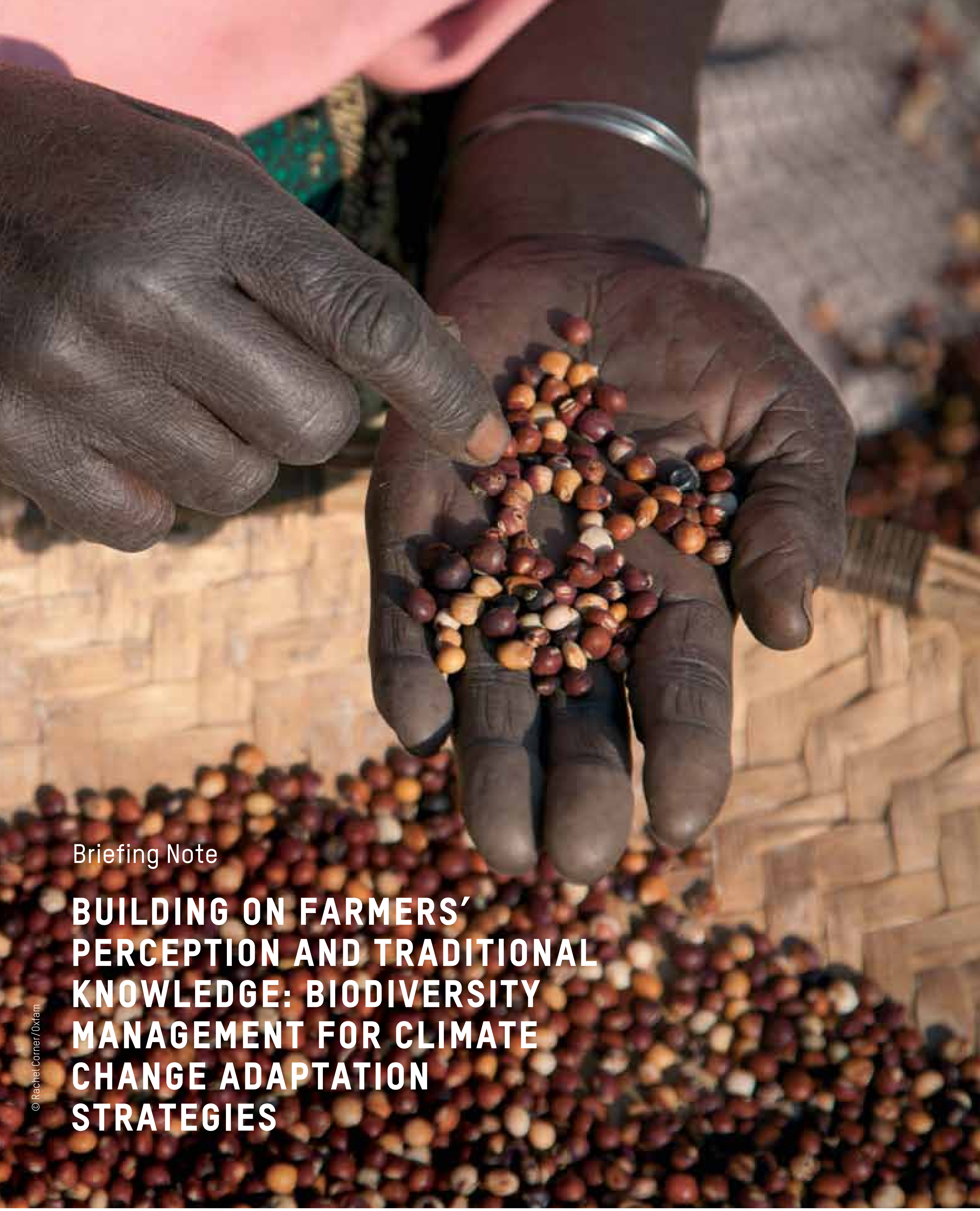

Briefing Note

BUILDING ON FARMERS' PERCEPTION AND TRADITIONAL KNOWLEDGE: BIODIVERSITY MANAGEMENT FOR CLIMATE CHANGE ADAPTATION STRATEGIES

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Abstract: *The initial findings of the survey in Peru, Zimbabwe and Vietnam support studies that the indigenous peoples and smallholder farmers are aware that climate change is taking place. Their perceptions of, and responses to, climate change are filtered by the impact on their farming systems and crop performances. The initial findings also confirm that indigenous peoples and smallholder farmers are adapting to climate change. They adapt by extending their traditional knowledge of weather predictions, biodiversity management and cropping calendars. This study highlights farmers' seed systems as an important aspect of adaptation. Farmers' choices of adaptation strategies have serious implications for their livelihoods. Failure in the shift to other crops could risk the ruin for both subsistence and market-oriented farmers. This implies that farmers would not take such risk unless they take climate change seriously. The dynamics of how farmers adjust and develop new knowledge in the context of extreme stress, such as climate change, needs to be understood and addressed as a major factor in the global response to climate change. The study suggests to further build on peoples' perceptions and traditional knowledge to strengthen their use of weather forecasts in their adaptation strategies, and for the scientific community to address inconsistencies between meteorological data and peoples' perceptions. The study further recommends the strengthening of social networks, including through biodiversity fairs, to support farmers' exchange of seeds and knowledge, particularly amongst women.*

Indigenous peoples and smallholder farmers (IPSHF) are critical actors in the collective global responses to challenges posed on food security and nutrition in the context of climate change. Their livelihoods are likely to be strongly impacted by climate change. Therefore, their knowledge of agro-ecosystems, their seed management and their resilience to the vagaries of weather conditions are critical to building appropriate local to global responses. Despite the increasing acknowledgement of IPSHFs' roles and knowledge by international policy forums and increasing availability of studies on farmers' adaptation strategies[1] , IPSHFs' participation in programmes and policies related to climate change often remains limited to the margins of mainstream agricultural programmes.

