



Women Farmers Adapting to Climate Change

Four examples from three continents of women's use of local knowledge in climate change adaptation

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Abbreviations

COSUDE	Swiss Agency for Development and Cooperation
ICT	Information and Communication Technology
ID	Identity Card
IDP	Internally Displaced People
INEI	National Institute of Statistics and Research
NAPA	National Adaptation Program of Action
NGO	Non-Governmental Organization
PEV	Post Elections Violence
SRI	System of Rice Intensification

Introduction

Climate Change increasingly affects the lives of many people, especially those of the poor in developing countries. In general, their livelihoods and food security, frequently already endangered by HIV and other health or socio-economic problems, are even more endangered by climate change impacts. Therefore, adaptation to climate change has become an important issue for “Brot für die Welt” and Diakonie Katastrophenhilfe, whose target groups are amongst the most exposed to and affected by climate change.

The vulnerability of women and men to the impacts of climate change is not even. Accordingly, they will be affected differently. The case studies show that climate change aggravates the tendency of the feminization of agriculture while men are pushed into migration. Thus, climate change aggravates already existing problems faced by men and women in developing countries whose livelihood depends on agriculture and access to natural resources.

Male and female farmers possess knowledge and experience that need to be taken into account in the design of adaptation strategies in smallholder agriculture. The authors of the study from Bangladesh point out that:

“The study did not reveal any climate change adaptation technology used only by women. The technologies are used by the community as a whole. Nevertheless, women are the main promoters of these technologies in agriculture.”

Consequently, the study does not draw on solely, but overwhelmingly on female knowledge. However, due to their generally weak position in society and family, women are usually not included in discussions and decision-making processes related to climate change or any other issue. Their limited access to information and resources such as land and credit further prevents them from developing their capacities in agriculture although they play a crucial role in food security.

Additionally, there is a gender-related bias regarding the value and usefulness of local knowledge as described in the study from Bangladesh:

“Women often feel ignored, overlooked and not taken seriously when they try to make their contributions and share their knowledge. They are seen as ‘farmwives’ rather than true farmers, and as such as not capable of producing and sharing valuable knowledge about farming. Society ignores the value of indigenous knowledge by continuing to view the knowledge and practices of women as ‘primitive’, unscientific and as a hindrance to development. The male members of the families think that if they use this unscientific knowledge promoted by the women, they cannot get more crops from the land. Men only believe in the usefulness of local knowledge if it is confirmed by a scientist or agricultural officer. Only then will they accept it as environmentally and socially appropriate and hence more sustainable.”

The present publication aims at showing that the local knowledge of women is valuable and useful for the adaptation of smallholder agriculture to climate change. The intention is to show that women are not only victims of climate change, but also part of the solution. In this sense, the publication is intending to strengthen the recognition that a gender perspective adds value and important insights to the debate on climate change.

Four case studies from three continents

“Brot für die Welt” commissioned the four case studies presented in this publication. The studies were conducted by former and current members of “Brot für die Welt” partner organizations as well as external consultants in Asia, Africa and Latin America. The researchers involved collected the information in a participatory way at the grassroots level.

The methodological approach in carrying out the case studies has been similar: One to three different communities in each region that are affected by climate change

were identified. Interviews, focus group discussions and workshops were conducted in all cases to collect and validate the information on local knowledge and climate change. Most of the interviewees and participants in discussions and workshops were women farmers, sometimes men were also included. The number of people who took part in the studies varied from case to case. Approximately 100 up to 300 people were included. The Indian case study was the only one in which information about the local knowledge of women was collected with the means of a questionnaire. The case studies from Kenya and Peru referred more often so secondary literature in comparison with the other studies.

All studies were based on the same Terms of Reference (ToR). However, since each context is different, each study developed its own focus with regard to the issues investigated and reported.

In some cases, the origin and scope of climatic changes are difficult to establish. Whether a change is local or global cannot always be determined conclusively. However, despite a climatic change occurring in a locally limited fashion, the adjustment strategies have global implications.

Summary of the case studies

The studies show that women have developed a large number of strategies to deal with the changing climate conditions. These are generally coping strategies and not adaptation strategies, as the women are reacting to changes the best they can. Adaptation strategies, however, require an additional thinking ahead and planning of measures to improve the adaptive capacity of women based on already existing capacities.

In coping with the changing conditions, women are relying on their local knowledge. The women interviewed expressed that they witness changes in weather conditions and the environment which they relate to climate change although this is not always the case. Climate change is a complex issue. Its origin and scope are often difficult to establish. Whether a change is local or global cannot always be determined conclusively.

The studies also transmit that in most situations climate-related problems are not separated from other problems rural women face. They do what they can and know to adjust to the changing conditions. Local knowledge is an important asset in this context but only in few cases has there been the necessary support provided by governments or NGOs to systematically use this knowledge for the development of adaptation strategies.

The efforts to cope with climate change as described in the studies are supported by the existing farming systems which already have several characteristics described as climate-friendly:

- The systems are diversified and characterized by the use of crop rotations, mixed cropping and/or the integration of bushes or trees. Some of the systems are agro-forestry systems.
- Leguminous crops are generally part of the farming system and widely planted as food crops. There is a rich variety of local seeds.
- Synthetic fertilizers and biocides are not at all or not much used.
- Manure and compost are used as fertilizers to maintain soil fertility.

According to a recent study (FiBL 2011), these measures increase soil organic carbon and some of them help to reduce emissions. Women are generally interested in maintaining and improving such diversified low external input systems because they provide a variety of food for the family and production does not depend on the availability of larger amounts of money.

In this context, the measures applied by women to cope with climate change take advantage of and partly reinforce existing climate-friendly tendencies. The measures described in all case studies are:

- Use of local seeds and crops which tolerate extreme conditions such as heat, drought, cold or flooding;

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- Diversification of the production system to reduce the risk of losing the harvest which can happen if just one or two major crops are planted;
- Use of plants and herbs to protect or cure crops and animals against insects and disease;
- Postponement of the time for planting and sowing of crops when rains are late.

These measures gain importance in the face of climate change because they reduce the risk of production. Human health threatened by climate change is another important aspect of the studies. In this context, women mainly rely on medicinal plants for curing. However, the studies also show that local knowledge can be failing because of extreme weather events or if the conditions are changing too much.

Another limitation is that traditionally there is a clear gender-related division of labor in agriculture. Yet, as it becomes increasingly difficult to gain a living from the land, agricultural production passes into the hands of women while men migrate to the cities. Particularly the case studies from Bangladesh and Peru show that women have to take more responsibility for the farming activities. In this situation, their decision-making power regarding agricultural production increases.

In order to improve existing systems, women need information, training and assistance. Two studies (Bangladesh, Kenya) correctly point out that this task should be in the hands of female extension workers. Yet, agricultural extension is still a domain of men.

Gender inequality impacts on adaptation to climate change. The weak position of women does not allow them to take decisions with regard to natural resource management. Women manage soil, seeds and water expertly but are not taken into account in decision-making and policy development neither at the local nor at higher levels.

In spite of its potential, the case studies also highlight that local knowledge alone is not sufficient to face the

immense challenges of climate change. They show how rural women struggle to maintain their families, in general without adequate external support and understanding of climate-related issues.

The studies also illustrate that governments at all levels are doing little to create an enabling political environment for the successful design and implementation of adaptation strategies in smallholder agriculture.

If there are initiatives to do so, as in Peru, where the regional government of Apurimac is elaborating the “Regional Strategy in the Face of Climate Change”, they are not supported by national policies. In Peru, at national level the investments in agriculture and the environment are minimal. Additionally, the decentralization of the country, a process favoring regional and local development as well as environmentally friendly policies, is hindered by bureaucracy.

The findings of the studies support the view of “Brot für die Welt” and its partner organizations that adaptation to climate change is part of a bigger process which results in the realization of the human rights of the affected population. Therefore a rights-based approach needs to form the basis of increasing women’s involvement in adaptation policies and the promotion of local knowledge in smallholder agriculture. This should be reflected in both governmental policies and local programs by non-governmental organizations.

1 Case Study India: Biodiversity-based organic farming with climate resilient crops

Vinod Bhatt (NAVDANYA)

1.1 Introduction

A participatory study for the documentation of women's knowledge on climate change was conducted in two vulnerable agro-ecosystems of India:

- The central Himalaya in the catchments of the Ganga in Uttarakhand which is facing the retreat of glaciers and instability of rainfall.
- The coastal region of Odisha (Orissa) which frequently faces cyclones and hurricanes as well as flooding.

Uttarakhand

The Pratap Nagar development block of the Tehri district in the state of Uttarakhand was selected for the study. The development block is located on the right bank of the newly constructed Tehri dam. The impoundment of the dam caused the destruction of the road from the Tehri district headquarter and the nearest market to Pratap Nagar. This has affected all aspects of life of the inhabitants in the region. In order to get to the nearest market and the district headquarter Tehri, people now have to travel 160 km instead of merely 25 km. As a consequence, Partap Nagar has become quite a vulnerable place to live in.

In the mountainous region, agriculture is traditionally practiced on terraced fields. More than 90 percent of the production is dependent on rainfall. Almost all the inhabitants are more or less dependent on agriculture for their livelihood.

The Tehri dam impoundment has also changed the micro-climate of the whole surrounding area. It has developed a rain shadow zone besides increasing humidity

and temperature during the summer season. A drastic reduction of rain spells has been recorded after the dam impoundment. Global impacts of climate change have further increased the drudgery of the inhabitants of this region, especially of the women. During the past five years, a large chunk of cultivable land has remained barren because of the changing micro-climatic conditions.

People have been forced to auction their milk-yielding animals due to the unavailability of enough fodder, especially in the year 2009. Long spells of drought have put an extra burden on the already overburdened women. They have to travel more than 10 km in search of fodder. Re-sowing is becoming a common phenomenon in agriculture as seeds fail to germinate due to insufficient moisture in the soil.

Landslides have become very common and frequent not only in the rim area of the Tehri dam lake, but also in other parts of the development block. They are not only destroying the fields but make the life of the inhabitants even more difficult by blocking the motor road which is the only way to reach the nearest market or health center.

As in the majority of the states in India, women represent the main workforce in the state of Uttarakhand. They work very hard from early morning to late evening, generally more than 16 hours a day. Their work includes cooking food, looking after kids and animals, collecting fodder, water and fuel, and working in the fields.

Odisha (Orissa)

Odisha is characterized by varied eco-climatic conditions. The West and North-West are drought-prone while the South and parts of the East are frequently affected by floods. However, in 2009, as a consequence of El Niño, even the East experienced drought.

In the recent past, Odisha has witnessed several disasters. In October 1999, a 'super cyclone' struck Odisha, killing at least 10,000 people and making 7.5 million homeless. However, human settlements behind healthy mangrove forests suffered little.

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In recent years, community seed banks of climate-resilient crops were established in Chandipur village of the Balasore district in Odisha. The seed bank conserves drought, floods, and salt-resistant varieties bred and conserved by local farmers. After the 'super cyclone', salt-tolerant varieties such as "Bhundi Kambanh", "Lunabekada" and "Sankarchin" have been conserved and distributed. After the Tsunami of 2004, salt-tolerant seeds from Odisha helped to rehabilitate agriculture in Tsunami affected areas of Tamil Nadu. During the drought of 2009, seeds of drought-tolerant millets helped farmers to produce some food.

In Odia culture and tradition, women have been given a high importance. They are referred to as the deity of the wealth of the house *gruhalakshmi*. It is believed that the house loses wealth and regard in society, if women get annoyed because of any disrespect shown to them. Such a house is referred to as *lakshmichhada*, meaning the house abandoned by the goddess Lakshmi, the presiding deity of wealth. However, this does not prevent the women from being overburdened with work.

1.2 Findings

1.2.1 The effects of climate change on women and men in the community

Women are the first to face the consequences of natural disasters and extreme weather conditions. If it is a dry year, they have to travel longer distances to collect water and fodder than in a normal year. In order to cope with the situation, women make use of their experiences and learning.

Uttarakhand

While 2009 was a year of intense drought and monsoon failure, in 2010 extreme rainfall characterized the weather conditions in the region. Women's indigenous knowledge proved relevant in both situations.

In the study region, the population suffers from the adverse impacts of the Tehri dam on the micro-climate of the region and the aggravation of climate vulnerability.

The entire area around the Tehri dam was badly affected in the monsoon season of the year 2010. It was observed that more than 50 per cent of the houses were damaged in the region. Landslides severely affected infrastructure as well as fields. Crops were washed away completely in the majority of the villages. "It's a disturbance in nature", said 74-year old Sri Mahinder Singh who was born in Tehri district. Never before did he witness rain as heavy as this year.

At the shore of the reservoir, people were flooded from below and above simultaneously. Fields and homes by the dam shore were submerged as the water level rose from 820 to 835 meters. The Tehri hydropower plant authorities did not want to release excess water from the dam, even though the water levels were affecting the surrounding villages. From their point of view, release through the slush gates meant spillage. The authorities filled the reservoir to make sure that they could generate enough electricity even in the dry season.

Since the impoundment of the Tehri dam, the area is experiencing a continuous reduction of rainfall. Only in 2010, rainfall was excessive. In general, the duration of rainfall is reduced whereas its intensity has increased considerably. Since the impoundment the numbers of wild boar, porcupines and monkeys have increased and become a serious menace for the cultivated crops.

Odisha (Orissa)

Most of the women in Odisha reported that the late monsoon rain causes a delay of planting paddy by 15 to 45 days almost every year. There is a shift of the onset of rain by more than a month in Kharif season (July to September) and about a month in Rabi season (November to April). Besides this, rainfall is not sufficient, resulting in reduced yields and lower returns to the farmers.

Paddy, one of the main crops of the state, is also becoming affected by climate change. Mainly affected are the hybrids and so-called high yielding varieties which need a lot of water and require external inputs to produce well. The climate-adapted rice varieties developed by the farmers through selection have a much better

capacity to sustain the impacts of climate change and to maintain the yield. The farmers feel that the conservation and propagation of climate-resilient varieties is necessary.

