteoglossiformes: Arapaimidae) en lagos de los ríos Beni y Madre de Dios (Bolivia).
- 4.5.2 Carolsfeld et al (2014a). Nutritional qualities of Bolivian Amazon fish.
- 4.5.3 Carolsfeld et al (2014b). Bolivian tropical aquaculture – viable contributions to food security and poverty alleviation?
- 4.5.4 Carvajal-Vallejos et al. (2014). Perspectivas de aprovechamiento sostenible de Arapaima aff. gigas en Bolivia en base a la pesca indígena.
- 4.5.5 Castel and Molina (2014). Long-term climate variability and trends in the Bolivian Amazon plain.
- 4.5.6 Coca et al. (2014). Desarrollo equitativo de la Pesca artesanal indígena en el norte Amazónico de Bolivia.
- 4.5.7 Macnaughton et al. (2014a). “Paiche reigns!” Local perspectives on livelihoods and management in indigenous fisheries after the introduction of Arapaima aff. gigas in Bolivia's Northern Amazon.
- 4.5.8 Macnaughton et al. (2014b). The contributions of small-scale fisheries to food security and socio-ecologic resilience: rural indigenous communities in transition, Northern Bolivian Amazon.
- 4.5.9 Martinez et al. (2014). Vulnerability Assessment in indigenous communities of the TCO TIM II.
- 4.5.10 Molina Carpio et al. (2014). Spatio-temporal variability and trends in the hydrology of the upper Madera River (1967-2013).
- 4.5.11 Rainville et al (2014). Women and Family-Based Aquaculture in the Bolivian Amazon: Poverty Reduction through Livelihoods Diversification with Polyculture.
- 4.5.12 Rico López et al. (2014b). Economía de la pesca comercial y de pequeña escala en la amazonia boliviana. Contribución de especies nativas y una especie introducida (el paiche – Arapaima gigas).
- 4.5.13 Van Damme et al. (2014b). The invasion of Arapaima gigas in the Bolivian Amazon.
- 4.5.14 Wojciechowski, M.J. (2013). Análise institucional e de desenvolvimento de sistemas socioecológicos complexos: um estudo de caso da pesca artesanal na Região Norte da Amazônia Boliviana.
- 4.5.15 Wojciechowski, M.J., Coca C., Macnaughton, A.E. (2014). Value chain optimization within a SSF “economic-welfare” hybrid model: an analysis of interventions in the indigenous small scale fisheries value chain in Bolivia's northern Amazon region of Riberalta.

##### Book Chapters

- 4.5.16. Carolsfeld et al (2014c). Contributions of fish invasions to small-scale fisheries in Latin America: selected case studies from Bolivia and Brazil.
- 4.5.17. Macnaughton et al. (2014c). Livelihoods, food security, socio-ecological systems and Amazon community-based fisheries: a map of experiences.
- 4.5.18 Macnaughton et al. (2014d). Transformative learning among communities and extension workers through an interdisciplinary “Dialogo de Saberes” approach: a case study of gender and food security interventions in Bolivian Amazon fisheries.





**Appendix 5 – Final Outcome Mapping Workshop Report**

**Appendix 6 – Project Communication Strategy Final Report**



## Appendix 1: The 13 AFS Expected Outcomes

1. **New technologies and/or farming systems and practices.** *How has the project developed new and improved agricultural technologies and/or farming systems and practices that increase food production? (e.g. technologies and innovations; staple crops; crop-livestock interactions; agricultural water management; new seeds and plants)*

The project worked with new technologies for small-scale fisheries and family-based aquaculture in two distinct regions of Bolivia.

In the Northern Amazon, new fisheries technologies included participatory stock assessment and the development of value-added products based on the introduced paiche fish (food products, fish-leather and crafts made from fish-scales). These contribute to improved, sustainable livelihoods (diversified income, more equitable distribution) as well as to sustainability (resource management strategies). The project promoted sustainable management of paiche fisheries and a complementary strategy to secure existing fisheries on native-species, with promising results for increased food production and food security making use of both native and introduced species. Stock assessment methods based on successful Brazilian experience were introduced (counting of individual paiche fish in a lake as they surface to breathe), and subsequent development of a model was initiated to estimate environmentally sustainable yields that also support ecological diversity and socially sustainable returns. This ‘accessible technology’ approach, combined with improved access and use rights guaranteed by a draft new national fisheries law (facilitated by the project), is contributing to booming value chains in the Amazon with associated increased food production and income.