Despite a number of studies on farmers' perceptions of climate change[2] , there are still discrepancies between IPSHFs' use of complex adaptation processes and farmers' limited adoption of technical options provided by agricultural research. Learning from the decades of experiences in participatory research worldwide regarding the role of peoples' traditional knowledge, how do we apply this to the new realities of climate change? How can we enhance farmers' traditional knowledge for weather forecast and agricultural planning? How do we strengthen multi-stakeholder collaboration in support of IPSHFs' adaptation strategies?

In an attempt to explore ways of responding to these questions, the *Asociación para la Naturaleza y el Desarrollo Sostenible* (ANDES)[3] ; Community Technology Development Trust (CTDT)[4] ; the Southeast Asia Regional Initiatives for Community Empowerment (SEARICE)[5] ; and Oxfam Novib, conducted a baseline survey in Vietnam, Peru and Zimbabwe, in 2012-2013. The aim was to understand and build on local peoples' perceptions, knowledge and needs, to identify and strengthen their coping strategies for climate change and scale this up. The further purpose is to generate knowledge amongst project partners and local peoples about what impacts climate change may have on food production and livelihoods, and which of these may also represent new opportunities for collaborative action. The baseline survey serves as a major input into defining Oxfam Novib's, partners' and IPSHF communities' programme interventions. This includes measuring of progress and results related to the scaling up of people's biodiversity management for food security in the context of climate change. This Briefing Note is based on the preliminary findings of the survey report. It reflects work in progress, as many issues need to be further investigated and addressed in the course of the project. The aim of this Briefing Note is to stimulate discussions with the wider stakeholders in the biodiversity management for food security for climate change adaptation in order to further guide the course of the project.

INDIGENOUS PEOPLES AND SMALLHOLDER FARMERS (IPSHF)

Whilst ANDES, CTDT and SEARICE have long been working in Peru, Zimbabwe and Vietnam, most of the areas in the survey, particularly in Vietnam and Peru, are new project sites. The farmers surveyed in Zimbabwe are mainly subsistence farmers, primarily in maize farming. The indigenous peoples and smallholder farmers of Vietnam are engaged in rice and cash crop farming. In the Andean mountains of Peru, people take advantage of every ecological niche. In the Low Zone, the IPSHF primarily produce for commercial purposes. The farmers in the Middle and Upper Zones largely cultivate for their own consumption, but they also sell some of their harvests. In summary, the baseline survey includes IPSHF that mainly produce for subsistence, as well as those that produce both for subsistence and selling in the market.

The average arable land area for households in Vietnam ranges from 0.1 to 0.4 hectare (ha). In Peru, the average arable land per unit in the Andes is 0.8 ha. In Zimbabwe, maize is grown on holdings of 0.4 to 0.8 hectares, with an additional smaller area of land (below 0.4 ha), for groundnuts, cowpeas and other crops.

In general, between 50% and 70% of women in the surveyed areas in Peru, Vietnam and Zimbabwe are involved at all levels of farm work – from seed selection, to planting and harvesting. The more 'muscular activities' (e.g. tilling) tend to be fulfilled by men, whereas women and female children bear primary, if not exclusive, responsibility for the household chores in addition to their agricultural tasks. The findings of the survey confirm general knowledge on gender roles in relation to cash and subsistence crops, in that men are primarily involved in the production of cash crops, whereas women take care of the crops for household consumption. In particular, in Peru, the decision of selecting the variety to be grown is almost exclusively associated with men in the Low Zone, since commercial crops are controlled by men. In the Upper Zone, this decision is completely made by women, as they are most knowledgeable about the native potatoes. In Zimbabwe, women play lead roles in subsistence agriculture, whereas growing cash crops in Vietnam is generally a man's domain.

[1] Below, T., et al. 2010.
[2] Moyo et al. 2012.
[3] ANDES' partners in Peru: the Environmental Authority of the Regional Government of Cusco, the Municipality of Lares and the International Potato Centre (CIP)
[4] CTDT's partners in Zimbabwe: Agricultural, Meteorology Group, the Department of Physics of the University of Zimbabwe, department of Agricultural Technical and Extension Services (AGRITEX), the Zimbabwe Meteorological Services Department (ZMSD) and the National Gene Bank of Zimbabwe.
[5] SEARICE's partners in Vietnam: the Centre for Sustainable Rural Development (SRD); Plant Protection Department (PPD) under the Ministry of Agriculture and Rural Development (MARD); and Field Crops Research Institute (FCRI).

TABLE 1.
SURVEY INFORMATION IN PERU, VIETNAM AND ZIMBABWE

Survey information	Peru	Vietnam	Zimbabwe
Project households[6] (target group)	2,062 households	6,750 households (546 households in Year 1)	3,800 households
Number of Sample Population	265 (10%)	200[7] (3% of the total target group) 675 (10% by Year 3)	382 (10 %)
Number of women of the Survey Sample	122 (46%)	125 (62.5%)	241 (63%)
Population estimate and target areas	7,138 inhabitants (54% men and 46% women) representing 23 indigenous communities and 2,062 Quechua families of the three zones (Lower, Middle and Upper) located in the district of Lares, Calca Province in the region of Cusco, Peru. These communities represent some of the poorest population in Peru, where 97% are in poverty and of which 89% are in extreme poverty[8]	2,340 inhabitants (47% men and 53% women) representing 546 farm households in 4 villages from 4 communes in 4 provinces in the upland area to the Northwest and Northeast of Hanoi as well as in the North Central region of Vietnam (Hoa Binh, Son La, Yen Bai and Thanh Hoa provinces)	502,000 inhabitants representing 171, 213 farming households[9] of Chiredzi district in Masvingo Province (25 villages), Goromonzi (13 villages) and Uzumba Maramba Pfungwe (UMP) (7 villages) districts, Mashonaland East Province, and Tsholotsho district (13 villages) in Matabeleland North Province
Ethnic groups	Quechua	There are three major ethnic groupings. The mountainous provinces of Yen Bai and Thanh Hoa are mostly of Kinh origin, 96% and 100%, respectively. Hoa Binh Province is composed mostly of Muong origin, while Son La Province is predominantly ethnic Thai.	The country does not use ethnic groupings but the main tribes are the Shona and Ndebeles

Source: Baseline survey of Peru, Vietnam and Zimbabwe (ANDES, SEARICE, CTDT 2012).