Farmers in Odisha expressed the need for short duration and drought as well as saline-resistant indigenous rice varieties. There were a number of indigenous rice varieties in the past which have either been lost or are on the verge of extinction. These varieties were well adapted to variable climatic conditions including drought, flood and salinity.

However, since the introduction of high-yielding varieties such as Swarna, farmers have lost most of their traditional varieties. A few farmers tried to grow the Swarna variety by using organic methods. The performance was comparatively good even in low rainfall conditions whereas the chemically grown Swarna paddy failed entirely due to its high water and external input requirements.

The majority of the women in Odisha expressed that:

- Climate is changing because of the excessive use of agro-chemicals, rapid loss of forest and profit-oriented industrialization.
- All seasons other than summer are becoming shorter. Summer is the dominating season; rainfall has been gradually diminishing for the last 5 years. 2010 has been the worst year so far.
- There is a shift of the onset of rain by more than a month in Kharif (summer) and less than a month in Rabi (winter). Rainfall is not sufficient, causing diminishing returns from the crops.
- Paddy is the main victim of climate change although vegetables and beetle leaf cultivation are also adversely affected.
- Traditional methods of forecasting droughts and floods are failing. This is an indication that things are changing from bad to worse.

- Repeated missile testing on the East coast and the construction of innumerable mobile towers are adversely influencing cloud formation and consequent rainfall.

- Extended summers are forcing households to change their eating and drinking habits.

- Climate change is also adversely affecting the health of human beings, especially children and elderly people. Malaria, diarrhea and influenza are the major diseases affecting the population.

- Some creepers, weeds and tall trees such as mango and Ficus are the least affected plants during the current period of extended summer without rain.

1.2.2 Existing coping strategies of women (and men)

Women have always utilized their knowledge gained through experience. They learned from their ancestors to cope with the situations of their time. Some of the experiences, observations, suggestions and practices performed and shared by the local women farmers to adapt to the changing climatic conditions are listed below.

Uttarakhand

Women have always utilized their knowledge. They learned from their ancestors to cope with the situations of their time. Biodiversity-based organic farming with selected local climate-resilient crops is considered the best solution for adaptation to climate change by almost all respondents.

Most of the women consider it to be an insurance against the unpredictable climatic conditions of the recent past. Additionally, mixed farming improves soil fertility. According to the women, the growing of traditional drought-resistant crops should be combined with collecting and eating traditional food such as wild fruit, flowers and vegetables.

The use of the following crops which are resistant to different environmental conditions is considered to

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be a successful coping strategy. Mandua, Jakhya, Til, Bhangjeer, Malkauni, Tor, San, Bajara, Jhangora and Kulath are identified as drought-resistant crops.

■ Mandua (finger millet) is a rain-fed crop which grows in any type of soil. It is resistant to drought as well as to very heavy rainfall. Traditionally Mandua is grown with many other pulses such as horse gram, curd bean, soybean, pigeon pea etc. It is an essential component of the diet in the whole hill region of Uttarakhand. Nevertheless, for two decades now, the area under Mandua is declining continuously. As a result, its share in the daily diet is also reduced significantly. In many parts of Uttarakhand it has been completely replaced by corn and wheat. Mandua is very rich in calcium and other essential minerals and low in carbohydrates. Therefore it is considered a good food for diabetic patients.

■ Malkauni (Jowar or Sorghum), Bajra (pearl millet) and Jhangora (barnyard millet) are also drought-resistant millets which thrive well in marginal to excessive rainfall conditions. They are grown on rain-fed land. Malkauni and Bajra are made into breads. They are not very popular in the hill region of Uttarakhand. In recent years Bajra is gaining importance due to its beneficial effect against diabetes. Along with some other ingredients, bread made out of Bajara (green millet) flour is considered highly beneficial for diabetic patients. Jhangora on the other hand is a healthy substitute for rice. It gives a very good yield even in poor and stony soil. Traditionally Jhangora rice was consumed throughout India during the fasting season. In comparison to rice it has a much higher nutritional value.

■ Til (Sesame) and Bhangjeera (Perilla fruticosa) are rain-fed, oil-yielding crops. Two spells of rainfall are sufficient to get a good yield of Til and Bhangjeera. Both of these crops also tolerate excess moisture and humidity. In the target area both Til and Bhangjeera are grown with other crops such as rice and finger millets etc.

■ Jakhya (*Cleome viscosa*) is highly tolerant to drought. Seeds are used to flavor different types of food items.

■ Tor (pigeon pea) and Kulath (horse gram) are normally grown with finger millets. Tor is grown on the hedges and the Kulath creeps on the Ragi (finger millet) plant. Kulath provides nitrogen to Ragi and in turn receives support to spread.

Most farmers consider paddy and finger millet to be resistant to heavy rain and humidity while wheat is considered to be more susceptible.

Barley as well as a traditional wheat variety called Misri are resistant to frost and snow according to the information collected during the study. Only very few farmers indicate that the indigenous variety of ginger is also frost-tolerant. Garlic and onions are considered to be frost-tolerant by many farmers. The indigenous varieties of ragi, sorghum, barley and paddy (Jhedu Dhan) are said to be the crops most resistant to hail and strong winds.

Most of the farmers interviewed in the context of the study share the view that the time for sowing and harvesting nowadays is delayed by at least 10 to 15 days in the monsoon season. This is the case with the harvest of winter season wheat. However, sowing and harvesting also depends on the crop variety. A large number of farmers stated that the normal sowing time is not significantly longer. Mrs Sunita Devi of Kuran village said that she had sown pulses and dry land paddy three times right from May to July in 2010 because the seed could not germinate due to insufficient soil moisture. It was recommended to advance or delay sowing by 15 to 45 days depending on the crop and season.

Only a small number of farmers treat their seed before sowing it. Different traditional methods are used to preserve the seed in order to maintain its viability. According to the women, their traditional methods of seed preservation, conservation and selection are working well so far, even with the extreme fluctuation of temperature and humidity. Traditional methods of seed conservation, preservation and selection are:

■ Mix seeds with ashes and store them in a sealed container.

- Mix seeds with red soil in a container and put a layer of red soil on top. Then seal the container.
- Rub seeds of pulses which are more susceptible to pest attacks with mustard oil and turmeric powder before sealing the container in which they are stored.
- Put seeds into a bottle or ridge gourd. The temperature inside the gourd always stays below 15 degrees centigrade which helps to maintain the viability of the seeds and keeps them free from pests.
- Save the best spike / bunch of the crop in the field for the next season's seed.
- Exchange seeds with farmers from other villages or sow them in a different field than before in order to maintain their vigor.

Seeds are also treated with cow urine or salted water and dried in the shade. Other treatment options include Mataka khad (a preparation made out of cow urine, cow dung and jaggery), garlic-paste water or sowing the seed mixed with apricot oil cake.

Traditional knowledge for the prediction of rain or drought is also considered helpful. Some of the indicators mentioned by the communities for prediction of rainfall are listed below:

- A ring of cloud around the moon indicates that it will rain within the next 15 days.
- Extreme heat and the urge to sleep during the monsoon season indicate rainfall within 24 hours.
- If birds are seen in groups and taking a bath in stagnant and fresh water frequently, it is an indication of the occurrence of rainfall within the next few days.
- If ants come out of their holes, it means that the humidity is high enough to generate rainfall within a few hours to days.

- If the bird named Tishuli (drongo) dives in the sky and starts singing, it is an indication for a good monsoon season.

- If cold air blows with speed from east to west it indicates the arrival of the monsoon shortly.

- If clouds move in eastern direction and the stars in the east glow like a bulb, it indicates a good monsoon rain.

However, in times of climate change, these indicators are often not reliable any more.

Almost all women share the view that there is an urgent need of conserving rain water which could be done following one or all of the methods mentioned below:

- Plantation of indigenous species in catchment areas.
- Construction of a series of water harvesting structures in order to store runoff rain water.
- Avoid the use of cement on natural spring sources: Whenever cemented structures have been constructed at the spring source, it has always led to the destruction of the underground water regime of that area. As a result the spring source either shifted down-hill or dried-up and was abandoned altogether.
- Promotion of roof water harvesting techniques. Stored roof water can be used for animals and for cultivating vegetables in kitchen gardens.
- Promotion of low water demanding crops, especially high-value millet crops.
- Equitable and judicious use of water.

During the study, village people also identified the domestic animals which are best suited for the changing climatic conditions. Most of the respondents are in favor of rearing cows, oxen and goats. In comparison to buffalos, the feeding requirements of cows are much lower. One pair of oxen is needed for plowing the land.

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The animals are light in weight and can be taken to the nearby forest for open grazing. Goats are browsing animals which can be reared on thorny bushes.

The most drought-tolerant fodder species are Bhimal (*Grevia* spp.) and Kharik (*Celtice* spp.) under agro-forestry and Banj (Oak) in forest areas. Community members prefer different fodder species such as Oak, Bhimal, Kharik, Timla, Moru and Mulberry.

In times of climate change, indigenous knowledge to cure general ailments is also considered important. Almost all women said that they use several medicinal plants such as *Eupatorium* Spp. (Kala Bindu), *Ageratum* (Basya) and *Spilanthus* (Akarkara) for wounds, cuts, bruises and fungal infections. Elderly women also treat a number of other diseases such as stomach pain, headache, diarrhea, dysenteries, constipation, fever, jaundice, cough and colds, eye diseases, burning, menstrual disorders, boils, back pain, and dropsy etc. using local herbs.

Finally, the women also mentioned the following foods or drinks which are good to use during the hot and dry season:

- Jhangora rice (barnyard millet) is cooked and eaten with Mattha (whey).
- Rice is cooked to get starch; the starch is cooled, mixed with Mattha and then consumed.
- Chatani (a sauce) is made by mixing green tomato, fresh mint leaves, onion and green coriander. This sauce is consumed with chapatti (bread) made out of ground-soaked rice.
- Soaked rice is grounded and mixed with Mattha and Misri (a kind of refined sugar) and made into a drink. This drink is consumed fresh.
- Breads made of Mandua (finger millet) flour is consumed with Mattha or Chatani (sauce) made out of mint, barberry and timur (*Xanthoxylum*) fruits and onion leaves.

- Juice or squashes made out of Burans (*Rhododendron*) flowers are considered the best cooling drink during the hot season.

- Lemon or orange juice and squashes are also served as cooling drinks.

- The root of a thorny herb called Kandara (ginger) is dug fresh and grounded to form a paste. This paste is mixed with Misri and cold water. This is said to be one of the best cooling drinks.

- To protect new-born babies, Brahmi (*Centella asiatica*) leaves are made into paste and put over the baby's skull and covered with a cloth. The paste is kept wet as far as possible.

Odisha (Orissa)

Climate-resilient crops, especially varieties of paddy, are also important for the women of Odisha. Farmers in the past have developed several climate-resilient varieties. In a seed bank in Odisha, some of the paddy varieties from the state which are salt-, flood- and drought-tolerant were collected and preserved. Some of them are listed below:

- **Salt-tolerant varieties:** Bhundi, Bhaliki, Kalam-bank, Sankarchin, Lunabarkra, Matia, Mayurkantha etc.
- **Flood-tolerant varieties:** Nalidhulia, Rabana, Seulapuni, Dhosa Raka Huda, Benasali, Musakani and Gudamathia etc.
- **Drought-tolerant varieties:** Baula, Basmati, Das, Bhuta, Mahanandi, Babaganesh, Jhalakseni, Lakshyadhira etc.

The community is well versed regarding the traditional knowledge related to the prediction of drought and rainfall. Surprisingly, the community has much more traditional indicators for the prediction of drought. However, many of the women claimed that none of these indicators are working any longer. Some of the important traditional indicators which predicted drought and rainfall are described below:

- Black ants carrying their eggs indicate coming rainfall.
- Wind blowing southwards indicates rainfall within a few days.
- A non-poisonous snake named Mati Birdie found roaming freely in the garden indicates good rainfall.
- Flowering of bamboo and cactus indicate a forthcoming drought.
- A red ring around the sun in the early morning indicates a coming drought.
- Mangala Sankranti and Sudasa Brata festivals falling in the same week is an indication of drought.
- The Mangala Sankranti festival usually takes place once in a year. However, there are years when it is celebrated more often. If this happens, it is an indication of a coming drought.
- A good harvest of mango and tamarind indicates less rainfall during the monsoon period.
- If coconut trees are not flowering, it indicates a forthcoming drought.
- Frequent cries of an aquatic bird (Dahuna) indicate a forthcoming drought.

It was observed by most of the farmers that fodder species such as neem, palm, sal and bamboo are resistant to severe drought.

Almost all the women said that decanted soaked rice and fruit juices are used during extreme hot and dry weather conditions. This soaked rice is called Pakhal and Bhat.

1.2.3 Potential of women's local knowledge for adaptation

Women's local knowledge is of immense value. It can be used effectively to reduce the impact of climate change.

If the crops listed and described above are promoted and cultivated by farmers, it would definitely help them to cope with the emerging problems due to climate change.

In addition, there are several strategies on community level that need to be strengthened.

Preserving local seeds:

- Establishing seed and grain banks in each village to insure food and seed sovereignty. By using traditional techniques seeds remain viable for more than five years. However, since germination is not always certain, a bigger amount of seeds has to be saved.
- Ensuring the conservation of indigenous crop diversity and crop genetic diversity by encouraging in situ conservation of plant genetic resources. Local climate-resilient crops and seeds are well adapted to the local climatic conditions, e.g. millets in Uttarakhand and salt, flood and drought-resistant rice varieties in Odisha.
- Encouraging the establishment of community seed banks with special focus on varieties with tolerance to environmental stresses caused or exacerbated by climate change, e.g. droughts, storms, floods etc.

Promoting farming methods suitable for adaptation to climate change:

- Continuing the promotion of agro-forestry and mixed farming to protect local flora.
- Promoting biodiverse organic farming based on agro-ecological principles by combining traditional agricultural knowledge with innovative farming methods. This leads to improved food self-sufficiency and food-security at farm and community levels.
- Giving more emphasis to the cultivation of vegetables, primarily for home consumption but also for sale.
- Encouraging community farming, especially regarding vegetable production. In community farming, a

Examples of successful struggles of women

Women's experiences with organic farming

A collective of 5,000 women, spread across 75 villages in the Andhra Pradesh region of southern India, practice chemical-free, non-irrigated, organic agriculture as one method of combating global warming. They follow a system of interspersing crops without using extra water, chemical inputs or pesticides for production. They grow as many as 19 types of indigenous crops per acre on arid, degraded lands.

