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Insights into the potato value chain of Bolivia – Market potentials for integrating native varieties in the context of Food Security

Conocimientos en la cadena de valor de papa de Bolivia – potenciales de mercado para la inte- gración de variedades nativas en el contexto de la seguridad alimentaria

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Abstract

Globalization, changing demand patterns and competition impose high pressure upon the potato system and especially poor, rural farm- ers of the Altiplano. An ongoing trend of the displacement of traditional food products and the import of other staple foods is conse- quently decreasing the diversity of produced native potatoes. Though, genetic resources are the most valuable assets that Andean potato farmers have in terms of food security, nutrition and household income. Value chains which link rural and urban markets, as well as the agro-industry, represent promising opportunities for increasing rural incomes through adding value to food products. This research about the potato value chain in La Paz aims to illuminate the complexity and persuasibility of the staple food system and shows its bottlenecks as starting points for improvement. The results indicate that the linkages of urban and rural markets of La Paz are very weak due to poor infrastructure and high transaction costs, hindering small farmers to enter bigger and more profitable markets. Consumers´ preferences foster the commercialization of improved potato varieties mainly used for the fast food and snack industry, promoting at the same time the loss of biological diversity. However, niche markets for native potatoes are identified in the gourmet food sector and within nutrition- al markets including hospitals and industries producing food supplements and baby food which yet need to be further analyzed.

Keywords: Potato value chain; agrobiodiversity; native varieties; food security; nutrition; product innovation.

Resumen:

La globalización y los cambios en los patrones de la demanda y la competencia imponen presión en el sistema de producción de papas, especialmente para agricultores pobres de la región del Altiplano boliviano. Una persistente tendencia a la migración hacia productos no tradicionales y el incremento de las importaciones de otros alimentos básicos conlleva a la disminución de la diversidad en la producción de papas nativas. Los recursos genéticos son el activo más valioso para los productores de papa andinos en cuanto a su seguridad alimen- ticia, nutrición e ingresos familiares. Las cadenas de valor que unen los mercados urbanos y rurales, así como la agroindustria, presentan una prometedora oportunidad para crear valor agregado en los productos alimenticios y, por consiguiente, incrementar los ingresos en la zona rural. La investigación sobre la cadena de valor de las papas nativas en La Paz tiene como objetivo iluminar la complejidad y mejorar la comprensión del sistema de alimentos básicos, muestra así también los cuellos de botella y puntos para mejorar el complejo productivo. Los resultados indican que los enlaces entre los mercados urbanos y rurales de La Paz son débiles a causa de infraestructura deficiente y los altos costos de las transacciones. Estas condiciones perjudican la oportunidad de los pequeños agricultores de conver- tirse en parte de mercados más lucrativos y de mayor escala. La preferencia de los consumidores promueve la comercialización de las variedades de papas genéticamente mejoradas, las cuales son principalmente utilizadas por la industria de la comida rápida y industria de bocadillos. Esto simultáneamente causa la reducción en la diversidad biológica del alimento. Sin embargo, el sector gourmet y mercados basados en valor nutricional, como los hospitales, presentan un nicho de mercado para las papas nativas. Se reconoce el potencial, que debe ser investigado, en la industria de suplementos alimenticios como es la comida para bebes.

Palabras clave: Cadena de valor de la papa; biodiversidad agrícola; variedades nativas; seguridad alimenticia; nutrición; innovación de productos.

INTRODUCTION

The potato (*Solanum tuberosum*) is an accessible product for all Bolivians being a superior option to other staple foods and the key factor for household food security. Aymaran and Quechuan communities of the northern Altiplano in La Paz, are the custodians of the numerous varieties of potatoes which assign multidimensional importance to their daily lives. The area probably contains about 370 different potato varieties grown in situ with different agronomic characteristics, uses and consumption forms (Iriarte et al. 2009).

Considering all abiotic and biotic variables in the harsh region of the Altiplano, shows the art behind potato cultivation and underlines its´ ecological adaptability. The ancestral knowledge about potato farming is quite developed and is expressed in the good management of varieties, bio-indicators, soils and reduction of climatic risks among others.