6 The average household size in the study area in Peru is 6 people (5 members involved in agricultural activities). In Vietnam, the average household size is 4.4 (ranging from 4 to 4.6), and in Zimbabwe it is 6 people, with 4 adults involved in agricultural activities.

7 Fifty households in each selected village

8 INEI 2009.

9 Zimbabwe Statistical Agency; ZIMSTAT 2012.

SURVEY METHODOLOGY

The survey used four sources of information for cross-referencing: a) farmer interviews using semi-structured household questionnaires; b) Focus Group Discussions (FGD's); and c) participatory rural appraisal (PRA), such as crop and gender calendars[10], resource mapping, soil mapping and diversity mapping and (d) statistical data from meteorological centres. Stratified random sampling was used in Vietnam and Zimbabwe. Whilst in Peru, stratified sampling[11] was done. The reference year varied between countries. When recording perceptions of climate variability over time, the questionnaire refers to farmers' recollection of weather patterns of 40 years ago in Peru, 10 years ago in Zimbabwe, and 10-20 years ago in Vietnam.

To compare farmers' perceptions of climate change and weather variability with long-term meteorological records, data were collected and analysed from the National Service of Meteorology and Hydrology (SENAMHI) of Peru; the Statistics of Meteorological Centre of Hoa Binh, Son La, Yen Bai and Thanh Hoa of Vietnam and the Zimbabwe Meteorological Services Department. However, the data from the survey have not yet been extensively compared with these meteorological records. This will be further done in the course of the project implementation. The meteorological data analysed are for the period of 2002-2010 in Vietnam, 1960-2008 for Zimbabwe, and 1992-2012 for Peru.

[10] Gender division of labour on farming and house chores.
[11] The population density between the zones in Peru varies greatly; stratified sampling was used to ensure that equal population of each zone is represented.

TABLE 2.
METEOROLOGICAL DATA IN THE THREE COUNTRIES[12]

	Peru		Vietnam	Zimbabwe	
Regions	Puna/Upper Valley Zone	Quechua / Middle Valley Zone	North Central Coastal Region (Thanh Hoa), North Eastern Region (Yen Bai), North Western Region (Hoa Binh and Son La)	Agroecological region 4 (Tsholotsho, Chiredzi, UMP districts)	Agroecological region 2b (Goromonzi)
Climate classification	High mountain dry tundra	Cold boreal climate	Tropical monsoon climate	Semi-arid	Semi-arid/ sub-humid
Temperature (average)	0°C and 7°C	11°C and 16°C	19°C and 23.7°C	15°C and 28°C	10°C and 22°C
Average rainfall/ annum	200-1,000 mm		1,200- 2,200 mm	450-600 mm	800 mm
Season	Rainy and dry seasons		Rainy (hot) and dry (cold)	Rainy and dry seasons	Rainy, cold and dry seasons

Source: Baseline Survey of Peru, Vietnam and Zimbabwe (ANDES, SEARICE, CTDT 2012); UNDP 2013; Brown, D. et al. 2012.

[12] W. Köppen's climate classification, http://www.elmhurst.edu/~richs/EC/101/KoppenClimateClassification.pdf

CLIMATE CHANGE: PERCEPTIONS AND PREDICTIONS

It is difficult to distinguish between more permanent climate change and temporary changing weather conditions. Nevertheless, famers recognise some of the recent events as climate change. More than 90% of the IPSHF in all three countries believe that their respective climates have changed based on three common and interrelated indicators based on the effect they have on their farming systems and crop performances:

(1) Changes in temperature, timing (onset and cessation), intensity and duration of the weather events, such as rain, frost, and drought. Farmers in all three countries reported changing patterns in the onset of the rainy season. For instance, 40 years ago in the Middle Zone of Peru's mountains, rain was recorded from September to October, while for the past years, the rainy season has only started in November. Similar observations were made in Zimbabwe and Vietnam.

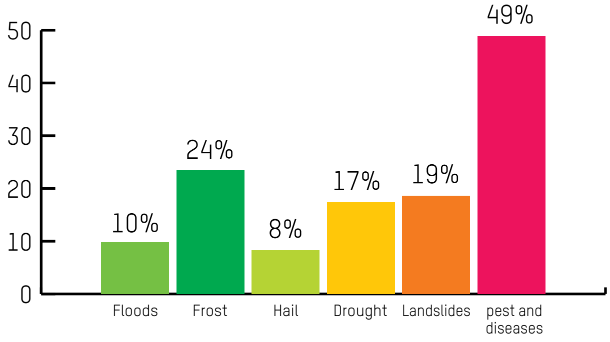
In Zimbabwe, the survey confirms that in all the districts, farmers have observed changes for the month in which the first rains occur (more than 95% respondents in all districts). They have also reported that unpredictable dry spells are more common than before (more than 90% of respondents in all districts). Furthermore, according to the farmers, dry spells have become longer and more severe. Dry weather may last up to one month, compared to a maximum of two weeks before the year 2000. Furthermore, the shift of the period of the dry spell has resulted in poorer yields, thereby compromising food security. Increasing drought is experienced by all districts (more than 80% respondents). It is attributed to natural processes and climate change. Floods are also experienced in two of the four districts; however, not as often as drought. Similar to drought, farmers attribute the floods to natural processes and climate change.
Some of these findings contradict the meteorological data in Zimbabwe (see section on weather forecasts and cropping patterns).