Solving water scarcity

The efforts of a group of women in the Pratapnagar area of the district Tehri Garhwal in Uttarakhand are also encouraging. The group solved their water problem through rejuvenating their old source of water in the village. Using traditional knowledge, the women planted trees around the water source and made small ponds above it to make sure that the source is recharged during the rainy season.

Improving water maintenance

Women's self-help groups in the Southern state of Tamil Nadu protect the areas around hand pumps. The women canalize wastewater and use it to water vegetable and fruit gardens. They collect a water users' fee from every household for the maintenance of the

hand pumps. The women trained in rainwater harvesting also learned how to repair hand pumps. They are now empowered to raise their voices with Panchayati officials from the forest conservation departments regarding environmental issues.

The Chipko Movement for the protection of the livelihood of small farmers

Women of Garhwal in Uttarakhand led a big movement opposing commercial logging because it directly threatened their livelihoods in 1970's. They used a tactic of 'hugging' trees to prevent cutting. In the 1970s and 1980s this type of resistance to the destruction of forests spread throughout India and became organized and known as the Chipko Movement. The name comes from the Hindi word for 'to stick' as glued because of the tactic of hugging the tree. Besides protecting trees, the Chipko Movement was involved in protecting the livelihoods of small farmers. A Chipko slogan 'ecology is permanent economy' represents their view that the only way towards prosperity is to focus on the protection of nature and agricultural biodiversity. It is because of the Chipko movement that the mass cutting of trees was stopped completely and rights were given to the communities to decide on mass cutting of forests. Cutting of trees above 1000 m³ were banned completely in the states of Uttarakhand and Himachal Pradesh.

group of 10 to 20 women collectively work together on a certain identified plot of land. Each member contributes a minimum of 0.2 acre of land. However, there is a need to experiment with different models of community farming.

- Conserving local breeds of animals, which are adapted to the local conditions.
- Promoting use of the traditional cultivation methods such as 'Thakuli Rop' in rice cultivation which is similar to the System of Rice Intensification (SRI) method.

- Encouraging conservation and regeneration of forest cover using local flora.

Improving water conservation:

- Improving water availability in rural communities by rejuvenating the old water sources and reintroducing or expanding rainwater harvesting and traditional irrigation systems such as chals and khals (ponds) etc.
- Rejuvenating the drying springs and streams by raising plantations in the catchment areas and adopting the

traditional watershed approach by constructing chals and khals.

Strengthening local culture and tradition:

- Promoting traditional food cultures combined with innovations through the development of new recipes could help to compete with the health foods promoted by multinational food companies. The promotion of millets and its processed products among consumers could help conserve local crops. It will also help in developing a better market for traditional or forgotten food. There is a need for the promotion of traditional food in governmental food programs, such as the mid-day-meal for schools kids.

- Re-establishing the traditional and local cultural practices and believes which promote and conserve the local biodiversity.

Women's contribution to agriculture in both of the regions visited during the study is of great importance. Their participation in all the activities from sowing to harvesting is very important. Agriculture without women is beyond imagination in both states. Constant raising of awareness among women will help to make the communities self-sufficient.

However, it is equally important to educate men about their role in agriculture and other domestic activities so that they work as supporting, not as hindering factors.

1.2.4 Other aspects for successful adaptation

Some other aspects which need to be considered for successful adaptation to climate change are listed below:

- Developing alternative energy sources such as electricity from small, village-level hydropower schemes (watermills), wind mills and solar power to reduce dependency on fossil fuels and also to lower the burden on the forest and consequently reduce CO₂-levels as well as to strengthen the carbon stock.

- Conserving and promoting the use of wild herbs and plants for food and primary health in order to help keeping the traditional knowledge alive and leading the society towards self-dependency.

- Promoting local fair-trade organic markets keeping in view the products of the small-scale organic farmers.

- Developing adaptation strategies in cooperation with rural communities.

- Ensuring women's participation in any meeting related to the development of the village as well as adaptation to climate change.

1.3 Contributing and hindering factors for the use of women's local knowledge

1.3.1 Contributing factors

The following factors favor the use of local knowledge for adaptation:

- Traditional crops such as finger millet, barnyard millet, pearl millet, sesame etc. are resilient to climate change. If conserved and cultivated, these traditional drought-resistant seeds will contribute to adaptation.

- Decisions regarding seed selection are done by women where men have gone out to work.

- Community feeling still exists in the villages encouraging community members to help each other and work together.

- Reservation of 33 per cent of the seats to women in all village and regional Panchayat elections.

- Increased temperatures as well as reduced winter in the upper reaches are helping people to grow crops in otherwise dry seasons.

- Some of the traditional practices of seed conservation, saving and multiplication are still very effective and are widely practiced.

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- Community seed and grain banks in some villages are helping people in mitigating climate change impacts.
- Rainwater harvesting by some of the villages is a good step towards conservation of water. This measure needs to be multiplied and made mandatory for each household.

1.3.2 Hindering factors

The hindering factors are manifold as the following listing shows:

Weather conditions:

- Some of the indicators of the past are either hardly working or not effective at all anymore.
- Rapidly changing climatic conditions in form of flash floods, cloud bursts and massive landslides etc.
- Rains have become unpredictable both in monsoon as well as winter season.

Impacts from current agricultural practices:

- Excessive use of agrochemicals.
- Reduced water availability, drying water sources.
- Reduced productivity of the land.
- Invasive species (weeds) such as Lantana, Eupatorium, Parthenium etc.
- Failure of crop seeds from companies.

Lack of participation of women:

- Low literacy and little awareness among women in comparison to men
- The decision making in almost all the works from household to agriculture is still in the hands of men if they are living in the village.

- Lack of evidence that illustrates the contribution of local knowledge in combating and adapting to climate change.

Reduced forest cover:

- Depletion of forest density especially of the broad-leaved and rapid encroachment of chirpine has also been identified as a significant cause of drying of seasonal springs. It would be worth mentioning that these seasonal springs have been a prominent source of irrigation water during the monsoon season.
- Forest fires and deforestation are leading to a loss of biodiversity and also an evacuation of animals from the forests resulting in increased damage to the crops in the villages.

Government policies:

- Infrastructure and policies mainly support the big farmers.
- Big hydropower schemes are not only displacing many people, but the tunnels made below villages are threatening the livelihood of the local communities.

1.4 Conclusions and lessons learnt

Since women bear the burden of being the providers of food and water, the impact of climate change on them is disproportionate through the deepening of food and water insecurity. However, women's knowledge can be the basis of adapting to climate change to secure women's livelihoods as well as food and water security. Women have thus collected a lot of knowledge and have adapted themselves to the changing conditions. Women also have taken initiatives to cope with newly emerging local problems.

The experience with small holders in different states of India confirms the importance and role of biodiversity-based organic farming. It not only ensures better yields but also reduces the risks related to climate change. Organic farming and the use of local crops and varieties re-

duces water demand and use significantly, making production less vulnerable to draught. It has been widely recognized now that the small and poor are much more vulnerable to climate change, therefore organic farming is capable of reducing their risk as the examples in the box indicate.

As the examples show, women possess great strength and if they collectively decide to take on a challenge, they can make it happen. They have always found ways to feed their families in very adverse situations around the world. Their knowledge on adaptation to climate change will contribute to adapt to the impacts of climate change.

2 Case Study Bangladesh: Increasing responsibility of women for agricultural production

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2.1 Introduction

The present paper is based on field research on „Local Knowledge of Women and its Contribution to the Development of Climate Change Adaptation Strategies in Agriculture“. The study team conducted the field studies in different communities in three different climate zones of Bangladesh.

Khulna District

The first field study was conducted with a community group of the Madhupur and Gazirhat Unions of the Khulna District, a saline and cyclone-prone area of Bangladesh. The community has started experiencing coastal climate change impacts such as salinity, flash-flood, repeated cyclones, intensified pest and vector attacks and intensified river erosion. The community lives within three major agricultural production areas called Boronal, Kola and Bashukhali “Beel” (agricultural and natural fish production area).

Agriculture and fishing are the main fields of occupation for the people of this community. The agricultural products are wide in range and variety. Rice is the staple food crop that supplies the producer with both food and fodder. Food production also includes other products such as pulses, peanuts, oil seeds, potatoes and other vegetables. The main cash crops are jute, Dhaincha (*Sesbania sp.*) and turmeric.

Families raise cows, goats, chicken and ducks as sources of subsidiary food as well as a source of income. Women of marginal and poor agricultural families of this community are involved at least 60 per cent of their time in the production cycle and participate in almost all major stages of agricultural production as well as crisis man-

agement. This includes climate change generated crisis management.

Jamalpur District

The second community group came from river basin areas in the middle of the country. The area is also known for Monga (annual seasonal famine twice a year). The community is from the Chikajani Union of the Jamalpur District. One of the major river systems, the Jamuna is flowing by the side of the union. The major climate change impacts in this area are early floods, repeated floods, increased pest attacks and draught during the dry months of October to May every year.

About half of the population has enough land to be engaged in agriculture. In Bangladesh, land by the side of houses is usually used for vegetable cultivation and growing fruits. Agricultural lands are usually lowlands, situated outside the villages.

The main food crop of this area is paddy. Maize, wheat, peanuts, pulses, sweet potatoes and oil seeds are other food products of less importance. The community produces a large amount of vegetables. Sugarcane is the major cash crop followed by jute. In a limited area the cultivation of water berries is becoming popular. Each family raises cattle and poultry, including pigeons.

Although the number of animals raised is small, the production presents an important contribution to the families' livelihood. As in the first community, the women from middle, marginal and poor farmer families spend about 60 per cent of their time with agricultural activities. Women participate in almost all stages of agricultural production. They also take part in crisis management, including climate change-related crisis management.

Bandarban District

The third community group lives in a hilly environment. It is an ethnic minority community with a very different agricultural system compared to the systems in the plain land. This community follows the traditional JHUM (slash and burn agriculture in hilly forests). Land in the

hills legally belongs to the government. The JHUM cultivators burn one hill or part of a hill and cultivate there only for one year. Next year they cultivate on another hill. Usually the same group of hill people comes back to one particular hill every four to five years. In JHUM cultivation the tribal people make pits in the hillside and put bin, paddy, spices, cotton, yam and vegetable seeds together into the same pit. The crops grow together and are harvested one after another or simultaneously.

Fruit orchards produce secondary sources of food for this hill community. Some animal husbandry is also common. The study took place in the Fytang Union of the Bandarban District. Extreme cold and heat, excessive rainfall during the monsoon seasons and drought during dry seasons are the most common climate change impacts for this community. Vectors, especially rats are becoming an increasing challenge for people's agriculture.

Agriculture is the main source of occupation. Wood collection and selling is the second major occupation for community members. When it comes to agriculture, the women are solely responsible for all major activities. The main product is rice. The tribal women plant different foods and spices such as chilli, ginger, turmeric and fruits. They are also responsible for crisis management, including climate change-related crisis.

2.2 Findings

The study team observed that indigenous knowledge has been used by women from generation to generation. It became evident throughout the study that the entire homestead agricultural activities are traditionally done by women while the farm activities are carried out by men. The homestead activities refer to processing such as winnowing, drying, packing, preparation of seed, row sowing etc.

Women grow rice, beans, pumpkins, cucumber, basil, and other vegetables. They also produce chilli, lady's finger, horseradish, egg plant, coconut trees, etc. The activities of digging the soil, sowing, planting, watering, caring and finally harvesting of crops are traditionally done by men. The women rear animals within their

homestead, mainly cows and goats. They feed green grass, straw oil cake, wheat-bran, rice-bran, and also serve water to their cows and goats. They also raise poultry in order to supplement their family income.

2.2.1 The effects of climate change on women in the community

In Bangladesh, a large portion of the population is chronically exposed and vulnerable to a range of climate induced hazards. Almost 49 per cent of the population consists of women and girls, the poorest and most vulnerable to climate change. Women have little access to assets, wealth and food and therefore have difficulties in adapting to climate change. In Bangladesh, women generally produce the food for the family and they are therefore disproportionately dependent on the natural resources that are threatened by climate change.

However, due to societal norms and discrimination, women have less access to technology and seed. Thus, they do not have the same possibilities or preconditions as men to invest and adapt their agriculture to changing conditions. Women often carry the main responsibility for caring for older people, children, disabled people or someone who is ill. When water-borne diseases in flood-prone areas or heat-related illnesses increase in the drought-prone areas like in the Chikajani Union of the Jamalpur District, the work burden for women increases. In consequence, women get less time for taking care of themselves.

During periods of flood and drought, illnesses such as diarrhea and cholera which foster undernourishment increase. Due to poverty, women do not have access to treatment and care and are more exposed to illnesses. When the harvests and the natural resources decrease, the workload of women increases. This lessens their possibilities to work outside of their homes.

After the cyclones "Aila" and "Sidr", a huge number of women migrated from their places of origin. During droughts in the Chikajani Union and because of salinity in the Madhupur Union, women spend even more time with a typically female chore – searching for drinking

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water and fetching or purifying it for the family. Climate change leads to more poverty and this increases the burden particularly for women-headed households. As a consequence, girls are often kept at home to care for their younger brothers and sisters instead of being sent to school. Thus, women and girls pay the maximum cost of climate change.

2.2.2 Existing knowledge and coping strategies of women

The study found that indigenous knowledge has been preserved by women through their work, their interests and especially their practice. A good coping strategy always reduces the vulnerability of both people and the environment and results in innovations for sustainable development. One reported innovation was the use of sugar to reduce soil salinity; a second one was to raise cultivable land to save it from water inundation during floods and spring surges. Women's relation with and perception of their environment tends to be comprehensive and multi-dimensional. Their coping strategies in regard to climate change and emergencies are exemplarily described in Table 1.