But the management of possible risks to food security and agricultural resources has become more important than ever since food systems are expanding towards a marginal level mostly in vulnerable and poor areas as in the Andean mountain region. Especially the small-scale potato farmers of Bolivia are prone to a wide range of risks and limited assets which directly affect their livelihoods. Changes as for instance unusual drought and frost patterns, diseases and pests are spreading as the climate warms up due to climate change (FAO 2009, Thiele et al. 2011). Additionally socio-economic characteristics as disparities in land holdings and imported staple food are aggravating existing livelihoods (CIP 2009). Competition from large-scale producers, missing rural-urban linkages and infrastructure cause traditional varieties to be hardly recognized in urban markets which hinder small-scale farmers to access dynamic markets that could be more profitable. Even though an increased demand for native potatoes can be noticed, Andean farmers have difficulties to meet the needed standards since one essential limiting factor of production is the low availability of native quality seed (Thiele et al. 2011). Smallholders are disadvantaged by urban consumers demanding for chips and fries supporting cross-border trade that benefits large producers with high yielding monocultures. (IFPRI, 2017). But since traditional knowledge and the use of biodiversity are the most valuable assets potato farmers have, the loss of ancient varieties and wild species by missing consumer demand threatens these key assets and brings up the topic of food security and sovereignty.

This current development of high poverty rates, low potato productivity and marginal participation in food markets of farmers in La Paz, shows a gradual abandonment of the countryside by the Bolivian population, which seeks for better economic opportunities in urban centers or even in other countries (Colque et al. 2015). Rapid urbanization in turn is intensifying issues as food insecurity, malnutrition and poverty also within urban areas. Food chains are reshaped due to changing diets or the "nutrition transition" describing a shift of consumption towards processed foods, causing diet-related diseases as overweight and diabetes. Therefore policies and research is dedicated to enhance rural-urban linkages as between smallholders and urban consumers in order to eradicate malnutrition and improve food security for rural areas as well as urban areas. Farmers benefit from larger markets and upcoming opportunities for native potatoes and consumers in turn receive local, nutritious foods whose demand maintains their biodiversity and cultural heritage (IFPRI, 2017).

In order to understand and tackle the challenges of today´s food systems the concept of value chains is used as unit of analysis for stimulating agricultural innovations. Within this context the focus lays next to the analysis, on the demand creation and market integration of native potato varieties through for instance processing and value-adding activities which benefit poor farmers. With taking the socio-economic environment of the potato value chain into consideration the analysis shows how the chain is structured and operated. Additionally chain impacts on household decision level and usage of genetic resources become visible as well as bottlenecks that could enhance the market entrance and agrobiodiversity (Hellin, 2013, Hellin & Meijer, 2006).

Within this context the two main objectives are:

- Elaborate a thorough analysis of the potato value chain in La Paz and how native potato varieties are managed.
- Investigate the potential of linking small scale farmers to nutritional markets in La Paz in order to improve market access and livelihoods.

METHODOLOGY

The data acquisition and knowledge gain was carried out through combining different qualitative and quantitative methodologies. The investigations that are subject to this work were preceded by a stay of three months in La Paz, from March to June 2017. The framework for this analysis required the collection and evaluation of data on multiple scales and an approach that gives deepened insights into decision and interaction processes. Moreover actions within the potato value chain do not proceed linear like the model suggests but rather in bidirectional ways driven by personal motives. Keeping this in mind, primary data from field visits, market observations, interviews and surveys has been gathered on a regional and local scale, to understand the different dimensions of the potato value chain in La Paz and how it functions. In order to successfully accomplish a value chain analysis, the FAO guidelines from Bellú 2013 were followed.

Semi-structured interviews with experts from essential parts of the potato value chain build the core of investigations. Because conversations establish the possibility to understand the personal context behind actions within the value chain, they therefore give sense to market observations and enclose to a total picture. Talking to local seed suppliers for instance gives information about different potato qualities and access limitations that affect farmers.