In terms of temperature, all three countries perceived changes (see Table 3). For example, in Peru, farmers perceive increasing average temperatures. In Vietnam, hot outbreaks/ high temperatures were reported in all provinces, whilst strong cold outbreaks were also reported. For Peru, Vietnam and Zimbabwe, perceived changes in temperature are mostly consistent with meteorological data.

(2) Extreme climate events. The farmers in the three countries state that they are increasingly affected by extreme weather events and that, to some extent, these events have influenced their crops and livestock. In Peru, most households identified the following extreme events: an increase in droughts, frosts, floods, hailstorms, and hence an increase in landslides and in the incidence of pests and diseases in their crops. In Vietnam, within a 10-year timeframe, the households have increasingly experienced droughts and flash floods, as well as hurricanes and tropical depressions. Within a 30-year period, from 1980 to 2010, Vietnam was hit by 27 hurricanes and tropical depressions, and 18 of these directly affected Thanh Hoa. The farmers in Hoa Binh have been severely affected by 19 hurricanes and 3 tropical depressions. Farmers in Zimbabwe also experienced persistent droughts, which they had never experienced before, especially in Chiredzi and Tsholotsho districts[13].

FIGURE 1.

Farmers perceived incidence of extreme weather event in Peru causing crop losses



Source: Baseline Survey of Peru (ANDES 2012).

(3) Increased occurrences of pests and diseases. Farmers in all countries indicate there is a marked increase in the number of pests and diseases and they see this as a strong indication of a changing climate. This suggests a relation between climate change and pest population dynamics, consistent with findings from other published reports[14].

In Vietnam, pests and diseases of crop production occur with stronger intensity (more virulent) and longer duration than in the past, resulting in an increase in crop loss. 80-90% of respondents believe the increase of pests and diseases are connected to climate change. The outbreak of brown planthopper causing rice grassy stunt virus damaged 67% of the area in Hoa Binh Province in 2008. This is suspected to have been triggered by the prolonged lower temperatures in the same year. This observation is consistent with published reports[15] on outbreaks of rice brown planthopper in many East Asian countries in 2005–2008.

As presented in Figure 1, almost 50% of the households in Peru indicated that climate change has resulted in an expansion of the range of major pests[16] , such as moths and the Andean potato weevil. The traditional exchanges of seeds are now increasingly infested with pests and diseases. From the lowlands, this may have contributed to the spread of pests to higher elevation zones. The traditional farmer-to-farmer seed exchanges are a major source of seeds and tubers.

[13] 3 droughts within a 5 year timeframe.
[14] Perez and Nicklin et al. 2010.
[15] Heong, E. et al. 2008; See also Otuka, A. 2008 and Heong, K.L. and Hardy, B. (eds) 2009.
[16] This is consistent with studies of Perez and Nicklin et al. 2010.

TRADITIONAL KNOWLEDGE AND PRACTICES

The three sets of data survey suggest that, in terms of responding to climate variability and change, farmers are resourceful and act based on locally-developed (indigenous) knowledge and practices. Although traditional knowledge is diverse and site-specific, the data show that observable natural and/or environmental indicators are the main means for farmers to predict weather and to develop their corresponding adaptation strategies. In Peru, traditional knowledge and ancestral practices used in the rural communities are primarily based on the Andean worldview where all elements of the ecosystem are regarded as living beings. The farmers' relations with the natural world have been able to develop environmental observation skills, which help predict, with some margin of anticipation (3 to 4 months ahead) the occurrence of rainfall and its intensity. This is then used in their annual agricultural planning [17]. Similarly, in Zimbabwe, communities have their own ways of forecasting seasons using traditional knowledge. The most commonly used indicators are animal behaviour, tree phenology, pre-season heating and cooling, prevailing wind direction, and cloud systems. The survey in Vietnam shows that farmers in Yen Bai and Thanh Hoa also predict weather patterns by observing changes in the behaviour of animals and cloud formations. Nowadays, in Vietnam, weather forecasts from meteorological services are the main source of information for the farmers[18].

WEATHER FORECASTS AND CROPPING PATTERNS

With regards to weather forecast information from the public system, it appeared that farmers in the survey of Vietnam and Zimbabwe have relatively good access to information, whereas this was less the case in Peru. Around 60 to 70% of the farmers in Vietnam receive weather forecasts and information, and more than 95% of these farmers plan their farming activities in accordance with this weather information. It was also reported that this information influences the types of crops grown on farms for the incoming season.

In Zimbabwe, the farmers have access to weather information from the Zimbabwe Meteorological Services Department (ZMSD), mostly through the radio and Agritex (government extension) personnel. Farmers in most districts understand and use the forecasts in planning agricultural activities. Most farmers rate the ZMSD forecasts as reliable. However, in Chiredzi, 40% of the farmers regard the forecasts as unreliable and do not use this for decision-making for agricultural activities. The results of the survey suggest that, generally there is not always agreement between the ZMSD forecasts and the traditional forecasts by farmers. For instance, farmers perceived marked decrease in rainfall, but the weather data indicated that average rainfall remained the same. This might be caused by the severity of the impact of the changes. For example, if average rainfall remains at the same level, but falls more in heavy spells, this results in more water run-off, which farmers cannot use and which may lead farmers to conclude there is less overall rainfall.