The participants of the study stated that in farming communities, knowledge about farming is shared and exchanged in public places, especially in the hat, bazaar, mosque, temples, shops etc. and that these spaces are generally dominated by men. Women often feel ignored, overlooked and not taken seriously when they try to make their contributions and share their knowledge. They are seen as 'farmwives' rather than true farmers, and as not being capable of producing and sharing valuable knowledge about farming.

The society always ignores the value of indigenous knowledge by continuing to perceive the knowledge and practices of women as 'primitive', unscientific and as a hindrance to development. The male members of the families think that if they use this unscientific knowledge promoted by women, they cannot get more crops from the land. Men only believe in the usefulness of local knowledge if it is confirmed by a scientist or agricultural officer. Only then they can accept it as en-

vironmentally and socially appropriate and hence more sustainable.

The participating women told the study team that women lack the time to talk and gossip with neighbours. However, they share their knowledge with family members, kin and relatives. There are no initiatives to establish linkages with local government institutions in order to invite women to play an active role at community level and share their knowledge and coping strategies concerning climate change. The study team observed that women's participation at local level is minimal. In a male dominated society as in Bangladesh, women are not encouraged to participate in local meetings to identify their particular needs and interests in order to support them in gaining more control over natural resources in relation to farming and livestock rearing. Due to discrimination, women are not participating in decision-making processes in the same way as men. As a result, women are at risk of being overlooked in decision-making processes that affect their lives and thus are denied possibilities to lift themselves out of poverty.

2.2.3 The potential of local knowledge and coping strategies of women

Despite the long-lasting experience of women in plant domestication and agriculture the study team observed that women farmers are not taken into account as key actors and stakeholders in the communities. According to the stereotype thinking in regard to gender, it is assumed that men as "heads of households" take most decisions and are in charge of most aspects of the production process, although women play multiple roles in agricultural production and cope with different disasters. There is a great need to create awareness of the important role that traditional knowledge of women and indigenous people can play in the promotion of sustainable development.

The study did not reveal any climate change adaptation technology used exclusively by women. The technologies are used by the community as a whole. Nevertheless, women are the main promoters of these technologies in agriculture. Table 2 and 3 list various techniques

Table 1: Current coping strategies of rural women

Impact of disaster on livelihood	Current coping strategy
Rural women of Madhupur and Gazirhat unions of the Khulna district	
Loss of housing	Reconstruct houses by buying new tins or collect tins from NGOs or union members as relief
Loss of livestock	Move to shelter or school, colleges, or in the killa
Water-borne diseases	Use traditional medicine or depend on kabiraj (herbal practitioner) or jar, fuk (treatment by using rituals of reciting spells)
Lack of fodder	Distress sale of livestock
Loss of crops and lack of employment	Migrate outside the village
	Take part in cash for work/100 days program of the local government
Rural women of the Chikajani union of the Jamalpur district (riverbank erosion, flood and drought-prone area)	
Submerged or eroded homes and homesteads	Take a loan from money lenders at very high interest
	Increase plinth level
	Raise homestead
After flood death and diseases of live-stock/poultry	Keep poultry and livestock in killa (high places)
	Use indigenous knowledge to prevent diseases
Lack of fodder	Buy fodder from nearby villagers
Difficulties in reaching markets	Hugely dependent on relief
Loss of crops	In the worst cases, women take one meal instead of three meals a day
	Cultivate crops in flood protected areas
Shortage of seeds	Collect seeds from mohajan (village money lenders)
Decreasing harvests because of sand deposits	Mix compost fertilizer with the sandy soil
Tribal women of the Fytong union of the Bandarban district (flash flood-prone area)	
Loss of property	Borrow money from private money lenders with exorbitant interest charges
Decrease in crop productivity because of silt ration	Use of local knowledge to diversify crops
Loss of fertile land	Practice group farming
Damage of stored seeds and grains	Late/delayed seed bed preparation
Increase of Malaria	Use traditional medicine
Lack of food, reduced access to inputs, sedimentation of crop land	Initiate multiple cropping and intercropping practices

and strategies in agriculture that can also be used for adaptation to climate change.

2.2.4 Other aspects for successful adaptation

Women learnt how to use local and indigenous technologies from their ancestors or through their own experience. However, they do not know the scientific base of this knowledge. It is necessary to conduct detailed research and investigation to validate local technologies

in a wider context. Pesticides or chemical fertilizer pose a serious threat to soil fertility. They create environmental deterioration and the loss of biodiversity which negatively impacts on the lives of human beings.

In this context, women can play a significant role by promoting their local knowledge. They can encourage the male members of their family to trust their inherited knowledge, practice it in the field and then share it with others. The few women who are elected in the local

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structures can take the leadership to disseminate local knowledge with all unions of the Upazila (subdistrict) in a certain district. NGO activists who are working in the remote areas of Bangladesh can develop initiatives to identify local technologies to promote environmentally friendly agricultural development in the country.

The local knowledge related to the treatment of fish, poultry and animal diseases has become particularly important since the onslaught of animal diseases has become very high. Trench horticulture has also proven to be very effective in the context of climate change adaptation. Trench horticulture is also widely used in Kerala, India and the low lying coastal areas of Sri Lanka.

However, local knowledge does not offer a solution to new challenges posed by climate change such as increasing inundation of crops in high tide or flood water as well as the increasing salinity of the soil.

Crop diversification is currently challenged by the introduction of the cultivation of Dhaincha (*Sesbania* sp.). Dhaincha is a shrub which can tolerate saline soils. The plant fixes nitrogen in the soil and the stems can be used and sold as firewood. Nowadays the shrub is increasingly cultivated on saline soils as an alternative to rice. In order to fight salinity, even sugar and alum are used on the land, particularly by women.

In Bangladesh, climate change is not systematically discussed in local communities. However, as a result of intense media coverage, climate change is a well known subject to women. In order to give women a voice, it is important to address climate change issues in popular language women can understand and refer to.

2.3 Contributing and hindering factors for the potential and use of women's knowledge

Despite the lack of information and knowledge about climate change and its impact on local agriculture, farming technology, animal husbandry and social communication, the preceding chapters clearly reveal that wom-

en (and men) possess a wealth of local and indigenous knowledge and skills which are helpful in adapting to climate change.

The knowledge and good practices of women as well as the lessons they have learnt through their day-to-day experience and observation is producing positive results in combating adverse effects of climate change at household and community level. The study documented a wide range of local knowledge promoted by women during the field work and affirms that the potential of this knowledge is immense in the context of the various local situations.

In order to make better use of this knowledge for future climate change adaptation, it is important to analyze the contributing and hindering factors for women to participate in climate change-related decision-making processes on agriculture.

2.3.1 Contributing factors

The knowledge possessed and inherited by women in rural Bangladesh is economically viable, socially acceptable, technologically replicable and environmentally sustainable. The study team observed that poor households and rural communities have been finding it very difficult to afford costly external agricultural inputs (seeds, fertilizers etc.) to adapt their agriculture to climate change. Thus, the know-how that is emerging from local wisdom does not only hold potential but significantly contributes to cost reduction, the re-generation of species and the generation of community well-being.

Women's skills and knowledge in regard to innovation, dissemination and replication of agricultural techniques is important at household and community level. Social communication among women demonstrates that learning from neighbouring women and communities is common and results in a high degree of collective wisdom for mitigating adversities caused by climate change. Formal (group based) and informal (household to household) discussions and the exchange of knowledge are the key to promote, transfer and practice the local knowledge of women. However, these processes

Table 2: Using indigenous knowledge in agriculture

Name	Type of usage
Increasing soil fertility	
Lime	During the sewing period of jute, lime is used on the land (½ kg lime per katha)
Organic fertilizer	Cow dung, chicken manure, ash, straw, rice stubble and water hyacinth are collected and mixed together. Mixed materials are kept in a hole for 3-4 months to prepare organic fertilizer and enable the women to avoid debts from buying chemical fertilizer on credit.
Shuta tree (type of tree that fixes nitrogen)	Women cultivate the plant in the month of Kartik-Poush for soil fertility
Crop rotation	Change yearly crop cycle pattern: Rice – Jute – Peanuts – Rice – Pulse and vice versa/or cultivation of Daincha.
Preventing soil salinity	
Tute (kind of chemical)	250 grams tute and 2.5 kg of lime per 0.5 acres of land
Mahogany seed powder	2.5 kg of powder per 0.5 acres of land
Sugar	12 kg of sugar per 0.5 acres of land
Protection from floods	
Raising cultured land	Make a trench in the land and use the soil for raising the land above tide level for horticulture.
Construction of dams	Creation of strong dams around the cultivable land to save the standing crops from rising water.
Digging of shallow canal	Dig a shallow canal around the land and fill it with water to save seedlings from crickets
Insect and pest control	
Use of "kaktarua" (scarecrow)	To control birds in the paddy field, a scarecrow is placed in the middle of the paddy field.
Biological pest management	To enrich soil fertility, women are using a range of biological pest management methods together with legumes, manure, cover crops etc.
Dry ash	Spread dry ash on their land to prevent attacks by insects
White mustard and ash	Use white mustard and ash after blending to prevent insects on their land
Tobacco leaf with ash, leaves of neem, seeds of jute	Water insects have been seen in the crops due to unavailability of rainfall. The powder of tobacco leaves, ash, seeds of jute and leaves of neem are thrown on the land after frying and blending them to control insects
Use of motki	Mud made container is covered with raw cow dung to protect grains from the attack of pests.
Neem	To prevent pests in stored grain, neem leaves are used in the bottom layers of motki. Women widely use the solution of neem powder and neem leaves with water and apply it in the vegetable fields to control insects.
Bamboo sticks	Bamboo sticks are usually placed in the rice fields for birds to sit on and eat insects.
Light trap	Light traps are placed in the fields to entrap insects.
Turmeric	Spreading of turmeric dust in the seed container to get relief from red ants.
Cow dung	The cow dung slurry is sprayed on the leaves of seedlings and saplings in order to protect these from wild and other animals.
Kerosene or burnt motor oil	Use kerosene or burnt oil in pest affected crops

Table 3: Using indigenous knowledge with livestock

Name	Type of usage
Treatment of cattle	
Onion and garlic	Use onion and garlic in intestinal diseases
Chili paste	Use chili paste for the treatment of different diseases
Onion and garlic	Mixture of onion and garlic helps to prevent intestinal diseases
Bamboo leaves	Leaves of bamboo are fed to the cow for the release of the placenta
Tulshi (Holy Basil)	Extracts of tulshi leaves are commonly used by women to cure cold and cough of livestock
Heat compress	Apply heat compress in case of cold and swelling throat of cattle
Local trees and herbs	Apply a paste of barks from eight local trees and herbs to treat Foot and Mouth Disease of cattle
Tela Kachu (kind of local herb)	Use Tela Kachu leaves in treating indigestion
Neem	Neem leaves are fried with oil and the fried Neem leaves are given to cows to eradicate itching
Garlic	Smashed garlic is used to get rid of flies from the body skin of cows
Use of hukka	The water of hukka is fed to cows to get rid of gas formation.
Use of "Dodh kharia"	In Bandarban, women fed it to the cows to cure them from fever.
Bamboo leaves	Use semi roasted bamboo leaves to treat indigestion of cattle
Ginger and turmeric	The mixture of raw zinger and turmeric with salt are fed to cows to get relief from constipation.
Use of Ghratokumari soft pulp	To get rid of pains and increase strengths, the leaves of Ghratokumari are boiled with mishri (crystallized sugar) and then fed to cattle.
Akanda tree	Use Akanda tree for relieving cold and cough in cows and goats
Basok leaves	The Basok leaves are boiled in water, then filtered and drunk by cows, goats to control cough and asthma
Biskatli	To control lice from the skin of goats, women widely use dry Biskatali plants after blinding
Rain tree (Albizia saman)	To cure the dysentery of goats the leaves of the Rain tree with water and salts are widely used
Treatment of birds	
Rain tree (Albizia saman)	To cure the dysentery of ducks and chicken, the leaves of the Rain tree with water and salts are widely used
Nishinda tree	To treat the paralyzed legs of ducks, smashed leaves of Nishinda are applied to the paralyzed area
Use of raw turmeric	To control foul cholera of chicken, turmeric is crushed, mixed with rice and fed to chicken
Turmeric	Smashed raw turmeric is mixed with boiled rice and fed to poultry to prevent "Ranikhet" disease
Treatment of fish ponds	
Banana stems	Use chopped banana stems to disinfect fish farms and fish
Name	Type of usage
Saline solution	To reduce the mortality of fish, the infected fish is put in saline solution for 2-3 hours and released again
Water hyacinths	Use water hyacinths to purify the water of fish farms
Potassium Permanganate	Use of Potassium Permanganate to disinfect fish and water
Lime and alum	Use lime and alum in water purification in infected fish farms
Use of cow dung in the pond	To increase fish food, women use cow dung in the pond which helps to enhance the production of zooplankton
Use of chicken manure	Women are collecting the manure from poultry cages and then supply it to fish ponds for the feeding of the fish

need to be supported and strengthened in order to fully use the potential of local knowledge.

The study team observed that the gender roles regarding the division of labour in small -scale agriculture are more or less similar across ethnicity, culture and geographical location. The study team concluded that women act increasingly as resource and knowledge managers. In indigenous communities, women are even the main actors in agriculture while men act as supporters. Indigenous women are involved both in homestead agriculture as well as in the fields where the main agricultural production is taking place. Thus, indigenous women play an important role in contributing experience and knowledge towards adaptation to climate change in their locality as well as in the country as a whole.

The study team further observed that climate change induced challenges, especially in the field of agriculture, have increased the involvement of women into agriculture and thus strengthened the inter-relationship between gender and natural resources management.

Almost all women participating in the study expressed that there has been a change in their use of time, i.e. they are gradually allocating more time for agricultural activities. They reported increased hours spent in the fields, which can be interpreted as an indicator that women are gaining more access and control over agriculture and farming.

This development is due to the fact that in the areas that were visited the male members of the family either migrate daily or seasonally to urban centres or to areas where they find seasonal employment. Thus, the migration of male family members enhances women's participation in agriculture and the domestic production system and consequently gives them more decision making power about the choice of crops, the use of inputs etc. However, the use of money is still largely controlled by men.