The Consumer survey represents the quantitative part of the applied methodology next to the qualitative observations and in-

terviews. The aim of the survey was to identify the awareness of the existing native potato variety and including the identifi- cation of consumers´ preferences for purchasing different pota - toes out of which market potentials can be assumed. The sur- vey was conducted in three different cities in Bolivia which are: the main study area La Paz, Cochabamba and Santa Cruz. La Paz and Cochabamba where chosen for sampling since they are micro - centers of potato biodiversity and therefore intersection points for trading and consumption. Santa Cruz is interesting for finding new market niches, as Yuka is more embedded in tradi- tional dishes and markets are not oversaturated with potato prod- ucts. For the survey, public places were chosen in combination with a potato-tasting of three different native varieties. Lastly a SWOT-Analysis has been applied on the base of gathered infor- mation to identify opportunities of success for native potatoes and finding the best path for producers, according to existing strengths and opportunities.

RESULTS

Potato value chain La Paz

The potato system in Bolivia is very unique in terms of vertical seed supply from high to low areas, heterogeneous agro-productive conditions according to the different ecosystems and fluctuating access to markets due to the seasonality of supply. Potatoes represent the main crop of production systems of poor farmers with 54,000 ha cultivated, accounting to 30% of the national area dedicated for potato farming (INE, 2017). Biodiversity is used as livelihood strategy for decreasing the risks of sudden weather shocks as droughts and frost.

The value chain involves the interlinkages of production, transportation, distribution and commercialization of raw potatoes and potato seeds. The market in La Paz is characterized by the coexistence of a formal and an informal system though the majority of the various distribution channels are part of the informal potato system. This informal system is fed by potatoes originating from cultivations that are solely managed by farmers without meeting the regulations of the National Institute of Agricultural and Forestry Innovation (INIAF). The formal system is led by SEPA who provides the largest proportions of certified potato seed in Bolivia and is controlled by the governmental entity INIAF (Almekinders et al. 2010, Swisscontact 2014).

La Paz represents one of the biggest and most important markets of Bolivia since it is used as trade intersection. The marketing system of potatoes has different elements as weekly fairs in rural areas or bigger markets in the city as in La Paz or El Alto with the possibility of storage. Wholesalers count to one of the most important actors in the value chain next to producers and retailers as they distribute large quantities to several market participants (see figure 1). They sell their products to supermarkets, restaurants, small industries and hotels. Wholesalers or Mayoristas negotiate with large volumes and relatively small unitary margins (Zeballos et al. 2009, CIP, 2009). Especially the wholesale market Rodriguez is essential in terms of potato trade whereby the main demand comes from households and restaurants which determine the traditional channel of commercialization. The choice of offered potato varieties is mainly determined by transportation and distribution. Others trust on their experiences of previous sales and taste (Devauxet al. 2010, Polar et al. 2012).

Trucker (Camiones) have an important function in the potato market as they represent the linkage of farmers and the market due to a lack of own transportation. In case of the Rodriguez market, Camiones come every week and bring potatoes of the most commercial varieties as Waycha, Holandesa and Sani Imilla, selling them to wholesalers (personal communication). Retailers have a business of smaller units which are cleaned and packed into new bags adding value to the potato. They are less specialized than wholesalers and have high unit margins since they have the highest risks and losses. As for every actor in the chain margins are as well determined by price fluctuations and negotiations.