In recent years, the *Servicio Nacional de Meteorología e Hidrología* (SENAMHI) in Peru has made significant progress in the climate monitoring and modelling[19]. However, the vast majority of households in the Low and Upper Zones do not have access to the SENAMHI weather information[20]. It is solely in the Middle Zone that 38% of households receive the information. From this group who receives the weather information, there are few who understand it; and those who do, do not use it. The gap may be influenced by factors, such as forecast data management in the station, distance between weather station and local communities, weak linkages in the communication and dissemination to farmers, and inadequate integration of weather forecast information for small farmers.

[17] The most prominent use of rituals in climate change prediction is clearly reported in Peru. Experts and elders observe clouds and stars on specific dates such as June 24 and August 1, to forecast the onset of the rainy season and the amount of rainfall in the next growing season. Also, in each agricultural season, rituals and festivities in praise of Pachamama and sacred mountains are practiced.

[18] In the past in Zimbabwe, rain making ceremonies were led by traditional chiefs who conducted them at sacred places at the beginning of the season. However, this practice is no longer common due to religious influence (Christianity). Indigenous or ethnic rituals were not covered in the baseline survey in Vietnam.

[19] Technological advances have enabled the installation of new weather monitoring stations, allowing for the flow of information in almost real time and its use in short-term weather predictions.

[20] Most likely due to the fact that the district capital is in the area.

CROP DIVERSITY MANAGEMENT AS ADAPTATION STRATEGY

Farmers have often used crop management to deal with biotic and abiotic stresses[21]. In all three countries, the survey suggests that now, with the climate changing, farmers are further adopting traditional crop management to cope with climate variability and change.

Crop management strategies of the farmer respondents include combinations of early and late maturing varieties, and more drought tolerant and pest resistant varieties[22]. For example, in Zimbabwe, farmers in UMP grow between 5 to 6 different crops and 3 to 4 varieties of each crop as an adaptation strategy. A number of the crops and crop varieties are from the community seed banks.

[21] Biotic stresses are damage to plants from other living organisms such as bacteria and virus. Abiotic stress includes drought, flood, and salinity.

[22] This is reported by other studies in Sub-Saharan Africa and Vietnam (Bryan et al. 2013; De Wit. 2006; Nhemachena and Hassan. 2007; Dang et al. 2013).

TABLE 3.
RELATIONSHIP BETWEEN WEATHER AND CROPS IN THE THREE COUNTRIES

	Peru	Vietnam	Zimbabwe
Rainfall		In areas with higher risk of waterlogging, tolerant varieties are planted and the appropriate crop management is practiced.	Farmers in the marginal parts of the country grow a mixture of both drought and flood tolerant crops to adapt to crop failures that are induced by droughts.
Temperature	Facing increasing average temperature, the strategy is to adapt different crops to higher altitudes to prevent pests and diseases.	Drought tolerant and early maturing short season varieties are grown during the "hot" months. Staggered planting is also identified as an option. Alternative crops such as potatoes and vegetables are also resorted to during the "cold" months.	Farmers hardly respond to temperatures being experienced to decide on which crops to grow.
Typhoon	N/A	Average of 6-8 typhoons per year. Crops are destroyed.	The country does not experience typhoons.
Drought incidence	Drought resistant varieties are cultivated: Boli potato in Middle and Upper Zones, yellow and white corn and Pacay broad beans in Middle Zone.	Growing early maturing varieties and planting early are the coping mechanisms farmers generally practice in times of drought and floods. Other strategies to mitigate drought include mulching (practiced by 60% of farmer respondents in Son La), water pits, tied ridges, contour ridging, and other soil moisture conservation measures.	As a drought adaptation and mitigation strategy, farmers grow short season varieties.
Floods and flash floods	Floods resistant varieties are cultivated: Boli potato in Middle and Upper Zones, Pacay broad beans and yellow and white varieties in Middle Zone.	Flood (water logging) tolerant and early maturing (short season) varieties are cultivated.	Low lying districts such as Chiredzi and Tsholotsho are affected by floods in 1 out of every 4-5 years. If such incidences occur, farmers' crops are destroyed but those staying close to rivers and low lying areas resort to vegetable production soon after the rainy season to benefit from the residual moisture.
Pest and disease incidence	Pest and disease tolerant varieties are cultivated: yellow and white maize and Cahchan potato in Middle Zone, and Boli potato in Middle and Upper Zones.	Periods of outbreak and incidence of pest infestation are recorded and the planting calendar is correspondingly adjusted. Resistant and tolerant varieties, and in some cases, indigenous varieties are planted.	Major pests that affect crop productivity in the country are the army worms which especially affect crop production during the early vegetative stages of crop growth

Source: Baseline Survey of Peru, Vietnam and Zimbabwe (ANDES, SEARICE, CTDT 2012)

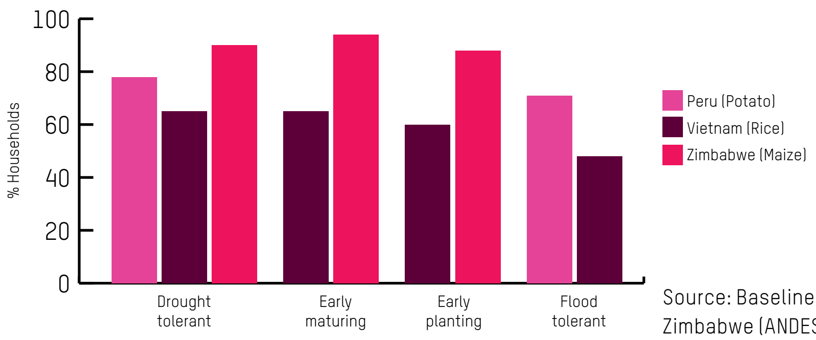
TABLE 4.
CHANGING CROPPING PATTERNS

Peru	With the increasing average temperature, some crops (maize, beans, wheat, and barley) in lower areas are moved up to higher altitudes, 'displacing' native crops like potatoes, oca, olluco and nasturtiums, which in turn are planted in increasingly higher areas to prevent pests and diseases.
Vietnam	During times of drought or flood, farmers adjust the time of planting and plant early or late maturing varieties.
Zimbabwe	Farmers in the drier districts of Chiredzi, Tsholotsho and UMP are growing shorter season varieties including more and smaller grain crop varieties because the season length was becoming too short to support the majority of the hybrid maize varieties.