In the Amazon region (Yapacani pilot focus), new aquaculture technology included a polyculture experiment (using native species *Colossoma macropomum*, *Piaractus brachypomus* or their hybrids, and *Prochilodus nigricans*) that provided additional sources of income and fish for home consumption, in addition to improving water quality and pond productivity. Also, technical training was delivered on a variety of aspects including: improved nutrition (incorporating locally available ingredients), disease prevention and treatment, cold chain, and fish breeding. The family-based culture approach and focus on farmer-led experimentation was informed by a technical review and participatory gap analysis of other past interventions in the region with a wide range of partners at national, regional and local scales. The participative research experiment was completed in February, 2014. Key results include: high local acceptance of the introduced practices, and surprising implementation by other producers outside of the experiment (n=7450 sábalo in 37 families directly in the region, with an estimate of over 50 families not engaged in the experiment, but now also implementing polyculture based on positive perceptions of the experiment. A protocol for developing small aquaculture projects, including feasibility assessment, discussion of technology options and limitations was developed with the national government’s aquaculture institute CIDAB (now IPD -PACÚ).



**2. Dietary diversity & nutrition.** *How has the project contributed to dietary diversity/balanced diets, particularly for women and children? (e.g. food safety practices and regulatory frameworks; food fortification; local nutritional needs)*

2a. A household survey (n=811) conducted at the start of the project identified moderate to high food insecurity in over 58% of rural and 40.6 % of urban households (in the low water season), as well as evidence of stunting and high rates of chronic infection. Poor knowledge and practices regarding Infant and Young Child Feeding were identified as a contributing factor, as well as moderately low dietary diversity. The project originally proposed promoting generalized increased fish consumption as a means of addressing these issues. It appears that this is most applicable to the urban and peri-urban poor, and experimental promotional campaigns were launched in co-operation with municipal governments, and pilot intervention initiatives to increase the use of fish among vulnerable populations have been initiated. This included initiatives to train fish sellers to improve fish quality and building a new market with improved processing conditions.

On the other hand, in rural regions, limited access to adequate food is exasperated by poor access to health services and clean water. In order to reach the more vulnerable and difficult to reach groups in the rural indigenous fishing communities, workshops were implemented as part of a larger strategy that also included discussion and workshops on value chain bottlenecks (transparency and social relations, hygiene and quality) using the 'Diálogo de Saberes' (knowledge dialogue) approach drawn from popular adult education. The food security component of the workshop days focused on: training on good hygiene and water treatment practices in the home; identifying the diversity of locally available wild foods with high micronutrient value, including many palm fruits with excellent nutritional properties (ex. chonta, palma real, asai) and discussing their use in everyday food security; and establishing partnership with representatives of the municipal health network 'Red de Salud' and national program 'Desnutrición Cero', who offered additional training on mother and infant health, breastfeeding, complementary feeding, and the use of fish to fortify Infant and Young Child Feeding practices. An agreement was signed with Red de Salud to co-develop and lead the community workshops, as well as a commitment to meet their legal obligation for regular visits to these communities to offer health services and advice. The communities were also provided with counseling and advice on methods to ensure the continued services, as well as to develop proposals for local water treatment.

2c. The fishery & aquaculture law proposed by the project represents a framework at national level paying attention to the important contribution of fish to food security, in addition to mention within the 13 pillars of "Agenda Patriótica 2025," launched in 2013. It is expected that this law will represent an umbrella for further development of regulatory frameworks at regional (department) and local (municipal) level. We are also working with the hypothesis that better food-safety practices can be driven by consumer demand, which in the project is being molded by experimental promotional campaigns. A set of indicators has been used by the project to measure fish quality in the markets and to evaluate progress. This same set of indicators will possibly be introduced by national authorities in governmental control programs.