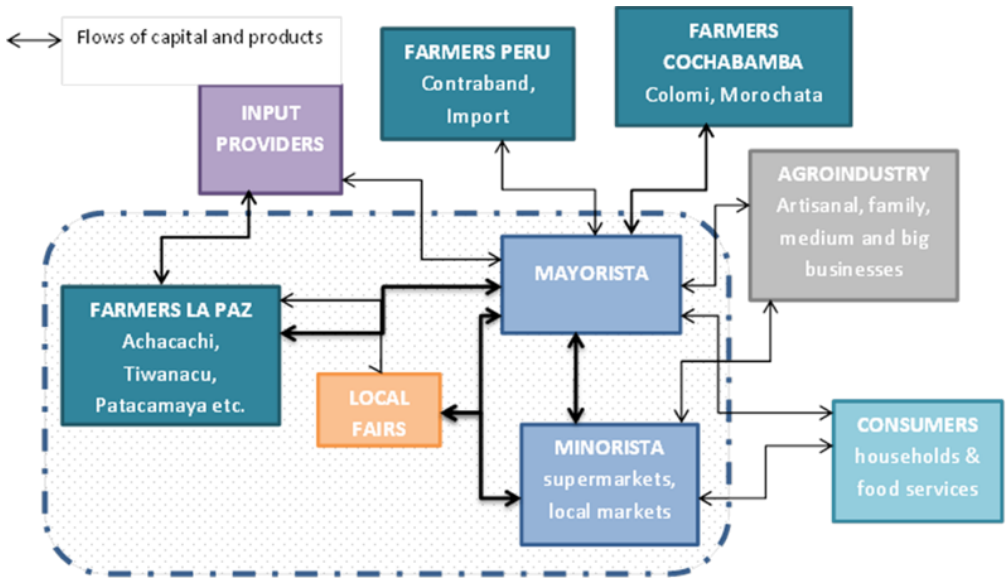

Figure 1: Interactions of main actors of the potato chain in La Paz

Consumer preferences

The sample of 195 consumers (LP: 47, CBBA: 101, SC: 47) gives insights into the last segment of the value chain, stimulating the creation of product innovations according to existing demand patterns. The results of the frequency of potato consumption show that about half of the sample group consume potatoes every day and 17% at least 4-5 days within one week, underlining the importance of potato as Bolivian staple food and in terms of food security. In order to understand what consumers are looking for in a potato and which varieties fulfill these specifications, respondents were asked to pick 3 attributes out of 12 that are important for the decision of purchasing a certain potato variety. Connecting preferred attributes and native potato gives a notion of their market potential and consumer acceptance. According to the 12 multiple-choice attributes, a potato which combines a pleasant taste, medium size and a floury consistency is preferred most.

Moreover consumers have been asked if they would be willing to pay a higher price if there were varieties on the market with attributes they desire and additionally with a high nutritional value (rich in iron and zinc). Over 70% stated that they would pay a higher prize whereas La Paz even has a willingness of almost 90%. Figure 2 also illustrates that the percentage of consumers who is willing to pay a higher prize, would pay either one or two Bolivianos more per kilogram of potatoes. 17% even stated that a higher price up to five Bolivianos more would be acceptable which however is questionable.

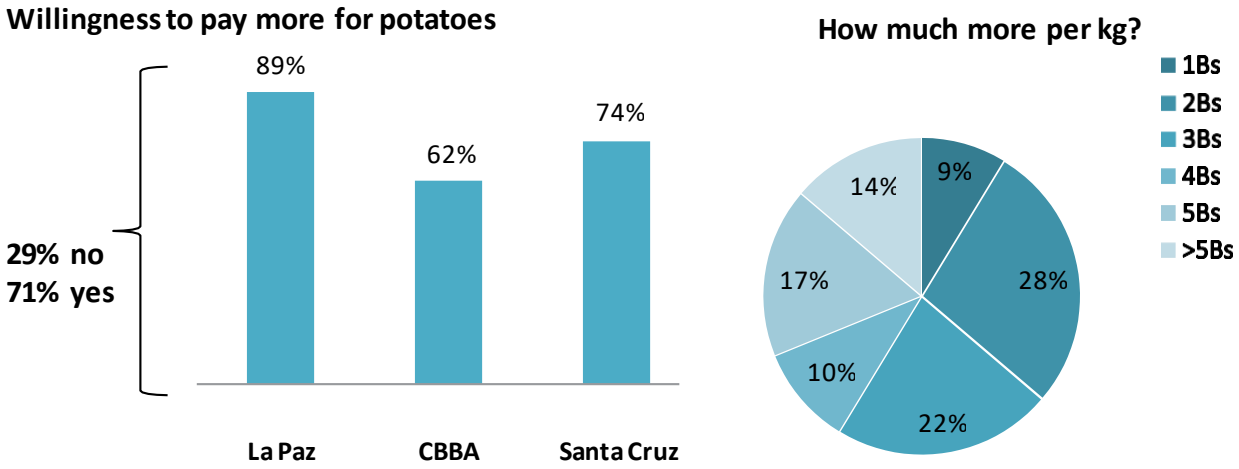

Figure 2: Willingness of consumers to pay more and amount for native potatoes

SWOT results

Strengths:

• The potato is the most important staple food in Bolivia in terms of Food Security since the consumption and income of sales determines household livelihoods.
• The potato has a wide ecological adaptability which allows farmers to plant them almost in every eco-region.
• The Potato has a good input/output ratio as it demands less land and natural resources than other staple crops and 85% of the plant is edible.
• The Potato has a short vegetative cycle which allows double and intercropping systems with the first harvest after 100 days.
• High nutritional value because of Vitamin C, B6, B1, minerals as potassium, calcium and phosphorus and micronutrients for instance iron and zinc. Moreover native potatoes contain a different form of starch which has a higher quality than in improved varieties. Dietary fiber and antioxidants are added on top when the crop is eaten with its peel.
• Bolivia has a comparative advantage in producing certified seed in comparison to other breeding companies as the Netherlands.
• Native potatoes have a high culinary quality since the wide biodiversity entails several different characteristics as form, color of flesh and peel, taste and consistency.

Weaknesses:

• Low level of productivity.
• Potato seeds have a low quality due to mixed genotypes, microbial contamination and pests. Moreover only a ridiculously small number of certified native seeds exists which leads to a low market supply of quality potato.
• Farmers have a lack of knowledge about pest management and diseases for example the weevil of the Andes.
• High transaction costs due to poor infrastructure of roads and storing capacities and slow or missing information transfer.
• Lacking access to financial services, market information, technology and inputs.
• Potato causes as bulky and heavy crop high transportation costs which constrains the exportation. Rural farmers who cultivate native potatoes are dependent on taxis and busses in order to sell their potatoes at bigger markets and forced to pay a high extra for transporting the potatoes.
• Fertile land is limited and production units are mainly smaller than one hectare and scattered.
• Climatic conditions bear high risks for farmers who have difficulties to cope with drought, frost and desertification and face food insecurity in times of sudden yield losses.
• Environmental conditions in the Puna Alto and Puna eco-region only allow one planting season (ano grande) which hinders small

farmers to supply native potatoes throughout the whole year and causes seasonal price fluctuations.
• Missing demand and poor infrastructure has led to high prices of native varieties.
• Contraband of cheaper potatoes at country borders of Peru and Argentina lead to higher competition and the abandonment of locally produced potatoes.
• Small and medium enterprises which demand native potatoes do not find the appropriate supply due to missing quantities and the lack of uniform quality throughout the year.
• Consumer ignorance of traditional consumption forms and missing awareness of potato diversity.

Opportunities:
• Several potato varieties are endemic in the Andean region and are not produced anywhere else on the market giving products an unique value.
• New land for agricultural production of higher altitudes can be set free by global warming since frost is a production constraint setting the agricultural frontier.
• Planting seasons may expand due to warmer temperatures giving the opportunity of production expansion.
• If consumers explore and appreciate the benefits of native potatoes the demand for them will increase and create better prices.
• Small offer of diversified products on potato base raises the chances for new and innovative products on the market.
• Nutritional products of native potatoes can tackle the issue of child malnutrition.
• Santa Cruz can have a high market potential since markets are not oversaturated with potato products and the benefits of native varieties are mostly unknown.

Threats:
• Native potatoes only have few market niches since some of their characteristics for instance form, color and taste make them difficult to process and therefore uninteresting for the fast food industry. This impedes the search for investors and product innovations.
• Ongoing urbanization leads to changes in employment whereby farmers leave behind agriculture and search for jobs in the secondary or tertiary sector losing the ability to be self-sustaining in terms of food.
• The low demand of native potatoes that have been produced locally triggers the ongoing extinction of wild species and the loss of biodiversity and cultural heritage.
• Climate change and conflicting use of waterbodies place farmers at risk since they are dependent from environmental water supply.
• Increasing importations of staple food and contraband lead to higher price fluctuations of potatoes and the dependency on international prices prone to speculations.
• Dissemination of genetic resources to other countries takes away traditional rights of farmers and ability to enter niche markets with unique potato varieties.

