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Final Report

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Title: Status quo and transformation of traditional apricot farming and processing in Gilgit-Baltistan, northern Pakistan

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1. Introduction

This report aims to summarize key approaches of my master thesis research in Gilgit Baltistan, (GB) Pakistan and to provide insights into preliminary findings. The study area in the Karakoram Mountains of GB is highly influenced by its rugged mountains which facilitates the formation of ecological niches, genetic isolation, and small settlements along river oases fed by melting water of glaciers. For many centuries apricot (*Prunus armeniaca* L.) has been imported to the area from Central and South Asia through the ancient trade route, known as the "Silk Road", where families gathered an astonishing diversity of apricots until the 1970's (Ullah et al., 2017). Over time apricots got well adapted and became abundant all over the arid inner mountain valleys of the Karakoram Mountains. Since the 1980's rural development programs have further promoted apricot cultivation and fostered more intensified farming practices. These efforts intended to enhance household (HH) livelihoods. My Master thesis aims to answer the following research question: (1) What is the *status quo* of the apricot diversity, apricot farming practices, gender roles in apricot farming and related socio-cultural and economic realities in GB? (2) Does intensified apricot framing improve income from apricots? (3) What are the drivers to adopt intensified farming techniques?

2. Objectives

- Collection of traditional knowledge and capture of *status quo* of apricot farming practices
- Comparison of intensified/modern with traditional apricot farming strategies and generating an intensification index for comparison.
- Assessment if intensification of apricot cultivation can contribute to improved livelihoods
- Identification of key factors for adoption and analysis of resulting strategies to enhance farmers' livelihoods and income

3. Research support

The section Organic Plant Production and Agroecosystems Research in the Tropics and Subtropics (OPATS) of the University of Kassel supported me with the development of my thesis topic. Furthermore, all necessary arrangements for traveling and conducting the field research were organized by the section. The University of Multan in Central Pakistan provided me with an invitation letter, necessary for visa and travel purposes and hosted me for the first week.
In GB, I was working with a research team of five people. It included one PhD candidate from the study area who introduced me to farmers and their family as well as a fellow master student focusing on the role of women in the apricot sector. Two local assistants made the team complete and helped with translation and other organizational matters.
The Indian office of the Alliance of Bioversity International and CIAT, namely Dr. Rana Jai supported me with the improvement of my thesis topic and supervised the process. We plan for a joint paper based on the data gathered during this field stay. Unfortunately, due to COVID-19 regulations no visit at the regional office in India was possible.
ATSAF's JSP provided as the funding organization the financial support for this research project in Pakistan.

4. Field research

Empirical data was collected in six 'dead-end valleys' (valleys that can be entered only through one road). In each valley three settlements were chosen based on their remoteness, accessibility, and presence of apricots. If available, the main market town and two increasingly remote villages were selected (Figure 1).