***Engagement of Canadian researchers with Southern researcher organizations (for CIFSRF-funded projects only). Is there increased use of Canadian knowledge and resources to address environmentally sustainable agricultural productivity and nutrition problems in developing countries?***

Most of the research in the project was done jointly, building on synergies between Canadian and Bolivian experience and know-how, as evidenced by the multi-authored nature of all of the publications. Canadian know-how on genetic analysis, nutritional analysis, food security surveys, participative value chain assessments and aquaculture are some specific contributions to the project, in addition to Brazilian know-how on aquaculture and economic evaluation that came out of earlier CIDA-funded projects in Brazil.

Canadian researchers in WFT and partners – particularly UBC – have contributed substantially to the project through direct engagement, coordination and collaboration on project activities in the field, as well as remote support for methodology development and targeted specific inputs from Canadian specialists on technical visits. The methodology for the household survey was developed in partnership with UBC and with contributions from FA and WFT. 22 people were trained in Bolivia to carry out such surveys. The food security intervention workshops were developed with inputs from UBC, WFT and FA researchers. FA staff were trained and provided with field supervision/collaboration on an ongoing basis for the value chain methodology by specialists from WFT. 2 Bolivian partners from the research institutions Asociacion FAUNAGUA and Unidad de Limnologia y Recursos Acuaticos at Universidad Mayor de San Simón, Bolivia spent a combined total of 12 weeks visiting Canadian research institutions to participate in training as follows: indigenous aquatic resource management and governance (Namgis Resource Management, Alert Bay, BC; First Peoples House, University of Victoria, BC), community-based resource management (COADY Institute certificate course in community-based resource management (St. Francis Xavier University, NB), nutrition research (Land and Food Systems, UBC; DFO *Marine Ecosystems & Aquaculture Division of the West Vancouver Lab*), genetic research on fish (iBOL and University of Guelph, Waterloo, ON; Department of Biology, University of Victoria BC, SeaStar Biotech), development of environmental DNA tools (Seastar Biotech and Department of Biology, University of Victoria BC), and modeling of lagoon ecosystems and fisheries to inform development of sustainable fisheries management plans (Department of Biology, University of Victoria BC). As a result, Canadian knowledge has been integrated into the objectives of the project and Canadian researchers have gained substantial knowledge about food production and nutritional problems in Bolivia. This bilateral learning is reflected in the publications that are coming out of the project. Some training was also carried out at Brazilian institutions, including 5 people (3 females, 2 males) during 19 days at CEPTA, São Paulo Brazil, on aquaculture protocols that were developed partly with the support of Canadian partnerships and technologies from CIDA funding in the 1990s, as well as 1 woman for 4 weeks at UFRJ for training on nutritional analysis and 2 females for 2 weeks at CAPINA for training on participatory economic feasibility studies and value chain development.

**3. *Research groups. How has the project contributed to stronger research groups for improved food security policies and decision-making?***

The Bolivian partners in the project, in particular FAUNAGUA, have been considerably strengthened through the project, with multiple training opportunities for staff, greater recognition of its input in multi-stakeholder venues and government policy development. FAUNAGUA has been able to expand its institutional capacity to new areas, conducting innovative research in domains with high potential for food security – e.g. aquaculture. The project has contributed to increasing access to information sources and networks and providing opportunities for research results that are now being published internationally. Additionally, the project has supported the Bolivian partners' emerging role as articulators in the region. They are now well-positioned as





instigators in networks involving public universities, the San Simón university of Cochabamba being the principal one. As well, they are playing an important role in disseminating research insights obtained through these networks in policies. The Fisheries & Aquaculture Law is an excellent example of how these networks can influence decision-making at the highest levels.