SWOT Strategies

Strategies for the integration of native potatoes and maintenance of biodiversity have been developed using the analyzed interlinkages of strengths, weaknesses, opportunities and threats within the potato value chain.

DISCUSSION

The results of tendencies of supply, demand and consumption of potato allow speculations about potential scenarios of the development of the potato system in Bolivia. If the trend continues that the country substitute's potatoes by importing staple food and even potatoes from other countries while consumers diets are restricted to convenience and fast food, peasant and indigenous agriculture will likely deteriorate, which in turn is the essential base of rural farmers (FAO, 2015). At the end of this development, the displacement of traditional products as native potatoes affects the diversity of production as farmers are adapting to the demand and consequently decrease their diversity of consumption as well (IFPRI, 2017).

Native potatoes in context of Food Security and Sovereignty
In terms of food security, native varieties contribute to the pillar of utilization concentrating on the qualitative aspect of food considering daily requirements of energy and micronutrients in order to achieve a state of nutritional well-being, meaning a physical state without hunger and malnutrition (FAO, 2015). This aim can be contributed to, since the native tubers have a high content of micronutrients as iron and zinc and other favorable nutritional aspects. Especially since Bolivia is facing high numbers of child and female malnutrition there is an urgent need for approach- es that are solution-oriented whereas benefitting at the same time other relevant topics as biodiversity and rural development through strengthening farmers´ livelihoods (WFP, 2012). Therefore agriculture and food production in Bolivia is dependent on the maintenance of the genetic diversity of potatoes which makes food production systems resilient and ends malnutrition sustainably.

In terms of food sovereignty, native potatoes contain the ancestral knowledge and production processes of previous Bolivian farmers reaching back to the Incas. Food sovereignty gives Bolivian potato producers the right to "produce, distribute and consume healthy food in and near their territory in an ecologically sustainable manner" (Altieri & Toledo, 2011). A food sovereignty strategy follows the guideline of production systems being biodiverse, fair and resilient. These characteristics address the pillar of access to productive resources containing the promotion of access to land, seeds, water, credits, local markets, genetic and other natural resources and a fair distribution of benefits (Lee, 2007). Through analyzing the value chain and enhancing the cooperation of smallholders and urban consumers by adding value to native potato products, economic development can increase,

	Strengths	Weaknesses
Opportunities	• Culinary qualities create platform for cooperating with local restaurants and hotels to invent new and fashionable potato products. • Use nutritional benefits to cooperate with local and regional Hospitals and supply them with native potatoes. • Use comparative advantage of seed production to specialize in this market segment to increase profits. • High percentage of farmers who only use organic fertilizer and no pesticides can get an eco-label and therefore add value to native potatoes.	• Introduction of governmental subsidies for supporting the production of certified native varieties in order to improve potato quality. • Build producer associations that produce specific range of native varieties in order to increase the supply for SMEs. • Offer mixed potato bags in supermarkets and street markets to give consumers an understanding of different varieties. • Invest in research to find native varieties that are suitable for industry as PayPa already did with the product line Nativa. • Promote the creation of an information system to share prices etc. in order to have better bargaining powers.
Threats	• Give native potatoes an economic value through creating high quality dietary supplements for children in order to maintain agrobiodiversity and improve farmers´ livelihoods. • Utilize nutritional benefits of native potatoes to tackle malnutrition of children with awareness programs and integrating them in school feeding programs. • Secure food sovereignty and genetic resources to keep the rights of endemic varieties and	• Increase national potato supply and invest in strengthening infrastructures to avoid increasing importations and contraband • Strengthen institutions and invest more financial capital in the agricultural sector in order to provide technical assistance and know-how. • Execute Participatory market chain approach in order to interlink market actors and build trust.

Table 1 SWOT-Strategy-Matrix for native potatoes

nutrition for rural and urban populations can improve and producers can benefit from new opportunities of larger urban markets (IFPRI, 2017).