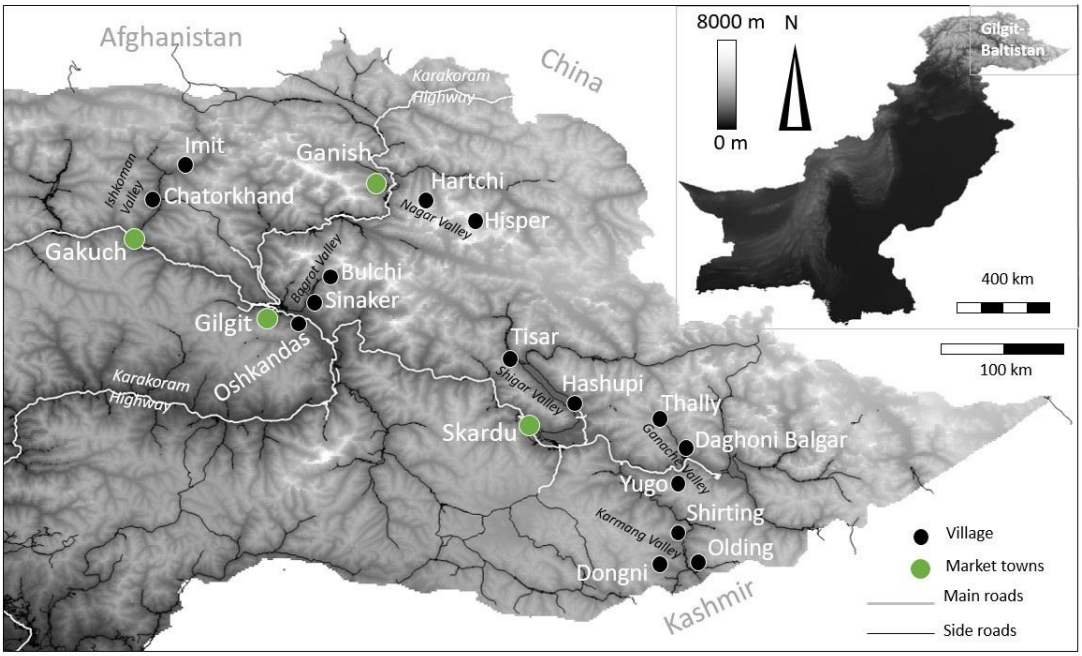

Figure 1: Selected settlements from main markets and dead-end valleys along the Silk Road (now Karakorum Highway) in Gilgit Baltistan characterized by pronounced apricot production and high varietal richness. Source: DIVA-GIS, www.diva-gis.org/gdata, accessed 28 January 2020

The selection of farmers was based on the following principles: i) the presence and willingness of female and male household decision makers (DM) to participate in the survey and ii) the cultivation of traditional or modern apricots by both DMs, whereby emphasis was placed on covering as much socio-economic diversity as possible. Due to limited official census information a linear snowball sampling was applied. In each village 4-5 farmers were interviewed, resulting in 86 interviews in 18 settlements. Local customs and the limitations of snowball sampling confined the spectrum of interviewees mainly to Muslims of the sub-sects Twelvers and Ismaili of the Shia Islam. Secondary data was obtained through 29 semi-structured interviews with multiple stakeholders, including representatives from the government and NGOs, farmer societies, individual entrepreneurs and local processing units (Figure 2).

Figure 2: Collecting data through key source interviews (top) and household interviews (bottom)

To describe the varietal richness the Simpson's diversity and evenness following Morris et al. (2014) were calculated. A household level intensification index was developed, by pooling the descriptive power of seven agronomic indicators into a single index (Table 1). For each HH the indicators were summarized by computing the mean.

Table 1: Used indictors for calculation of the agronomic intensification index used in the project area of Gilgit-Baltistan, Pakistan

Indicator name	Indicator description	Type of indicator	Mean
New varieties (NV)	Percentage of new varieties[1]	Continuous in %	0.08
Grafting (GR)	Percentage of grafted trees	Continuous in %	0.67
Farm-yard manure (FYM)	Application of manure to trees	Dummy, 1 yes, 0 no	0.72
Compost (Co)	Application of compost to trees	Dummy, 1 yes, 0 no	0.07
Mineral fertilizer	Application of mineral fertilizer	Dummy, 1 yes, 0 no	0.21
Pesticide (PSC)	Application of pesticides	Dummy, 1 yes, 0 no	0.13
Sulfur Drying (SD)	Use of sulfur of apricot drying	Dummy, 1 yes, 0 no	0.59
Intensification Index	Level of intensification	Continuous in %	0.37

[1] New varieties were defined by each interviewee

5. Preliminary results

5.1. Study area and interviewees

The study area is characterized by a unique cultural and linguistic diversity (Kreutzmann, 2014). Interviewees in six valleys spoke five different languages and belonged to three sects of Islam. The most talked language among the participants was Balti (43%) followed by Shina (30%) and Bruscheski (16%) while 69% were Shia Muslims, and 22% Ismailis, the rest being Sunnis. The average interviewee had finished middle school, while a quarter didn't have any formal education and 12 % had a university degree.

5.2. Apricot diversity

The study area has an astonishing diversity of apricots (Figure 3). The Simpson's diversity index of 0.95 indicates a very high probability that two random chosen individuals belong to different varieties. The prevailing diversity is, however, not evenly distributed as reflected by the Simpsons evenness index of 0.2. The three varieties Halman, Karfo chuli, Shikanda are the dominant ones making up 27.2 % of all studied apricot trees (Figure 3).

Figure 3: Apricots on branches (right) and fruits put to dry in the sun (left) in Gilgit-Baltistan, Pakistan.

5.3. Remoteness

In each valley the most remote households showed significantly less income generated from apricot products, were less likely to sell them and if sold in smaller quantities than households in lower parts of the valley. No household employed labor and the price received for the dried apricots was with a mean of 0.5 US $/KG (1

US$ = 161.5 Pakistani Rupees, RS) significantly lower than in less remote areas where farmers sell their dried apricots on average for twice the price. These finding go alongside with a significantly lower mean intensification index values compared to the less remote villages.