Source: Baseline Survey of Peru, Vietnam and Zimbabwe (ANDES, SEARICE, CTDT 2012)

FIGURE 2.

Farmers' perceptions of how they adapt the use of different crop varieties to changing climates



Source: Baseline Survey of Peru, Vietnam and Zimbabwe (ANDES, SEARICE, CTDT 2012)

In terms of crop diversity management for climate change adaptation, farmers in the three countries say that they use a combination of traditional and modern varieties. Households in Peru indicate that they adapt by cultivating more drought tolerant traditional varieties potatoes (Boli varieties) (71 and 78% respectively). Other traditional varieties include yellow and white maize, Pacay broad beans and Canchán potato. In Vietnam, where people have lost their traditional varieties, they adapt by using modern drought tolerant and early maturing varieties of rice (65% of households). They also resort to early planting and use flood tolerant varieties when needed. In Zimbabwe, the use of early maturing and drought tolerant varieties of maize (more than 90% of households) represents the main coping strategy. In addition, in Zimbabwe, hybrid maize is perceived as having average to very good tolerance to drought. As a possible response to drought tolerance, 37% of the respondents think that hybrid maize could be useful, whilst 54% considers the possibilities of a combination of hybrid and open pollinated varieties. In the meantime, in Zimbabwe, farmers are shifting from maize to small grains (traditional and modern varieties) of sorghum and millets as a strategy to adapt to increased drought conditions.

FARM-SAVED SEEDS

Farm-saved seeds and traditional farmer-to-farmer exchange play a crucial role in providing food security worldwide. In Africa, reliance on farm-saved seeds is as much as 80–90%[23]. Seeds to be saved on-farm are traditionally selected from standing crops based on farmers' observations and assessments of crop performance in relation to farmers' preferred traits. The seeds are selected and stored for the next season's planting. It emerged from the survey that particularly the seeds for the most important crops are stored for the next season. The data shows that in contrast to farmers in Vietnam, farmers in Peru and Zimbabwe largely use farm-saved seeds, which significantly contributes to seed availability and security. Women play a strong role in Peru and the task of saving seeds is shared between men and women, while, in Zimbabwe, seed selection is mainly done by women. In contrast, in Vietnam, farmers source their seeds from the market, and gradually from the newly established farmer fields schools organised through the project. Breeding and selection is dominated by men, but many women also exert influence, particularly in Son La province. In Yen Bai and Thanh Hoa, women have control over breeding and selection of planting materials.

In Zimbabwe, for example, at least 90% of farmers in the four districts confirmed that they used seed from the previous harvest, except for hybrid maize. Further, it is indicated in Table 5 that the main advantage for farmers to use farm-saved seed, is based on 'drought tolerance' qualities. In contrast to Peru, 'availability' is the primary reason. The finding also suggests that 'affordability' and 'early maturity' are important. It could be interpreted that, apart from 'affordability', Zimbabwean farmers' practice of saving seeds, particularly drought resistant and early maturing varieties, also help them to cope with the effects of climate change. The survey also suggests that, despite farmers commonly practicing seed-saving activities, overall there is very limited or no farmer breeding activities in the project areas.

[23] Jarvis, D.I., Sthapit, B., and Sears, L. (eds) 2000.

TABLE 5.
PERCENTAGE OF RESPONDENTS HIGHLIGHTING ADVANTAGES OF USING FARM SAVED SEEDS IN ZIMBABWE

Strengths	Chiredzi	Goromonzi	Tsholotsho	UMP
Drought resistance	38	5	68	15
Higher yields	0	23	0	19
Readily available	14	21	5	16
Early maturity	19	7	27	9
Affordability	29	21	0	13
Retain variety	0	0	0	6
Pest tolerance	0	2	0	4

Source: Zimbabwe baseline survey CTDT 2012

In Son La, 34% of farmers perform rice seed selection through panicle selection, from which they get the seeds for planting in the incoming season. Farmers in the surveyed villages indicate that they do not exchange their rice varieties anymore. In addition, 95% of households in Hoa Binh, Yen Bai and Thanh Hoa purchase seed varieties from companies or breeding centres. In all selected provinces, 100% of the farmers purchased hybrid maize. This dependency on commercial sources could be explained by the poor quality of farm-saved seeds and the loss of traditional or local varieties.

In terms of *accessibility*, almost all households in Peru, Vietnam and Zimbabwe confirm a relatively secured access to seed, either through farm-saving, which is extensively practiced in Peru and Zimbabwe, or through purchase, such as in Vietnam. Farmer-to-farmer exchange also remains an important source of traditional seeds. In particular, in Peru, barter markets, seed fairs and women's social networks play important roles. In Zimbabwe, the more resilient seeds are not available in the market and are instead maintained by the farmers in Goromonzi province and by the community seed banks in Tsholotsho, UMP and Chiredzi. The survey also indicates that while seed availability in Peru is not a problem, seed quality is increasingly problematic. The repeated use of the saved seeds results in degeneration; leading to reduced crop yield and less resistance over time. This could pose as a serious threat to farm-saved seeds and farmer-to-farmer exchanges.