Field level investigation and observation affirms that women's empowerment is supported significantly when their interests and needs are taken into account at com-

munity level. This happens especially in the indigenous communities. Women from the Marma community reported that the village headman and elders take their views and opinions into account by allocating land to them for farming, thus granting access and control over productive resources to women.

As a result, higher efficiency in resource utilization and increased productivity can be observed. This leads to the conclusion that in a gender-sensitive social environment, women seem to be more encouraged and inspired to put their agricultural knowledge and skills into practice.

2.3.2 Hindering factors

The study team recorded multiple hindering factors for women regarding the potential and use of local knowledge for adaptation to climate change. Traditional gender discrimination at family and society level, structural injustices, lack of access and control over productive resources, high rate of illiteracy, lack of access to information etc. are key hindering factors which still overshadow some positive developments described above.

The study team documented that household members do not participate equally when making decisions. Due to deeply rooted patriarchal family values and community attitudes, participation and representation of women is negligible in rural Bangladesh except in the case of ethnic minority communities. This investigation reveals that the cultural construct of gender roles and behaviours also reduces women's ability to function effectively. Under such circumstances, a culture of silence for women prevails at community level and the incapacity to contribute in knowledge creation is systematically instituted.

Religious and social restraints on female mobility have also been noted as a potential hindering factor for dissemination of knowledge, skills and experience of women at a wider level. The study team noted that in rural areas women's mobility is determined by their male counterpart. In addition, there are significant gender inequalities associated with access to credit, labour,

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other production inputs and information on new technologies.

The study team further affirms that women in rural Bangladesh are marginal groups and they do not have access to information in the same way as their male counterparts. As a result, insights, experiences and gender-mediated wisdom and knowledge on climate change adaptation is not taken into consideration for innovation, dissemination and replication of adaptation methodologies.

Another striking revelation was made by the study team: Most employees of governmental service providing agencies are male. The field level workers of the Department of Agricultural Extension are all men. This generates an institutional exclusion of women, as women in rural Bangladesh are usually less assertive in front of outsiders and therefore do not share their knowledge, findings and learning with male officers whom they perceive as agents of a market driven, commercial agriculture.

It has also been discovered during the field visit that women's influence over resource allocation and their possibilities to decide on the allocation of funds for adaptation purpose are insignificant. Financial resources borrowed from NGOs or other formal financial institutions by rural women is often spent or utilized by their male counterparts according to their own decision, neglecting the huge potential of women's ways of adapting to climate change.

Using demographic data and statistics, the study team found that the participation and representation of women in the national labour force in general and in agriculture, trade and service in particular is insignificant and does not provide enough incentives for women's engagement. Wage discrimination is also widely prevalent. Therefore the study team wants to stress that this male-centred development model is also acting as a hindering factor.

2.3.3 National climate change policies

There are several issues in policy discussions which refer to taking into account the needs and knowledge of

women in climate change adaptation. Those issues entail participation and representation, institutional access to knowledge and information, rights and entitlements in livelihood and productive assets, urban-rural migration, access to safe water and sanitation, basic health care and regional including international development cooperation.

The study team noted that Bangladesh has a set of policies that relates to environmental issues in general and climate change in particular. Bangladesh prepared the National Environment Policy in 1992. Similarly, the Coastal Zone Policy was adopted in 2005.

In the same year the country produced the National Adaptation Program of Action (NAPA) on climate change. In addition to those policies, the Bangladesh Climate Change Strategy and Action Plan was devised in 2009.

An in-depth review of those policy papers conducted by the study team reveals that the policies explain and underline sectoral need and response mechanisms about the consequences of climate change. However, there are no clear targets and directions about gender-related outcomes from those policies. Similarly, the policies shed insufficient light into gender relations when examining the causes and consequences of climate change.

However, our field investigation clearly demonstrated the following links between gender and climate change and thereby adaptation.

■ **Gender and agriculture:** Men's and women's different roles (women being responsible for water collection, vegetable gardens, small livestock and men for cash cropping, large livestock) determine climate change adaptation priorities. They may be different for men and women according to their roles.

■ **Gender and water:** Due to climate change women may have to walk longer distances for water collection and therefore suffer from an increased risk of violence. Women and men have different priorities in regard to water use (women use water for cooking, men for irrigation) and therefore different adaptation priorities.

■ **Climate change** may have a gendered impact on **wage labour**: In insecure times there is a need to safeguard women's rights to equal wages, access to unions and secure contracts.

■ **Gender and climate change-related disasters**: Women are usually not taught to swim, do not tend to climb trees and are thus more vulnerable during floods. Their long hair and clothing, i.e. saris, also hinders them to escape from the water. It is necessary to involve women in disaster response and early warning systems.

■ **Gender and post disaster vulnerabilities**: Women suffer from violence and the lack of privacy in emergency shelters.

■ **Gender and migration**: Men migrate due to climate change leaving women at home with an increased work burden. Women become heads of households which can lead to increased decision making, but the absence of men can also increase their risk of losing the land due to restrictions on women's land rights.

The study team further noted that in regard to participation and representation of women at the grassroots level, policy formulation and implementation the Union Parishad Law was revised in May 1997 and after seven months, for the first time in Bangladesh, women could be directly elected into the local government structures. However, field level investigation showed that women do not enjoy functional authority over the shaping of local policy as they are prevented from equal participation by the imbalances of power in comparison to men.

The importance of media as well as Information and Communication Technology (ICT) as a means of promoting climate change adaptation knowledge to the rural population and thereby enhancing agricultural production and reducing vulnerability has not been taken into consideration adequately.

The mainstream electronic media do not make sufficient attempts to promote women's participation in climate change-related issues.

However, media and ICT increase the timely and transparent flow of information between service providers and service users and have the potential of contributing to the empowerment of women.

2.4 Conclusions and Lessons Learnt

During the analysis of the case studies a few interesting phenomena surfaced and the following conclusions can be drawn from this study for women's local knowledge and its contribution to adaptation to climate change in agriculture.

Socio-economic factors

■ Participation of women in agriculture is higher in families with small landholdings (within the range of 0.33 acres to 1.5 acres) who depend on subsistence agriculture as the land is not suitable for commercial farming.

■ Women above 40 years of age are more active in agriculture than the younger ones as the Muslim heritage system hardly leaves any land for the young generation of subsistence farmers.

■ In ethnic minority communities, traces of a matriarchal society are still present. This becomes obvious when regarding the leading role women play in agriculture.

Gender-related factors

■ Indigenous knowledge has passed among women from generation to generation. This is a very rare practice among men.

■ Men take the impacts of environmental degradation and climate change in agriculture less seriously than women who are becoming increasingly responsible for agricultural production while men migrate to earn a living.

■ Belief in and practice of indigenous knowledge is mostly the domain of women.

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- Men are more inclined than women towards mechanical or technical solutions such as the use of machinery, pesticides and fertilizers.
- Women are better in indigenous knowledge management as well as dissemination. Despite of their limited mobility they can communicate better than men and make use of informal forums such as the common place for fetching water etc.

3 Case Study Kenya: Gender inequality exacerbates the impact of climate change on women and girls

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3.1 Introduction

In Kenya, the issue of climate change is not new, but its integration into key development concerns for pro-poor planning is a fairly new initiative. More recent is the integration of a gender-sensitive perspective to climate change adaptation which had never been emphasized. This study which was assigned by “Brot für die Welt” is the first study to be done within the Kuresoi community in Kenya on the linkages between gender and climate change.

This gender and climate change case study was formulated and undertaken with the objective of showing how women are affected by climate change and what their coping and adaptation mechanisms are. The overall goal of the study was to strengthen the recognition of the gender perspective in the debate on climate change and examining the specific contribution of women to the adaptation of smallholder agriculture to climate change.

The Kuresoi/Mau complex

Kuresoi, where the case study was conducted, is in the west of the newly created Molo District bordering the expansive Mau Complex. The Mau Complex is the largest indigenous forest in East Africa covering an area 675,000 acres. It is the largest water catchment area in Kenya with numerous rivers originating from it. Evictions from the forest started in November 2009; two months after the parliament adopted a report on the eviction to preserve the water tower.

Kuresoi is located in the highlands of Kenya, West of the Rift Valley with an altitude range of 2,000 to 3,000 m

above sea level. Being on the windward side of Lake Victoria, the area receives high rainfall (< 2000 mm) with about 120-150 rainy days per year. The fertile soils in Kuresoi are derived from volcanic parent material that makes the region to be of high agricultural potential. The area has food throughout the year. This trend is however changing with the change in weather patterns that is now making the area to be food insecure. This is partly because the volcanic soil is easily eroded by the high rainfall and flooding resulting from the complex topography.

The Kuresoi area is the home of different communities with the majority being the Kalenjin, Kikuyu, Gusii and Luhya. Kuresoi is divided into three administrative sub-locations each holding a population of about 750 households of peasant farmers who own about one hectare of land per household. Smallholder farming is mainly for subsistence because of the small size of land where crops like maize, potatoes, kales, cabbages and peas are grown. Tea is the main cash crop growing in the area. The location is adjacent to the Mau forest complex, which is the largest water catchment area in Kenya. This forest is degraded mainly because the farms do not produce enough to meet the developmental requirements of the increasing population, thus the forest is cleared to gain land for cultivation.

There are unclear land tenure systems in Kuresoi since most smallholder farmers do not have title deeds for the land. The government can displace them anytime. Women do not own land. The existing title deeds are in the custody of men, thus land ownership and control is still a preserve of men. Women have to get permission from men to access land for use and management. Most women in Kuresoi have their national identity cards (IDs) as well as their voters' card kept by men; this limits women engagement in political processes. These are some of the basic indicators of how women are still marginalized within the Kuresoi community.

Typically women – particularly those in poor, rural locations like Kuresoi – are expected to assume sole responsibility for their families' subsistence. In order to make ends meet, women in Kuresoi toil in farms and small

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businesses for income generation. With the challenge of being the sole providers in their families, women have developed coping mechanisms and techniques such as shouldering all the household responsibilities and fending for the family. As their farm produce fetches better prices on the main road and has better returns as compared to the Kuresoi centre, women take on the burdensome travel with their goods to the main road, because of the very poor road accessibility of Kuresoi.

In addition, women are frequently excluded from decisions on spending or on their children's education. All income earned by the women is handed to the men who decide what to do with the money. The men's earnings are not shared with the women. The men use it for themselves and it is the men who decide on the children's education. Women are rarely consulted, since they are treated as children themselves and are not allowed to talk where men talk. The expectation that girls will help their mothers with household tasks and with caring for younger siblings means that they are more likely to be excluded from opportunities to receive an education than boys, although these gaps are gradually closing with the free primary education in Kenya.

3.2 Findings

3.2.1 Gender and climate change effects in Kuresoi

Gender-specific data was gathered on the effects of climate change especially on the women in Kuresoi. The Kuresoi area is already affected by climate change: In the past, the area did not experience dry spells, but has now been affected by long droughts. Mitigation and adaptation mechanisms need to be taken into account in the face of shifts in weather patterns and resulting environmental phenomena. This has affected both men and women, but women are more affected by it. Women have the least capacity and opportunity to prepare for the impacts of the changing climate and to participate in

negotiations on mitigation and adaptation, yet women constitute the largest percentage of smallholder farmers in Kuresoi.

Children and youth – especially girls – and elderly women, are the most vulnerable to climate change in Kuresoi. The study found that climate change exacerbates existing inequalities in the key dimensions that are not only the building blocks of livelihoods, but are also crucial for coping with change. This includes wealth, access to and understanding of technologies, education, access to information and access to resources. Women in Kuresoi are particularly marginalized in regard to these aspects.

Gender, water and climate change

Women and girls in Kuresoi generally assume the primary responsibility for collecting water for drinking, cooking, washing, hygiene and raising of small livestock, while men use water for livestock and bathing. These distinct roles mean that women and men often have different needs and priorities regarding water use. The environmental degradation and deforestation¹ of the Mau forest has resulted in the drying of rivers and persistent droughts coupled with a lack of water. Water shortage is also a major result of climate change in Kuresoi/Mau. The water shortage directly affects women because it is their role to take care of the water needs.

Water shortage poses a threat to food security and women are the hardest hit because they are expected to provide food on the table for the family, as climate change already impacts on the men's participation in food provision. Men engage in alcohol drinking and rarely support the women in search for food, especially since the destruction of the environment and deforestation has resulted in a lack of food. Bees that produce honey have been affected by climate change. With the drying of rivers and the decreasing water levels in Kuresoi they migrate to areas where they can easily find water. Initially men could hunt in the forest or search for honey

¹ The effects of climate change include food and seed insecurity, soil infertility where conservation agriculture cannot be practiced as was the case before in Kuresoi.

but nowadays the men's search in the forest are in vain. The bees no longer make honey as before; the food men were hunting is hard to come by due to the effects of climate change. The burden of climate change effects on men are therefore transferred to women and are thus increasing the women's workload.

Climate change also leads to increasing frequency and intensity of floods and deteriorating water quality in Kuresoi/Mau. This is likely to have a particularly harsh effect on women and girls because of their distinct roles in relation to water use and specific vulnerabilities in the context of disasters. The heavy rainfall and frequent floods that result from climate change also increase the women's workloads, as they devote more time to clean and maintain their affected houses after flooding. Kuresoi experiences torrential rains that cause havoc. During the dry seasons occasioned by climate change, women in Kuresoi walk long distances in rough terrain in search of water. This time could be spent in school, earning an income or participating in public life.

As the water points in Kuresoi are mainly springs located in valleys near bamboo plants which are bushy, this increases the risk of women and girls to suffer from harassment and sexual assault. Gender-based violence through sexual harassment or assault is not discussed openly by women because of the associated stigma. Therefore most of the respondents feared talking about it but there have been cases of harassment and sexual assault to women and girls especially in prohibited and conflict areas.

The people of Kuresoi, due to their proximity to the Mau forest suffer from the invasion of wildlife. Elephants often come to drink water from the protected springs of the community thus destroying the crops as well as attacking people. This is an indication that even the wildlife in the forest is affected by climate change as they encroach on the human settlements to drink water.