5.4. Improved income with increased intensification

Added technology	US$
1st	0.45
2nd	0.54
3rd	0.67
4th	0.82
5th	1.16
6th	1.26
7th	1.54

The data proves that intensified farming is positively correlated with relative income generated by apricot products. The adoption of one of the agronomic practices used for the index (Table 1) can lead to a maximum increase of relative revenue 1.54 US$/tree accounting for more than a third of the average relative income (4US$/tree) derived from apricots (Table 2). Even though there is a significant positive relationship between the index and the income from apricots the coefficient of determination R^2 is with 0.07 very low. This indicated furthermore the complexity of the system subject to study and the multitude of potential explaining variables.

Table 2: Back-transformed increase of US$/tree revenue for increased adoption of intensified farming technologies in the study area GB, northern Pakistan. The per adoption increase was calculated using a regression analysis, with log-transformed apricot revenue/tree as the response variable $\hat{Y}$ and the index as the predicting variable X_1. The regression model is as follows: $\hat{Y} = 0.69 + 1.45X_1$; As the index spans seven technologies and has the maximum at 1, each added technology was calculated with $\hat{Y}(X_1 + 0.14)$ until $X_1 = 1$.

5.5. Drivers for intensified apricot farming

As households in GB have diverse income sources and apricot farming is generally not the main source of income (Shahzad, 2021), value attributed to apricot cultivation and resulting choices regrading intensification depends on various factors. Factors from four categories (farm and farmer characteristics, production characteristics, knowledge and apricot management) are expected to shape the decision-making process of framers to apply intensified farming techniques (Table 3). The analysis of predictors for the intensification index will be part of my master thesis, but not this report.

Table 3: Descriptive statistics of major parameters explaining adoption in Gilgit-Baltistan, Pakistan.

Name of variable *Farm and Farmers characteristics*	**Variable description**	**Type of Variable**	**Min**	**Mean**	**Max**	**SD**
Education	Level of formal education	Categorical, 1 to 5	0	2	5	1.66
Gender	Gender of the farmer	Dummy, 1 male, 2 female	1	1.12	2	0.32
Age	Age of farmer	Continuous	20	49	78	12
Phone	Access to phone (females)	Dummy[1]	0	0.44	1	0.5
Income	Total income of HH per year	Continuous, US$	158	4 014	19 136	3 261
Loan	Loan taken in last 12 month	Dummy[1]	0	0.29	1	0.45
Land	Amount of land for apricot production	Continuous, acre	0	0.75	12.5	1.5
Experience	Number of years cultivating apricots	Continuous	2	20.22	53	11.75
Varieties	Number of cultivated apricot varieties	Continuous	2	6.01	40	5.95
Trees	Number of apricot trees	Continuous	6	60	550	80
Density	Density of apricot trees/ acre	Continuous	5.6	128	600	112
Membership	Member in famers society	Dummy[1]	0	0.6	1	0.49
Assets	HH owns mechanized farm equipment (female answer)	Dummy[1]	0	0.11	1	0.31
Attitude	Like apricot cultivation	Dummy[1]	0	0.95	1	0.22

Name of variable	Variable description	Type of Variable	Min	Mean	Max	SD
Production characteristics						
Fresh sold	Amount of fresh apricots sold	Continuous, kg	0	267	2000	535
Fresh price	Price of fresh apricots	Continuous, RS	18	31	40	9
Dry yield	Total yield of dry apricots	Continuous, kg	0	215	1080	193
Dry sold	Amount of dry apricots sold	Continuous, kg	0	153	1000	171
Dry price	Price of dry apricots	Continuous, RS	13	132	430	83
Working hours	Working hours for apricots average/day during season	Continuous, hr	0	5.1	16	3.4
Income apricot	Total income of HH from apricot production per season	Continuous, US$	0	151	1 463	212
Knowledge						
Training	Received training for apricot production/ processing	Dummy[1]	0	0.45	1	0.50
Gratis training desired	Gratis training desired	Dummy[1]	0	0.90	1	0.30
Training desired	Training for money desired	Dummy[1]	0	0.86	1	0.35
Apricot management						
Cutting	Weeding through cutting gras	Dummy[1]	0	0.72	1	0.45
Grazing	Weeding trough animals	Dummy[1]	0	0.86	2	0.38
Irrigation	Time used for irrigation	Continuous, hr	0.2	3.5	24	4.1

[1] Dummy: 1 yes, 0 no

6. Conclusions

This research in northern Pakistan helped me to gain major insights into the realities of scientific data collection, intercultural collaborations and their challenges. I was able to get first-hand experience in planning and conducting my own research in a foreign environment. The acquired knowledge and personal development of this research are great assets for my future carrier aspirations in this field.

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