Additionally, in terms of *ability and willingness to pay for seeds*, the farmers in Peru, Vietnam and Zimbabwe, are willing to pay for good quality seeds that allow them to increase yields. However, in Thanh Hoa, Vietnam, 42% of the households have to purchase seeds through credit, and the rest indicate that they could afford to directly pay for their preferred seeds. In Vietnam, the farmers in the survey generally buy seeds from the formal seed sector. However, they described these seeds as poor in yield, prone to degeneration and susceptible to drought. Hybrid seeds, which they described as high-yielding, are also available and used by the farmers. However, they claim that hybrid seeds are expensive. Despite complaints of poor quality and high cost, most of the farmers in Vietnam have become dependent on the formal seed system, suggesting that local seed systems have eroded.

INITIAL FINDINGS AND RECOMMENDATIONS

The preliminary findings of the study are presented below. The project remains a work in progress. These early results serve as a signpost for further learning and actions with the IPSHF communities and stakeholders in the course of the project implementation. This could also be of relevance to the wider groups of stakeholders engaged in plant genetic resources for food and agriculture. Building on IPSHFs' local knowledge and biodiversity management for climate change adaptation could lead to mainstreaming their roles and engagement in food and agricultural programmes and policies related to climate change.

- The initial findings of the study agree with most of other studies that farmers are aware that climate change is taking place. This study confirms that farmers' perceptions of, and responses to, climate change are filtered by how their farming systems and crop performances are affected. Therefore, to develop a further understanding of farmers' responses to local impacts of climate change, farming systems and crop diversity are good entry points. To better support IPSHF, studies and programme interventions on the relations between peoples' agro-biodiversity management and climate change adaptation require the integrated disciplines of agro-biodiversity and climate change experts.

- The preliminary finding of this study agrees with other studies that climate data and farmers' perception do not always seem compatible. However, this study suggests that there may be valid functional reasons why this is so. The study confirms that when people have good access and understanding of the governments' weather forecasts, such as in Vietnam, they use them for seasonal agricultural planning at household and community levels. The study suggests to further build on farmers' perceptions and traditional knowledge to strengthen their use of weather forecasts in their adaptation strategies; and for the scientific community to address discrepancies between weather forecast and peoples' perception. Another study, which was also carried out in other regions of Zimbabwe[24], has reported that effective forecast communication to farmers is feasible. Most important is the regular participation of the user communities as partners in interpreting and operationalising weather data. The forecasts proved especially useful in years of large deviations from climatology, such as in El Niño years. The effective climate forecasting has helped farmers to feel more in control and gain confidence with their choices for adaptation. It is therefore worthy to find ways of reconciling climate data with the farmers' perceptions.

- The initial finding of the study also agrees with many studies that biodiversity management, through e.g. employing a combination of crops and crop varieties, is an important component of farmers' climate change adaptation strategies. The initial finding further suggests that farmers adapt their traditional knowledge of weather predictions for the purpose of more long-term climate change adaptation. This study also adds the dimension of farmers' seed management as an important aspect of adaptation. Furthermore, the study suggests that the reported increase in pest and diseases occurrence and virulence, perceived to be a result of climate change, may also impact on farmers' seed systems. Increase in seed-borne diseases such as suggested of the potatoes in Peru, poses additional threats to farm-saved seeds and the farmers' way of seed exchange. For many IPSHF, this exchange is their main source of seed supply. Therefore, the strengthening of farmers' seed systems is an important aspect of programme and policy interventions related to climate change adaptation and food security. Building resilience to climate change through seed security therefore requires: a) empowering farmers to manage their own seed system;

b) enhancing their capacities to develop or produce good seeds according to their needs and preferences; and c) ensuring they have continuous access to breeding materials for their own and their community's use.

- More studies are needed on the socio-economic consequences and limitations of various adaptation strategies of the IPSHF. How sustainable are the IPSFH's coping strategies? Furthermore, what are the consequences if farmers do not get assistance in adapting to climate change? As the women farmers in Peru expressed, "We keep planting our potatoes higher and higher, but how far can we go till we hit the sky?"[25] This suggests that while traditional knowledge remains very important to develop adaptation strategies, it may not always suffice given the major changes in the climate and marketplace.

- Considering that it is difficult to distinguish between more permanent climate change and weather variability, other studies suggest that farmers' awareness of climate change may also be influenced by externalities such as media, governments and civil society interventions. The initial findings of this study do not support nor refute such influence. Instead, this study confirms that farmers are indeed adapting to climate change through adjusting cropping patterns and diverse use of crop and crop varieties. Farmers' choices of adaptation strategies have serious implications for their livelihoods. For instance, failure in the shift to new crops could risk the ruin for both subsistence and market-oriented farmers. This implies that farmers would not take such risk unless they take climate change seriously. Therefore, the dynamics of how farmers adjust and develop new knowledge in the context of extreme stress, such as climate change, needs to be understood and integrated as a major factor in the global response to climate change. This also has implications in how farmers are to be engaged in the global policy arena considering the gap between farmers' knowledge and scientific knowledge.

- The study further recommends the strengthening of social networks, including biodiversity fairs, to support farmers' exchange of seeds and knowledge, particularly amongst women. The survey shows that women play a major role in food production, particularly in seed management. Strengthening the IPSHFs' knowledge, social network and access to plant genetic resources will strengthen their positions as decisive actors in the collective global responses to food security and nutrition in the context of climate change.

[24] Patt and Gwata . 2002.
[25] Based on FDG conducted by Manicad 2011.