Gender, agriculture and climate change

Although rural women and men play complementary roles in guaranteeing food security, women tend to

play a greater role in natural resource management and ensuring nutrition. In Kuresoi, women often produce, process, manage and market food and other natural resources. They are responsible for raising small livestock, managing the dairy (producing mursik- the local sour milk), maintaining vegetable gardens and collecting fuel and water. The women's agricultural knowledge should not be overlooked, especially in seed identification. Women are assigned the responsibility of seed identification and storage. Women are thus responsible for 80 per cent of the food production. Men, by contrast, are generally responsible for cash crops and larger livestock.

In Kuresoi, customary laws restrict women to property and land rights. This makes it difficult for women to access credit and agricultural extension services, while also reducing their incentive to engage in environmentally sustainable farming practices and to make long-term investments in land rehabilitation and soil quality. Despite these obstacles, the new constitution of Kenya, which was promulgated on 4th August 2010, provides a window of opportunity for women's property and land rights as well as affirmative action for women to gain access to land. The new provisions are hoped to support women's adaptation to climate change through agricultural productivity and food security.

Gender, health and climate change

It has been widely recognized that the diminishing water availability associated with climate change will lead to an increase in water-borne diseases. Other likely health consequences of climate change include higher rates of malnutrition due to food shortages, increased mortality and morbidity, increased respiratory diseases where air pollution worsens. These are some of the health problems within the Kuresoi community. Children under five along with the elderly are the main victims of sanitation-related illnesses. Gender discrimination in the allocation of resources, including those relating to nutrition and medicines puts girls at greater risk than boys.

Women and girls are generally expected to care for the sick, particularly in times of disaster and environmental

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stress. In the Kuresoi/Mau community, women face a great challenge because there is no health facility in the area.

During the field trip, it was observed that the entire area is served by one public health centre in the Kuresoi market which is up to 30km away from many people in Kuresoi. Women have to walk long distances to take their children, husbands and themselves to a health facility.

The road infrastructure is poor and there are no public service vehicles in the area due to the difficult terrain. Therefore women end up carrying the sick family member in a sack (gunia). The increasing impacts on health thus add more work to the general burden of women.

Gender and conflict

The Kuresoi area has been severely affected by conflicts not related to climate change. The post elections violence (PEV) in Kenya of 2007/2008 greatly affected the Kuresoi/Mau community. The area has experienced political violence in every election period during which hundreds of people became internally displaced. During the field visits, the research team observed people staying in Internally Displaced Persons (IDPs) camps.

Another reason for displacement and conflict is the government policy to evict people living in the Mau forest. The eviction by government has not been well managed because people lost their livestock and crops which were burnt down and destroyed. The 'cut line' between the Mau forest area and the new settlement area poses a great problem to the people in the Kuresoi/Mau area.

The forest warders frustrate the women. When they are found collecting firewood in the forest they are arrested and at times sexually molested. Men are also arrested for grazing their livestock in the forest and are extorted a lot of money before being released. It is well-recognized that climate change will result – and is already resulting – in a growing scarcity of natural resources such as water and arable land in Kuresoi/Mau.

Women, children, the disabled and the elderly are the most vulnerable in any conflict situation and displacement. The household workload increases substantially, forcing many girls to drop out of school to help with the daily chores. With heightened competition over diminishing and unequally distributed resources due to climate change, conflict over resources is set to increase. Most of the conflicts in Kenya are resource-related.

3.2.2 Existing coping strategies of women

The study team found that the community in Kuresoi/Mau has developed various adaptation strategies to climate change. Both men and women use their local knowledge to adapt to the climate change effects. However, women have taken the lead in coping with climate change in Kuresoi. Some of these coping strategies include:

Adaptation strategies related to water

- Planting of bamboo along the springs to protect the water. The water from the protected springs is safe for drinking and for home use. The emphasis of the people of Kuresoi is now to change attitudes and behaviour through the adaptation of best practices to climate change adaptation in order to avoid the destruction of ecosystems.
- Use of improved bamboo straws to tap water from the springs to ease the collection by women. As the location of the springs in valleys remains a challenge to women, there are also efforts to purchase or construct water tanks at home as a coping strategy.
- Other strategies the women mentioned include the drilling of wells in the area using community experts in underground water locations.
- Improving the spring by creating a subsurface dam from the protected spring, then pump the water by gravitation to the households.
- Scaling-up of roof water catchment techniques for water harvesting and storage by the community.

Adaptation strategies related to agriculture

- Conserving indigenous trees which are drought-resistant. The Kuresoi communities have established indigenous tree nurseries. They get the seedlings from the forest and replant them at minimal costs. They only need the polythene tubes for the seedlings.

- Planting drought-resistant crops such as sorghum, potatoes and local vegetables (ndereme). The women who took part in the research described various adaptation strategies such as planting drought-resistant crops. One woman said:

“As we never know when the rain will come, we had to change. I started to change the way I prepare the seedbed so that we don’t lose all our crops. I am also using different crops depending on the situation.”

- The women were also clear about what they needed in order to adapt to the floods: crop diversification and agricultural practices, but also skills and knowledge to learn about flood and drought-resistant crops and the proper use of manure, pesticides and irrigation.

- Use of new agricultural technologies such as plant varieties and animal breeds resistant to drought and heat.

- Adaptation of good agricultural practices for sustainable agriculture such as agricultural techniques to maintain soil fertility.

- Honey was identified as an asset to the community. It is used as medicine as well as a food preservative. Although climate change has affected beekeeping, the community in Kuresoi is adapting new technologies of beekeeping.

3.2.3 Local knowledge and climate change adaptation

The research study in the Kuresoi/Mau community revealed that women have a great deal of knowledge of and experience in coping with the impacts of climate

change. They understand their own needs and the types of interventions required to ensure more sustainable agricultural processes in the face of climate change. This study captures the local innovation and context specific knowledge and experience of women’s existing coping strategies and adaptation priorities in Kuresoi.

It has to be noted that the women who took part in the research might not be aware of all the possible adaptation strategies or all the ways to overcome constraints, but they certainly know their present situation best and have an urgent list of priorities to secure a livelihood in the face of the new challenge. The study identified the following potentials of local knowledge of women to adapt to climate change:

- The use of traditional medicine by the Ogiek community elders. The herbal medicine was used to alleviate the suffering from sickness in areas near forests. Since hospitals and medical facilities are far away, herbal medicine has proven to be effective and affordable to many people in the forest.

- The community in Kuresoi uses local knowledge to locate water points where they can have protected springs. They also have local knowledge of where to drill a well at a point where the underground water table is near. This local knowledge has the potential of helping communities to solve the problem of water scarcity.

- The people of Kuresoi explained how they preserve food using traditional preservation techniques. This was shared by the Ogiek elders who used to cut hunted meat into small pieces and dip them in harvested honey. This was used as food reserve in times of shortage. Such knowledge can be scaled up for other food in communities who lack storage facilities like refrigerators.

- To cope with diminishing seeds, the Kuresoi women have started getting the wild vegetable seeds and planting them on their farms to increase access to food. These wild vegetable thrive better in harsh conditions as they have already been accustomed to surviving in the forest without a lot of care.

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It also becomes clear from the study that there is a need for clear governmental policies and programs to protect the forest ecosystem. The people of Kuresoi/Mau should be allowed to take good care of the Mau forest as an adaptation strategy – a system also known as agroforestry.

3.2.4 Other factors for adaptation

Despite their wealth of knowledge, the report also reveals the great need to support women with regard to climate change adaptation. Women face particular constraints in their capacity to adapt to existing and predicted impacts of climate change. A gender sensitive response requires an understanding of existing inequalities between women and men, and the ways in which climate change can exacerbate these inequalities.

Conversely, it also requires an understanding of the ways in which these inequalities can intensify the impacts of climate change for all individuals and communities. For instance, in Kuresoi, men have greater access to vital information on climate change mitigation and adaptation strategies for cultural reasons: Women are too busy caring for the family and the community. Thus, their engagement in the public sphere is limited.

This case study of the Kuresoi community found that women's and men's unequal access to and control of resources is one of the key dimensions of gender inequality. The lack of information and opportunity for women to feed their own knowledge into community or national adaptation and mitigation strategies jeopardizes the larger processes of reducing climate change and its impacts on smallholder agriculture. Gender sensitivity in consultation and decision making is essential for effective mitigation and adaptation responses to climate change.

The case study in Kuresoi found that women are not fully consulted and involved in decision making processes. The Kuresoi community should recognize the capacity of women and men, girls and boys to contribute important knowledge and insights on climate change adaptation. With more participative processes, the climate change mitigation and adaptation strategies and

interventions will truly identify and meet the needs of those they aim to assist.

The barriers to women's access to new technology, extension services and credit facilities also need to be addressed. Female agricultural extension officers should be encouraged to work with women and act as role models. Women and men perceive risks differently, including risks related to climate change. Women are more sensitive to risks and less likely to perceive governmental policies and measures taken to deal with climate change as sufficient.

In addition, although there is currently little research explicitly linking climate change with both conflict and gender, there is a considerable body of work that exists on gender and conflict from which lessons can be drawn. In Kuresoi, further work should be carried out on engendering early warning systems regarding conflict to better ensure that previously overlooked signs of instability are taken into account.

3.3 Contributing and hindering factors for the participation of women and the use of their knowledge and experience

3.3.1 Contributing factors

The following contributing factors can be identified:

- The Kuresoi community still possesses a wealth of indigenous knowledge on environmental conservation. The symbiotic relationship with nature is a contributing factor to climate change adaptation. The community members still use herbal medicine to cure most ailments.
- The new constitution in Kenya is a contributing factor for climate change adaptation because issues of environmental conservation are entrenched in the new constitution. This supports both men and women in Kuresoi to adapt to climate change.
- The enabling environment through the affirmative action entrenched in the new constitution gives both

men and women equal chances to climate change adaptation. This means that both men and women can engage in decision making processes on how to come up with sustainable and effective ways of climate change adaptation.

3.3.2 Hindering factors

The following factors hinder the use of women's knowledge and participation:

- Gender inequality, discriminatory cultural and societal attitudes and negative stereotypes perpetuated in family and community are preventing women to participate in climate change adaptation.
- The high levels of illiteracy and limited access to education for women is a hindering factor. The study team observed during the case study in Kuresoi that only 30 per cent of the respondents could read and write.
- Economic dependency and a lack of adequate financial resources for women is a hindering factor to effective climate change adaptation.
- Lack of access to information for women and poor infrastructure are hindering factors for climate change adaptation.
- HIV/AIDS and other related effects such as caring for the sick members of the family is a hindering factor for climate change adaptation because women will have limited participation in climate change adaptation.

3.4 Conclusions and lessons learnt

This report provides insights into the complexities of climate change mitigation and adaptation. It emphasizes the need to include women in developing and implementing mitigation and adaptation strategies, both to ensure their full participation in these processes and to ensure that such strategies are effective in addressing the 'bigger picture' of climate change and its human impacts. Women often possess knowledge and experiences that can contribute to the design of adaptation strategies for

agriculture. However, due to their generally weak position in society and family, their responsibilities to care for the sick and their lack of rights and resources women are usually not included in discussions and decision making processes related to climate change.

Therefore some of the lessons learnt during the elaboration process of the case study regarding local knowledge and women's participation for climate change adaptation include:

- A key lesson learnt from the study is to recognize the importance of including women in development processes including decision making on climate change mitigation and adaptation in Kuresoi. The study found that women are good guardians of the natural resources. Therefore, there is an urgent need to identify the obstacles to women's participation in decision making and find ways to address the constraints by supporting grassroots awareness raising, confidence building, advocacy and leadership training programs for women in Kuresoi.
- Gender mainstreaming and integration strategies are crucial for women's empowerment for climate change mitigation and adaptation in Kuresoi.
- In order to design gender sensitive mitigation strategies, there is a need to know more about gender differentiated impacts of climate change. This will entail gathering existing knowledge on climate change, including local practices and indigenous knowledge. Gender disaggregated data and in-depth qualitative studies on climate change should be collected using gender sensitive participatory approaches. These are essential for furthering the mitigation and adaptation agenda and ensuring that both are efficient and equitable.

4 Case Study Peru: Climate Change and Gender in Peru's Apurimac Region

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4.1 Introduction

Peru, situated on the central coast of South America, is one of the top ten countries in the world in terms of biodiversity. Consequently, the country is more vulnerable to extreme climate changes which affect the flora, fauna and the rural Andean population. This population has few resources to address disasters related to natural events and the impacts of climate change on health, food security, and water.

This study focuses on the Apurimac region located in the Peruvian Andes. Climate change in Apurimac is manifested in extreme weather variations: torrential rains, drought, hot spells, frost, hailstorms, snow, and windstorms. This situation puts small-scale producer families, particularly women, in a highly vulnerable position.

The Apurimac region has a rugged topography and a wide variety of ecological zones and microclimates. According to the 2007 National Census, conducted by the National Institute of Statistics and Research, 409,190 people live in a region of 20,895.79 km², which is distributed in seven provinces, 80 districts, and 450 rural communities.

The region's current climate and future climate projections are detailed in the table 4.

The lakes, springs, wetlands and glaciers located in Apurimac's highlands feed this region's numerous rivers and streams. The diverse flora and fauna includes domesticated and wild species. This refers to domesticated and wild species: puma, spectacled bear, gray deer, Andean deer, fox, weasel, deer, pampas cat, red deer, viscacha, skunk and many others. There also is a variety of native insects, reptiles, amphibians, birds and fish. Furthermore, there are a wide variety of South

American camelids (alpaca and llama) which have been domesticated since pre-Columbian times, and a smaller quantity of wild species (vicuña and guanaco). Wild pastures compose 60 per cent of the region's two million hectares. Only ten percent of the region has agricultural potential.

In Apurimac, like in most of the Peruvian Andes, the predominant organizational structure is based on the traditional agricultural community. This type of social and territorial management draws upon the ancestral ayllu, the historic structure for collective community organization combined with elements of Spanish colonial influence.