The project engaged 168 policymakers and 65 NGOs in activities, including 3 Ministries (Ministry of Environment, Ministry of Lands and Rural Development, Ministry of the Exterior) and the National Centre for Aquaculture Development Research (CIDAB, now IPD-PACU). This has meant a good reach in terms of influencing policy both through technical contributions and facilitating consensus-building amongst stakeholders. This is evidenced by the approval of the new aquaculture and fisheries law, creation of a draft policy on the use of introduced fish species (paiche), joint publication of aquaculture development strategies and protocols, and a baseline of fisheries data to assess the impacts of hydroelectric development. The new national Public Decentralized Institute for Fisheries and Aquaculture (IPD PACU) has incorporated and endorsed project outputs including the strategic policy directions for Tropical Aquaculture document, and the protocol for tropical family-based aquaculture. The Bolivian partner (Faunagua) has leveraged the project and successfully secured funding from the Brazilian NGO Fondo Socioambiental CASA, the Bolivian NGOs Fundacion Amigos de la Naturaleza (FAN) and the Programa de Investigación Estratégica en Bolivia (PIEB), the International Union for Conservation of Nature (IUCN) for work in southern Bolivia, the Ministry of the Exterior, and The National Institute for Agricultural and Forestry Innovation (INIAF). Internally, Faunagua considers the project a ‘programmatic approach’ for initiatives with fisheries, and, uses it as a model and framework to support integrated approaches in its other work.

**4. Food distribution.** *How has the project contributed to more equitable food distribution for food security? (e.g. more equitable access to quality food)*

5a. The project has contributed significantly to the consolidation of a fish market in Riberalta where low-priced (native) fish are available and to the development of models and (regulatory) frameworks that guarantee fish quality in these markets. Additionally, paiche processing in Trinidacito through a new fish processing plant provides fish meat from the belly portion of paiche and “racks” of paiche ribs that are sold at affordable prices or donated to local needy families. Nutritional analysis suggests that these are in fact the parts of the fish that are most nutritious in terms of micronutrients and essential fatty acids. Local consumption of paiche during the project increased from 5 to 18% of the households in Trinidacito, as measured in 24 hr recall interviews.

5b. In the fisheries & aquaculture law a specific “principle” was included due to project input on the contribution of fish to food security:

“Art. 4. Seguridad y soberanía alimentaria: La pesca y acuicultura contribuirán de forma prioritaria a la seguridad alimentaria de la población boliviana. Se considera a la carne de pescado como un producto estratégico para contribuir a la seguridad alimentaria del pueblo boliviano.”

Though this article is not in itself a guarantee for more equitable (fish) food distribution, the impact of its content might cascade along the regulatory systems at regional (autonomous governments) scale which have to be designed and/or adjusted in the next few years.



5c. The family-based aquaculture units supported by the project sustain a value chain supplying high quality fish to local markets in Yapaçani (over 60% of the production), which traditionally had only seasonal access to a depleted resource in the local rivers.

5d) The project collaborated with the Riberalta municipal government in developing Fish Fairs to promote consumption of high quality and diverse local fish. These were implemented in each of the three years of the Project, with official designation of the event for the 5-6th of August by the Municipal law N° 18/2012-2013.

**5. Food processing and storage.** *How has the project contributed to improved post-harvest food processing and storage techniques for food security?*

6a. An area of the project specifically deals with improving handling and processing of fish to improve the quality reaching the consumer, carried out in collaboration with the Argentinean Foundation PROTEGER. A survey was conducted to identify problems in fish handling, as well as a survey on current market conditions, and a component of a household survey that indicated a high incidence of diarrhea (potentially an indicator of poor water quality and/or hygiene). As a result, training workshops were held focussed on cooking of fish, including using appropriate hygiene and promoting the use of healthy cooking techniques and recipes that make use of a diversity of locally available, highly nutritious foods. Additionally, an integrated program to improve hygiene and processing at all stages of the fish production chain (from river to plate) was piloted, involving a variety of different actor groups, and associated with a process to improve local technologies for fish conservation and processing (testing live-storage boxes, improved hygiene in transportation boxes, monitoring quality along the production line), an upgrade to the local fish market, and the documentation of protocols for hygiene and processing in an accessible manual (together with SENASAG - the government institution with responsibility for food safety). Research on improved assessment tools for fish quality and improved, socially equitable provisioning of ice were initiated, but not completed within the project period. Improved ice boxes were designed, and as an alternative to ice, live-holding facilities were designed and constructed for remote fishing communities.