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Literature scan:
A range of empirical studies on farmers' perceptions and adaptations to climate change was conducted in particular in sub-Saharan Africa, including in Zimbabwe (Kurukulasuriya and Mendelson 2006; Nhemachena and Hassan 2007; in Juana et al. 2013). These studies suggest that farmers are aware that the climate is changing. Other studies supported this and further emphasised the importance of determining if farmers' perceptions of climate change and variability correspond to actual long-term climatic records (i.e. study in Zimbabwe, Moyo et al. 2012). Many of these studies indicate that, although there are broad agreements between farmers' perceptions and the data obtained from meteorological stations, some of them reported discrepancies between the two. In contrast to Sub-Saharan Africa, such studies are still very limited in the Southeast Asian context, including in Vietnam (Dang et al. 2012). The study concludes that farmers in Vietnam are increasingly conscious of local climate change and this was basically consistent with agricultural officers' opinions and recorded weather data. In Peru, such studies have been conducted, although not as extensively as in Sub-Saharan Africa. One of the recent studies concludes that despite limited evidence of climate change, farmers do indeed perceive the climate to be changing. Perceptions of climate change appear to be mainly based on farmers' experiences, i.e. those who had been involved in farming longer were more likely to perceive long-term changes in temperature, precipitation and rainfall variability (Bryan et al. 2013). Further, it is suggested that changing crop varieties (planting more drought resistant crops) and early/late maturing varieties are perceived as the most common and least costly adaptation in some Sub-Saharan Africa countries, such as reported in Kenya (Bryan et al. 2013). This is confirmed by the study in Ethiopia, indicating that as part of an integrated coping strategy, crop genetic diversity (in the form of drought resistant and early maturing varieties and crops) is considered as preferable by the farmers (Asfaw et al. 2013). The impacts of climate variability on agriculture through pest and diseases have been observed by several studies in Southeast Asia and Latin America countries, including in Peru (Perez and Nicklin, et al. 2010). This study concludes, that climate change – apart from impacting agriculture through de-glaciation, changes in hydrology, and soil –has resulted in range expansion for important pests, such as moths that attack potatoes and quinoa and the Andean potato weevil. Climate may directly influence pests and diseases though altering their population dynamics.

REFERENCES

Below, T., et al. 2010. Micro-level Practices to Adapt to Climate Change for African Small-scale Farmers. A Review of Selected Literature. IFPRI Discussion Paper 00953. http://www.ifpri.org/sites/default/files/publications/ifpridp00953.pdf

Brown, D. et al. 2012. Climate change impacts, vulnerability and adaptation in Zimbabwe. Working Paper No.3: December. London, UK: International Institute for Environment and Development.

Bryan, E. Ringler, C., et al. 2013. Adapting agriculture to climate change in Kenya: Household strategies and determinants. Journal of Environmental Management, 114, 26-35.

Centre for Meteorology and Climatology-Vietnam Institute of Meteorology Hydrology and Environment (IMHEN). 2012. http://www.imh.ac.vn/

Dang, H.L. 2013. Farmers' perceptions of climate variability and barriers to adaptation: lessons learned from an exploratory study in Vietnam. Mitigation and Adaptation Strategies for Global Change, DOI 10.1007/s11027-012-9447-6.

de Wit, M. 2006. The perception of and adaptation to climate change in Africa, CEEPA discussion Paper No.10. CEEPA, University of Pretoria.

Heong, K.L. and Hardy, B. (eds) 2009. Planthoppers: New threats to the sustainability of intensive rice production systems in Asia. Los Baños (Philippines):International Rice Research Institute.

Heong, K.L., Escalada, M.M., Nguyen, H.H., Chien, H.V., Choi, I.R., Chen, Y., et al. 2008. Final report: Research and implementation issues related to management of the brown planthopper/virus problem in rice in Vietnam. Canberra, AU: ACIAR. http://www.aciar.gov.au/publication/FR2008-23.

Jarvis, D.I., Sthapit, B. and Sears. L. (eds.) 2010. Conserving agricultural biodiversity in situ: A scientific basis for sustainable agriculture. Rome: International Plant Genetic Resources Institute.

INEI 2009. Instituto Nacional de Estadistica e Informática. Mapa de Pobreza Provincial y Distrital.

Köppen. W. Climate classification. http://www.elmhurst.edu/~richs/EC/101/KoppenClimateClassification.pdf

Moyo et al. 2012. Farmer Perceptions on Climate Change and Variability in Semi-Arid Zimbabwe in Relation to Climatology Evidence. African Crop Science Journal, 20.

Nhemachena, C. and Hassan, R. 2007. Micro-level analysis of farmers' adaptations to climate change in Southern Africa. IFPRI, Environment and Production Technology Division. Washington, DC: International Food Policy Research Institute.

Otuka, A. 2008. Rice Planthoppers in Vietnam and Their Migration. National Agricultural Research Center, Tsukuba, Ibaraki 3005-8666, Japan.

Patt, A. and Gwata, C. 2002. Effective seasonal climate forecast applications: examining constraints for subsistence farmers in Zimbabwe. Global Environmental Change, 12, 185-195.

Perez, C., Nicklin, C., et al. 2010. Climate change in the High Andes: Implications and adaptation strategies for small scale farmers. The International Journal of Environmental, Cultural, Economic and Social Sustainability, 6, http://www.Sustainability-Journal.com

Servicio Nacional de Meteorologia e Hidrologia del Perú-SENAMHI 2012. http://www.senamhi.gob.pe/.

United Nations Development Programme (UNDP), Bureau for Crisis Prevention and Recovery (BCPR). 2013. Climate Risk Management for Agriculture in Peru: Focus on the Regions on Junin and Piura. New York, NY: UNDP BCR.

Zimbabwe Statistical Agency-ZIMSTAT 2012. http://www.zimstat.co.zw/.

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