Rural women in Apurimac are primarily Quechua-speaking and live with their families at altitudes between 1,500 and 4,700 meters. They take advantage of different ecological zones for agricultural production and high-altitude cattle rearing within a system of collective labor and community management. However, they farm privately owned plots. Andean women face serious productive, economic and social challenges which are aggravated by extreme climate variability and affect their domestic and productive activities. Women and men share responsibilities for food production and income generation.

4.2 Findings

The impact of environmental degradation on the workload and standard of living is undeniably different for women and men in accord with their culture. This is also the case in Apurimac where women share responsibility for natural resource use and management. They fulfill their families' needs by producing and gathering food, fetching water, collecting firewood and engaging in other social, economic, cultural and environmental activities.

4.2.1 Effects of climate change on rural women's lives

The rural women interviewed are clearly aware of climate change because they permanently face torrential

Table 4: Current climate and future climate projections

General information	Description
Current Climate	<p>High diversity of microclimates and ecological zones due to contrasts in altitude (ranging from 1000 to 5450 m) and rugged topography</p> <ul style="list-style-type: none"> ■ Mean annual maximum temperature: 8 to 32°C ■ Mean annual minimum temperature: - 8 to 20°C ■ Mean annual rainfall: 200 to 1500 mm
Future Climate Projections	<p>Observed tendencies (based on local perception and climate studies):</p> <ul style="list-style-type: none"> ■ Change in temperature and precipitation patterns (frequency, temporality, and intensity) ■ Increase in extreme weather events <p>Climate scenarios (Ministry of the Environment- MINAM, Second National Communication on Climate Change in Peru to the United Nations Framework Convention on Climate Change, 2010):</p> <ul style="list-style-type: none"> ■ 0.4 to 1.44°C increase in minimum air temperature (to 2030) ■ -10 per cent and -20 per cent decrease in the annual precipitation (to 2030) ■ Disappearance of all glaciers below 5,000 meters (to 2020) ■ Appearance of a large scale El Niño phenomenon (to 2020)
Primary Vulnerability	<ul style="list-style-type: none"> ■ Exclusion and marginalization of rural and small-scale producer communities) ■ High poverty levels ■ Malnutrition ■ Insufficient access to basic services, health and quality education ■ Inadequate productive infrastructure ■ Decline in communal organization ■ Loss of traditional small-scale producer knowledge about natural resource management
Expected Impacts of Climate Change	<ul style="list-style-type: none"> ■ Water resources: decrease in water sources ■ Agricultural biodiversity: deterioration of wild and cultivated biodiversity ■ Farming activities: reduced yields and increased losses due to extreme climatic events, decreased water sources, and the appearance or migration of pests and diseases ■ Human health: increase in malnutrition and illnesses such as acute diarrheal illnesses, acute respiratory infections, and skin problems ■ Infrastructure: damage caused by extreme climatic events and related hazards
Institutional Mapping of Stakeholders	<ul style="list-style-type: none"> ■ State: Regional government, local government, State ministries (Agriculture, Health, Education and Environment), national and local water authorities- ANA/ALA, National Institute for Civil Defense- INDECI ■ Small-scale producer communities and their specialized committees ■ NGOs ■ Universities

Source: Information taken from PACC, Diagnosis on Climate Change in Apurimac, 2011.

rains, drought, hot spells, frost, hail, storms, lightning and thunder, which have become more accentuated in the past ten years. One rural woman described the changes:

“Before everything was normal. You could rely on the weather. We knew the time of the rain, frost, wind, hail, snow and lightning. It’s now a complete mess. There’s contamination from

the mines and cars. The frogs, fish, and high-land plants have disappeared mostly due to increased temperatures.”

The lives of rural women and their families have changed a great deal because of this situation. Agricultural production has declined, intensifying the low levels of adult food consumption and the chronic malnutrition in children. Income and assets are decreasing. Diseases are

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spreading and affect children's health and education. Temporary and permanent migration of youth and entire families is increasing, thus accentuating the rural region's natural and social disintegration.

Effects on agricultural activities

Agricultural activities are a family endeavor. Andean women participate in the preparation and sowing of the land. They prepare chicha (corn drink) and food, make sure that food is available during the planting season, decide on and prepare the crop varieties to be planted and place the seeds in the furrows. They work to procure plentiful harvests and income from animal sales. Climate change, however, alters their way of life by disrupting the agricultural calendar.

Women are deprived of food, income and assets, and are overburdened with chores. Family disintegration due to migration also takes its toll. This situation generates increased hardship as well as family and social conflicts. New illnesses, such as depression and gastritis, develop.

Rains now arrive late and last for shorter periods of time. The Apurimac Civil Defense's report on the 2010 and 2011 heavy rains states that precipitation has been torrential in recent years. This situation further overburdens rural women. Springs, rivers and lakes dry up in the absence of rain. The temperature increases, animals die from lack of grazing areas and planting is delayed. In these conditions, women make extra efforts to locate grazing areas and water for their animals. They try to sow some crops. Decisions regarding how the scarce irrigation water should be used often cause family conflicts. Women frequently have to give up their small animals in order to maintain the larger ones.

Torrential rains exacerbate these problems. The rain does not penetrate the soil but washes the topsoil away and impoverishes it. If the rain does penetrate and ends muddying the soil, the roots rot and plant growth is hampered, thus affecting future harvests. At the public level, the rains cause landslides and damage roads, and consequently cut off rural populations. The rains also provoke deaths and other irreparable losses.

When the harvest is lost, rural women are forced to barter or to borrow. In some situations, they cannot even replant the crops because the seed supply has shrunk.

Sometimes the winds intensify to become hurricanes, as occurred in 2008 and 2009, and blow roofs off homes, uproot plants, and in dry periods cause huge dust storms that affect human eyesight. Even the manure and crop residues blow away, leaving the fields bare. Women are in charge of taking care of the damaged crops and of replanting uprooted plants.

The frost which falls after the rainy season and at the end of the harvest cycle affects the maturing crops such as potatoes, beans and peas. In this situation women have few alternatives: They can either try to replant lost crops or abandon that season's harvest. Regarding animal husbandry, they can either search for pasture or sell their animals. Temperature change also forces them to find other locations to make chuño which is an important staple food in the Andean family's diet. The artisanal transformation processes use the environment's low temperatures to dehydrate potatoes. The women explained:

"In the past, the areas to make chuño were not far away. These areas are no longer fertile and we have to travel to higher altitudes. Making chuño is very hard work. We have to squash it, carry it home and we are also in charge of drying and storing it. Well-prepared chuño can keep for up to five or six years. It maintains its good flavor during this time."

Hail, like frost, arrives without warning. Small-scale farmers are familiar with hail and the havoc it can cause. When it affects crops in the early growth phase, they can still recover. If hail falls when crops are flowering or at the onset of the maturation period, the damage is severe and leads to a small and low-quality harvest.

Although thunder and lightning do not have the same impact as other phenomena, they are particularly dangerous for women, children, and youth who herd animals in the highland plateau regions.

Drought is a recurrent phenomenon in Peru. Its extremely serious effects can diminish or destroy harvests and lead to animal death due to diseases and the absence of grazing areas. It also forces people to migrate.

Hot, dry spells increasingly interrupt the rainy season. This phenomenon slows crop growth and fosters the emergence and spread of diseases. Crops may wither in just one week. When the rains return, plants barely recover. Shrubs, grasses, and even eucalyptus trees wither in the scorching heat. During this time, grazing lands and forests catch fire, thus destroying wild and domestic animals' food sources. Fire wood is scarce during these spells.

Climate change increases the incidence of insects and diseases (such as blight, bacterial wilt, corn blight, Andean weevil, moth or flea beetle) attacking crops during the early growth and development stages. The damage can partially or fully destroy them. This situation becomes even more menacing when potatoes and corn, the two key products of the local diet, are affected.

Wild animals like skunk, parrot, partridge, pigeon, thrush, sloth, owl, goldfinch, Andean sparrow, and deer also attack the crops from the moment that they are planted through the end of the harvest. Their forays can be extremely devastating and deprive farming families of their harvest.

The Andean agricultural and food strategy includes food storage. Farmers, especially the women, are traditionally knowledgeable about the amount of seeds to be stored for the following season and the quantity which need to be planted. Everything has altered with climate change. The damage caused in the past by Andean weevils, mice and rats was less severe than it currently is.

Alongside agriculture, livestock production demands a great deal of the women's time and energy. Depending on the ecological zone, farming families in the highlands raise South American camelids, sheep, and cattle. In the mid-altitudes, they have sheep, cattle and horses. Families in the lower regions raise cattle, sheep, horses and small animals. Women and children are responsible for

the latter, which are directly related to family diet and daily income. These animals play the role of a petty cash fund due to the ease with which they can be bred, cared for, and immediately sold when family emergencies arise. Agricultural activities furnish the foodstuff while livestock production provides cash and other important support.

One of the women interviewed stated:

„A bull helps with the planting. A horse or donkey helps to carry seed and chicha (corn drink). We can kill an alpaca to eat the meat or sell it to buy things at the store or to pay the day-workers. In general, all of the animals help with the sowing.“

In much the same manner as it does on crops, climate change promotes livestock diseases such as pneumonia, diarrhea, scabies, hair and wool loss, parasitic flatworm, rabies, swine fever, and conjunctivitis. This provokes economic loss and increased workload for rural women.

Effects on domestic activities

Women have multiple domestic tasks that overlap with their productive and social activities in the community. Climate change's increased frequency and gravity currently affect women in different ways:

- Torrential rains impede women from easily washing and drying their family's clothing. Dirty clothes accumulate rapidly since clothing gets soiled faster with the increased amount of mud. Firewood gets damp and is more difficult to burn, filling the kitchen with smoke. Domestic tasks are more arduous and increase women's work burden. Women also perform tasks related to caring and feeding animals.
- Drought and heat place an extra burden on women due to the scarcity of water and pastures for grazing animals. Women have to fetch water from sources farther away from their homes. Moreover, bacteria and fungus rapidly contaminate the water during the periods of

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more intense heat. Women also have to gather grass for their animals in more distant areas. To salvage a minimum amount of crops and grass, women help men to water the few irrigated fields which exist.

- Hailstorms prevent women from performing their normal herding activities. They have to clean the pasture, either carry grass to the pens or lead their animals to graze in other areas.
- When frost freezes the water, women are unable to fetch water in the morning. Also, they have to look for grass for the animals and treat their illnesses provoked by the cold weather.
- Snowfall prevents women from their normal herding activities.

Climatic conditions seriously affect the health of women and their families. The Apurimac Regional Health Directorate attributes respiratory and gastrointestinal infections primarily to the low temperatures experienced in the mid-range and high altitude regions and the lower regions' high temperatures. New and unknown illnesses such as gastritis, stress and depression have appeared in recent years in the Andes. Needless to say, illness places a strain on the family economy and hinders family members to work in the fields and in animal husbandry activities.

Women have been historically discriminated against in obtaining access to formal education. Female illiteracy rates remain high, particularly among the Quechua-speaking population. Young women in recent years have gained better access to formal education and participate in public activities.

However, family impoverishment, now exacerbated by the effects of climate change, encumbers this progress. Participation in local and culturally-defined recreation also has been reduced due to economic transformations. Women from Chincheros explained:

“We had many patron saint celebrations in the past. Even though a great deal of money was

spent on these celebrations, they made the people happy. They were beautiful customs. Women were in charge of beer sales and food preparation. Guinea pigs and chickens were killed. Men annually collected funds to cover the costs. We now only celebrate the community's anniversary. We have stopped celebrating some festivals because we are no longer able to cover their huge costs.”

Migration by small-scale producers and rural inhabitants is not a new phenomenon in Peru. The data from the National Institute of Statistics and Research (INEI) shows a complete turnaround in recent Peruvian population figures. In the 1950s, the rural population was 70 per cent and the urban population was 30 per cent. Sixty years later, the urban population is 73 per cent and the rural population is 27 per cent.

In Apurimac, migration is driven by rural impoverishment, political violence, and inadequate and unilateral public policies.

The women of Chincheros stated:

“Young people have no future here. They move to other places such as Lima, Chanchamayo, or Cusco. We know that climate change aggravates our poverty. There are a lot of families who have left and have never returned. Others return after several years, but upon arriving, they find their homes and fields extremely deteriorated and they remain impoverished.”

4.2.2 Local adaptation strategies to climate change

Due to their extreme marginalization and social exclusion, Andean farming families in general, and women in particular, are challenged to adapt to climate change. They have few resources and methods to manage risks and adapt. They cope with the situation by taking advantage of the knowledge inherited from ancient Peruvian culture. They are well familiar with nature and apply this understanding to their local farming system,

which has long been under pressure, in order to adapt to the social, cultural and environmental changes that they confront.

Western knowledge has not yet been integrated into the system in a meaningful and useful way. Quite the contrary, many of the interventions in the region that promote external knowledge and resources have not produced the expected results. Consequently, rural women still use ancient knowledge to contend with climate change and are developing new skills and local strategies along the way.

Their knowledge about the seasons and plant and animal behaviour are fundamental to their weather forecasts.

„When snow covers the Sallccantay [mountain] in August and September, we know that we'll have a good year. When the clouds float over the Apurimac River, we immediately begin to get ready for planting. The condor's descent from the highland plains and the birds' aerial circling is a sign that it will rain. Rain also will fall when the eagles descend from the higher altitudes. Observing this, we prepare for planting.“

Although the „reading“ of the season might be correct, little can be done in the face of climate change.

Adaptation strategies in agricultural activities

Women employ a range of methods to protect their harvests, and in so doing obtain the income needed to exist in the modern world.

- When the rains are delayed, the planting season gets postponed. Even the planting of irrigated fields entails high risks when the rains are delayed. Success depends on the amount of water available; the use of irrigation water is strictly controlled.

- Faced with rain, frost or hail, the crops are rotated. Rapidly maturing crops are often replanted to avoid losing the entire harvest.

- Priority is given to irrigating the corn crop.