**6. Risk-mitigation.** *How has the project contributed to better risk-mitigation for food security? (e.g. mechanisms that cope with the impacts of climate change, and other shocks such as food price volatility)*

7a. Historical data on rainfall since 1946 were tabulated and analysed in the project, with new monitoring stations for rainfall and water level established for improved on-going monitoring. This provided a baseline and an opportunity to look at climate trends, to help predict the likelihood of climate-change related impacts.

The sensitivity of fishing communities to climatic changes and existing spontaneous adaptation strategies in 4 pilot communities were also mapped and presented to local and regional institutional partners for discussion. Significant contributions have been made to the inclusion of adaptation strategies in planning of fisheries in indigenous territories, in this case the territories affiliated to the indigenous organizations CIRABO and CIPOAP through a cooperative agreement with FAN). The indigenous strategic plan will gradually be incorporated in municipal development plans (PDM), thus guaranteeing governmental support in risk-mitigation and strategic intervention. The effectiveness of this will become evident in the response to the flood of February/March 2014.



7b. The project, together with other partners, investigated two further stressors to the region: introduced species and dams. The effect of the introduction of the paiche fish was studied, including its impact on native fish and its contribution to changing fishing livelihoods. These results are being published in a number of venues, and contributed to designing a draft governmental policy on management of the paiche.

Dams are a second predictable threat. Two large dams were recently built on the Madeira River in Brazil, influencing the migration of fish, and potentially changing the flood regime in Bolivia. FAUNAGUA prepared a baseline document on indicators of impacts of these dams for the Ministry of Foreign Affairs, informed by the PPV project. Approx. 65% of the base line data originated from the project. These monitoring tools (base line + monitoring system) will be valuable for predicting impacts and risk-mitigation to protect livelihoods that depend on fish.

**7. Access to resources.** *How has the project contributed to improved access to resources for food production and security? (e.g. land tenure, extension and credit, market access)*

The project contributed to improved access to fish resources through participative revision of the new law regulating fisheries and aquaculture, gaining approval by the indigenous government of the TCO II for indigenous commercialization of fish resources, and ensuring sales stalls for direct sales by indigenous communities at the remodelled fish market.

Access to the fishing resource is a key component for urban fishing livelihoods, but also a source of conflicts between urban commercial fishers and rural indigenous fishers. It was decided not to intervene directly in this conflict, but rather to strengthen local stakeholders to prepare them for engaging in multi-stakeholder discussion.

As a first step, the project helped create a legally constituted regional fishing Federation that represents 14 existing fishing and commercial associations who previously did not have legal status – including both urban and rural fishers. This is the first time that indigenous fishermen and women from this region are specifically represented at the national level. The Federation played a crucial role in the participative review and modification of the Fisheries & Aquaculture Law, where resource access by the two groups in conflict is partly clarified and regulated.

The PPV Project also contributed significantly to the legalization of the commercial exploitation of fish resources by indigenous communities, opening the door to improved indigenous livelihoods. Prior to this, commercial fishing was prohibited in the TCO TIMII, even though about 13 communities depended on this livelihood directly or indirectly. Now they can do this legally, through establishing local Community Plans that include a resource harvesting and management strategy.



**8. Income generation.** *How has the project contributed to improving vulnerable/poor people's ability to purchase more and better quality food, in particular for the benefit of women and children?*

Much of the project was focussed on improving livelihoods and income in fisheries or aquaculture, depending on the region. This was done primarily by diversification of value chains, a pilot new value chain was set up for processing paiche in Trinidadcito, and improving equity in the native fish value chain was attempted.

The project improved female participation in the fisheries value chain in Riberalta through diversification and creation of value-added products. An initial step was to create a women's organization for training and empowerment of females in the fishing community, which has participated significantly in establishing the annual fish fair and promoting the diversified, increased consumption of fish at the fairs and in the markets. While the impact on general fishing incomes of these advances are not yet evident, family incomes of group participants have improved, providing opportunities for purchasing more and better food. Four female-led microenterprises were established, three of the female leaders previously had no income-earning activities:

- 1) The restaurant "el Buen sabor del Pescado Amazónico". The restaurant is open daily, specializing in fish head soups for breakfast. Initially it is working with the pacupeba head, but it will soon be supplemented by paiche-head soup. It is generating an average monthly income of Bs. 2491,00 (USD 363,64).
- 2) Sale of value-added raw fish products, sold daily in the Central Market (stuffed cutlets, rolls, meatballs, sausages), with a monthly average income of Bs. 2098,00 (USD. 306,27)
- 3) Manufacture and repair of fish nets, carried out in the home, with a monthly income of Bs. 960,00 (USD. 140,00)
- 4) Filleted and prepared fish, prepared in the home under special order, with a monthly income of Bs.1071,00 (USD. 156,35)

The new paiche processing plant in Trinidadcito, established by the project, increased the number of fishers receiving and income from the fish resource, provided 5 new incomes (3 women) at the processing level, and initiated new opportunities for income from fish leather and fish scale art. Local artisans were trained in leather and scale art production and two enterprises have been established, employing 7 people (including 3 women). During a meeting of 30 international Ministers of Foreign Affairs in La Paz on the 10th of May 2013, handicrafts from these family enterprises were presented to each chancellor as a souvenir and example of Bolivia's unique and high-quality artisanal goods.

Increasing income at one level of the value chain requires negotiations at the other levels, especially in Bolivia, where market prices of fish can be controlled by municipal government and do not generally consider an analysis of the costs of production or fair distribution of benefits along the value chain, but rather are concerned only with maintaining lowest possible prices to increase accessibility of product. Participative value chain analysis had improved the transparency of the native fish value chains from indigenous communities, providing an opportunity and tools to open negotiations for increased final prices based on the real costs of production, and more equitable distribution of income. The aquaculture family enterprises supported by the project (in Yapacani) are increasing their income and using fish for family consumption through the production of sabalo fish from polyculture that have minimal production cost.





**9. Policy options.** *How has the project influenced the development and implementation food security policies?*

The project has influenced government policy directly through participative writing and review of the new fisheries and aquaculture law (now approaching final approval), discussions and negotiation with indigenous governments on commercial use and access of fisheries resources (leading to a new regulation for the approval of commercial opportunities for fishing in one indigenous territory so far), consolidation of a national working group to address introduced aquatic species (leading to a specific bi-ministerial resolution on commercial fisheries for the introduced paiche fish, expected this year) and the development of a protocol for culture of the native pacu fish, as well as a strategic plan for development of family-based aquaculture in the Amazon region (both to be published this year). While the contribution of fish to food security was included in the law proposal, it is expected that effects of all of these policies on food security will be secondary and long-term, through improved resources access, strengthened policy support for value chains (“productive complexes”) and improved livelihoods.

The Household survey results and the vulnerability and adaptation research, in addition to new partnerships with local and regional health authorities will allow for the development of more relevant food security programs and policies, addressing specific needs in the region and including the information in the “Plan Operativo Annual” of 2014 and 2015. There is keen national interest in the results of the household survey, especially through the Desnutrición Cero program. An example of inclusion of project results in municipal POAs has been the creation and legal designation of the fish fairs and the “Fisherman/woman’s Day”.

The strategic Alliance of the PPV Project with CIDAB, responsible for development and regulation of fisheries and aquaculture in the country (now the IPD PACU), and the project’s communications strategy on low fish consumption in the country, helped induce the Minister of Rural Development and Lands to re-evaluate the 2010-2015 strategic plan for the agricultural sector to formally change the focus on “development of technologies and innovation for agriculture, fisheries, and forestry”, in which there is a proposal to increase the per capita fish consumption from the current 1.8 kg/person/year to 5.2 kg/p/yr.

The paiche management workshop, held in 2013 with the help of the PPV project, was a pioneering event in Bolivia. For the first time, scientists, national authorities, and urban and rural indigenous fishermen/women met over 2 days to discuss and organize available information on the paiche and create management scenarios for its utilization. As an introduced species, this fish is not covered by other fishing regulations, meaning that its management and exploitation (including access rights) were unclear. A bi-Ministerial Resolution between the Ministerio de Medio Ambiente y Agua and the Ministerio de Desarrollo Rural y Tierras resulted from the meeting. The writing of this resolution counted on a legal team from the MMAyA, MDRyT, Servicios de Áreas Protegidas Nacional and the PPV.