Potential for nutritional-, and other niche markets

Value chains face a need to constantly adapt since product innovations have a lifecycle and are influenced by the market environment. Upcoming innovations do not necessarily have to be totally new, they rather are a combination of existing ideas that benefit both, consumers and producers but are always responding to a certain demand. Through responding to those demands market participants can benefit of new business opportunities that hold greater promises (Bernet et al. 2006). The biodiversity of potatoes needs to be spread to all actors in the value chain, especially to the consumers since their demand is the driver of change. Attractive options in terms of usage and preparation need to be presented to eclipse imported varieties and promote native ones. Therefore the industrialization of potatoes is important as growing demand should be taken advantage of at Andean level (Devauxet al., 2010).

Potatoes are suitable for a wide range of products which diversifies possible opportunities of commercialization. Incentivizing the consumption of native varieties on national level for different niche markets cannot be forced wherefore product innovations need to have an additional value next to flavor in order to find market acceptance. As underlined before, one of the main strengths of native potato varieties which stands out in comparison to commercial ones is their high nutritional value. This nutritional quality of antioxidants, micronutrients and fiber is the potential for entering markets that set high value on the product composition of ingredients. Such nutritional markets in La Paz could encompass child hospitals, baby food producers, school feeding programs or industries of food supplements. However, the generation of a new product based on native potatoes can be the main innovation needed. Small industries and research organizations already made pilot tests in the past for different products as chips or pre-cooked native potatoes which hit upon approval by consumers.

For example PROINPA, Papa Andina and PayPa have been working on the promotion of pro-poor innovations for pota- to based food systems and developed virus-free quality seeds and native potato chips next to other products so far (Devaux et al. 2009, Swisscontact 2014). The Bolivian market offer of native potatoes focusses mainly on one single product, which is the selected, washed and bagged fresh potato. Other potentials for native potatoes are seen in the gourmet kitchen because of the diverse characteristics in form, color and taste which allow unique opportunities for cooks (Devaux et al. 2011). Therefore culinary qualities of potatoes create a platform for cooperating with local restaurants and hotels in La Paz to invent new and fashionable potato products. Ideas of products could for example be colored Gnocchi and mashed potatoes in purple or orange depending on the varieties color of flesh. Furthermore concepts of Corporate Social Responsibility (CSR) could be introduced in the native potato business with companies benefitting through social marketing and an improved image. Implementing a Participatory Market Chain Approach for commercial innovations can assist in product elaboration and promotion and additionally in public awareness. Followed up market studies can show the product acceptance and improve new marketing concepts (Bernet et al. 2006). Referring to the above mentioned, farmers and local restaurants as GUSTU could work together and elaborate demanded potato varieties and their possibility of supply. The ongoing establishment of farmer associations could for example help to meet the requested quantity of restaurants.

CONCLUSION

• Potato consumption in La Paz transcends cultures and culinary traditions, however it maintains to be the most important strategic product contributing to food security with biodiversity as a key asset for food security, nutrition and livelihoods.

• The magnitude of contribution to employment and income justifies efforts to strengthen the development of the potato sector. Nevertheless Andean producers are located in territories of high vulnerability and risks facing high poverty rates, low potato productivity and marginal participation in food markets. Therefore value chains linked to the agro-industry present new opportunities for adding value and raising rural incomes.

• Demand trends show that societies´ consumption is changing towards products from foreign markets, displacing their own traditional products consequently decreasing the diversity of potato production.

• In order to meet the demand, the quality and yield of potatoes, seed need to be improved through creating access to disease-free seed that will improve crop yield and quality.

• Entering into bigger markets should go hand in hand with natural resources management and the maintenance of biodiversi- ty while combining the traditional knowledge with new market strategies and local partners as NGOs, institutions and others. Through this, small-scale farmer´s competitiveness can be increased and new production strategies formed while maintaining the genepool of potatoes and the traditional knowledge.

• Further research and promotion of enhancing biodiversity and product innovations should focus on actors of the nutritional markets as the biggest national potential for integrating native potatoes is seen in this niche market.

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