- Various strategies are employed to endure frost and hailstorms. One woman interviewed stated:

“Every year is different. Sometimes the frost is heavy; sometimes it is mild. In a community meeting, community members agreed to purchase two or three dozen anti-hail rockets each year. When there is a threat of hail, the authorities are in charge of shooting the rockets. They are lit and directed towards thicker clouds. We also purposefully burn accumulated crop residues. The smoke drives away the hail. Some women pray, making signs of the cross in the direction from which the hail comes.”

- New seeds are tested and planting is tried in other regions observed to be free from frost. Women no longer water their crops in the afternoon since they have experienced that frost affects their recently irrigated crops. Grass is chopped down after the frost to facilitate regeneration.

- Increased amounts of compost, worm compost, and liquid fertilizers are used for soil fertilization in order to prevent plant diseases and diminish the frost's effects.

- Given the uncertainty regarding the harvest, women diversify their production by raising guinea pigs and poultry and making homemade yogurt and cheese.

- Women are introducing or expanding the production of native crops such as tarwi (*Lupinus mutabilis*), quinoa or amaranth to improve children's nutrition.

When the harvest has been damaged or diminished, men migrate to look for jobs as workers in the mines or in public work projects implemented in the region.

The most common insect attacks and crop diseases are blight, bacterial wilt, corn fungus, Andean weevil, moth, corn worm and slug. Facing these, women use the following methods (Table 5)

Table 5: Strategies against insects and diseases

Name			Strategy
Quechua	Spanish	English	
Rancha	Rancha	Blight	■ Plant seeds with a larger distance between them and mound the soil for good water drainage
Puca poncho	Puca poncho	Puca poncho	■ Use selected seeds, rotate crops, mound the soil for good water drainage
–	Marchitez bacteriana	Bacterial wilt	■ Use selected seeds, rotate crops, mound the soil for good water drainage
Apputi	Carbón de maíz	Corn fungus	■ Use selected seeds and rotate crops
Ccarasaco, papa kuro	Gorgojo de los andes	Andean weevil	■ Use selected seeds, use wild ambrosia ash in storage to disinfect the seed and protect it from insects
Acsho (larvae) Lapaysho (adult)	Polilla	Moth	■ Use macerated chacanuay (Apurimacia michelii) roots to fumigate
Piki piki	Pulguilla saltona	Flea beetle	■ Use macerated chacanuay roots to fumigate
Shillhui	Lorito	Cicada	■ Use macerated tarwi with rocoto pepper and wormwood to fumigate
Ccarhua	Epicauta	Blister beetles	■ Use macerated chacanuay roots to fumigate
Utus kuro	Gusano de mazorca	Corn worm	■ Rotate crops, fumigate with macerated chacanuay roots
Ccollu ccollu	Babosa	Slug	■ Use fruit peel traps ■ Sprinkle with salt and ash ■ Use an infusion of wormwood and hemp ■ Diversify crops and vegetables

Source: Institutional creation, 2011

Faced with animal attacks on crops, women refine and apply their traditional techniques, such as spraying the field with rotten urine, using slingshots and rattles to scare off birds, putting up human-shaped scarecrows, trapping birds, covering fruits with plastic, and using dogs to track bothersome animals in their fields.

Rotating the grazing areas is a common strategy for rearing livestock. Small-scale producers also rent small fenced in pasture areas from their neighbors who do not own animals. They additionally gather crop residues at harvest time, particularly for cow feed. Some families prefer to raise guinea pigs and other small animals because they do not have the conditions to raise larger animals or are unable to replace them after their death or sale.

The practice of growing grass in small irrigated plots is expanding gradually; this is a new method to adapt to climate change. One rural woman described how this is done:

“We reduce the quantity of animals, keeping the best ones, and plant a small plot of fodder plants such as alfalfa and oats. We do this with the support from institutions that work in the region.”

As modern medicine is very expensive and unavailable in many communities, women use traditional remedies to treat their animals. They generally use herbs and plants such as watercress, pumpkin or barley that revive their sick animals. Peruvian pepper tree (*Schinus molle*), Andean mint (*Minthostachys mollis*) and eucalyptus are used for pneumonia. Tarwi water helps against fleas and grounded grains are used for bruises and feebleness. The women explained:

“We first use homemade plant medicines for remedies. If these don’t help, we buy medicine, requesting guidance from the technical assistant or specialists in animal husbandry and veterinary medicine.”

They employ other additional measures:

- During the rainy season, they build covered areas and roofed chicken coops. They use oil and lemon remedies. They cut and solar dry the pasture grass to eliminate humidity.

- During periods of drought and high temperatures, they build canals and qochas, to increase the natural grazing areas and wetlands. Qochas are rivers and/or ponds, connected by a channel network, that make up an alternative soil and water management system for crops and pasture. They drain standing water, use animal fat and hot oil to treat the animals. They use sulfur and burned oil to exterminate ticks. Wormwood is used to eliminate fleas.

- During periods of frost and hail, they use insulating anti-hail rockets.

- Chamomile water is used to treat animal conjunctivitis caused by high winds.

Animal husbandry requires a great deal of effort, care and money. Rural women have been forced to make increased efforts to obtain grazing areas and water, get medicine to treat their animals, and prevent animal deaths.

Adaptation strategies in domestic activities

Women lack alternative technologies to carry out their domestic activities. They continue to wash and clean by hand. A great deal of effort is put into agriculture and animal husbandry activities. As a result of migration, families are short of labor to carry out all their basic activities.

However, with the support of some private and public institutions, a number of enhancements – like improved stoves – are being introduced to alleviate rural women’s domestic work and to mitigate the effects of climate change. Domestic water systems or public water tanks reduce women’s work. Access to water close to the home contributes to the reduction of long walks to fetch water from irrigation canals or springs, and prevents the use of contaminated water. Although extremely limited,

there also are efforts to implement solid waste management measures, such as toilets, drains and landfills.

Some communities are installing solar heating using Trombe walls. A Trombe wall is a wall built in direction of the sun with materials that can trap the heat. It is a very efficient manner to take advantage of solar thermal energy. It transforms a house’s wall into a natural heater. Improvements also include the recommendation to remove small animals from the kitchen and the home and raise them in separate areas.

Furthermore, efforts are underway to introduce family vegetable plots with simple irrigation systems to improve food security and overcome water scarcity. A number of people in higher and mid-range altitudes have some experience using plastic greenhouses to cultivate vegetables. These new technologies aim to improve this population’s diet and, thereby, reduce the vulnerability of women, children, and elderly people to climate change.

Adaptation strategies in health

Rural women are extremely observant and take advantage of the skills and knowledge passed on from their ancestors. They employ this knowledge using locally-found herbs and shrubs to treat different illnesses. This resourcefulness is critical since public health centers are limited.

- During the periods of torrential rains, frost and hail, women treat colds and coughs with infusions of herbs such as ragwort (*Senecio tephrosioides*) and carqueja (*Baccharis genistelloides*).

- During the periods of drought and heat, women treat headaches, fever, diarrhea, cramping and sore throats with cold baths, infusions and gargles using avocado pits, wormwood, palm, wormseed and coca leaves.

“When my children are sick with a cough and a fever, I gather all sorts of herbs. I boil a fistful of each herb in a big pot. Then I bathe the children in this water. They go to sleep and wake up healthy.”

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When the illness cannot be cured by traditional means, modern medicines are purchased or the sick person is taken to the nearest health center or hospital in the region.

Education and migration

Education is a fundamental aspect of rural families' survival strategies. Faced with increasingly difficult conditions to persevere, families see their children's education as an investment to get out of poverty since they see no future for farmers or highland pastoralists.

Access to education has improved for boys and girls, although still more so for boys. Sooner or later, however, youth are forced to leave their rural communities since secondary technical and professional studies are unavailable in these areas.

In the interviews, women stated:

“There’s been a lot of migration. People have left to Arequipa or Cusco. No one wants to be a pastoralist or farmer. It’s a shame. Potatoes come from Andahuaylas, vegetables from Arequipa, cheese from Chumbivilcas and tarwi from Colquamarca.”

Migration has many causes and expressions. It is a slow process, unless particular circumstances accelerate it. Generally it tears the family apart. The women usually remain in the community to attend to productive activities while the men travel to urban areas. Sometimes the women follow them. However, it should be mentioned that only few migrants manage to improve their families' living conditions.

Given the absence of national, regional and local policies that draw attention to new opportunities in the rural areas, migration appears irreversible.

4.2.3 Local knowledge's potential to adapt to climate change

The indigenous people of the Andes possess an extraordinary amount of knowledge about nature. They are the

heirs of an ancient culture that aimed at building a life in harmony with the natural environment. This knowledge emerged, was tested and accumulated through the centuries and survived four centuries of European invasion and conquest. It continues to be the main knowledge that is drawn upon in the climate change adaptation process.

Without much external support, communities have been developing and implementing risk management and adaptation for some time now. They face many difficulties in the process, however, due to their marginalization and social exclusion.

Practice has shown that the effects of climate change cannot be addressed without taking into account the rural population's ancestral knowledge. Adaptation and mitigation measures have to be coherent with rural men and women's profound knowledge of the land and natural resource management technologies and strategies. Possible external adaptation and mitigation strategies to climate change must be appropriate for local realities in order to be successful.

4.3 Favourable and limiting factors for the potential and use of local knowledge to address climate change

4.3.1 Favorable Factors

The concern about global warming and the effects of climate change generate a favorable context for the use of local knowledge. Peru has a legal framework to regulate the country's environmental management. Based on this, the Apurimac Regional Government created the Regional Technical Group on Vulnerability and Adaptation to Climate Change. The regional strategy on climate change is currently being developed, supported by the Ministry of the Environment and COSUDE's Adaptation to Climate Change Programme 2010-2011.

Furthermore, several international cooperation agencies are implementing environmental projects, some of which focus on revalorizing local knowledge, technologies, and strategies.

Additionally, public, private and social institutions as well as the population in general, clearly understand the seriousness of the effects of climate change. However, as of now, concrete actions continue to be insufficient.

4.3.2 Limiting Factors

There are internal and external factors which limit the promotion of local knowledge concerning climate change.

The internal factors are related to the marked tendencies of individualism of the farming families which in many ways contradict communal living and result in community fragmentation and the scarcity of alliances which debilitate these communities and obstruct their negotiating power with the State, mining companies and other entities related to environmental management.

Communities lack policies that allow them to successfully deal with the effects of climate change. Their relationship with the local municipalities is inadequate to address the relevant issues.

A former community leader commented:

“After the training courses provided by different institutions, increased emphasis has been placed on water issues in recent years. Reforestation has been carried out in one area of the community to preserve the water sources. However, most springs are unprotected. The cracks in the canals cause water loss. Users are just not aware of the issues. Instead of dealing with them successfully, we face a huge number of problems. Honestly, we aren’t prepared. What can you do to avoid climate damage? It is impossible to control. We are not educated about these very important issues.”

Additionally, migration results in the reduction of the labor force and the exodus of a new generation of leaders capable of leading their communities and addressing climate change.

External limiting factors are related to the State, private actors and the wider society in the context of a national development model that foments imbalance, inequality and inequity between regions and social groups. This model is the result of entrenched centralism, ineffectual decentralization initiatives, and inconsequential reforms by the Peruvian State:

- The development model is reproduced at the regional level, giving priority to investment in the lowlands, provincial cities, and roads and social infrastructure. 82 per cent of the public investment in the region is allotted to the latter while only about twelve percent is designated for productive improvement and two percent for environmental development (Senisse 2011).

- The country’s decentralization process, originally an important strategy to develop a new regional and local development model that takes into account environmental protection policies, has been bureaucratized.

- Rural inhabitants and small-scale producers are increasingly wary of mining because of its history of causing environmental destruction. Although the Peruvian mining legislation requires social responsibility, mining continues to be a source of social conflict.

4.4 Conclusions and lessons learnt

4.4.1 Conclusions

The study of climate change and its effects is important considering the close relationship between climate change and all forms of life on this planet. In Peru, it is particularly significant due to the country’s ecological diversity. The failure to address climate change, particularly by decision makers in the public and private sectors, is serious negligence.

Women in Apurimac face a particularly dramatic situation since they have few resources to manage the effects of the climate change. They depend on the knowledge, techniques and organizational structures inherited from Andean culture. They do not have access to appropriate science and modern technology for their social and

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environmental conditions. Public investment is equally unfavorable since it is designed solely to expand the internal market for manufactured goods.

Peruvian decentralization could be an effective strategy to modify the discriminatory course of national development. However, it has yet to be implemented in a manner that transforms the dramatic effects for the rural population and small-scale producers' quality of life.

In the past five years, less than two per cent of public investment in Apurimac has been allotted to environmental projects. This demonstrates the Peruvian government's lack of interest and short-sightedness about the gravity of climate change.

Lastly, mining expansion and the related destruction of the fragile Andean environment foster social conflicts in this region. These will become increasingly acute and augment the rural population's vulnerability for as long as the state keeps neglecting this problematic.

4.4.2 Lessons learnt

The information provided by rural women and community authorities demonstrates that women live with, are aware of, and cope with climate change by employing adaptation and mitigation strategies based on ancient knowledge and some modern strategically and regionally-promoted approaches.

The ancestral knowledge and strategies that farmers use to face the challenges posed by climate change engender new knowledge and experiences that should be collected and systematized for dissemination.

Notwithstanding their marginalization and social exclusion, rural men and women do not remain immobilized in the face of climate change. Since their families' lives depend on their resourcefulness, they confront climate change with their available resources.

Considering the environmental degradation and social disintegration faced by indigenous rural communities, however, it is obvious that by the effects of climate

change cannot be addressed solely by their reliance on ancestral Andean wisdom. Adequate policies and dynamics which promote comprehensive rural development in favor of small-scale producers are indispensable to successfully address climate change. Nevertheless, this demand calls for fundamental changes in state economic and environmental development policies.

Inter-institutional coordination is crucial in order to lobby public and private institutions as well as community authorities and leaders regarding the need to develop a program that initiates regional change and transformation. The program should emphasize the environment, climate change and its impact on rural life, as well as improving the rural standard of living.

Finally, it is important to raise the issue of rural women and climate change within women's organizations and the women's movement in order to generate a movement that reflects, acts in solidarity, and demands the attention of public and private institutions.

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