**10. Information and Communication Technologies (ICTs).** *Has the use of ICTs contributed to increase access to information and improved food security for the most vulnerable? (e.g. equitable use of technologies, such as radio, television, telephones, computers, and the Internet).*

While internet, radio, and television were key tools in communication in the project, increasing equitable access to these technologies were not part of the project’s objective.



**11. Gender.** *How has the project considered women's specific needs in the design of the research, participation of women in the research, and potential impact of research on women? How has the project: a) improved women's access to and control over income?; b) reduced women's drudgery or workload (time spent) in agriculture?; and/or c) improved women and children's access to adequate and diversified diets?*

The project's gender strategy included a variety of activities at different levels: gender specialist engagement in research design; training of project staff on concepts and tools for gender analysis, gender-responsive activity planning and data collection; participatory approaches to research and development interventions that included either a gender-responsive aspect or a gender transformative approach; and the collection of gender-sensitive sex-disaggregated data for baseline and monitoring.

Two gender specialists participated in the overall design of the project strategy and activities, and three training workshops were carried out with project research team members (n=12) in the first year to mainstream concepts and tools for gender analysis, gender-responsive activity planning and implementation and collection of gender sensitive, sex-disaggregated baseline and monitoring data. One researcher was trained in participatory methods for gender analysis (Mosaic, Canada) and 5 researchers were trained in gender and public policy (CEBEM Bolivia), all in the 2nd year of the project. An interdisciplinary working group on gender engaged in a strategic review of the project's gender strategy and activities in the second year of the project, and 3 representatives from this working group subsequently participated in a CIFSRL-led workshop on gender in South Africa.

The First Regional Fisherwomen's Forum, held in Riberalta in 2013, helped promote a discussion of women's identity in fishing, fishing as part of sustainable livelihoods, and the diversity of activities women and men participate in related to fisheries. In addition to contributing to the formation of a collective identity for women in the fisheries sector, the results of the forum provided valuable information on gender aspects of fisheries livelihoods, value chains and dietary diversity that informed the selection and design of community-level interventions.

The Arapaima Association created by the project to develop new income generation opportunities for urban-based women engaged in the fisheries sector (value-added paiche fish products), provided opportunities for leadership development and increased visibility of women in fisheries, and create a safe space for reflection and dialogue on gender inequalities and women's empowerment. The active participation of female fish culturists in Yapacani as part of a farmer-led research experiment involving polyculture (including sabalo as food fish and to improve returns in existing pacu ponds) contributed to the increased role of women in their own development. The training in Trinidadito on the use of paiche by-products (leather and scales) in artwork and craft, also incorporating local seeds and fruits, improved the productive capacity of 17 indigenous women of this community. One of these (Bebby Macuri) was recognized by the Ministry of Culture and Tourism with an award called "Formulario Unico" in the category of "Tejido Originario". The 'Dialogo de Saberes' workshops carried out with communities in El Sur trained rural indigenous fishing families, with strong female participation, on economic feasibility analysis, increasing transparency and understanding of the fixed and variable costs of fishing at various levels of the value chain and providing a basis for improving control over income through collective price negotiations with middlemen. The food security workshops applied in the El Sur communities developed an improved understanding among female, male and youth participants of the locally available ingredients and recipes to improve dietary diversity, as well as improved knowledge on infant and young child feeding protocols including locally available foods, especially fish.



**12. Environment.** *How has the project tested for and contributed to environmental sustainability? (e.g. Has the project affected the environment? If so, are contributions environmentally sustainable?)*

The environmental assessment for the project was waived by IDRC, as it was determined that there were no likely significant negative environmental impacts of the project activities. In a broader sense, the project fostered environmental sustainability throughout, in its focus on promoting training and planning for aquatic resource management that is environmentally and socially sustainable, specifically fishing. It also included assessing environmental impacts of hydroelectric development, and outlining environmentally responsible aquaculture practices in a national protocol for small-scale culture of tropical native species, published by the project in collaboration with the national agency responsible for aquaculture development as well as a consortia of regional aquaculture research institutes and extension agencies.